"Crossing Boundaries and Navigating Intersections"
2021 WA-BC Chapter Annual Meeting
Hosted Virtually March 1–3, 2021

Program and Abstract Book

2021 WA-BC AFS Annual Meeting

Virtual Conference March 1-3

March 1, 2021

Meeting Kickoff and discussions surrounding Spokane AFS 2022

11:00 AM-12:00 PM

We will kickoff the meeting with some early housekeeping and finish the hour with discussions surrounding the AFS Annual Meeting to be held in Spokane 2022
Housekeeping and Introductions: Paul Spruell, President, WA-BC AFS and Alf Haukenes, President Elect, WA-BC AFS
Guests: Leanne Roulson and Dan Brauch

Plenary Session

1:00 PM-4:00 PM

PlenSess


Andrea Reid


Zachary Penney

Meeting at the Confluence: The Sympatric Coexistence of Indigenous and Western Science in Modern Fisheries

The co-management of threatened, endangered, or at-risk ecological communities is complicated. While the relationship between Indigenous and non-Indigenous sovereigns and stakeholders is improving there continue to be areas of inertia that inhibit moving towards consensus when developing approaches to ecological crises. This is unfortunate as there are limited amounts of energy and resources to be applied to the growing list of crises and that boundaries prompted by history, culture, and perspective continue to inhibit areas of possible synergy that could contribute to positive outcomes. The primary purpose of this plenary is to be reminded that Indigenous and non-Indigenous participants in co-management inhabit the same landscape with aquatic systems that occupy the attention of both groups. Our two plenary speakers, Drs. Zach Penney and Andrea Reid, have unique perspectives gained from their personal and professional experiences that can contribute to an understanding of the time and place that we occupy and our roles in caring for the plants, animals of our region. Their insights are valuable in providing a necessary introduction for discussing case studies and identifying pathways for building consensus where we can become larger than the sum of our parts as we address increasingly complicated issues that threaten our aquatic systems.

Student Author Gathering

6:00 PM-7:00 PM

An open invitation to all student authors for this year's meeting

March 2, 2021

The Future of Bull Trout Conservation and Management Across Its Range

8:00 AM-11:00 AM

The Future of Bull Trout Conservation and Management Across Its Range
8:15 Joseph Maroney, Kalispel Tribe of Indians
25 years of the Kalispel Tribe's efforts to recover Bull Trout
8:30 Rachel Chudnow, University of British Columbia
Multi-state (spatial) capture-recapture modeling to explore movement and distribution patterns of upper Fraser watershed fluvial bull trout
8:45 Daniel Nolfi, U.S. Fish and Wildlife Service
Bull Trout 5-year Status Review (Including the Incorporation of a SSA Framework)
9:00 Michael Sullivan, Alberta Fish and Wildlife Division
What is Killing our Bull Trout? Cumulative effects modelling to help Alberta's iconic fish
9:15 Michael LeMoine, Skagit River System Cooperative
Landscape resistance mediates native fish species distribution shifts and vulnerability to climate change in riverscapes
9:30 5 minute stretch
9:35 Brett van Poorten, Simon Fraser University
Evaluating options for removal of an introduced competitor to promote bull trout recovery
9:50 John Hagen, Independent consultant
Use of Spatially-Continuous Aerial Redd Count Surveys to Facilitate Bull Trout Habitat Conservation Planning in Northcentral British Columbia
10:05 Adam Kanigan, University of British Columbia
Movement patterns by bull trout in relation to prey pulses provided by sockeye salmon
10:20 Nathan Furey, University of New Hampshire
Feeding and predation-based selection of bull trout on migrant sockeye salmon smolts
10:35 Philip Howell, US Forest Service
My Bull Trout Crystal Ball--Past and Future

The Future of Bull Trout Conservation and Management Across Its Range (Panel Discussion)

11:00 AM-12:00 PM

A collaborative session designed to offer a more interactive discussion prompted by the morning's presentations on Bull Trout Conservation

Adaptations Dynamics in Aquatic Ecosystems

1:00 PM-2:15 PM

Title: Adaptation Dynamics in Aquatic Ecosystems
1:05 Michael Phelps, Washington State Universtiy
Understanding Salmonid Physiology to Improve Conservation
1:20 Christopher Duke, Washington State University
Rearing temperature influences body shape and sprint swim speed in clonal rainbow trout
1:35 Jasmine Richman, Washington State University
Investigating the Activin Receptor Signaling Pathway in Rainbow Trout
1:50 Alex Lopez, Washington State University
Acclimatization of Chinook Salmon (Oncorhynchus tshawytscha) in Increased Temperature Stress

Adaptations Dynamics in Aquatic Ecosystems (Panel Discussion)

2:20 PM-2:55 PM

Adaptation Dynamics in Aquatic Ecosystems
A breakout discussion section desinged for more collabortive interaction with the authors of the presentations delivered in the Adaptation Dynamics session

Contributed Papers 1

3:00 PM-5:00 PM

Contributed Presentations 1
15:00: William Bosch, Yakama Nation Fisheries /Yakima-Klickitat Fisheries Project
Bigger isn't always better: Relationships between juvenile migration traits and age-at-maturity in a Columbia River hatchery salmon population
15:15: Taylor McCroskey, Oregon Department of Fish and Wildlife
The upper Deschutes Reintroduction: past, present and future adaptive management
15:30: Alyssa Nonis, University of British Columbia
Using Advanced Remote Sensing Approaches to Characterize Salmonid Habitat Potential
15:45: Mark Sorel, University of Washington,
Association between pinniped abundance and survival for individual populations of adult spring/summer Chinook salmon in the lower Columbia River
16:00 Rebekah Stiling, University of Washington
Population structure and habitat availability determine resource use by rainbow trout in high elevation lakes
16:15 Bryce O'Connor, University of Northern British Columbia
Linking spatial stream network modeling and telemetry data to investigate thermal habitat use by Arctic grayling
16:30 Alexander Reyes, Washington State University
Decoding the food web for Omak Lake, the largest saline lake in WA.

Student - Mentor - Introductions

6:00 PM-7:00 PM

It is always good to get to know the current cohort entering our profession. This gathering is designed for all to allow students to introduce themselves and briefly outline their projects.

March 3, 2021

Salmon Above Grand Coulee – Opportunities and Concerns

8:00 AM-10:30 AM

Salmon above Grand Coulee-Opportunities and Concerns
8:15 Joshua Murauskas, Four Peaks Environmental Science
Salmon and steelhead abundance during construction of Grand Coulee Dam, 1933-1942
8:30 jeff Fryer, CRITFC:
Grand Coulee Fish Maintenance Project 1939-1947
8:45 John Sirois, Upper Columbia United Tribes
Overview of the efforts of the Upper Columbia United Tribes to study Fish Passage and Reintroduction to the Blocked Area through a phased scientific approach
9:00 Brian Bellgraph, PNNL
Estimates of Chinook Salmon Spawning Habitat in a Blocked Reach of the Columbia River Upstream of Grand Coulee Dam
9:15: 5 minute stretch
9:20 Thomas Biladeau,
Coeur d'Alene TribeSalmon Habitat in the Blocked Area: Restoring a Home in the Hangman Creek Watershed
9:35 Conor Giorgi, Spokane Tribe of Indians
Cultural and Educational Releases, Returning Salmon to the Blocked Area
9:50 Casey Baldwin, Confederated Tribes of the Colville Reservation Behavior and Fate of Adult Summer Chinook Salmon Released Upstream of Chief Joseph Dam
10:05 Steve Dearden, Whooshh Innovations
Upstream adult passage concepts for Chief Joseph and Grand Coulee

Salmon Above Grand Coulee – Opportunities and Concerns (Panel Discussion)

10:45 AM-11:30 AM

Salmon above Grand Coulee-opportunities and concerns (Panel Discussion)
This session is designed to allow for a more interactive opportunity with the authors of of the Salmon above Grand Coulee symposia.

WA-BC AFS Chapter Annual Business Meeting

12:00 PM-1:30 PM

An opportunity for direct interaction between the WA-BC AFS Excom and Wa-BC AFS membership.

Lamprey

2:00 PM-3:00 PM

Lamprey are certainly gaining interest in the region and the expertise that is represented in our region provides a wonderful opportunity to for our members and registrants to gain a current understanding of the science that is occuring.

2:05: Christina Wang, USFSWS

Expanding the Pacific Lamprey Conservation Initiative into Canada

2:20: Jocelyn Wensloff, Central Washington University

An Ecological Comparison Between Resource Subsidies: Pacific Lamprey & Pacific Salmon

2:35: Devayne Lewis, CRITFC

Translocation of Pacific Lamprey within the Columbia River Basin as part of ongoing conservation and restoration efforts

Contributed Papers 2

3:15 PM-5:00 PM

Contributed Presentations 2

3:20: Sarah Richardson

Differentiating the effects of two invasive fish on native invertebrates of Turnbull National Wildlife Refuge.

3:35: Caleb Jetter

Movement ecology of hatchery-origin white sturgeon in the regulated Upper Columbia River

3:50: Shayna Hamilton

Tournament Talks: connecting anglers with relevant fisheries research virtually

4:05: Danielle Quinn

Using app based tournaments as a source of fisheries data

4:20: Thomans Smith

The role of turbulence and velocity gradients in microhabitat selection by juvenile salmonids

4:35: Kaeili Davenport

High Variability of Life History Characteristics in Non-native Brook Trout in Eastern Washington

The Future of Bull Trout Conservation and Management Across Its Range

25 years of the Kalispel Tribe's efforts to recover Bull Trout

Joseph Maroney
Kalispel Tribe of Indians

The U.S. Fish and Wildlife Service listed Bull Trout under the Endangered Species Act (ESA) in 1999 as one Distinct Population Segment that encompasses the current range of the species. From 2002-2004 a draft recovery plan was developed but never finalized. It included demographic targets and necessitated stable or increasing trends in those metrics over several Bull Trout generations to establish ESA recovery. In 2015 a revised recovery plan for Bull Trout was finalized. It was based upon the Recovery Framework developed by State/Federal Management Teams. Tribes were not involved in the development of the Framework. The Final Recovery Plan relies solely upon threats-based management and abandons any requirement that populations meet demographic targets (e.g., abundance) in order to be considered recovered under the ESA. My discussion will highlight challenges with the new Recovery Plan and how the Kalispel Tribe is working towards recovering the species. Projects that I will highlight and describe will be fish passage at hydropower projects, non-native fish removal, and introduction of Bull Trout into Sullivan Lake/Harvey Creek.
The Future of Bull Trout Conservation and Management Across Its Range

Multi-state (spatial) capture-recapture modeling to explore movement and distribution patterns of upper Fraser watershed fluvial bull trout

Rachel Chudnow
University of British Columbia

Though increasingly common in marine systems, lakes, and even linear river corridors, telemetry investigations in complex, non-linear systems, such as fluvial watershed networks, remain rare. Further, research on bull trout, a highly migratory, conservation-listed species, historically occurred in highly impacted systems or in a reactionary manner following overharvest. We utilized telemetry and multi-state capture-recapture modeling to estimate fluvial bull trout movement and distribution patterns in highly connected, relatively pristine habitat within British Columbia's upper Fraser watershed. The observed post-spawning migration and distribution patterns suggest these bull trout are exploiting seasonal resource pulses during salmon smolt outmigration. Utilization of habitats distributed across the watershed and identified long-distance migrations (>300km) highlight the importance of habitat connectivity between headwater spawning habitats and larger rivers. This work provides highly valuable information for prioritizing conservation actions and identifying restoration opportunities both in the upper Fraser and across the species range.

Bull Trout 5-year Status Review (Including the Incorporation of a SSA Framework)

Daniel Nolfi
U.S. Fish and Wildlife Service

In 1999, the U.S. Fish and Wildlife Service (Service) listed all populations of bull trout within the coterminous United States as a threatened species pursuant to the Endangered Species Act of 1973 (Act). A 5-year review for bull trout is required by the Act and is the Service's periodic analysis of the species' status conducted to ensure that the current listing classification of threatened is appropriate. A 5-year review is the recording of the deliberative process used to make a recommendation on whether or not to reclassify the species. In 2016 the Service developed and began implementing the Species Status Assessment (SSA) Framework as a consistent national approach to assessing the status of both petitioned and previously listed species. To support the completion of the 5-year review for bull trout and be in alignment with the new Service-wide approach, the Service will assess the US coterminous status using the SSA framework. The SSA is a science-based analytical framework that helps us characterize a species' ability to sustain populations in the wild over time (viability). We use the best available scientific information regarding demographics, habitat, environmental risk factors, and conservation measures to analyze the species' current and future resiliency (abundance and habitat quality), redundancy (distribution), and representation (adaptive capacity). Following Service policy, the SSA will be both partner and peer reviewed.

What is Killing our Bull Trout? Cumulative effects modelling to help Alberta's iconic fish

Michael Sullivan
Alberta Fish and Wildlife Division

Bull Trout, Alberta's provincial fish, was once the most widespread and abundant trout across our mountains and foothills. In spite of decades of concern, worry, recovery planning, and monitoring, it continues its decline to a species-at-risk, with local extinctions and few recoveries. The failure of recovery planning and implementation for Bull Trout and other Alberta stream trouts lead to a novel technique of cumulative effects modelling. Termed "Joe Modelling", it follows three sequential actions; 1) quantifying assumptions around threats, 2) with threat responses scaled to a common population response, and 3) with those responses quantified on discrete population units. The output represents the quantification of the best-available knowledge (including science and traditional knowledge) into a set of most-likely hypotheses around causes of decline and recovery, to be tested with adaptive management. Difficulties in implementing these necessary actions has highlighted a basic failing of much species-at-risk management; the exposure and acceptance of trade-offs by decision-makers.

Landscape resistance mediates native fish species distribution shifts and vulnerability to climate change in riverscapes

Michael LeMoine
Skagit River System Cooperative

A broader understanding of how mobility and landscape resistance influences climate change vulnerability is needed for stream fishes. Previous studies have focused on climate change vulnerability of larger more mobile salmon, trout, and char, yet smaller less mobile fishes are rarely used to demonstrate the effects of climate change, but they may be vulnerable to climate change. We revisited 280 sites over a 20-year interval throughout a warming riverscape. We described change in site occupancy (i.e., site extirpation and colonization probabilities) and associations between site occupancy and environmental conditions for four fishes spanning a range of body sizes and thermal preferences. Bull trout experienced a 9.2% (95% CI = 8.3%–10.1%) reduction in occupancy, mostly in warmer stream reaches, and westslope cutthroat trout experienced a 1% increase. Slimy sculpin experienced a 48.0% (95% CI = 42.0%–54.0%) reduction in occupancy associated with warmer stream reaches and areas subject to wildfire. Longnose dace primarily occupied larger streams and increased its occurrence in barrier free stream reaches as water temperatures warmed. Sculpin and dace were constrained by instream barriers limiting their ability to respond to climate drivers. Aquatic communities likely exhibit a range of responses to climate change, and that improving fluvial connectivity for the least mobile fishes will be important climate adaptation tactics for conserving aquatic biodiversity.

Evaluating options for removal of an introduced competitor to promote bull trout recovery

Brett van Poorten
Simon Fraser University

Recovery actions for imperilled species are never guaranteed to work. For example, how should you control an introduced species if you are unsure whether or how it affects a native bull trout population? Bull trout in Pinto Lake, Alberta, were closed to fishing in the 1980s, and recovery was proceeding until 1993, when cutthroat trout were first discovered in this headwater lake. Bull trout appeared to decline thereafter, prompting biologists to begin a cutthroat trout control program aimed at helping bull trout recovery. In this talk, we will examine the scant available data to reconstruct both populations over time, evaluate various hypotheses on how cutthroat affect bull trout. We then construct a decision table which helps decision makers choose the control option that suggests the fastest recovery. While recommendations from this work were not necessarily what managers wanted to hear, it underscores the importance of recognizing parameter and model uncertainty in any recovery action before it is too late.

Use of Spatially-Continuous Aerial Redd Count Surveys to Facilitate Bull Trout Habitat Conservation Planning in Northcentral British Columbia

John Hagen
Hagen
Independent consultant

Bull Trout spawner abundance monitoring in British Columbia is typically conducted at small spatial scales, e.g. 3-8 km index reaches. Such data may not provide the knowledge required for effective habitat conservation planning, e.g. the distribution of critical spawning and early rearing habitats, or total spawner abundance. In the 70,000 square-Km Williston Reservoir watershed in northcentral British Columbia, we have applied a spatially-continuous, helicopter-based aerial redd count method to acquire abundance and critical habitat information at large spatial scales. In our application of the method so far, aerial redd detection efficiency relative to traditional foot surveys has been estimated within 28 calibration reaches. Aerial redd detection efficiency (average = 53%) has been sufficiently high to suggest that the method is suitable for identifying key spawning streams for all but the smallest populations and for indicating their relative importance. However, variability among redd detection efficiency estimates has also been high (SD = 15%), suggesting the method is not suitable for applications requiring precise estimates. The resulting data have been urgently needed. In 22 days of accumulated effort since 2014, the number of identified critical spawning zones in the basin has increased from 4 to 72, encompassing 460 km of stream habitat, and a provincially-significant stronghold of Bull Trout abundance has been identified in the watershed's northern reach.

Movement patterns by bull trout in relation to prey pulses provided by sockeye salmon

Adam Kanigan
University of British Columbia

Predators frequently exploit migrant prey, but the scale of movements by predators in response to migrants is generally unrecognized and rarely studied. We used acoustic telemetry to study the movement patterns and spatial distribution of 65 adult bull trout (Salvelinus confluentus) in relation to the timing of sockeye salmon (Oncorhynchus nerka) spawning and the out-migration of sockeye salmon smolts for three years in the Chilko Lake system, British Columbia – the largest producer of sockeye salmon in Canada. Telemetry revealed that some bull trout moved over considerable distances (>100 km, annually) and that a portion of bull trout returned to the lake outlet in consecutive years during sockeye spawning and the smolt out-migration, presumably to consume sockeye eggs and flesh, and migrant smolts, respectively. Previous use of acoustic telemetry has revealed that pulses of migrant sockeye smolts appear to influence the behavior of bull trout at the Chilko Lake outlet, while stomach content analysis has shown that bull trout will opportunistically exploit the migration by binge-feeding on smolts. These findings suggest that bull trout may be

participating in migratory coupling – a phenomenon where large-scale movements by predators are induced by seasonal migrations of prey. Such behavior may allow bull trout to maximize exploitation of migrant smolts, which potentially account for a substantial proportion of their annual diet.

Feeding and predation-based selection of bull trout on migrant sockeye salmon smolts

Nathan Furey
University of New Hampshire

Over several years, we have investigated the predator-prey relationships between native bull trout (Salvelinus confluentus) and juvenile sockeye salmon (Oncorhynchus nerka) outmigrating from Chilko Lake, British Columbia. During this spring outmigration, bull trout feed nearly exclusively on sockeye salmon smolts, and feed at high rates, constituting binge-feeding. By comparing predated smolts to those captured at random in the population, predation selection was investigated. Bull trout consistently (in each of the years 2013 - 2015) fed on smaller smolts, indicating size-based selection of prey. In addition, we used a high-throughput quantitative polymerase chain reaction (qPCR) platform to screen for the presence of 17 infectious agents found in salmon and assessed 14 host genes associated with viral responses. In one (2014) of the two years assessed (2014 and 2015), presence of infectious haematopoietic necrosis virus (IHNv) resulted in 16-25 times greater chance of predation; in 2015 IHNv was absent among all samples, predated or not. Thus, we provide evidence that infection can impact predation risk in migrants. Some smolts with high IHNv loads also exhibited gene expression profiles consistent with a virus-induced disease state. The mechanism by which this selection occurs is not yet determined. By culling infectious agents and smaller-sized fish from migrant populations, fish predators could provide an ecological benefit to prey.

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My Bull Trout Crystal Ball--Past and Future

Philip Howel
US Forest Service

Some of the past highlights of bull trout history and management from its earliest taxonomy, ESA listing, and recovery efforts will be discussed, as well as future challenges to the conservation of the species. The role of the Salvelinus confluentus Curiosity Society (ScCS) will also be covered.

Adaptation Dynamics in Aquatic Ecosystems

Understanding Salmonid Physiology to Improve Conservation

Michael Phelps
Phelps
Washington State University

The unique ecological life history and economic importance of Pacific salmonids means that there are high stakes for ensuring their longevity. Successful salmon conservation will require a detailed knowledge of their physiology and how genetic and environmental perturbations impact their fitness. These complex questions have driven the creation of the Thorgaard Center for Salmon Physiology and Genomics (TCSPG) at Washington State University. The centers mission is to gain insight into how changes at the genetic level influence salmonid physiology and their ability to thrive in current and future environmental conditions with the goal of improving fisheries management and conservation of these iconic species. This talk will outline the work we are doing to further this mission. This includes our research to develop new molecular tools to extract critical biological information from genetic stock identification (GSI) and environmental DNA (eDNA) samples. We are expanding upon genetic discoveries to identify the biological mechanisms underlying complex life history traits. Our center is using gene editing technology to improve access to eDNA data, to find answers to questions in fish physiology that were not previously possible, and to develop new strategies for genetically tagging individuals that could reduce or eliminate the need to physically tag fish (e.g., coded wire tags). Despite the diversity of current projects there are many new frontiers left to travel.

Rearing temperature influences body shape and sprint swim speed in clonal rainbow trout

Christopher Duke
Duke

Washington State University

Temperature has far-reaching influence on phenotype in fish, and plastic response to altered temperature at early life stages can have downstream effects on critical performance

phenotypes. Body shape and dimensions can be altered by temperature in a number of fish, in turn changing swim performance capabilities. Sprint swimming speed is vital for predator evasion, prey capture, and migration through rapid water in salmonids, and subcarangiform swimmers such as salmonids generate a portion of their forward thrust with lateral body surface. We examined sprint swim speed, growth, and body shape in response to temperature between four clonal strains of rainbow trout (Oncorhynchus mykiss). Our research suggests that sprint swim speed can be influenced by temperature through temperature's influence on body shape.

Investigating the Activin Receptor Signaling Pathway in Rainbow Trout

Jasmine Richman
Richman
Washington State University

The activin receptor signaling pathway, a member of the transforming growth factor β superfamily, is a key regulator of skeletal muscle growth in vertebrates. Some members of this pathway, such as myostatin, have been well characterized as individual units. However, the interactions between activin receptor signaling pathway members, such as Activin A, remain uncharacterized in both mammals and fish. Previous studies have shown that while myostatin is an important muscle-specific regulator, it does not act alone. To study the interactions in the activin receptor signaling pathway, we utilized NanoString technology to quantify the expression of fifty-five genes across thirty-two different tissues and developmental stages of rainbow trout (RBT). From this data, we were able to characterize potential signaling mechanisms for each tissue as well as to identify the ligands that are produced within skeletal muscle. In addition to analyzing pathway wide gene expression patterns we have also used the CRISPR/cas-9 system to characterize the function of Activin A in RBT since Activin A is believed to be a co-dominant signaling ligand in mammals in addition to myostatin. Intriguing findings from our research suggest a potential function for the poorly studied Activin C in fish skeletal muscle growth with Activin A having a major role in a variety of tissues including reproductive organs, as has previously been established in other model systems.

Acclimatization of Chinook Salmon (Oncorhynchus tshawytscha) in Increased Temperature Stress

Alex Lopez
Lopez
Washington State University

Climate change and the associated rise in water temperatures have caused concern for the future of Chinook salmon. This keystone species is an important species to the ecosystems in which they inhabit, providing nutrients throughout the trophic level when they return from their long migration. In this study we are interested in testing the effects of rearing

temperature on skeletal muscle biology and performance. Muscle performance is a major factor that contributes to the overall fitness of the fish and is believed to be impacted by changes in environmental temperature. Our main field site is a tributary of the Lower Crab Creek near Mattawa, Washington called Red Rock Coulee (RRC). In the fall of 2020, we collected gametes from spawning RRC Chinook salmon as well as fish from the Priest Rapids hatchery (PRH) on the main stem Columbia River as a regional control. The fish are being raised at 10°C and 16°C to examine changes in muscle biology between optimal and high temperature environments. A full genomic profile of the fish is being performed to establish a genetic baseline for RRC fish and to determine the level of introgression from Priest Rapids hatchery fish. We are also performing phenomics experiments testing swim performance, respiration rate, and metabolic rate. For molecular analysis we will quantify gene expression and epigenetics changes in muscle contractile genes between the temperature groups. These studies will allow us to determine how muscle performance.

Salmon Above Grand Coulee – Opportunities and Concerns

Salmon and steelhead abundance during construction of Grand Coulee Dam, 1933-1942

Joshua Murauskas
Four Peaks Environmental Science & Data Solutions

Columbia River Basin salmon and steelhead populations were decimated by commercial fisheries and land use practices by the early 1900s. Large-scale hydroelectric development commenced by the 1930s with construction of Rock Island Dam (1933, rkm 730), Bonneville Dam (1937, rkm 235), and Grand Coulee Dam (1941, rkm 960), further affecting or eliminating already depleted stocks. Harvest data from the early 1900s, counts of adult fishes in the earliest Columbia River fish ladders, and mitigation established for construction of the Grand Coulee Hydroelectric Project all provide useful historical context for future management considerations. These data are presented and discussed to better understand current trends and how reintroduction efforts may contribute to viable salmonid populations in the Upper Columbia River Basin.

The Grand Coulee Fish Maintenance Project 1939-1947

Jeff Fryer
Columbia River Inter-Tribal Fish Commission

The building of Grand Coulee Dam blocked passage of salmon into Canada and resulted in an extensive fish salvage operation. From 1939 through 1943, all upstream migrating salmon were trapped at Rock Island Dam and transplanted to the Wenatchee, Entiat, Methow, and Okanogan rivers as well as to a new hatchery (Leavenworth) in the Wenatchee with eggs and

fry distributed to facilities in the Entiat and Methow rivers. In addition, there were habitat improvements in these tributaries. The success of this program has not been well evaluated, although salmon numbers did increase. Looming over this project was the prospect of more dams soon to be built on the Columbia River and proposed dams for the Wenatchee Basin. I'll review the project, some of the outcomes, and look at some of the lessons learned; some of which are not necessarily correct, with Sockeye Salmon the focal species for this presentation.

Overview of the efforts of the Upper Columbia United Tribes to study Fish Passage and Reintroduction to the Blocked Area through a phased scientific approach

John Sirois
Upper Columbia United Tribes

This presentation will give an overview of the efforts of the Upper Columbia United Tribes to study Fish Passage and Reintroduction to the Blocked Area through a phased scientific approach. To many in the Pacific Northwest, salmon is interweaved into the cultural and economic values, however for the Upper Columbia United Tribes, salmon is at the very core of their culture that has been blocked for generations. The Upper Columbia United Tribes (UCUT) – which include Coeur d'Alene Tribe of Indians, Confederated Tribes of the Colville Reservation, Kalispel Tribe of Indians, Kootenai Tribe of Idaho, and Spokane Tribe of Indians – with support from the United States Geological Survey (USGS) and Washington Department of Fish and Wildlife (WDFW), have initiated an extensive investigation into the reintroduction of anadromous fish to accessible habitats upstream of Chief Joseph and Grand Coulee dams, which was further adopted by the Northwest Power and Conservation Council (NPCC) in the 2014 Columbia River Basin Fish and Wildlife Program. This phased approach used to pursue reintroduction applied the knowledge gained and successful outcomes derived from sequential phases of research and evaluation. This presentation will focus on how Phase 1 examined riverine and reservoir habitat conditions, donor stock availability, reintroduction risk to resident species, key assumptions regarding fish survival, life cycle modeling and potential passage facilities, effectiveness of state-of-the-a

Estimates of Chinook Salmon Spawning Habitat in a Blocked Reach of the Columbia River Upstream of Grand Coulee Dam

Brian Bellgraph
Pacific Northwest National Laboratory

Spawning habitat of Chinook salmon was estimated upstream of Grand Coulee Dam to support the feasibility evaluations of reintroducing anadromous salmon to this blocked reach of the Columbia River. A two-dimensional depth-averaged hydrodynamic model was developed for a 76-km reach between Kettle Falls, Washington, and the US-Canada international border and used to predict water velocities and depths at 10%, 50%, and 90% flow exceedance values. Hydrodynamic model outputs were combined with calculated bed

slopes and empirical and modeled data on substrate availability to estimate salmon spawning habitat availability. A probabilistic spawning model was developed to estimate suitability for spawning salmon based on habitat characteristics at the exceedance flow levels and three substrate classifications. A majority of the highest probability salmon spawning habitat was located between Northport, Washington, and the international border. The model predicted 17.6 ha of spawning habitat at the 50% exceedance flow level for areas with pebble and cobble substrates; this equates to an approximate redd capacity of 2,893 to 4,091 non-overlapping redds, depending on mean redd size. Estimated capacity of spawning adults ranged from 5,786 (assuming two fish per redd and lowest number of redds) to 32,728 (assuming eight fish per redd at highest number of redds). We conclude that suitable Chinook salmon spawning habitat is available upstream of Grand Coulee Dam.

Salmon Habitat in the Blocked Area: Restoring a Home in the Hangman Creek Watershed

Thomas Biladeau
Coeur d'Alene Tribe

Described historically as a cool, clean and productive stream with vast floodplains and prolific beaver activity, Hangman Creek provided extensive spawning and nursery habitat for salmon and steelhead within the Spokane River watershed. In addition to abundant fish and wildlife, the fertile soil concurrently supported productive agriculture operations in the adjacent uplands. Over the last century however, resource extraction and human development have reached a level where the natural ecosystem could no longer support a sustainable population of salmon or steelhead. Throughout much of the watershed, floodplains and wetlands are actively drained to provide access for agriculture operations, and the adjacent uplands have some of the highest rates of topsoil loss in the region. Much has changed in the watershed following the complete extirpation of anadromous fish. Current efforts to reintroduce salmon and steelhead in the blocked area have highlighted the urgency to restore a “home” for salmon that resembles what was historically abundant. Within the upper Hangman Creek watershed, the Coeur d'Alene Tribe is actively rehabilitating the landscape to prepare for the inevitable return of anadromous fish. Restoration strategies build upon transitioning away from active agriculture operations within the floodplains and into restoring natural ecological processes.

Cultural and Educational Releases, Returning Salmon to the Blocked Area

Conor Giorgi
Spokane Tribe of Indians

Depending on the watershed, anadromous salmon have been absent from the upper Columbia River and its tributaries for 80 to 110 years. Their absence has left an indelible mark on indigenous communities, on the people who had relied on anadromous fish for millennia. Over the past several years that mark has begun to fade. In this presentation

you'll hear about the actions upper Columbia Tribes have taken to return salmon to their people. Cultural and educational releases of both juvenile and adult Chinook are among the first steps taken to restore the connection between the people, the fish, and the land. Ceremonies and traditions of the tribes have been rekindled by salmon swimming in the waters of their ancestors. While a Chinook darting up a riffle of the Sanpoil River, Tshimikain or Hangman Creek may offer a glimpse of what once was, results from limited monitoring hint at what will soon be.

Behavior and Fate of Adult Summer Chinook Salmon Released Upstream of Chief Joseph Dam

Casey Baldwin
Confederated Tribes of the Colville Reservation

Grand Coulee Dam (GCD) and Chief Joseph Dam (CJD) have blocked anadromous fish from 1200 km of the Columbia River (and many tributaries) since 1941. The government mitigation included hatcheries downstream of CJD, which did not provide a benefit to the Tribes and First Nations who were most effected. In recent years, the Upper Columbia United Tribes have been actively pursuing fish passage and reintroduction to the blocked area. In 2019, this work culminated in several cultural and educational releases of Chinook salmon upstream of CJD and GCD. These historic events were broadly celebrated by the tribes with ceremonies that honored the return of anadromous salmon for the first time in more than 80 years. Following the ceremonial releases, 59 adult summer/fall Chinook with acoustic tags were released in August to evaluate the behavior and fate of the translocated fish. This was a first step in gathering information to guide research and management objectives for the reintroduction. This presentation will highlight the results of the acoustic tracking study regarding behavior, survival and fall back rate.

Upstream adult passage concepts for Chief Joseph and Grand Coulee.

Steve Deardon
Whooshh Innovations

In this presentation we will examine some of the technical challenges and considerations for installing upstream adult fish passage at the two dams. Using prior installations as examples, potential solutions will be discussed, with descriptions of the applicable technology and potential impact to the reintroduction effort.

Lamprey

Expanding the Pacific Lamprey Conservation Initiative into Canada

Christina Wang
Wang
US Fish and Wildlife Service

Pacific Lamprey is a native anadromous species that historically returned to spawn in large numbers into watersheds along the West Coast of the United States and Canada, but populations have declined in abundance and become restricted in distribution throughout Washington, Oregon, Idaho, and California due to a variety of limiting factors and threats. The Pacific Lamprey Conservation Initiative (PLCI) is a collaboration among United States tribes, federal and state agencies and local organizations working together to address threats and conserve Pacific Lamprey throughout its range. In 2012, a conservation agreement, with 33 signatories and many more supporting organizations, was signed and these PLCI partners have collaborated to implement on-the-ground conservation actions and research for Pacific Lamprey (and other native lamprey species) throughout the U.S. range. Western Canada comprises a large and significant part of the native range for Pacific Lamprey but their status in Canada is unknown. PLCI partners would like to engage Canada with the goals of building relationships, assessing the population status of Pacific and other native lamprey species, identifying common threats, and jointly implementing outreach and restoration actions.

An Ecological Comparison Between Resource Subsidies: Pacific Lamprey & Pacific Salmon

Jocelyn Wensloff
Central Washington University

Stream resource subsidy studies in the Pacific Northwest have focused on Pacific salmon (Oncorhynchus spp.), overlooking other anadromous fish species such as Pacific lamprey (Entosphenus tridentatus) as potential subsidies. In order to better understand how Pacific lamprey could subsidize stream food webs, I used a modified nutrient diffusing substrate (NDS) approach to compare the stream ecosystem response to nutrients transported by Pacific lamprey and Tule fall Chinook salmon in the Upper Yakima River Basin. Using lamprey and salmon tissue as a nutrient amendment in summer and fall NDS deployments, I measured chlorophyll a as the autotrophic food web response and community respiration (CR) as the heterotrophic food web response. Chlorophyll a responded equally to lamprey and salmon but was significantly higher in summer, possibly due to greater light availability. Alternatively, although CR responded to lamprey tissue, the response was significantly higher to salmon, particularly in fall compared to summer. These results indicate that Pacific lamprey are equivalent to salmon as a resource subsidy for the autotrophic food web. Moreover, lamprey spawning occurs in the summer when salmon do not spawn, possibly extending the temporal subsidy provided by all anadromous fish returns in Pacific Northwest

streams. These data indicate that anadromous lamprey and salmon are equally important as resource subsidies, which should be considered in justifying lamprey restoration.

Translocation of Pacific Lamprey within the Columbia River Basin as part of ongoing conservation and restoration efforts

Devayne Lewis
Lewis
CRITFC

Supplementation and/or augmentation of Pacific Lamprey (Entosphenus tridentatus) in the Columbia River Basin (CRB) is being spearheaded by the Columbia River Inter-Tribal Fish Commission (CRITFC) and its member tribes in response to drastic declines in Pacific Lamprey distribution and abundance throughout the CRB. The importance of Pacific Lamprey both culturally and ecologically to CRITFC and its member tribes is immeasurable. Pacific Lamprey declines in the region threaten the persistence of cultural traditions and interactions between tribal members and Pacific Lamprey that have occurred for millennia. Conservation measures initiated to halt the decline of Pacific Lamprey in the CRB include translocation of adults from the lower Columbia River to tributaries where they were once abundant in the Upper Columbia and Snake river basins. Lamprey are collected at Bonneville, The Dalles, and John Day dams and are distributed to CRITFC member tribes for transportation and release into tributaries in ceded lands in Eastern Oregon, Washington, and Idaho. Here adult Pacific Lamprey can spawn in habitats of rivers and streams that are difficult to reach due to passage challenges posed by mainstem Columbia and Snake river dams. Translocation is an emergency stop-gap measure aimed at stemming the decline of Pacific Lamprey in the Columbia River basin, and not an end goal or long-term solution. However, translocation is integral to supplementing lamprey in areas of reduced abundance.

Contributed Papers

Bigger isn’t always better: Relationships between juvenile migration traits and age-at-maturity in a Columbia River hatchery salmon population

William Bosch
Yakama Nation Fisheries / Yakima-Klickitat Fisheries Project

Recent evidence indicates many Pacific Salmon populations are returning at younger ages and smaller sizes. Hatchery culture, management practices, and environmental factors greatly influence release size and juvenile migration timing. These factors in turn influence important demographic characteristics in returning adults, including age-at-maturity. Extending existing studies, we analyzed more than 450,000 PIT-tagged spring Chinook Salmon juveniles detected exiting Cle Elum Supplementation and Research Facility (Yakima River, Washington, USA) acclimation sites over twelve brood years (2003-2014; juvenile migration

years 2005-2016; adult return years 2006-2019) and evaluated juvenile size at release and emigration timing relative to other factors. Fish that left acclimation sites earlier or were smaller had longer travel times to Bonneville Dam (500-530 km downstream of acclimation sites) than fish that migrated later or were larger. On average, the largest and earliest migrating juveniles arrived at Bonneville Dam on May 7, while the smallest and latest migrating juveniles arrived at Bonneville Dam on May 18 and May 25, respectively. Smaller and later-emigrating juveniles had the lowest adult return rates to Bonneville Dam, but these fish returned at older ages. Fish that returned at younger ages were generally earlier juvenile migrants and larger at release. The smallest fish at release returned no age-2 mature progeny, while the largest returned no age-5 progeny.

The upper Deschutes Reintroduction: past, present and future adaptive management

Taylor McCroskey
Oregon Department of Fish and Wildlife

In 2009, the reintroduction of salmon and steelhead into the upper Deschutes basin, Oregon, occurred after 40 years of anadromous runs being extirpated from the area due to blocked passage by three hydropower dams on the Deschutes River. In the initial stages of the reintroduction project, fry releases, approximately 500 to 700 thousand of both spring Chinook and summer steelhead, were used to seed habitats in the upper basin tributaries. Smolts releases were then phased in to determine the difference between the two release strategies. Due to poor survival and outmigration, lower capture numbers at the fish collection facility, possible negative genetic interactions with native redband trout populations, and low adult return numbers the fry program for reintroduction purposes was discontinued in 2019. In 2020, one hundred thousand smolts, of both spring Chinook and summer steelhead, were released in the upper tributaries to try and increase the number out of migrants and returning adults. This presentation will cover the adaptive management decisions as to: why discontinue fry releases; why increase smolt releases; acclimation strategies for both the short term and the long term for smolts; change in rearing of both spring Chinook and summer steelhead; release timing and locations; and studies that will help better inform adaptive management decisions of these major changes in the upper Deschutes Reintroduction.

Using Advanced Remote Sensing Approaches to Characterize Salmonid Habitat Potential

Alyssa Nonis
University of British Columbia

Traditional approaches for quantifying habitat for stream-dwelling juvenile salmonids can be time-consuming and challenging to obtain on large spatial scales. The potential to use airplane-derived ALS (Airborne Laser Scanning) data to characterize stream habitats could

enable larger scale and more rapid land-use planning. To investigate this, in summer 2019, we surveyed juvenile salmonid habitat in five streams on southern Vancouver Island. Our first objective was to develop fish habitat relationships with physical stream characteristics and habitat-specific salmonid density. Fish density was correlated with gradient, bankfull channel with, small wood cover, and pool habitats. Our next objective is to extract these habitat features from the ALS data and attempt to develop predictive models between the ALS and field data. Preliminary assessments of the ALS data suggest that gradient, habitat types, and instream wood can be delineated. Thus, successful delineation could enable the use of ALS data to assess salmonid habitat potential across large spatial scales.

Population structure and habitat availability determine resource use by rainbow trout in high elevation lakes

Rebekah Stilling
University of Washington

The energetic base of lake food webs primarily originates in pelagic, littoral-benthic, and terrestrial habitats. Fish use carbon fixed in these habitats in varying proportions, acquired through consumer-prey transfers along energetic pathways. Habitat availability, allochthonous inputs, and population density are known to influence this variability, however the extent that these factors interact are not well understood. We leverage the similar food webs of stocked mountain lakes to address how population size and habitat availability determine reliance on basal resources by rainbow trout. In 16 lakes we measured bathymetry, CPUE, and fish muscle and primary producer C and N stable isotope ratios. Stable isotope mixing models quantified proportional reliance on resources for each fish. Compositional regression analysis identified how interactions between habitat availability and population size influence reliance on basal resources. At low abundance resource utilization is similar regardless of relative habitat availability; at high abundance rainbow trout increase reliance on terrestrial or pelagic resources.

Linking spatial stream network modeling and telemetry data to investigate thermal habitat use by Arctic grayling

Bryce O'Conner
University of Northern British Columbia

Temperature is a driving factor in ectothermic animal movements due to its effects on metabolic processes and ecological interactions. River networks have a high amount of thermal habitat heterogeneity and this is exploited by fish to increase fitness. In order to effectively manage conservation resources, a better understanding of how aquatic ectotherms interact with environmental temperature is needed. Our objectives were to explore thermal habitat availability and use by Arctic grayling in the Parsnip River Watershed in Northern British Columbia. A combination of spatial stream network modeling and acoustic telemetry data was used to address the objectives. Preliminary exploration of water

temperature data in the Parsnip River revealed a mean 2019 and 2020 August water temperature of 10.8ºC ± 1.8ºC and 10.1ºC ± 2.4ºC respectively. The range of recorded 2019 and 2020 August temperatures were 17.0ºC-5.6ºC and 22.4 ºC-5.2ºC respectively. The presence of a thermal gradient in the watershed was revealed by the spatial stream network model and is expected to influence distributions of Arctic grayling in the watershed. Ongoing analysis of water temperature data will be presented along with initial insights into grayling thermal habitat use.

Decoding the food web for Omak Lake, the largest saline lake in WA.

Alexander Reyes
Washington State University

Saline lakes are inland waters with alkaline properties defined by the concentration of all ionic constituents (Hutchinson 1957). Alkaline lakes host an important biodiversity (Wetzel 2001). Most importantly, they are one of the most productive ecosystems in the planet (E.E.Stüeken 2014). They host a wide range of organisms, which are the pillar for a whole fish community (Bowman 2008). The Omak is the largest saline lake of Washington and its water's pH is regularly higher than 9.0 (Bennet 1962). It is adjacent to the Colville Indian Reservation and by 1985; the lake had an estimated 85% area suitable for limnetic habitat (Kucera 1985). Lahontan cutthroat trout is the main fish specie that dominate this ecosystem and it is well adapted to pH fluctuations from 8.8 to 9.7 as I recorded in 2019. With such conditions, it would be important to know the community of organisms capable to survive (Grant 2006). Even more, which organisms are in charge to sustain the feeding requirements for Lahontan fisheries in such peculiar ecosystem? Who eats whom? Thus, the main research goal is to elucidate the food web for Omak Lake. The first stage of the research consists on performing a stomach content analysis (SCA). This would provide a picture of what fish has been eating recently. Stomachs from 194 fish were retrieved on a seasonal basis. The second stage comprises analyzing the isotopic content of the liver to obtain a long-term picture of Lahontan's diet.

Differentiating the effects of two invasive fish on native invertebrates of Turnbull National Wildlife Refuge.

Sarah Richardson
Eastern Washington University

The purpose of this study is to investigate the impacts of two invasive fish within the historically fishless wetlands of Turnbull National Wildlife Refuge (TNWR) in Cheney, Washington. The brook stickleback, Culaea inconstans, and pumpkinseed, Lepomis gibbosus, have invaded many of the lakes at TNWR, sometimes co-invading the same waterbodies. Past studies have indicated that these fish impact food web structure but have not yet differentiated between the two. The following ongoing study aims to disentangle the individual impacts of these fish to determine if they affect native invertebrates differently. To

do this, lakes were sampled from each of the following four categories: fishless, brook stickleback invaded, pumpkinseed invaded, and co-invaded for a total of 10 lakes. Sampled lakes will be compared through the abundance and diversity of invertebrates and stable isotope analysis (13C and 15N ratios). Upon completion, the results of this study will provide insights on the dynamics of multiple species invasions on food webs and the native species of wetlands. With this knowledge, managers at TNWR and other wetlands may better mitigate the harm caused by invasive fish.

Movement ecology of hatchery-origin white sturgeon in the regulated Upper Columbia River

Caleb Jetter
University of Northern British Columbia

Advancements in animal tracking technology and analytical techniques have expanded the disciple of movement ecology. An improved understanding of where, when, and why an animal moves can greatly assist in the management and recovery of endangered species. White sturgeon (Acipenser transmontanus) in the Upper Columbia River (UCR) are listed as endangered due to their considerable decline over the last century. Although recent conservation aquaculture initiatives have successfully delayed the extirpation of the species, more knowledge is needed on how this expanding population of white sturgeon interact with and occupy a regulated river system such as the UCR. Through the use of acoustic telemetry and hidden Markov models (HMM), this study investigates how the movements of hatchery-origin sturgeon are influenced spatially (between habitats and countries) and temporally, by biological factors (age, size, and sex), and by river regulation (temperature and discharge).

Tournament Talks: connecting anglers with relevant fisheries research virtually

Shayna Hamilton
Anglers Atlas

It is well established that citizen science efforts can be enhanced by ensuring that communication between scientists and anglers is well established. However, scientists may not be fully aware of what communication strategies are most effective for sustainably engaging anglers. To better understand what motivates recreational anglers to contribute catch data, a series of webinars are being offered as part of an American Fisheries Society Task Force. Each webinar is designed to engage a specific segment of recreational anglers by matching them with the researcher using their data. We pose standard polls and questions directly to the anglers, both during the event and in follow-up surveys to determine what areas of fisheries research are most impactful to anglers. This series of webinars follow an iterative learning approach to constantly improve our ability to communicate with anglers and learn what matters most to them.

Using app based tournaments as a source of fisheries data

Danielle Quinn

Anglers Atlas

In 2020, COVID-19 restrictions forced the cancellation of many fishing tournaments across Canada and drastically scaled back primary fisheries research. To address this situation, MyCatch - a catch reporting app - was modified to host Covid-safe fishing tournaments while collecting data for fisheries research. A total of 14 tournaments were launched with anglers submitting high quality data that can be reviewed and verified independently. Each submission included GPS coordinates, date and time information, and a photo of the fish on a measuring device. In 2020, a total of 383 tournament anglers submitted records of 12,459 fish covering 66 different species. This represented over 5,000 hours of angling effort across 116 Canadian waterbodies. The timing, duration, spatial boundaries and target species of these events can be tailored to meet the needs of fisheries scientists by using prizing to focus on the most important data needs.

The role of turbulence and velocity gradients in microhabitat selection by juvenile salmonids

Thomas Smith
The University of British Columbia

Drift-feeding salmonids select locations in streams where velocity is low and adjacent velocities are high, minimizing energetic costs of swimming while maximizing the probability of encountering invertebrate drift. Turbulence is also an important attribute of river hydraulics with known effects on swimming costs for drift-feeding salmonids, however, its role in mediating microhabitat selection by these fish is unknown. To address this knowledge gap, we conducted an intensive study of velocity microhabitat selection by drift-foraging juvenile rainbow trout (Oncorhynchus mykiss) in the Coquitlam River, British Columbia. Velocity and turbulence intensity at holding and adjacent locations of 29 fish were compared to conditions at locations with similar depths and velocities where fish were absent. Fish selected locations turbulence was lower and changes in turbulence intensity were less prominent compared to locations where fish were absent. Our results will help build a better understanding of turbulence effects on habitat selection, and inform bioenergetic models of habitat selection through the potential effects of turbulence on swimming costs and prey capture success. The active development of these models is key to improving instream flow management, as well as stream restoration efforts.

High Variability of Life History Characteristics in Non-native Brook Trout in Eastern Washington

Kaeli Davenport

University of Montana

Instances of invasive fish are expected to increase with global climate change, making it critically important to determine how these invaders will respond to environmental variation. In this study, I aim to understand how diverse temperature regimes may alter life history strategy in invasive Eastern Brook Trout (Salvelinus fontinalis). During October- November 2017, Brook Trout were collected using backpack electrofishing from eight different streams located within the Pend Oreille river basin in eastern Washington. Streams include Sullivan, Cee Cee Ah, Le Clerc, Highline, Cusick, Calispell, Ruby, and Lime Creeks. Fish were measured for total length (mm) and weight (g) in order to calculate Fulton's condition factor ((wt/l3) x 100,000). Otoliths were removed to determine age and maturity was assessed based on the presence of mature gametes. Eggs were counted for females and male gonads were measured to estimate energetic allocation to reproduction. Preliminary analysis suggests that there may be some support for Brook Trout in warmer streams expressing characteristically fast life history traits. However, we have also observed extremely high levels of variation within streams and clear exceptions to the general patterns. Our data suggest that temperature is not the only environmental factor shaping the life history characteristics of introduced Brook Trout.