AMERICAN FISHERIES SOCIETY

Washington - British Columbia - Idaho Chapters

2024 CONFERENCE

RETURNING HOME

ANADROMOUS FISHERIES IN THE PACIFIC NORTHWEST

April 29 - May 2, 2024

Spokane, WA

The Centennial by Davenport Hotels | 303 West North River Drive Spokane, WA 99201

WELCOME TO SPOKANE

WHAT ARE THE TOP 10 THINGS TO DO IN SPOKANE ACCORDING TO TRIP ADVISOR?

https://www.tripadvisor.com/Attractions-g58759-Activities-oa0-Spokane_Washington.html

TOP 10

1. Manito Park
2. Riverfront Park
3. Spokane Falls
4. Centennial Trail
5. Martin Woldson Theater at the Fox
6. Green Bluff
7. Downtown Spokane Shops & Trails
8. Barrister Winery
9. Northwest Museum of Arts & Culture
10. Mount Spokane

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COVER PHOTO: Josh Williams, WDFW

PRESIDENT'S MESSAGE

Greetings AFS members and guests,

Welcome to Spokane! We are so excited to join you at the first-ever joint annual meeting between the Washington-British Columbia and Idaho chapters. Spokane is an ideal location for this arrangement and we hope the success of this meeting leads to future meeting collaboration between chapters.

First of all, we all owe a debt of gratitude to the tremendous, diverse team of volunteers whose blood, sweat, and tears made this meeting possible. Both chapters have their own set of traditions and customs at annual meetings, so joining forces has been a process of learning and compromising. Cross-boundary relationships and bonds have been formed by team members that will last a lifetime, and that will be reflected in the meeting agenda. Please see the names of the Core Planning Team in this brochure and thank them for all of their hard work.

The number of oral and poster presentations in the schedule, relative to the number of registrants for the meeting, is as high as you will ever see at an AFS meeting. While this may in part be to extra arm-twisting, it more accurately reflects how much our chapter members have been looking forward to joint attendance, and how great the planning team did in advertising the meeting and setting up a strong, unique set of symposia. The meeting kicks off with a variety of outstanding Monday workshops, followed by a powerhouse lineup of plenary speakers Tuesday morning. This will set the stage for continued strength and variety in the remainder of the meeting schedule. There is truly something for everyone interested in building their knowledge base and sharing their findings with like-minded fisheries professionals charged with sustaining fishery resources across the Pacific Northwest.

We also ask you to stop by the vendor booths and thank our corporate sponsors who were invaluable partners in making this meeting affordable. And don't miss out on the various social events –

PRESIDENT'S MESSAGE

it's a chance to informally ask follow-up questions to speakers you heard present, and it's a great way to network and enjoy each other's company. Finally, we remind folks of AFS's meeting Code of Conduct; we will have designated 'Safety Officers', meaning the two of us, so if at any point you want to speak to someone about an incident you experience or witness, please feel free to let us know.

We hope you enjoy every aspect of this meeting. We encourage you to meet new people from your own or opposite chapters and build your networking channels. We challenge you to learn new, innovative ways of managing and conserving the fisheries in your jurisdiction. We hope you help support our organization by participating in the various fundraising efforts that will be ongoing throughout the meeting. And we ask you to help foster professionalism, respect, and empathy in our organization by respecting opinions and interpretations that might differ from your own. For some, this may be one of the first AFS meetings they have ever attended; it is our hope that those people walk away a bit awestruck at the quality of the science and depth of camaraderie we all display. For the veteran meeting goers, remember what it was like at one of your first meetings, and look for opportunities to make a positive impression on someone new to this whole process.

We hope you enjoy your time here in Spokane, and wish you safe travels home!

Sincerely,

Kevin Meyer, President

Idaho Chapter of AFS

Janine Bryan, President

Washington-British Columbia Chapter of AFS

WA-BC EXECUTIVE COMMITTEE

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JANINE BRYAN

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2024 WA-BC-ID AFS PLANNING COMMITTEE

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SEAN SIMMONS

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MARIKA DOBOS
REBEKAH HORN
KEVIN MEYER
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WEBSITE
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TUCKER BRAUER
SUSIE FRAWLEY
JEFF FRYER
NICK PORTER
JOSH WILLIAMS

REGISTRATION
DONA HORAN
JESSE MCCANE
KRISTI STEVENSON

POSTERS
BRETT KELLY

VOLUNTEER COORDINATION
JIM CHANDLER
COURTNIE GHERE

AUDIO & VISUAL
ERIC BERNTSEN
JANINE BRYAN
JOSH WILLIAMS
KRISTI STEVENSON

SOCIAL EVENTS
RYAN BRANSTETTER
COREY DONDERO
ERIC GEISTHARDT
KAT GILLIES-RECTOR
ALEX LOPEZ
ROB RYAN

MEETING LOGO & SWAG
REBEKAH HORN
JOSH WILLIAMS

DIVERSITY, EQUITY, & INCLUSION
KAT GILLIES-RECTOR
ROB VAN KIRK

RETURNING HOME
ANADROMOUS FISHERIES IN
• THE PACIFIC NORTHWEST •

A huge "Thank You!" to the

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MEETING INFORMATION

Registration will be open each morning at 7:30 AM in the Prefunction Area.

Oral Presenters were asked to submit their presentation prior to meeting arrival. However, if this has not already been done, speakers are required to have their presentation uploaded the day before their scheduled talk, with no exceptions. All talks will be woven together from start to finish for each 4-hour time block, and there will be no opportunity to inject talks on the day of your presentation. Computers will be set up in the Ballroom Prefunction area for uploading and review; see the schedule below for uploading times each day, and the registration desk for details.

Poster Presenters can attach their poster to their respective poster location (coded by poster number) on Monday afternoon or any time on Tuesday in the Ballroom Prefunction area. The designated Poster Session is Wednesday morning (see below). Posters must be dismantled by noon on Thursday.

Code of Conduct: This meeting, like all American Fisheries Society events, is governed by the AFS Code of Conduct. Its purpose is to ensure a safe, productive, and welcoming environment for all meeting participants, including vendors and non-AFS guests. In addition to the Code of Conduct Reporting Form provided as an online reporting mechanism for violations, we are providing onsite contacts for Code violations. Janine Bryan (WA-BC AFS President) and Kevin Meyer (ICAFS President) will accept complaints at any time from meeting attendees. Please take time to familiarize yourself with the Code of Conduct and its importance.

Abstracts will be available for every talk and posters on the Idaho AFS website, after the meeting has concluded. Please access these abstracts as needed once they have been posted.

Fundraising for auction and raffle items will be done using the GiveSmart virtual platform accessible with any smartphone. The link is https://afs24.givesmart.com/, or text AFS24 to 76278. Although bidding will be virtual, all items will be present at the meeting so winners can collect their prizes the night of the fundraising banquet. This year, we have rounded up some really great items including an Alpacka pack raft, multiple fly rods, and numerous other fantastic items. In addition to the raffle at the banquet, we will also have a raffle during the Trade Show! Only individuals that attend the Trade Show will have a chance to win. Chat with our vendors to find out more. We're hoping to make this one of the biggest years ever for fundraising!

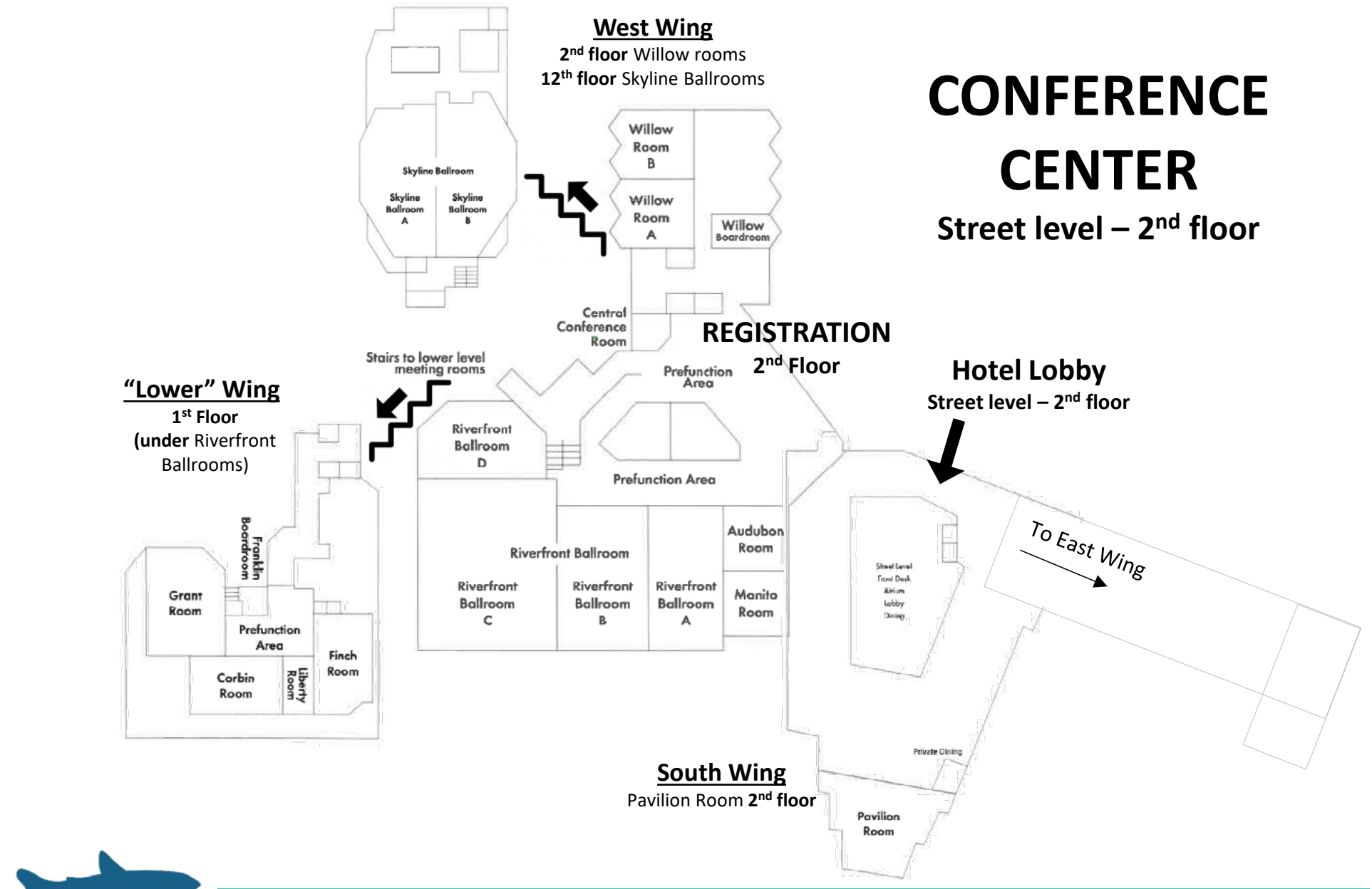
Student Mock Interviews will be held from 9:30-11:30 am on Wednesday in the Willow Rooms. Idaho AFS Mentoring Committee and WA-BC AFS are excited to host mock interviews for students and young professionals. Students and early career professionals can receive constructive feedback on practice interviews, with guidance geared toward both seasonal positions and permanent positions in the fisheries and natural resource fields. Please either bring a hard copy of your resume. Interviews are 20 minutes including time for feedback.

Lactation Room For nursing caregivers, the Liberty Room will be provided for nursing, milk storage, or other nursing needs. A refrigerator will be provided, but bottles and a breast pump will not.

AFS Childcare Engagement Survey Your chapter would greatly appreciate your response to this brief survey. This is part of our efforts to best support our membership

SYMPOSIA GUIDE (alphabetically by Key Word)

CONFERENCE MAP



RIVER

CONCURRENT SCHEDULE

Monday (April 29)

Workshops

8:00 - 9:40	Aquatic Connectivity	*Audubon*
	The Lamprey Lens	*Manito*
	Salmon Forecasting	*Riverfront A*
	Nutrition in Aquaculture	*Riverfront B*
	Genetics 101	*Riverfront D*
	Communicating Science	*Pavilion*
9:40 - 10:00	***Break with Coffee - Prefunction Area***	
10:00 - 12:00	Aquatic Connectivity	*Audubon*
	The Lamprey Lens	*Manito*
	Salmon Forecasting	*Riverfront A*
	Nutrition in Aquaculture	*Riverfront B*
	Genetics 101	*Riverfront D*
	Communicating Science	*Pavilion*
12:00 - 1:00	***Lunch Break (on your own)***	
1:00 - 3:00	All About PIT-Tagging	*Riverfront B*
	Genetics 101	*Riverfront D*
	Aquatic Connectivity	*Offsite*
3:00 - 3:20	***Break with Coffee - Prefunction Area***	
3:20 - 5:00	All About PIT-Tagging	*Riverfront B*
	Genetics 101	*Riverfront D*

TRADE SHOW AND POSTER SETUP
Audubon, Manito, Riverfront A, & Prefunction Area

5:00 - 6:00	AFS EXCOM and Planning Meeting *Complimentary Suite*	Volunteer Meeting *Prefunction Area*	Alphabet Social 5:30 - 6:30 *(offsite - Wonder Market)* *835 N Post St, Spokane, WA 99201*
6:30 - 9:00	Welcome Social (offsite - Wonder Market) 835 N Post St, Spokane, WA 99201		

CONCURRENT SCHEDULE

Tuesday Morning (April 30)

Plenary Session

Riverfront A/B/C/D

8:00 - 8:10	Introduction to the Meeting	**Kevin Meyer** President of the Idaho Chapter of the American Fisheries Society **Janine Bryan** President of the WA-BC Chapter of the American Fisheries Society
8:10 - 8:15	Introduction to the Plenary Session	**Lauren Andrews** President-Elect of the Idaho Chapter of the American Fisheries Society
8:15 - 8:45	The Future of Salmon	**Monica Tonasket**
8:45 - 9:40	Urgency & Adequacy: Rebuilding Snake Basin Fish Stocks	**Jay Hesse & Russ Thurow**
9:40 - 10:00	***Break with Coffee/Snacks - Riverfront A***	
10:00 - 10:10	Introduction to the Plenary Session	**Sean Simmons** President-Elect of the WA-BC Chapter of the American Fisheries Society
10:10 - 10:40	How cold-water fishes survive summer in warm river basins: examples of adaptive capacity from Oregon	**Jonathan Armstrong**
10:40 - 11:10	Linking concepts of adaptive capacity to trout and salmon in the Pacific Northwest	**Christopher Caudill**
11:10 - 11:40	Exceptionally high mortality of migrating adult female salmon: a large-scale pattern and a conservation concern	**Scott Hinch**
11:40 - 12:00	***Break***	

WA-BC Chapter Annual Business Meeting & Lunch — *Skyline Ballroom*

12:00 - 1:40 **ICAFS Committee Meeting Lunch**

Anadromous Fish - Grant
Aquaculture - Corbin
Aquatic Habitat - Finch
Mentoring - Willow A
Native Fish - Willow B
Public Education - Pavilion

CONCURRENT SCHEDULE

* Student	Tuesday Afternoon (April 30)					
Room	Riverfront B	Riverfront C	Riverfront D	Grant	Finch	Corbin
Symposium	Hatcheries 1	Fish Passage 1	Data	Drones 1	Tribal	Pinnipeds
1:40	Reflections on a 30+ year career in Columbia and Yakima Basin salmon restoration **Bill Bosch**	A quick look beyond habitat loss from dams and culverts in the PNW **Wayne Watne**	Ack! How do I cite this? Data citation and attribution for dynamic natural resource databases **Katie Barnas**	Monitoring Channel Response to Low-Tech Processed-Based Restoration Using UAV **Tulley Mackey***	Traditional Ecological Knowledge at Work: Adapting Indigenous Practices to Inform Ecosystem-Based Management Decisions for Herring and Salmon in Puget Sound **Jayde Essex**	Participatory modeling to evaluate pinniped management as a tool for salmon recovery in Puget Sound **Liz Allyn***
2:00	Columbia River Basin Hatcheries – Mitigation for hydrosystem operations and development of the basin **Maureen Hess**	Aquatic Organism Passage (AOP) Solutions at Culverts and Fish Barrier Management in North America **Shane Scott**	Data endurance: Documenting metadata and connecting to published data with MonitoringResources.org and large language models **Samuel Cimino**	Simulating riparian forest harvesting impacts on stream temperatures using RPAS-acquired LiDAR **Leanna Stackhouse**	Aquatic Invasive & Non-Native Species: An Indigenous Perspective **Anthony Capetillo**	Columbia River pinniped predation: A summary of information gained from a decade-long study **Michelle Wargo Rub***
2:20	Using Hatcheries for Conservation: An Overview of the Integrated Chinook Program in Idaho **David Venditti**	Lower Boise River Fish Passage Study **Colin Custer**	How large language models rich metadata can support greater interoperability of data and movement towards best practices. **Tom Bird**	Assessment of salmonid spawning habitat using Remotely Piloted Vehicles in a large river. **Jared Stieve***	Recent adaptations of the Kootenai river native fish conservation aquaculture program to restore white sturgeon and burbot **Brian Michaels**	Long-term Tracking of California Sea Lions Using Flipper-mounted SPOT Tags **Sarah Colosimo**
2:40	Evaluating Mitigation Objectives for Spring/ Summer Chinook Salmon Hatcheries in the Snake River Basin **Jonathan D. Ebel**	A cost-effective approach to implement and monitor the effectiveness of a fish passage project in the Potlatch River basin in northern Idaho **Brian Knoth**	Salish Sea Initiative Interactive Map and Marine Survey Tool **Tamara Fraser**	Developing a Drone-based Community Monitoring Program to Engage and Inspire Alaskan Tribal Communities in Fishery Science **Daniel Auerbach**	Benewah Watershed Stream and Floodplain Restoration: Building Climate Resilience for Native Trout **Stephanie Hallock**	Lower River and Estuary Pinniped Monitoring Program **Sam James**

CONCURRENT SCHEDULE

* Student	Tuesday Afternoon (April 30; continued)					
Room	Riverfront B	Riverfront C	Riverfront D	Grant	Finch	Corbin
3:00	Evaluating the success of Chinook Salmon and Steelhead hatchery mitigation programs in Idaho: a fishery and harvest perspective **Brian Leth**	Potential Solutions to Thermal Barriers in the Lake Washington Ship Canal **Lucas Hall**	An ocean intelligence system for the North Pacific Ocean **Lara Erikson**	Eyes in the Sky: A case study evaluating the accuracy of UAS enumerations of Chinook salmon (Oncorhynchus tshawytscha) redds using orthomosaic models. **Cade Crookshanks***	Towards a Prioritization Approach for Aquatic Habitat Restoration Projects that Incorporates Indigenous Interests **Eric Berntsen**	**TECH TALK** **Matt Knoff** **LoTek**
3:20 - 3:40	***Break with Coffee/Snacks - Riverfront A***					
Symposium	Hatcheries 2	Fish Passage 2	Sturgeon	Drones 2	Kokanee	Physiology
3:40	Anticipating and implementing changes in hatchery mitigation programs - Two examples from the Lower Snake River Compensation Plan. **Rod Engle**	Assessing juvenile coho access to critical overwintering habitat through floodgates **Zachary Sherker***	Population dynamics of white sturgeon in the upper Snake River, Idaho: evaluation of management options for a harvest fishery **Donavan Maude***	Application of drones for Snake River fall Chinook Salmon redd surveys **Bill Arnsberg**	Deadwood Reservoir: Managing a kokanee fishery for multiple objectives **Timothy D'Amico**	Influence of egg size and parental genetics on the metabolic rate of Chinook and pink salmon embryos **Alexander Iritani***
4:00	Deep River Net Pens- a multifaceted approach to the costs and benefits of bio-programming changes in a remote hatchery rearing site. **Kristopher Warner**	New Solutions for Tide Gates, Fish Passage and Working Landscapes **Jason Nuckols**	Validation of techniques for estimating the age and growth of known-age White Sturgeon **Courtnie Ghere***	Estimating Abundance of Chinook Salmon Redds Using Drones in Region 7 **Noah Frost**	A Razors Edge: The Balance of Predator and Prey in Lake Pend Oreille **Ryan Hardy**	Managing Smoltification for Improved Outcomes for Anadromous Fish **Jesse Trushenski**
4:20	Snake Basin In-Season Management of Salmon, Steelhead, and Coho Tribal and State Fisheries **Jason Voegel**	Regulating Fish Passage in Washington State **Matt Curtis**	Failing to Thrive – Can translocation help rebuild White Sturgeon populations? **Jacob Hughes**	Monitoring and Analysis of River Corridors with UAV LiDAR **Cody Marschner**	Kokanee population trends in an eastern Idaho reservoir **John Heckel**	Analysis of changing gene expression across semelparous migration illuminate phenotypes driving end of life histories in Pink salmon gorbuscha **Max Butensky**

CONCURRENT SCHEDULE

* Student	Tuesday Afternoon (April 30; continued)					
Room	Riverfront B	Riverfront C	Riverfront D	Grant	Finch	Corbin
Symposium	Hatcheries	Fish Passage 2	Sturgeon	Drones 2	Kokanee	Physiology
4:40	Monitoring hatchery success and Chinook salmon recovery in the Nooksack watershed **Zoë Lewis**	Squalicum Creek Barrier Removal and Estuary Restoration **Miah Whiteaker**	An evaluation of the White Sturgeon population and sport fishery at C.J. Strike Reservoir in response to an acute, localized mortality event **Philip Branigan**	**TECH TALK** **Silvana Germana Innovasea**	Improving the growth of kokanee using nitrogen addition: a case study of Dworshak Reservoir **Sean Wilson**	Predicting the likelihood of gas bubble trauma in fishes exposed to elevated total dissolved gas in the lower Clark Fork River, Idaho **Paul Kusnierz**
5:00	After the Sunset: A Case Example of the Outcome of Suspending Hatchery Propagation at a Large Regional Scale **Tom Chance**	Lessons Learned from Forest Road Treatments with Applications to the PNW Transportation Network **Wayne Watne**	15 Years of Shovelnose Sturgeon Monitoring in the Missouri River, Montana: River Discharge and Water Temperature Cue Different Stages of Movement Including Tributary Entrance **Brian Tornabene**		**Kokanee Discussion**	Sex Reversal of Brown Trout Exposed to Differing Estradiol Treatments **Elizabeth Mamer**
5:20 - 5:30	***Break***					
5:30 - 6:30	***Trade Show with snacks and beverages*** *Audubon/Manitou/Riverfront A*			***Student Mentoring Panel Discussion*** *Riverfront D*		
6:30 - 9:00	***Student/Professional Mixer - Riverfront B/C***					

CONCURRENT SCHEDULE

* Student	Wednesday Morning (May 1)					
Room	Riverfront B	Riverfront C	Riverfront D	Grant	Finch	Corbin
Symposium	Hatchery 3	Fish Passage 3	Tech 1	Anglers	Bull Trout 1	General 1
8:00	Genetic monitoring of hatchery salmonids with multi-generational pedigrees **Rebekah L Horn**	Resilient Waters - A systems thinking approach to fish passage and flood infrastructure for the Lower Fraser Watershed **Dan Straker**	Juvenile Anadromous Fish Utilization of Side Channels in the Lemhi River, Idaho **Michael Hall**	Engaging Anglers to Support Fisheries Research and Management Through App Based Fishing Tournaments **Sean Simmons**	Completing the Bull Trout Species Status Assessment and next steps for Bull Trout Recovery **Dan Nolfi**	Salmon and Climate Initiative: advancing a climate-resilient recovery approach for Pacific salmon throughout their North American range **Lucas Hall**
8:20	Effects of Supplementation in Upper Yakima River Chinook Salmon **Ilana Koch**	Washington Department of Fish and Wildlife Fish Passage Resources **Kaylee Kautz**	Modular, adaptive, mechanistic evolution of Whooshh Technologies: How they Work **Redwood Stephen**	Postrelease mortality of spring Chinook Salmon from a mark-selective recreational fishery in the Yakima River, Washington. **Anthony Fritts**	Collaboration in Bull Trout Recovery **Aimee Taylor**	How Do Management Goals for Wild Chinook Salmon Align with Feasibility? **Tim Copeland**
8:40	Genetic consequences of Chinook salmon strays from hatcheries in Southern British Columbia **Timothy Healy**	Improving Fish Passage Through Flood Protection - Lessons Learned **Sarah Lawrie**	Utilizing the Spotting Patterns of Bull Trout to Identify Individuals in Photo Identification Software **Lonnie Parry-Gillis***	Big Fjord Cutthroat Trout Project **Gregory Shimek**	Warm Creek Restoration Project: Is piscicide compatible with Bull Trout conservation? **Brett High**	Integrating research, restoration, and hatchery supplementation to conserve and recover a Snake River Spring Chinook Salmon population **Brian Simmons**
9:00	Hatchery Practices can Increase the Effective Population Size of a Captive Broodstock **Craig Steele**	Returning Home Within the Neighborhood – Understanding and Mitigating the Effects of Fragmentation in the Clark Fork - Pend Oreille Basin **Paul Spruell**	Automating fish passage counting using AI/ML **James Joslin**	Collaborating with Anglers to Monitor a Pelagic Fishery in Lake Pend Oreille **Jeff Strait**	Bull Trout biology and the importance of connectivity. **Judith Neibauer**	A state-space model for estimating smolt abundance at rotary screw traps **Luciano Chiaramonte**

CONCURRENT SCHEDULE

* Student	Wednesday Morning (May 1; continued)					
Room	Riverfront B	Riverfront C	Riverfront D	Grant	Finch	Corbin
Symposium	Hatchery 3	Fish Passage 3	Tech 1	Anglers	Bull Trout 1	General 1
9:20		**TECH TALK** **Doug Bonham Stream Data Science**	Metrics for Estimating Strike Injuries During Fish Passage through Kaplan Turbines **Tao Huang**	An assessment from the intensive water temperature monitoring consortium in the Teanaway Community Forest **Gabriel Temple**	Providing Bull Trout Passage Through Central Cascade Reservoirs **Danny Didricksen**	Lasting Effects of Juvenile Life Histories: Freshwater Migratory Diversity and Long-term Consequences in a Population of Spring Chinook salmon (Oncorhynchus tshawytscha) **Sam Owens***
9:40-10:00	***Break with Coffee/Snacks - Riverfront A***					
10:00-11:40	**Poster Session - Prefunction Area**			**Idaho DEI Meeting** 10:00 - 11:00	**Salmon Run Predictions**	
					Pavilion	
11:40 - 1:40	**ICAFS Business Lucheon Riverfront B/C**	**WA-BC Chapter Working Groups (Breakout Box Lunches)** Angler Engagement & Citizen Science - Grant Fish Passage & Habitat Restoration - Corbin Hatchery Evaluation - Finch Pinniped Interactions - Willow A Sockeye - Willow B			**1:00**	Introducing a Novel Stock-Specific Indicator of Salmon Survival in the Marine Environment **Brian Burke**
					1:20	Winter ichthyoplankton community composition and predicting Columbia River spring Chinook salmon adult returns for 2024 **Elizabeth Daly**
					1:40	Assessing the Impacts of Environmental and Ecological Variables on the Performance of Fraser Sockeye **Yi Xu**
					2:00	Incorporating marine climate indicators to predict Chum Salmon Oncorhynchus keta returns in south Puget Sound, Washington **Matthew Bogaard**

CONCURRENT SCHEDULE

* Student	Wednesday Afternoon (May 1; continued)					
Room	Riverfront B	Riverfront C	Riverfront D	Grant	Finch	Corbin
Symposium	Hatchery 4	Fish Passage 4	Tech 2	Escapement 1	Bull Trout 2	General 2
1:40	Contribution of naturally and artificially reconditioned repeat spawning female steelhead to spawning above Lower Granite Dam: repeat spawning pathways and life histories **Laura Jenkins**	Fish Passage Improvement Structure (Fishway) Assessment & Maintenance **Danny Didricksen**	Technology modifications to extend application potential: Eel to Pacific Lamprey **Whitney Goodwin**	Integrating data on the Snake River steelhead fishery enhances reporting of protected natural-origin stocks **Ryan Vosbigian***	The genomics of isolated lake bull trout **Alexandra Fraik**	Impacts of lake elevation decline on spawning habitat of a critical, native forage species **Sarah Barnes**
2:00	Living life on the straight-and-narrow or a merry-go-round: developing physiological tools to assess juvenile salmonid rearing in circular vessels **Dina Spangenberg**	Fishes in Ditches: Fish Removal as a Tool for Identifying Fish Passage Prioritization **Adam Crispin**	Next-Generation Miniature Transmitter Development for Fish Passage Monitoring **Daniel Deng**	Using an integrated model to estimate Chinook Salmon spawner abundance in the Middle Fork Salmon River basin, Idaho **Joshua McCormick**	Population Genetic Structure of an Isolated species assemblage of Bull Trout, Dolly Varden, and Rainbow Trout in the North Cascades. **Erin Lowery**	Interactions Among Yellow Perch, Northern Pikeminnow, and Smallmouth Bass in Lake Cascade, Idaho **Bryce Marciniak***
2:20	Developing methods to Improve the homing fidelity of hatchery-reared salmon **Andrew Dittman**	Audit of Remediated Culvert Barriers in the Fraser River Watershed **Patrick Zubick***	Bottlenecks to Survival for Chinook, Coho, and Steelhead **Jamieson Atkinson**	Estimation of Adult Steelhead in a Coastal River Using SONAR **Kevin See**	Population Demographics and Dynamics of Juvenile Bull Trout in a Montane Ecosystem **Sage Unsworth***	Smallmouth Bass response to tournament displacement in a highland Idaho reservoir **Eli Felts**
2:40	A review of Chinook (Oncorhynchus tshawytscha) and Coho Salmon (Oncorhynchus kisutch) hatchery release practices in British Columbia **Sam James**	Understanding and Prioritizing Aquatic Organism Passage at Watershed Scales **Dan Dauwalter**	Detection of Environmental DNA using CRISPR-Cas12 Technology **Tholen Blasko**	Reanalysis of lower Columbia winter steelhead spawning data using a spatio-temporal model **Jeremy Harris**	Assessment of the Potential Extirpation of a Bull Trout Population in the Wenatchee River Basin, WA **Jose Vazquez**	Abundance and density dependent survival of Burbot in the Kootenai River's hatchery-augmented fishery **Joshua Heishman***

CONCURRENT SCHEDULE

* Student	Wednesday Afternoon (May 1; continued)					
Room	Riverfront B	Riverfront C	Riverfront D	Grant	Finch	Corbin
Symposium	Hatchery 4	Fish Passage 4	Tech 2	Escapement 1	Bull Trout 2	General 2
3:00	How does varying age at maturation in hatchery fall Chinook affect evaluation of hatchery releases? **Brian Beckman**	**TECH TALK** **Biji Kobara** **BioSonics**	Acoustic Telemetry Techniques and Applications for Assessing Juvenile Salmon Passage Behavior at Pacific Northwest Hydroelectric Facilities **Drew Stang**	Can mark-recapture methods improve redd based escapement estimates? **Dan Rawding**	Predator-prey interactions between bull trout and sockeye salmon in Chilko Lake, British Columbia **Adam Kanigan***	Seasonal variation in small-bodied fish communities in side channel habitats before and after culvert removal **Eric Harmon***
3:20-3:40	***Break with Coffee/Snacks - Riverfront A***					
Room	Riverfront B	Riverfront C	Riverfront D	Grant	Finch	Corbin
Symposium	Hatchery 5	Passage 5	Tech 3	Escapement 2	Bull Trout 3	General 3
3:40	Panel Discussion	Panel Discussion	Effectiveness of Tools used to Evaluate Bull Trout Capture at the Cabinet Gorge Dam Fish Passage Facility **Tyler Zumwalt**	A method to compute adult anadromous salmonid abundance by PIT tagging juvenile outmigrants **Jason Neuswanger**	What Controls The Abundance Of Nonnative Brook Trout In Central Idaho Bull Trout Streams? **Nicholas Voss***	Shifting climate conditions affect recruitment in Midwestern stream trout, but depend on seasonal and spatial context **Bryan Maitland**
4:00	Panel Discussion	Panel Discussion	Low head, bidirectional, self-energy generating, continuous passage technology **Mike Messina**	Estimating Aggregate Coho Salmon Terminal Run and Escapement to the Lower Fraser Management Unit **Steven Rossi**	Spatiotemporal distribution of juvenile Bull Trout in Kachess Reservoir, Washington **Blake Hamilton**	Using MYY Brook Trout stocking and manual suppression to eradicate nonnative Brook Trout in Idaho **Jennifer Vincent**

CONCURRENT SCHEDULE

* Student	Wednesday Afternoon (May 1; continued)					
Room	Riverfront B	Riverfront C	Riverfront D	Grant	Finch	Corbin
Symposium	Hatchery 5	Passage 5	Tech 3	Escapement 2	Bull Trout 3	General 3
4:20	Panel Discussion	Panel Discussion	Using visual recognition technology to automate sonar counts of salmonids returning to spawn **Erik Young**	Escapement Discussion		Evaluation of using biological control to suppress Brook Trout populations in Idaho mountain lakes **Brett Kelly**
4:40	Panel Discussion	Panel Discussion	Use of an Acoustic Telemetry Pressure Tag to Evaluate Behavior and Approach Depth of Juvenile Salmonids at Yale Dam **Leah Nagel**	Escapement Discussion	Nonlethal Methods of Assessing Bull Trout (Salvelinus confluentus) Reproductive Status and Life History Strategies in the Upper Salmon River Basin **Joe Hirsch***	Fish population monitoring in response to the Quagga Mussel treatment in the mid-Snake River **Mike Peterson**
5:00	Panel Discussion	Panel Discussion	Local hydraulics influence habitat selection and swimming behavior in adult California Central Valley Chinook salmon at a large river confluence **Sean Luis**	Escapement Discussion		
5:30 - 6:30	**Spawning Run - Meet in Prefunction Area**					**Eastern Washington University Alumni Social** Pavilion
6:30 - 9:00	**Grand Social/Auction - Riverfront A/B/C/D & Audubon/Manito**					

CONCURRENT SCHEDULE

* Student	Thursday Morning (May 2)				
Room	Riverfront B	Riverfront C	Riverfront D	Grant	Finch
Symposium	Hatchery 6	Genetics 1	Piscivory 1	Sockeye 1	Infrastructure
8:00	Can reducing smolt size help adult returns? Comparing rearing strategies for a Chinook salmon hatchery program **Deborah Harstad**	An improved genetic marker panel for conservation monitoring of Upper Kootenay River burbot **Audrey Harris**	Northern Pikeminnow and Non-Native Predator Fishes in Anadromous Waters **Marika Dobos**	Sockeye International Competition	Design and Biological Testing of Two New Hydroturbines Installed at Ice Harbor Dam **Bradly Trumbo**
8:20	Biotic and abiotic factors affecting adult survival of Snake River hatchery fall **William Young**	Efficient species identification for Pacific salmon genetic monitoring programs **Zachary Robinson**	Comparison of Pectoral Fin Rays and Lapilli For Estimating Age of Northern Pikeminnow **Caleb Wilson***	Sockeye International Competition	Restoration elements of the klamath river renewal project (i.E. Lower Klamath project) **Daniel Chase**
8:40	PBT and PIT tags: Lyons Ferry Hatchery M&E of Snake River Fall Chinook **Michael Herr**	Preliminary results of population distribution, genetic structure and diversity of Coastal Cutthroat Trout (Oncorhynchus clarkii) throughout Washington and Oregon states **Amelia Louden**	Not all those who wander are lost: leveraging PIT tag data to better understand northern pikeminnow movement **Jessica Diallo***	Sockeye International Competition	
9:00	Relative post-release performance of Rainbow Trout fry stocked at two target lengths in alpine lakes of Idaho **Will Lubenau**	How can the genomic history of introduced salmonids inform their native range conservation and management? **Morgan Sparks**	Interannual and seasonal diet patterns of sympatric non-native predatory fish inferred through DNA metabarcoding **John Winkowski**	Sockeye International Competition	The More, the Merrier: Using Adult Pacific Lamprey Translocations to Increase Passage Rates at Wells Dam, Columbia River **Mariah Mayfield**

CONCURRENT SCHEDULE

* Student	Thursday Morning (May 2; continued)				
Room	Riverfront B	Riverfront C	Riverfront D	Grant	Finch
Symposium	Hatchery 6	Genetics 1	Piscivory 1	Sockeye 1	Infrastructure
9:20	Mobile spontaneous autopolyploidy testing for determining and removing 12n hatchery kootenai river white sturgeon **Mark Elliston**	Examining the evolutionary history of Rainbow Trout using mitochondrial sequences and nuclear single nucleotide polymorphisms **Tyler Breech***	Biological Trends for Three Piscine Predators During 33 Years of Reward Based Recreational Fisheries for Northern Pikeminnow (Ptychocheilus oregonensis) **Grant Waltz**	Sockeye International Competition	Native fishes and the Hells Canyon Complex Relicensing **Erin Kenison**
9:40-10:00	***Break with Coffee/Snacks - Riverfront A***				
Room	Riverfront B	Riverfront C	Riverfront D	Grant	Finch
Symposium	Hatchery 7	Genetics 2	Piscivory 2	Sockeye 2	General 4
10:00	Initial Results from a Chinook Mass Marking Pilot: Broodstock Management and Mark Selective Fisheries **Michael Thom**	The Effect of YY Male Stocking and Concurrent Electrofishing Suppression on Two Brook Trout Populations in Central Idaho **Dan Schill**	Insights from Recent Studies of Smallmouth Bass Predation on Juvenile Fall Chinook Salmon in the Lower Snake River **Ken Tiffan**	Life-cycle model reveals sensitive life stages and evaluates recovery options for a dwindling sockeye salmon population **Neala Kendall**	A stunted Walleye fishery in a southern Idaho reservoir **Conor McClure**
10:20	Use of feed rings in reduction of waste of feeding events **Kaleb Barclay***	Interspecific hybridization in a large-river population of Yellowstone cutthroat trout: a 20-year programmatic evaluation **John Hargrove**	A collaborative effort to control the spread of invasive Northern Pike in the upper Columbia River Basin. **Charles Lee**	Bringing the salmon home – Evaluating the feasibility of sockeye salmon reintroduction to historic habitat in the Columbia River upstream of Grand Coulee Dam **Patrick Zubick**	Response of Macroinvertebrates to Changes in Water Supply and Temperature in the Henry's Fork Snake River **Rob Van Kirk**

CONCURRENT SCHEDULE

* Student	Thursday Morning (May 2; continued)				
Room	Riverfront B	Riverfront C	Riverfront D	Grant	Finch
Symposium	Hatchery 7	Genetics 2	Piscivory 2	Sockeye 2	General 4
10:40	Evaluation of fall Chinook subyearling and yearling release strategies in Hood Canal **Devin West**	Introgression in native Redband Trout from a desert watershed **Kyle Rufo**	Population dynamics of Walleye in Lake Roosevelt **Danny Garrett**	Snake River Sockeye Salmon Captive Broodstock and Springfield Hatchery Smolt Program: a 10-year perspective **Eric Johnson**	The feasibility of Grandparentage testing to monitor genetic risks posed by straying hatchery steelhead in the Snake River Basin **Matthew Campbell**
11:00	Evaluation of alternative approaches to hatchery propagation of steelhead to minimize fitness loss. **Christopher Tatara**	Genetic pedigree analyses reveal differences in movement and growth patterns for 'rescued' young-of-year steelhead **Haley Ohms**	Food Habits and Growth of Walleyes in Lake Pend Oreille, Idaho **Susan Frawley**	40 years of Sockeye Salmon Research at Bonneville Dam **Jeffrey Fryer**	Exploitation and catch-and-release of salmonids in Idaho high mountain lakes **Kevin Meyer**
11:20	Age at release affects developmental physiology and sex-specific phenotypic diversity of hatchery steelhead trout (Oncorhynchus mykiss) **Don Larsen**	Does habitat extent predict a decline in genetic diversity for fragmented populations of redband trout? **Adam Zambie***	Suppression and Management of an Introduced Walleye Population **Eric Geisthardt**		
11:40	***Conference Wrap-up with Best Paper and Poster Awards - Riverfront B/C***				
12:20-2:20	***WA-BC and Idaho Chapters EXCOM Post-Meeting (Box Lunch) - Skyline Ballroom***				

POSTER SESSION

#	Poster Title	Author
1	Western Division American Fisheries Society and You!	**Timothy Copeland**
2	Using a Shiny App and PTAGIS Data to predict salmon returns to facilitate improved in season harvest and brood stock management	**Hayley Muir**
3	Defining Thermal Thresholds for Bull Trout and Brook Trout in Glacial Headwaters.	**Nichole Ring***
4	Effects of Euryhelmis cotti on Shorthead Sculpin in Birch Creek, Idaho	**Logan Thompson***
5	Revisiting karyotype counts of Mountain Whitefish	**Emily Underwood**
6	Collaborative efforts to increase in-hatchery rearing survival and adult-return success of threatened Upper Columbia summer steelhead at Winthrop National Fish Hatchery	**C.J. Smith**
7	Distribution of Brook Trout and Yellowstone Cutthroat Trout in Moody Creek, ID	**Dylan Bair***
8	Fish Distribution in Brush Creek	**Shaelyn Haberman**
9	Spatiotemporal Variability of Trace Elements in the Skagit River, WA	**Nikhil Amin***
10	Making their home in Idaho: status of Least Chub in the upper Snake River	**Eric Billman**
11	Can you tell me where your home is? Using rotary screw trap fry capture data and degree days to estimate the location of spring-run Chinook Salmon redds in Clear Creek, Redding, CA.	**Chelsey Hand**
12	Density and distribution of snails, the first intermediate hosts of Euryhelmis cotti, in Birch Creek, Idaho	**Daniel Rosso***
13	Rostral Teeth of Endangered Sawfish Hold Important Life History Information in Their Internal Structure and Chemical Makeup.	**Linh Truong***
14	Changes in fish habitat resulting from the Eightmile Creek Stream Restoration Project	**Ashton Buma**
15	Assessing spatial and temporal changes in stream fish communities of the upper Salmon River headwaters	**Luke Anderson**

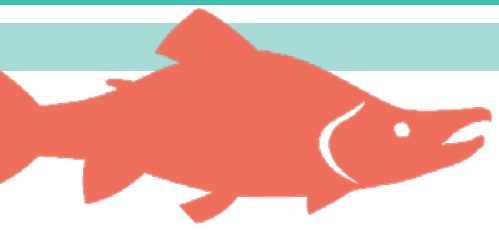
*** Student**

POSTER SESSION

#	Poster Title	Author
16	Comparison of Genetic Preservation Methods for Fish Tissue Samples in the Columbia River Basin	**Janae F. Cole**
17	Precocial Chinook Salmon in the Lemhi River, Idaho	**Ian Mott**
18	Upper Thermal Tolerance of native Cottus spp. from the Blue Mountains of Washington and Oregon.	**Rachael Valeria***
19	Analysis of Chinook Salmon Otoliths to Examine Early Life History	**Julia Grams***
20	Investigating the relationships between biotic and abiotic factors that affect migratory behavior in Westslope Cutthroat Trout (Oncorhynchus clarkii lewisi) within the Priest River system.	**Kyle Keenan***
21	Burbot At The College of Southern Idaho	**Avery DeWit***
22	Fish Passage Barriers and Stranding Associated with Irrigation Diversions	**Jenni Novak**
23	The Influence of Ecoregions and Land Use and Land Cover on Fish Assemblages in Southern Minnesota	**Masaki Hara**
24	Factors influencing bull trout populations on the Salmon Challis National Forest	**Patrick Catalano**
25	Efforts toward development of a standardized visual survey protocol for western North American fresh-water mussels	**John Erhardt**
26	Seasonal dynamics of Contracaecum multipapillatum infection in brook stickleback (Culaea inconstans) Turnbull National Wildlife Refuge	**Sarah Flores***
27	Pacific Salmon Data Discovery Tool	**Katie Barnas**
28	Juvenile salmonids surprisingly swap streams separated by saltwater shorelines	**Stuart Munsch**
29	Length and Fecundity of Yellow Perch	**Amber Young**
30	Stream temperature monitoring in forested tributaries of the Skagit River Basin	**Susannah Maher**

*** Student**

TECH TALKS & TRADE SHOW



TRADE SHOW! Come see all of our awesome sponsors and vendors at the trade show on Tuesday, April 30th from 5:30 PM to 6:30 PM in the Audubon/Manitou Rooms!

TECH TALKS

Company: LoTek (Tuesday, April 30, 3:00 PM, Corbin)
Title: Creating compatibility in acoustic telemetry
Presenter: Matt Knoff
Abstract: Acoustic telemetry is widely used to investigate aquatic animal movement. Pulse position modulation (PPM) is an acoustic telemetry method that allows multiple unique identification codes to be transmitted at a single acoustic frequency, typically in the 69 kHz range. However, because the potential number of unique identification codes (i.e. tags) is ultimately limited by the number of pulses in the PPM signal, this poses a practical limitation. In addition, different manufacturers have developed different approaches to encoding the transmitted data, hampering compatibility across brands. A lack of broad compatibility across telemetry systems restricts users to a single manufacturer and operating system, reduces market competition and limits innovation. As the aquatic animal tracking research community organizes towards networks of devices and data, incompatibility becomes more problematic and jeopardizes the unique scientific benefits offered by the networking approach. Here, we introduce the new Open Protocol encoding systems to address this need for cross compatibility between manufacturers and networks, for both a short term and long term solution.

Company: Innovasea (Tuesday, April 30, 4:40 PM, Grant)
Title: NexTrak: The Future of Acoustic Telemetry
Presenter: Silvana Germana
Abstract: NexTrak, Innovasea's breakthrough acoustic telemetry system, is ushering in a new era of science, collaboration, and discovery for aquatic animal researchers by delivering improved performance and higher quality data. The R1 receiver is the first product available as part of a larger NexTrak ecosystem of new receivers, transmitters, and enhanced cloud-based tools that will provide researchers with a richer, more complete picture of animal behaviour. Recent R1 field tests show 40 percent greater range than previous receivers which reduces the number of receivers required to cover the same area. Its advanced processor is better at filtering out noise and decoding tag transmissions leading to twice as many detections while also enabling researchers to reliably track fish in new habitats and challenging acoustic environments.

Company: BioSonics (Wednesday, May 1, 3:00 PM, Riverfront C)
Title: BioSonics Automated Riverine Smolt Counter
Presenter: Biji Kobara

Company: Stream Data Science (Wednesday, May 1, 9:20 AM, Riverfront C)
Title: Seeking Feedback on Fish Counter Concept for Small Streams
Presenter: Doug Bonham

Company: Bio-Oregon (No Presentation)
Contact: Loren Jensen, 360-556-0811, loren.jensen@bio-oregon.com
Description: At Bio-Oregon, we are dedicated to producing top-quality feed. Bio-Oregon fish feeds are specifically formulated to support fish immune systems, optimize growth, and provide the best conversion rates. All our feeds are backed by extensive research and field trials. We constantly strive for improvements in feed performance, logistics and customer service. Bio-Oregon is committed to supplying nutritious diets that are economically, ecologically, socially, and culturally responsible. That is why our feed mills were the first in North America to achieve the Best Aquaculture Practices certification. Whether you are looking for starter feeds, grower feeds, health-boosting formulas, or brood feed, Bio-Oregon has the right diet for your program.

WORKSHOPS

Monday, April 29th 8:00 AM to 5:00 PM

Genetics 101

Full Day (8am - 5pm); Riverfront D

Instructors: Rebekah Horn and Hayley Nuetzel, Columbia River Inter-Tribal Fish Commission (CRITFC), and Audrey Harris, Pacific States Marine Fisheries Commission (PSMFC)

Description: Genetic data are becoming more widely incorporated into fisheries management, with applications including the quantification of adaptive diversity and population resiliency to climate change, genetic identification of samples to species and origin in forensic cases, and genetic monitoring of hatchery stocks through pedigree-based analysis. Though managers and biologists may not collect genetic data firsthand, a baseline understanding of the types of genetic data available, their utility, and how results may apply to management plans can prove extremely useful. This workshop is designed for non-geneticists within the field of fisheries and will cover 1) introductory genetic basics and terms, 2) best practices for DNA sample collection, 3) the laboratory workflow from sample to genetic data, and 4) the types of genetic analyses and results fisheries managers and biologists can expect to encounter. Participants in the workshop will experience a mix of lectures from experienced geneticists and hands-on activities with workshop material that participants can take home for future reference.

Aquatic Connectivity, Flood Capacity, and Structural Integrity Associated with Road-Stream Crossings: Concepts and Tools for Management

Full Day (8am - 12pm Classroom, 1pm - 5pm in Field); Audubon Room

Instructors: Kat Hoenke, Southeastern Aquatic Resource Partnership, Dan Dauwalter, Trout Unlimited, and Carlos Camacho, Idaho Department of Fish and Game

Description: Aquatic organism passage (AOP), capacity to pass flood flows, and infrastructure integrity are important features of road-stream crossings. This full day workshop will cover these basic features associated with road-stream crossings, how to assess them using common protocols, and how the data can be integrated into frameworks and tools to prioritize crossings for removal, replacement, or improvement. The workshop will highlight a protocol used by the Southeastern Aquatic Resource Partnership (SARP) and show how using it will help build a national database to help prioritize crossings that should be removed or modified to allow for aquatic organism passage. The workshop will include half-day classroom portion and half-day field training portion where organizers will train attendees on how to collect data using the SARP protocol and its associated tools, access the data from SARP's database, and see how collected data are used in the National Aquatic Barrier Prioritization Tool (Aquaticbarriers.org).

Monday, April 29th 8:00 AM to 5:00 PM

The Lamprey Lens - Incorporating Lampreys into Restoration and Monitoring Projects

Half Day (8am - 12pm); Manito Room

Instructors: Monica Blanchard, Christina Wang, Ann Grote, and Max Calloway U.S Fish and Wildlife Service

Description: Pacific and Western River lampreys are native anadromous fish that live throughout the northwest; however, though their populations have declined in concert with Pacific salmonids, they are rarely incorporated into stream monitoring projects and restoration efforts. Lack of awareness has been identified as a key threat to the protection and restoration of Pacific Lamprey and other native lamprey species across their historical range. This is especially true in the northern reaches of their range, in Washington, British Columbia, and Alaska. The goal of this workshop is to address this lack of awareness and train biologists and practitioners to evaluate projects through a "lamprey lens". This workshop will educate participants about native lamprey species, basic biology and habitat use, ecological importance, and known distributions. Participants will learn how to incorporate lampreys into project planning and implementation, with a focus on restoration and passage projects. The workshop will provide tools that participants can apply in their home watersheds, including techniques for monitoring and identification of lamprey species and life stage, as well as best management guidelines for incorporating lampreys into projects.

Communicating Science: A Guide to Scientific Storytelling

Half Day (8am - 12pm); Pavilion Room

Instructor: Katherine Strickler, Washington State University

Description: Communication is an essential part of being a scientist. Fisheries biology is generally an applied science, and for it to be effectively used, we need to share scientific knowledge with other scientists, managers, the public, journalists, and policymakers. Many of us have been trained to share our work with other scientists but have had little (or no) training in communicating fisheries science with other audiences. Regardless of the audience, the heart of all effective communication is the ability to tell a good story. In this half-day workshop, participants will learn and practice principles of good storytelling, including crafting narratives of their work, targeting messages for different audiences, and using their excitement about their work to create a story that sticks. The majority of the workshop will feature a format of interactive, hands-on activities. Participants will use their own or others' research to create messages to communicate with their intended audiences. The skills we practice in the workshop will help participants tell better science stories, whether in a journal article, a newsletter, a policy paper, or a conversation with a landowner concerned about fisheries management.

WORKSHOPS continued

Monday, April 29th 8:00 AM to 5:00 PM

Nutrition in Aquaculture: What are we feeding our fish and why?
Half Day (8am - 12pm); Riverfront B

Instuctors: Riley Brown, Idaho Power, Tyson Fehringer, Idaho Department of Fish and Game, and Melissa Wagner, College of Southern Idaho

Description: This workshop will encompass a wide perspective on fish nutrition. Talks from fisheries professionals around the Pacific Northwest will focus on the key ingredients in common feeds, species-specific needs, the importance of quality nutrition for overall fish health, and the nuts and bolts of developing feed projections.

Predicting Salmon Returns - A survey of Existing Models and an Exploration of New Methods for Building Better Predictions
Half Day (8am - 12pm); Riverfront A

Instructors: Matt Falcy, Assistant Professor, College of Natural Resources, University of Idaho and Mark Scheuerell, Associate Professor, School of Aquatic and Fishery Sciences, University of Washington

Description: Predicting salmon returns is a critical part of salmon management, however models used in the past such as the Ricker stock recruit relationship, are not performing well in today's rapidly changing environments. This workshop will walk participants through the range of models used to predict salmon returns, and then explore new strategies for building better models.

All About PIT Tagging
Half Day (1pm - 5pm); Riverfront B

Instructor: Nick Porter, BioMark

Description: In this workshop we will discuss PIT tag theory and function, site selection, examples, and species-specific tagging. Armed with knowledge you will better understand the capabilities of PIT technology and when to use it.

Josh Williams, WDFW

PLENARY SESSION

Tuesday, April 30th 8:00 AM to 11:40 AM

The Future of Salmon

with Monica Tonasket

A welcome from the Spokane Tribe and video on Salmon reintroduction project.

ABOUT

Monica Tonasket is an enrolled Member of the Spokane Tribe of Indians. She currently serves on the Spokane Tribal Business Council as the Council Secretary. She has 29 years' experience working in various positions at Casinos, Enterprises and Tribal Government, and 25 years of experience in Supervisory, Managerial and Director Positions. She has spent the majority of her career as a Human Resources Director and Administrative Director for the Spokane Tribe. Monica graduated from Gonzaga University with a Bachelor's degree in General Studies with a concentration in Organizational Leadership. She serves as a founder and mentor of the Spokane Tribal Youth Council and serves on a variety of boards in the areas of Health, Education, Natural Resources, and Environmental Justice. She is a mother of four children and is very involved with her family and community and enjoys participating in community events.

Tuesday, April 30th 8:00 AM to 11:40 AM

Urgency & Adequacy: Rebuilding Snake Basin Fish Stocks

with Jay A. Hesse & Russ Thurow

Anadromous fish in the Snake River basin are cultural and ecological cornerstones. Their historical ubiquity is well documented, but their contemporary plight and the necessary restorative measures have lacked urgency - this appears to be changing. A vision for restoring these iconic species to healthy and abundant levels was established by a diverse group of sovereign entities and stakeholder parties through the Columbia Basin Partnership (CBP) Phase 2 Report. The National Marine Fisheries Service outlined a suite of actions necessary to achieve the CBP mid-range goals by 2050, which includes breaching of the four lower Snake River dams as a centerpiece action in their Rebuilding Interior Columbia Basin Salmon and Steelhead report. The Confederated Tribes and Bands of the Yakama Nation, Confederated Tribes of the Umatilla Indian Reservation, Confederated Tribes of the Warm Springs Reservation, Nez Perce Tribe, State of Oregon, and State of Washington advanced the Columbia Basin Restoration Initiative (CBRI) which is being supported by the United States Government Commitments as part of a Stay to long-standing litigation on the Columbia River System Operations. In addition, this presentation will describe the current status of stocks relative to goals. Adult returns of wild-origin Snake Basin stocks in 2023 were; ~7,500 spring/summer Chinook salmon, ~15,000 steelhead, ~9,000 fall Chinook salmon, and <100 sockeye salmon). With the exception of fall Chinook salmon, all were well below even the lowest management threshold required for ESA-delisting and also resulted in many populations at or below quasi-extinction thresholds (50 or fewer spawners). Hatchery-origin returns make up a vast majority of the total number of salmon and steelhead returning to the Snake River basin, however hatchery-origin returns continue to be below their mitigation goals (i.e. not meeting promised compensation for hydro-system impacts). Consistently achieving adequate returns of anadromous fish into the Snake River basin requires a shift in focus from one of not increasing failure risk (jeopardy standard) to one of achieving success (healthy and abundant).

PLENARY SESSION

Tuesday, April 30th 8:00 AM to 11:40 AM

ABOUT

Jay Hesse is the Director of Biological Services for the Nez Perce Tribe's Department of Fisheries Resources Management; and has worked for the Nez Perce Tribe for 30 years. He helps manage the Tribe's Research Division, a team of over 60 staff, working on fish population status and trends monitoring and hatchery evaluation projects. His recent work assignments focus on hydro-system operations, including development of the 2019-2021 Spill Operations Agreement. Mr. Hesse has expertise in anadromous fish population dynamics, hatchery effectiveness research, strategic planning, effective communications and multi-entity collaboration. He provides technical and management representation for the Nez Perce Tribe in multiple Columbia River basin fisheries co-management forums. Mr. Hesse served as president of the Idaho Chapter of the American Fisheries Society (2016-2017) and is recipient of the John Robertson Award for outstanding leadership. He routinely mentors students and has co-authored multiple peer reviewed publications, including the recent Water Biology and Security article "A review of potential conservation and fisheries benefits of breaching four dams in the Lowe Snake River."

Mr. Hesse graduated from Michigan State University with Bachelor of Science and Master of Science degrees in Fisheries and Wildlife.

ABOUT

Russ Thurow is an Emeritus Fisheries Scientist with the US Forest Service-Rocky Mountain Research Station. He has fisheries degrees from the Univ. of Wisconsin- Stevens Point and the Univ. of Idaho. For more than 40 years, he has been investigating wild Snake River basin salmon and steelhead. Russ is intimately familiar with Central Idaho's Middle Fork Salmon River basin and its remarkable aquatic resources.

Josh Williams, WDFW

Tuesday, April 30th 8:00 AM to 11:40 AM

How cold-water fishes survive summer in warm river basins: examples of adaptive capacity from Oregon

with Jonathan Armstrong

Large river basins exhibit a variety of thermal regimes, which in turn present different challenges and opportunities to mobile poikilotherms, such as fish. For cold-water taxa such as salmonids, physiologically optimal temperatures expand and contract across landscapes throughout the annual cycle. In this talk I explore how fish track this shifting mosaic of physiological potential, and I focus specifically on how trout in large rivers cope with warm summer temperatures through three tactics: move, migrate, or tolerate. I will share the results of field studies in the Willamette and Klamath river basins that show a diversity of responses that will likely confer adaptive capacity in the face of climate warming.

ABOUT

After growing up in Southern Oregon, Armstrong did his graduate research in Bristol Bay Alaska, working with the University of Washington Alaska Salmon Program. He was awarded a Smith Conservation Research Fellowship to conduct postdoctoral studies at the University of Wyoming and then joined the faculty at the OSU Department of Fisheries, Wildlife, and Conservation Sciences in 2016. Armstrong's research group works at the nexus of physiological ecology, animal behavior, and landscape ecology to advance climate adaptation planning.

Tuesday, April 30th 8:00 AM to 11:40 AM

Linking concepts of adaptive capacity to trout and salmon in the Pacific Northwest

with Christopher C. Caudill

Assessing ecological and evolutionary effects across multiple scales remains a key challenge to predicting the response of populations to environmental change. Adaptive capacity is an emerging concept in climate change science that considers how biological and human systems interact in the face of altered environments to allow populations to persist (or not). I will present: 1) a framework for synthesizing concepts of adaptive capacity from several disciplines; 2) summarize our recent work on redband trout attempting to identify key drivers of adaptive capacity from genomic to social-ecological system (SES) scales; and 3) provide two case studies on ESA-listed salmon and steelhead that illustrate biological and management elements of adaptive capacity. The studies highlight the potential for ecological-evolutionary feedbacks and the importance of identifying the relative role of genetic, phenotypic, and environmental factors that may ameliorate impacts of changing climate at local scales. While dams and reservoirs have strong negative impacts to native salmonids, several past and on-going efforts contribute to adaptive capacity in warming landscapes. Recent modeling approaches in the current age of 'Big Data' provide the opportunity for unprecedented integration across scales in coming years. More broadly, consideration of adaptive capacity elements, including connections and feedbacks among physical, biotic, and social system components, can enhance mechanistic understanding and identify conservation opportunities under current and future conditions.

ABOUT

Chris Caudill is faculty in the Department of Fish and Wildlife Sciences at the University of Idaho where he has studied anadromous fish migration, aquatic ecology and environmental change using interdisciplinary approaches since 2003. In recent years, he has co-led a large multidisciplinary effort funded by NSF and Idaho-EPSCoR to integrate studies from genomic to watershed to social-ecology-systems scales in resident redband trout populations of Idaho. He continues to pursue the application of molecular and modeling approaches to conservation and management issues in aquatic systems.

Tuesday, April 30th 8:00 AM to 11:40 AM

Exceptionally high mortality of migrating adult female salmon: a large-scale pattern and a conservation concern

with Scott Hinch

Sex ratios are fundamental to the demographics and characteristics of populations yet factors responsible for observed sex ratios on salmonid spawning grounds are rarely examined. Historically, female sockeye salmon (Oncorhynchus nerka) were the majority on Fraser River spawning grounds, but in recent decades, there has been a decline in the relative proportion of females in several populations. Differential mortality between sexes in spawning sockeye salmon is believed to originate during or after their anadromous ocean life. Coincident with the decline in proportion of females on spawning grounds has been large changes to oceanic, estuarine and river migration environments. Over the past 30 years, numerous telemetry tracking and laboratory studies from our group have examined mortality of adult Fraser River sockeye salmon during their freshwater homing migrations. We reviewed 19 published studies which provided 40 situations where male and female mortality could be directly compared during riverine homing migrations. Female mortality averaged 2.1 times greater than males, and up to 8-fold higher in some cases. High female mortality was also evident in migrating coho (O. kisutch) and Chinook salmon (O. tshawytscha), as well as for sockeye in other non-Fraser systems. Female mortality was highest when migration conditions were challenging (e.g. high / turbulent flows, high temperatures, fisheries gear escape, confinement and/or handling), and towards the end of river migration. There are indications that differential mortality could be caused by energy exhaustion, physiological stress, and/or pathogens, but strong evidence suggests cardiac performance may be the key factor. Relatively higher migratory female mortality is probably a common phenomenon in salmonids during challenging migrations, but has been difficult to study. Our findings from the largest salmon producing river in Canada raises concerns for the long-term sustainability of wild migratory salmonids everywhere, and we encourage research into how global change could be affecting sex-specific mortality in other fish species and regions. Given the pace of climate-change induced riverine warming, female-specific mortality will certainly become more pronounced in coming years.

PLENARY SESSION

Tuesday, April 30th 8:00 AM to 11:40 AM

Josh Williams, WDFW

ABOUT

Dr. Hinch is a Professor and Associate Dean in the Department of Forest and Conservation Sciences at the University of British Columbia where he leads the Pacific Salmon Ecology and Conservation Laboratory (https://www.pacificsalmonecologyconservationlab.ca/). He is an expert in the field of fish migrations, ecophysiology and behavioral ecology and is the Pacific leader of Canada's Ocean Tracking Network. He pioneered the field of conservation physiology in salmon. His current work utilizes telemetry tracking and genomic transcriptome approaches to examine behaviour and mortality of smolts and adults during their coastal and riverine migrations, the effects of migration obstacles (dams, high temperatures, and fisheries gear encounters) on adult salmon, and the role that pathogens, disease and climate change has on these migration issues. He works closely with fisheries managers so that research results can be readily applied and has served on several federal investigations into declining salmon stocks. In collaboration with social scientists, he is investigating ways that science and knowledge can be more effectively mobilized by stakeholders and decision makers. He has authored ~ 300 peer-reviewed papers and book chapters, has been cited >20,500 times, and has an h-index of 81. He has trained 70 MSc and PhD students, and 30 PDFs and Research Associates. He is a Fellow of the Royal Society of Canada, a Fellow of the American Fisheries Society (AFS), has been awarded the AFS Award of Excellence (their highest award), and the AFS Award in Fisheries Education. He is also a Distinguished University Scholar, UBC's highest honour for researchers.

SYMPOSIA ABSTRACTS

Angler Engagement in Support of Citizen Science

Moderator: Sean Simmons

Back to Guide

Wednesday, May 1, 8:00 AM to 9:40 AM

Symposium Abstract

Anglers play an important role in providing scientists and managers with valuable data about the state of our fisheries and this is increasingly being described as "Citizen Science". Local fish and wildlife clubs and other conservation groups have a long history of supporting fisheries research and management. More recently, new forms of electronic reporting through mobile apps have been developed which has greatly expanded the capacity of anglers to play meaningful roles in fisheries. This means anglers are becoming ever more important to fisheries research and management. For this symposium we are seeking fisheries professionals and anglers who have led (or been part of) a fisheries science project that supports research or management goals in a meaningful way. One of the important outcomes from this symposium will be a better understanding of the range of strategies used by fisheries professionals to engage anglers, and also the best practices that are necessary to achieve long-term angler engagement. This symposium is open to fisheries professionals and anglers alike.

8:00 AM

Engaging Anglers to Support Fisheries Research and Management Through App Based Fishing Tournaments

Anglers play an important role in providing scientists and managers with valuable data about the state of our fisheries. Often referred to as "Citizen Science", it has a long history in fisheries research and management, through programs like angler log books and other self-reported tools. More recently, new forms of electronic reporting through mobile apps have greatly expanded the capacity of anglers to play meaningful roles in fisheries. In this talk, we will be sharing our experience of using app-based fishing tournaments to collect fisheries data for both research and management purposes. The presentation will cover all stages of the process, from integrating the experimental design requirements into the rules of the event, developing appropriate incentive structures that motivate anglers to participate, and applying suitable quality controls (both automated and manual) to ensure data integrity. This event based approach is flexible enough to yield benefits across a wide range of fisheries research and management objectives, and can also be carried out at lower costs than many conventional fisheries methods.

Sean Simmons, sean@anglersatlas.com

8:20 AM

Postrelease mortality of spring Chinook Salmon from a mark-selective recreational fishery in the Yakima River, Washington.

Fishery managers often implement mark-selective fishing regulations that provide harvest opportunity on abundant hatchery salmon populations while requiring release of at-risk natural-origin populations. However, implementing these decisions requires fisheries managers to account for post-release mortality of any natural-origin fish caught and released by anglers, which can be variable and is unknown for spring Chinook Salmon Oncorhynchus tshawytscha recreational fisheries in eastern Washington. Using fish largely caught by recreational anglers, we conducted a two-year paired control and treatment radio-telemetry study to estimate the post-release mortality of adult spring Chinook Salmon caught and released in a mark-selective fishery in the Yakima River, Washington. Our results validate the post release survival rates commonly applied to inland salmon catch and release fisheries allowing managers to responsibly manage inland salmon fishing seasons and ensure conservation objectives are met.

Anthony Fritts, anthony.fritts@dfw.wa.gov

8:40 AM

Big Fjord Cutthroat Trout Project

Anadromous Coastal Cutthroat Trout Oncorhynchus clarkii clarkii are one of the least studied salmonids but are a highly prized target in sport fisheries in coastal waters of the Pacific Northwest. We utilized recreational anglers and fishing guides to assist the Coastal Cutthroat Coalition (CCC), Hood Canal Salmon Enhancement Group and the Washington Department of Fish and Wildlife in collecting genetic samples and completing stream restoration work. Specifically, the goals of this project are to describe the genetic stock structure of Coastal Cutthroat Trout in Hood Canal, WA in order to (1) provide genetic baseline for a major geographic region of Puget Sound (2) identify source populations of fish caught in the marine sport fishery (3) describe migratory patterns of individual Cutthroat Trout and (4) carry out stream restoration based on project findings. With the help of the fishing community, we captured and sampled 147 cutthroat trout across 12 months and reported preliminary results throughout the study period on social media and on the CCC webpage. Additional results from this work will be discussed.

Gregory Shimek, gregs47@icloud.com

9:00 AM

Collaborating with Anglers to Monitor a Pelagic Fishery in Lake Pend Oreille

Engagement with anglers has greatly improved the ability of Idaho Department of Fish and Game (IDFG) to understand the state of the Gerrard-strain Rainbow Trout (Oncorhynchus mykiss, Gerrard) fishery on Lake Pend Oreille (LPO). Numerous species introductions have created challenges for fisheries managers, and yet, have provided incredible angling opportunities. Most notably, the Gerrard fishery gained popularity after their introduction in 1941. This trophy fishery has been highly valued by anglers and a major management focus for IDFG. Gerrards are pelagic and difficult to sample with traditional fisheries techniques, making research and monitoring difficult for managers. As species composition and population dynamics of LPO change over time, evaluation of the Gerrard population is critical for effective management. The Angler Science Program began in 2016 to assist IDFG biologists monitoring the recovery of the trophy status of the Gerrard fishery following a Lake Trout (Salvelinus namaycush) suppression program that began in 2006. Angler logbooks reported valuable information on effort, catch rates, and size structure of the fishery. Anglers were also trained to collect pectoral fin rays for age and growth analyses. These structures were used to quantify the relationship between lake conditions and Gerrard growth rates. More recently, angler efforts were used to increase the number of T-bar anchor tags deployed to estimate exploitation and use rates. The program has grown over the years to meet new objectives and address challenges such as participation and data quality. The management of Gerrards in LPO has greatly benefited from collaboration with anglers.

Jeff Strait, jstrait41@gmail.com

9:20 AM

An assessment from the intensive water temperature monitoring consortium in the Teanaway Community Forest

The United Nation's Intergovernmental Panel on Climate Change predicts that climate change will disproportionately impact inland freshwater systems in northern latitudes in the coming years as climate change advances. A general increasing trend in global temperatures has been observed from past to present and is anticipated to continue into the future unless there is a major societal shift to reduce greenhouse gas emissions that are thought to be the primary contributing factor. These trends will likely lead to warming inland streams contributing to a shifting distribution of suitable habitats for cold water adapted fish such as Cutthroat Trout Oncorhynchus clarki and Bull Trout Salvelinus confluentus. With the help of citizen scientists, state and tribal biologists, and NGO's, we developed a water temperature monitoring network across the Teanaway Community Forest located in central Washington State. Our aim was to better understand current thermal conditions and to assess decadal trends in stream temperatures across this watershed. We coupled stream temperature information with instream flow measurements to provide an overview of aquatic conditions from the past and present relative to future projections for this basin. We believe this information will play a critical role in shaping cold water fish conservation efforts moving forward into an uncertain future.

Gabriel M. Temple, gabriel.temple.wabc.afs@gmail.com

Conservation and management of Native Bull Trout and Dolly Varden in the coastal and inland Pacific Northwest

Moderator: Judy Niebauer

Back to Guide

Wednesday, May 1, 2024 8:00 AM to 5:00 PM

Symposium Abstract

Bull Trout and Dolly Varden are collectively the native char of the Pacific Northwest, and have been conservation-listed at the state, provincial, and federal level. The two species interact within marine and freshwater ecological communities across coastal and inland watersheds within the region. The diversity of life history and migration patterns of these native char results in a broad range of habitats used that face natural and anthropogenic challenges. These species require access between very cold headwater tributary spawning and rearing areas and lower elevation foraging and overwintering habitats in lakes, reservoirs, rivers, and marine areas. Research informs conservation efforts and management program objectives across the variety of spatial habitat and population scales. New information addresses key questions such as abundance monitoring, migration behaviors, timing and use of connected habitats, population genetics and resilience, and management of threats. Findings from these efforts inform species status assessments for future conservation and recovery. This symposium provides the opportunity to share new science and presentations will be organized to address the following topics: 1) current species status, 2) new species information and population dynamics, 3)management and conservation actions, and 4) efforts that inform conservation and management pathways for maintaining Pacific Northwest native char across their range into the future.

8:00 AM

Completing the Bull Trout Species Status Assessment and next steps for Bull Trout Recovery

The coterminous population of bull trout was listed as Threatened under the Endangered Species Act (Act) in 1999. The Act requires periodic 5-year review (Review) of listed species to assess its progress towards recovery and thus determine if the species still warrants protections under the Act. Incorporated into the current Review for bull trout is the Species Status Assessment (SSA), a relatively new analytical framework developed to deliver foundational science for informing decisions under the Act. The process allows for increased transparency and repeatability while promoting collaboration with our partners in the review of best available science. The SSA process has three successive stages: 1) species needs, 2) current condition, and 3) future condition. It incorporates modeling and scenario planning to predict extinction risk through the lens of the "3R" conservation principles (resiliency, redundancy, and representation). The SSA results in a characterization of species viability (extinction risk) at given points in time, current and future. The SSA culminates in a peer and partner reviewed scientific document that remains dynamic, and thus more easily updated as new information is obtained. For bull trout, the SSA follows previous Reviews in recognizing the Core Area as the fundamental unit of analysis.

Daniel Nolfi, daniel_nolfi@fws.gov

8:20 AM

Collaboration in Bull Trout Recovery

The Yakima River Basin Bull Trout Working Group (BTWG) is a diverse group of people with the shared goal of recovering 15 populations of threatened Bull Trout in the Yakima River Watershed. Regional groups like this one should be looked to as an example on how to progress Bull Trout recovery in an efficient manner. The BTWG is comprised of individuals from state and federal agencies, the Yakama Nation tribe, non-profits, Central Washington University, landowners, and the public. The BTWG meets every other month to contribute new ideas, discuss, and delegate recovery actions. Members of the BTWG join forces in the field and on data analysis. Work includes

annual collection of demographic and redd data, the rescue-and-rear program, research on fish movement and migration, and preparing for future restoration and reintroduction efforts. With a concise plan laid out by the BTWG, smaller entities like Mid-Columbia Fisheries Enhancement Group's Bull Trout Task Force (BTTF) can provide boots-on-the-ground support. BTTF collects data to support species status assessments and potential for translocation. They provide extensive education and outreach to the public and remove passage barriers. In 2023 alone, BTTF conversed with 514 recreationists in Bull Trout country, removed 115 rock dams blocking passage, rescued 500 Bull Trout fry, assisted on 36 redd surveys and 12 demographic surveys. The Yakima Basin BTWG and BTTF are a great example of how partnerships, diverse perspectives, and a shared common goal can have measurable impacts on endangered species recovery.

Aimee Taylor, bttf@midcolumbiafisheries.org

8:40 AM

Warm Creek Restoration Project: Is piscicide compatible with Bull Trout conservation?

Warm Creek, a tributary to Sawmill Creek in central Idaho is home to one of ten local populations of Bull Trout Salvelinus confluentus in the Little Lost River Core Area. Brook Trout S. fontinalis have recently become a threat to this population. Warm Creek had been disconnected from Sawmill Creek until 2004 when a stream habitat project reconnected the system. Prior to the reconnect, Brook Trout had not been observed in Warm Creek. However, after the project, Brook Trout from Sawmill Creek began expanding their distribution upstream into Warm Creek. In response, multiple organizations initiated a project to protect Bull Trout in Warm Creek from hybridization and competition. The project involved installing a fish barrier and removing Brook Trout upstream. In 2022, collaborative efforts led to barrier site selection, the design of a barrier, and a species distribution survey. The following year, collaborators completed planning and permitting requirements, installed the fish barrier, and conducted a rotenone piscicide treatment on the lower 1.6 km section of Warm Creek. Prior to the treatment, backpack electrofishing crews removed fish from within the treated section and chemical deactivation zone. All Bull Trout were held in a live well outside of the treatment area and were returned to Warm Creek post-treatment. With an upstream fish passage barrier in place in Warm Creek and Brook Trout removed, reinvasion should not occur, and Bull Trout in Warm Creek are secured. This timely project indicates that piscicide treatments for Bull Trout can be beneficial for conservation.

Brett High, brett.high@idfg.idaho.gov and
Bart L. Gamett, bart.gamett@usda.gov

9:00 AM

Bull Trout biology and the importance of connectivity.

Bull Trout and Dolly Varden belong to the family Salmonidae, along with other trout, salmon, grayling, and whitefish. These Char are included in the genus Salvelinus. Bull Trout were considered Dolly Varden until 1978, when formally recognized as a distinct species (Cavender 1978). They were petitioned and listed under state, provincial, and federal authorities at varying levels since the early 90s. They exist as smaller residents and larger migratory forms, some migrating between lakes and rivers or fresh and marine waters, daily and seasonally. In comparison to salmon, Bull Trout and Dolly Varden are iteroparous and use their habitat year-round. Migrations are necessary between spawning, rearing, forage, cover, cold water, and overwintering areas for all life histories and life stages. Survival depends on access and connectivity between such habitats. Studies show that the timing and use of habitats varies between populations. Today studies describe spawner abundance, genetics, habitat needs, and extensive migrations for both fluvial and anadromous bull trout. Data gaps exist in understanding life stages, such as, egg, fry, juveniles, and subadults; while there is a need to understand life histories, distribution, refugia, hooking mortality, predation, prey base, etc. Managing the survival of bull trout and Dolly Varden and their ecologically connected habitat is complicated. Collecting and calibrating this information is essential for improving numbers, reproduction, and distribution. Continuing to communicate and share information, including linking it to the status and threats, will help to inform recovery and management.

Judith Neibauer, jneibauer9395@gmail.com

9:20 AM

Providing bull trout passage through central Cascade reservoirs

Fish passage conditions on tributaries to Rimrock, Keechelus, Bumping and Kachess reservoirs in the Cascade Mountains of Washington State are monitored to identify and remedy fish passage issues that develop as reservoir levels decline annually. Fish passage monitoring is conducted by the Washington Department of Fish and Wildlife (WDFW), through a contract with The United States Bureau of Reclamation (USBR). Monitoring typically occurs from June into October with drought and water storage issues playing a role in the timing, duration, and extent of stream de-watering and degradation of fish passage. Monitoring these streams allows WDFW to provide immediate relief as passage issues develop. At each site, small scale fish passage features are constructed and maintained by hand throughout the summer. Dozens of features at each site are removed, modified, or built each year to maintain fish passage. In some years drought conditions require that a temporary fish passage flume be constructed to facilitate fish passage from the reservoirs into the natal spawning tributaries of Bull Trout.

Danny Didricksen, daniel.didricksen@dfw.wa.gov

1:40 PM

The genomics of isolated lake bull trout

Multiple life history forms of bull trout (Salvelinus confluentus) are known across their native range. These include anadromous, fluvial, adfluvial and non-migratory stream-residents. Although a few bull trout populations located in small, sub-alpine lakes have been reported, the biology of this life history form is incomplete. We undertook a genomic characterization of four subalpine lake populations of bull trout in the Clearwater and Salmon River basins in Idaho to determine whether a fifth, non-migratory, lake resident life history form is possible. Bull trout were sampled from both the lake populations as well as the closest spwaning populations that retained access to other habitats. Using >50,000 single nucleotide polymorphisms (SNPs), we estimated patterns of diversity and divergence between the lake and creek populations. We found significant, but variable, patterns of genetic divergence between each pair of lake and creek populations of bull trout providing strong support for reproductive isolation. Additionally, we found evidence suggesting that lake populations in the Salmon River shared more recent common genetic ancestry amongst each other than their closest, physical stream populations. We similarly found support for divergence of Fish Lake Bull trout from any other Clearwater or Lochsa population. Although questions remain, the evidence to date implies that lake bull trout are non-migratory and are genetically distinct from the closest, physical genetic populations. The implication of these findings is important because there are conservation concerns for bull trout in the US, and life history diversity and small population persistence are key features of recovery plans for this species.

Alexandra Fraik, afraik@uidaho.edu

2:00 PM

Population Genetic Structure of an Isolated species assemblage of Bull Trout, Dolly Varden, and Rainbow Trout in the North Cascades.

We analyzed a combination of GT-Seq SNPs, microsatellites, and genotyping by sequencing data to describe the diversity, structure, and effective population size Bull Trout (Salvelinus confluentus), Dolly Varden (S. malma), and Rainbow Trout (Oncorhynchus mykiss) in the Skagit River Hydroelectric Project Area, located in Washington, USA (Project Area). The Project Area's hydrogeological history, which includes both ancient connections and blockages due to glaciation and recent isolation from the construction of the Skagit Hydro Project, makes the interpretation of the colonization and evolution of the three species complex. Hybridization between Bull Trout and Dolly Varden and between Rainbow Trout and Cutthroat Trout (O. clarkii) was common. The differentiation between Project Area Bull Trout and downstream populations was high (FST=0.28), like that observed between the coastal and interior lineages. Project Area Dolly Varden was distinct within the southern subspecies (S. m. lordi) genetic cluster and was characterized by a pattern of isolation by distance. Nearly all Rainbow Trout were highly differentiated from both the coastal (O. m. irideus) and interior

(O. m. gairdneri) genetic lineages and genetic structure was generally associated with contemporary watershed boundaries. However, some genetic clusters were widely distributed across multiple watersheds, and a population from Pyramid Creek, which is isolated upstream of a barrier, clustered with the coastal subspecies, indicating potential human introduction. Effective population size in Bull Trout and Dolly Varden was small (Ne<50). In conclusion, except for Pyramid Creek Rainbow Trout, all three species from the Project Area were highly genetically distinct from nearby conspecific populations, suggesting a prolonged history of isolation.

Erin Lowery and Dan Bingham,
erin.lowery@seattle.gov

2:20 PM

Population Demographics and Dynamics of Juvenile Bull Trout in a Montane Ecosystem

Bull Trout (BLT) Salvelinus confluentus populations throughout much of Idaho have stabilized or increased since listing under the Endangered Species Act in 1998. However, the BLT population in the Coeur d'Alene Core Area, Idaho (CDACA) has experienced substantial declines in abundance. The CDACA population has been monitored annually using spawning ground surveys since 1992, but little is known about early life stages. An understanding of juvenile BLT population demographics and dynamics is a crucial first step towards identifying factors limiting BLT abundance in the CDACA. In 2022–2023, we sampled 200 stream reaches in the upper St. Joe River basin. In total, 1,531 BLT were sampled varying in length from 29 to 257 mm (mean ± SD; 109 ± 44 mm). In 2022, average density estimates varied from 0.1 BLT / 100 m2 in Sherlock Creek to 3.5 BLT / 100 m2 in Medicine Creek and averaged 1.4 BLT / 100 m2 (SD = 1.4) for all streams. In 2023, density estimates varied from 0.3 BLT / 100 m2 in Sherlock Creek to 8.9 BLT / 100 m2 in Medicine Creek and averaged 2.1 BLT / 100 m2 (SD = 3.4) for all streams. Using scales, BLT varied in age from 0 to 4 years. Habitat was surveyed at a subset of sampling reaches and movement was tracked using passive integrated transponder tags. This study provides insight on the ecology of juvenile BLT that can be used to guide conservation and management decisions in the basin.

Sage Unsworth*, unsworth@uidaho.edu

2:40 PM

Assessment of the Potential Extirpation of a Bull Trout Population in the Wenatchee River Basin, WA

Data from the Mid-Columbia Basin indicates several local Bull Trout populations may be extirpated or nearing extirpation. One such population is the Nason Creek population in the Wenatchee Subbasin, where redds have not been observed in the population's primary historic spawning habitat since 2019. To assess the status of the Nason Creek Bull Trout population, USFWS conducted local distribution and abundance assessments using a combination of eDNA and night snorkel surveys. Night snorkel surveys were used to assess current Bull Trout abundance within all primary historic Bull Trout spawning and rearing reaches in the Nason Creek watershed. Environmental DNA samples were then collected at all potential Bull Trout habitat within the watershed to determine if Bull Trout spawning and rearing had transitioned to new locations. Night snorkel surveys were also used to assess Bull Trout presence and relative abundance within areas where Bull Trout eDNA was detected outside of historic habitat. A total of 15 juvenile and subadult Bull Trout were found during snorkel surveys in historic spawning and rearing reaches, which indicated recent Bull Trout spawning occurred within these reaches, but likely not at levels sufficient to sustain an independent population. Environmental DNA and follow-up snorkel surveys found that juvenile Bull Trout were present outside of historic spawning habitat, but densities in surveyed locations were also low and likely not sufficient to maintain a permanent population. This data indicates the Nason Creek Bull Trout population is extant but likely near extirpation, and management action may be required to prevent population extirpation. Our results emphasize the need for status assessments and potentially recovery actions in other regional watersheds which are considered at risk of near-term Bull Trout extirpation.

Jose Vasquez, jose_vazquez@fws.gov

3:00 PM

Predator-prey interactions between bull trout and sockeye salmon in Chilko Lake, British Columbia

Bull trout and sockeye salmon are species of ecological, economic, and cultural importance in the Pacific Northwest and are of conservation concern. We conducted a series of studies investigating relationships between bull trout and sockeye salmon in Chilko Lake and Chilko River, British

Columbia, one of the largest sockeye salmon producing systems in the Fraser River watershed. Over four years (2017 – 2021), we tracked the movements of adult bull trout throughout the system via acoustic telemetry. Bull trout exhibited seasonal movements towards the lake outlet, often over several kilometers, presumably in response to feeding opportunities provided by outmigrating sockeye salmon smolts in the spring and sockeye salmon spawning in the fall. In 2021, we examined bull trout stomach contents in the spring, summer, and fall and found that diet composition and ration size were influenced by sockeye salmon life history and capture location. Bull trout caught near the lake outlet in the spring and fall gorged on outmigrating smolts and sockeye salmon eggs, respectively, with stomach contents representing up to 13% of bull trout mass. This intense consumption appears to be facilitated by digestive plasticity, as bull trout exhibited large digestive organs in the spring and fall relative to the summer. These results suggest sockeye salmon are an important resource to bull trout. We are currently working to understand the influence of sockeye salmon subsidies on bull trout growth and energy budgets, and how bull trout growth and survival may be affected under different climate change and prey availability scenarios.

Adam Kanigan*, Nathan Furey, Scott Hinch, Andrew Lotto
akanigan@gmail.com

3:40 PM

What controls the abundance of nonnative brook trout in central idaho bull trout streams?

Brook Trout Salvelinus fontinalis is not native to western North America but was widely introduced to promote angling opportunities between the late 19th and late 20th centuries. Non-native Brook Trout negatively affect native salmonids such as federally threatened Bull Trout S. confluentus. Recent research indicates that Bull Trout in Idaho are consistently rare or absent in stream reaches where Brook Trout exceed a relatively low density, but the conditions under which Brook Trout are capable of reaching this density are poorly understood. Consequently, a more precise understanding of the reach-scale abiotic and biotic controls on non-native Brook Trout abundance could aid a variety of conservation and management objectives. To address this knowledge gap, we used backpack electrofishing to estimate Brook Trout and native salmonid abundance in >150 stream reaches located in Bull Trout spawning and and rearing habitat in central Idaho. We conducted in-stream habitat surveys within each reach and supplemented these data with GIS-derived estimates of stream gradient and temperature. Lastly, we used generalized linear mixed-effects modeling to relate Brook Trout abundance to our abiotic and biotic covariates and used Akaike Information Criterion to identify the most parsimonious model structure. We discuss our results in the context of our current understanding of interactions between Brook Trout and Bull Trout as well as the wide variety of ongoing research and management activities focused on Brook Trout in Idaho.

Nicholas S. Voss*, nvoss@uidaho.edu

4:00 PM

Spatiotemporal distribution of juvenile Bull Trout in Kachess Reservoir, Washington

The Yakima River Basin in central Washington state is considered a core area within the Mid-Columbia River Recovery Unit for ESA-listed Bull Trout. Kachess Reservoir, an impoundment which consists of two historic lake basins (Big and Little Kachess), hosts two adfluvial Bull Trout populations. These lakes are connected by a small channel under low-water conditions. Kachess Reservoir is subject to water level fluctuations from operations as a storage reservoir as well as the continued threat of water limitations resulting from climate change. We implanted 20 juvenile Bull Trout with acoustic transmitters to determine spatiotemporal use of Kachess Reservoir in 2022 and 2023. Drought conditions in 2023 presented a unique opportunity to identify potential correlation between Bull Trout distribution and reservoir pool elevation. Distribution varied between Little and Big Kachess by both season and year. Core area (50% utilization distribution) had a 58% overlap between 2022 and 2023, with distribution shifting south to encompass more of Big Kachess in 2023. Distribution was especially disparate in the fall months (23% core area overlap), which correspond with the lowest reservoir pool elevations. Furthermore, there were no movements

between Little and Big Kachess from August to November 2023, compared to 81 movements during the same time frame in 2022, indicating a potential physical or thermal barrier to movement. These spatiotemporal trends suggest that Bull Trout may have more difficulty accessing spawning tributaries in Little Kachess under drought conditions, which are likely to become more frequent and intense under future climate and water management projections.

Blake Hamilton, blakerhamilton@gmail.com

4:40 PM

Nonlethal Methods of Assessing Bull Trout (Salvelinus confluentus) Reproductive Status and Life History Strategies in the Upper Salmon River Basin

Bull trout (Salvelinus confluentus) can express several life history strategies that are both migratory (i.e., fluvial, adfluvial) and residents that stay in tributaries which can coexist within one population. This variety of life histories can make it difficult for managers to effectively manage these populations as there is no definitive way to differentiate between resident and migratory life histories. To remedy this, we will employ a variety of methods to evaluate whether Bull Trout are resident or migratory by using a combination of ultrasonography, blood steroid concentrations, and PIT (passive integrated transponder) tag movement data. A pilot study was conducted in August of 2023 to evaluate whether these methods would be effective. Using Brook Trout (Salvelinus fontinalis) as a proxy for Bull Trout showed that both ultrasonography and blood steroid concentrations are effective methods for evaluating whether female fish are gravid and if the sex steroid concentrations are distinguishable between spawning fish and immature fish. Bull Trout were also given ultrasound examinations and the presence of oocytes in their body cavity was confirmed. However, our sampling permit did not allow for blood draws from Bull Trout at that time, so this method will have to be built upon in future sampling seasons.

Joseph Hirsch*, Paul Hohenlohe, James Nagler, Alex Fraik, Brett Bowersox
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Josh Williams, WDFW

Data Longevity Achieved! Reproducibility throughout the lifecycle and beyond

Moderator: Megan Dethloff

Back to Guide

Tuesday, April 30, 1:40 PM to 3:20 PM

Symposium Abstract

Reproducibility is a fundamental concept within the scientific method and it drives scientific advancement. This concept applies to all parts of our scientific work processes, and its successful application relies on the FAIR data principles of Findable, Accessible, Interoperable and Reusable. Achieving reproducibility can be challenging for researchers and resource managers, especially in less data-driven parts of their work process. Part of the challenge arises from the differences in how people interpret whether their work meets the FAIR principles, such as how easily it can be found and accessed, and what is envisioned for current and possible future applications of the data (i.e., interoperable and reuse). Another challenging aspect is how to apply FAIR along with other principles and guidance that may seem at odds with each other such as the Collective benefit, Authority to Control, Responsibility and Ethics (CARE) principles for responsible data governance. In this symposium, we discuss reproducibility throughout research and resource management workflows, from ideation and planning to sharing for data re-use. We will explore how biologists and researchers have adapted their approaches, accessed different expertise, and leveraged new technology and software to meet the four pillars of FAIR, while addressing new guiding principles such as Open Data and CARE. Presenters will highlight novel thinking, surprising results and a host of new friends met along the way as we rely on new expertise and disciplines to align with FAIR.

Co-sponsored by Pacific Northwest Aquatic Monitoring Partnership, StreamNet, and Fisheries and Oceans Canada.

1:40 PM

Ack! How do I cite this? Data citation and attribution for dynamic natural resource databases

Data citation standards for static, written documents are readily available, well known and have changed relatively little over the past few decades. In contrast, electronic databases are often dynamic, yet are increasingly considered standalone citable products. We propose that open access, long-term, multi-contributor, dynamic databases necessitate the creation of new citation guidelines. Proper data citation and attribution both ensures that the data is properly documented for future use, and the data collectors, stewards, processors, and data analysts receive due credit. We will discuss FAIR and CARE data standards, and suggest minimum and ideal data citation guidelines for multi-contributor dynamic natural resources datasets.

Katie A. Barnas, Mari Williams, Jennifer M. Bayer, Sheryn Olson
katie.barnas@noaa.gov

Josh Williams, WDFW

2:00 PM

Data endurance: Documenting metadata and connecting to published data with MonitoringResources.org and large language models to preserve the data lifecycle

Preserving how, why, when, and where data are collected and analyzed by the descriptive documentation of metadata helps extend the longevity of data. MonitoringResources.org, a metadata documentation tool, supports data longevity by providing a platform that encourages data discovery and reproducibility. Within MonitoringResources.org, users can: plan step-by-step instructions for how data are collected and analyzed; provide rationale as to why data are collected; and document information as to where and when monitoring events occur. The metadata in MonitoringResources.org support making data more findable and accessible through descriptive documentation to help inform decision-making at a variety of spatial and temporal scales that often cross typical jurisdictional boundaries. However, the availability of this metadata does not necessarily mean it is easy to ingest. The highly descriptive procedures in Monitoring Resources have loose guidelines on content, making it difficult for humans to compare many documents at once. Therefore, we have started investigating the use of large language models (LLMs) to analyze and predict written text to assist with metadata documentation and discovery. Our efforts show that thorough metadata documentation coupled with LLMs can create more discoverable, interoperable, reproducible, and persistent data.

Samuel A. Cimino, Jennifer M. Bayer, Tom Bird, Minh Doan
scimino@usgs.gov

2:20 PM

How large language models rich metadata can support greater interoperability of data and movement towards best practices.

Fisheries management and research efforts are increasingly aiming to re-use data or repeat data collection analyses. However, while there's a push for broad-scale data accessibility, there's a notable gap in how research methodologies are described and shared, potentially leading to large variability in how data programs measure the data needed for decision-relevant indicators. Methods descriptions are necessary for understanding the provenance and quality of measured indicators, for comparing between them and applying them in new settings. However, methods are usually very context-specific. With only loose guidelines on structure and content, it is difficult for humans to write methods clearly or to compare between many methods at once.
Our work aims to improve the quality, comparability and usability of methods documentation by leveraging Large Language Models (LLMs). Using the MonitoringResources.org methods database, we demonstrate how LLMs can be used to build a foundational corpus of language to help bridge understanding between disciplines, or align language within a topic. We show how this vocabulary, combined with generative AI can support users to write rich, generalizable and usable metadata, or support readers to summarize work. With these generated text bodies, we then show how topic clustering can help condense any large body of work into a smaller number of relevant clusters for discovery and analysis. We suggest these three functions can help data creators and maintainers to properly describe, organize and reuse methods documentation and their resulting data. In doing so, we hope to achieve a improve data interoperability and repeatability, as well as convergence on best practices for broadly-used methods.

Tom Bird, tom.bird@dfo-mpo.gc.ca

2:40 PM

Salish Sea Initiative Interactive Map and Marine Survey Tool

Fisheries and Oceans Canada (DFO) and 33 First Nation partners are co-developing an interactive online Map as part of the Salish Sea Initiative. The application will serve as a tool for participants to visualize ecosystem components of interest and access other information useful for creating partnerships, planning and implementation of marine stewardship work and cumulative effects assessments. The map is being created under contract with an experienced provider of geospatial products and tools designed with Indigenous ecological

and traditional data in mind.

- Ease of use;
- Spatial analysis, data analysis and visualization tools;
- Recognition and celebration of Indigenous cultures;
- Protection of Community data rights of privacy and ownership;
- Inclusion of reference materials on marine cumulative effects and ongoing marine stewardship activities.
- Over 400 spatial data layers as well as 100 reference sources

In keeping with the goals of reconciliation and First Nations principles of ownership, the map will include

- Control of data sharing and privacy in the hands of each community;
- Keyword, spatial and temporal search functions;
- A place-naming tool, to support the inclusion of traditional knowledge and history;
- Indigenous language keyboards including; diitiidʔaaʔtx̌, Halq'eméylem, həńdəmińəḿ, Hul'qumi'num, ləkʷəŋən, Nuučaaḥuł, SENĆOŦEN, and Sḵwx̱wú7mesh.
- Sharing of stories and photos related to named places;
- Sharing of curated map views by link and email;
- Upload function to allow data sharing while ensuring complete data privacy;
- High performance even under low-bandwidth;
- Plain language descriptions of highly technical information;
- A planning function to aid in stewardship activities; and
- Compliance with First Nations principles of data ownership, control, access, and possession (OCAP).

The DFO team has also been developing a Marine Survey Tool using a free downloadable mobile app.

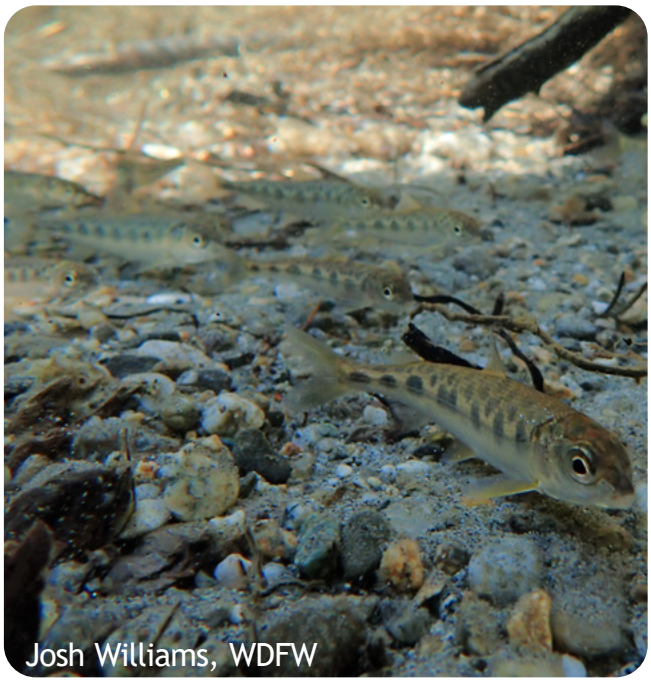
Tom Bird, tom.bird@dfo-mpo.gc.ca

3:00 PM

An ocean intelligence system for the North Pacific Ocean

The International Year of the Salmon (IYS) was an initiative across the Northern Hemisphere to support resilient management of salmon and understand the implications for people. Two successful international expeditions into the Gulf of Alaska were completed in 2019 and 2020, and a pan-Pacific international expedition involving 5 vessels successfully surveyed the Central and Eastern North Pacific in winter 2022. To build on the success and enhanced knowledge derived from the IYS expeditions, the North Pacific Anadromous Fish Commission (NPAFC) and the North Pacific Marine Science Organization (PICES) are planning to design, test, and implement a collaborative international ocean intelligence system for the North Pacific. The system will utilize innovative technology, enhanced monitoring (by ships, uncrewed autonomous vehicles, satellites, etc.), data mobilization and analytical methods to provide timely knowledge and advice to decision-makers about the effects of climate on ocean basin conditions and coastal socio-ecological systems. This presentation will introduce the project, known as BECI (Basin-scale Events to Coastal Impacts), which has been endorsed as a project under the UN Decade of Ocean Science for Sustainable Development. BECI is currently in the planning stage and is developing a science plan to build and guide the project over the course of the Ocean Decade.

Lara Erikson, lerikson@psmfc.org



Josh Williams, WDFW

Application of drones in fisheries research and environmental monitoring

Moderator: Alexander Fremier

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Tuesday, April 30, 1:40 PM to 4:40 PM

Symposium Abstract

Over the last decade researchers are using remotely piloted vehicles (RPVs, aka drones) in fisheries science and management. RPV technologies can help fill data gaps for understanding fish populations and be integrated into riverine ecosystem monitoring. New technologies allow researchers to interrogate persistent questions and potentially answer new questions because of the new observation scale that RPVs provide. This session aims to highlight: (1) how scientists are using RPVs, (2) what questions require further attention, and (3) what the next generation of RPV-based technologies are. We hope to move past RPV feasibility studies to begin mainstreaming RPVs for answering ecological questions and furthering long-term monitoring.

1:40 PM

Monitoring Channel Response to Low-Tech Processed-Based Restoration Using UAV

"Limited tools are available for resource managers to evaluate short-term geomorphic changes related to low-tech, process-based restoration (LTPBR). This lack of information reduces the ability to determine whether a project is on a desired trajectory, which can impede the development of adaptive management plans to correct unwanted outcomes or maintain and improve processes working as intended. To address this problem we outline a cost-effective, accurate, and repeatable monitoring approach using UAV technology coupled with structure-from-motion (SfM) photogrammetry to evaluate two LTPBR projects in central Idaho. Building off previous work using SfM photogrammetry and digital-elevation models (DEMs) to detect channel response to LTPBR, we used a point cloud analysis tool, developed specifically for detecting change of complex surfaces in three dimensions. Change detection using point cloud analysis provides greater accuracy because small surface complexities, such as streambed roughness, are often lost through interpolation when generating DEMs. The greater accuracy provided through point cloud analysis allows managers to track geomorphic change over shorter temporal scales, providing a monitoring solution to inform adaptive management within a relevant time frame Leveraging the high accuracy of change detection for point clouds requires specific data collection methods using georeferenced ground control points and defined UAV flight parameters. We outline best

practices for data collection and offer a post-processing workflow that provides flexibility to overcome data collection shortfalls and discrepancies. Finally, because our two project sites vary across physical and temporal scales, we demonstrate the utility of our approach across a spectrum of LTPBR projects.

Tulley Mackey, mack4534@vandals.uidaho.edu

Josh Williams, WDFW

2:00 PM

Simulating riparian forest harvesting impacts on stream temperatures using RPAS-acquired LiDAR

Solar insolation at the water's surface is the primary driver of thermal regimes in small forested streams. Harvesting of riparian vegetation can increase stream temperatures, sometimes pushing stream thermal regimes into lethal ranges for anadromous salmonids. Riparian buffers can help mitigate potential high temperatures caused by removal of riparian vegetation. Emerging technologies, such as LiDAR data collected from remotely piloted aerial systems (RPAS), can help predict the potential impact of forest operations under varying management scenarios on instream characteristics before harvesting commences. In this study, we used RPAS-mounted LiDAR data to model insolation for the area surrounding five stream reaches on Vancouver Island, Canada. Canopy height models (CHMs) derived from the LiDAR data were used to create simulations of forest harvesting, in which individual tree crowns were identified and removed to emulate varying "thinning" scenarios in the riparian forest surrounding the streams. The harvesting simulations, which ranged from 25% - 100% riparian forest harvesting, were then used as inputs to the insolation model. This allowed us to predict stream temperatures under varying insolation scenarios using a quadratic regression model where stream temperature was the response variable. Our results indicate that thinning of riparian forest buffers by 25% and 50%, respectively, can increase stream temperatures up to 1°C, whereas 100% removal (i.e. clearcut) of the riparian forest could increase stream temperatures by 5.8°C. This study demonstrates the applicability of RPAS-based LiDAR data to help monitor and inform how potential forest management practices may affect fish and stream ecosystems.

Leanna Stackhouse, leannast@mail.ubc.ca

2:20 PM

Assessment of salmonid spawning habitat using Remotely Piloted Vehicles in a large river.

Modeling Pacific Salmon microhabitat is an important step in planning and implementing recovery actions. Most current approaches to modeling involve extensive field efforts to create channel bathymetry and use 2-D hydraulic models to predict depth and velocity at specific flows or map meso-habitats (e.g. riffles and pools), which may miss important microhabitat features. These tasks can be time consuming and impractical, particularly when modeling longer river extents. Here, we present a methodology using remotely piloted vehicles (drones) to rapidly collect physical habitat characteristics important for spawning Pacific Salmon across large extents while still maintaining a high spatial resolution. Our method can be used to estimate water depth, velocity and substrate size across the river segment (multiple reaches). Using habitat suitability curves, we are able to model suitable habitat. The procedure we developed allows the mapping of large expanses of spawning habitat relatively quickly and at a low-cost. We validated the physical characteristic model by comparing modeled and field collected data and used geolocated redds from 2023 to further validate our approach. The overall goal is to create an initial validated model to quantify spawning habitat at scales relevant to the management of specific populations of Pacific Salmon. This presentation will go over data collection, processing, and development of both models, including preliminary results. We will also explain study limitations and possible solutions, and innovative approaches to applying the methodology to other fish species and rivers.

Jared Stieve, jared.stieve@wsu.edu
Alexander Fremier, alex.fremier@wsu.edu

2:40 PM

Developing a Drone-based Community Monitoring Program to Engage and Inspire Alaskan Tribal Communities in Fishery Science

The Yukon and Kuskokwim Rivers have seen steep declines in chum and Chinook salmon over the last decade which have limited subsistence fisheries, jeopardizing both food security and traditional ways of life. The management of all fisheries relies on population estimates derived from state and federal sources, yet in many of the salmon-bearing tributaries these surveys are infrequent due to a variety of logistical challenges. It is estimated that >50% of waterways in the Yukon watershed have not been surveyed disallowing legal protection based on Alaska state statute. In parallel to these data needs is a strong desire to increase

community involvement in monitoring across the region, particularly among resident youth. Drones provide an alternative survey technique that can be used to mitigate current survey issues, allowing for data collection at a higher frequency, across large extents, and provide reliable population estimates in areas that are either surveyed infrequently or not surveyed at all. Further, with proper training and protocols drones can be integrated into community monitoring programs along salmon-bearing waterways and represent an exciting platform for engaging youth in the fishery science and management process. We hypothesize that by using drones we can provide reliable population estimates and/or supplement current survey techniques. In addition, through a community monitoring program we can increase the number of waterways being surveyed all the while providing workforce training in an ever-increasing ecological drone field.

Daniel Auerbach, daniel.s.auerbach@wsu.edu

3:00 PM

Eyes in the Sky: A case study evaluating the accuracy of UAS enumerations of Chinook salmon (Oncorhynchus tshawytscha) redds using orthomosaic models.

The annual enumeration of redds (i.e., spawning nests) are widely used by fisheries managers to monitor population abundance and distribution of salmonids in the Pacific northwest. Because many of these populations are vulnerable, data from redd enumerations, through intensive ground surveys or the use of manned aircraft, have formed a cornerstone of annual population enumeration and projection. Despite their utility, traditional techniques can be costly, dangerous, and inconsistent if not completed with proper training. These challenges underscore the pursuit of alternative methods that provide accurate results preformed and analyzed in a replicable manner. Given the recent advancements of Unmanned Aerial Systems (UAS), or 'drone' technology, we evaluate the effectiveness of this equipment by identifying Chinook salmon redds in an established long-term study reach of Johnson Creek, Idaho in partnership with the Nez Perce Tribe (NPT). After collection of aerial imagery from multiple flights at different spawning periods, Agisoft Metashape software was used to construct digital orthomosaic models which provided an objective and independent imagery against which to compare traditional ground survey methods conducted by the NPT. Analysis of both survey methods yielded comparable results with both methods enumerating a total of 143 redd sites. In addition to an analysis of UAS redd quantification accuracy, we highlight digital orthomosaic models constructed within this study and their potential for future utility in fisheries research.

Cade Crookshanks*, croo8280@vandals.uidaho.edu

3:40 PM

Application of drones for Snake River fall Chinook Salmon redd surveys

The Nez Perce Tribe (NPT) Fall Chinook Salmon (Oncorhynchus tshawytscha) Monitoring and Evaluations program has conducted redd surveys via helicopter from 1988 to 2022 in the Clearwater River Subbasin. Since the Snake River fall Chinook Salmon were listed as "threatened" under the Endangered Species Act in 1992, the NPT has added the Grande Ronde, Imnaha and Salmon rivers to their helicopter survey areas. In 2019 we initiated an evaluation to determine the effectiveness of replacing helicopter surveys with small, unmanned aircraft systems (sUAS) or drones. Initially sUAS surveys were completed on the lower Clearwater River and compared manned helicopter surveys. Results demonstrated little variation in redd counts between the two methods from 2019-2022. In 2023 all surveys were conducted using sUAS and no manned helicopter surveys were completed. Surveys included multiple drone pilots conducting approximately 520 flights from October 13th to November 30th from roads, rafts, and jet boats. Redd counts were calculated as the average number of redds in each transect enumerated by reviewing videos by multiple reviewers. These surveys yielded spatial distribution of fall Chinook Salmon spawning as well as an index of spawner abundance. There were several constraints to conducting sUAS surveys including: weather, daylight visibility, water turbidity, access, and keeping drone in line of sight. New tools have emerged in drone technology, including using drone photos creating orthomosaic of combined images and digital elevation images. The project would like to use this technology in future surveys to achieve a better estimation of redds, especially in high density spawning areas with high levels of redd superimposition.

Bill Arnsberg, billa@nezperce.org
Morgan Sublett, morgans@nezperce.org

4:00 PM

Estimating Abundance of Chinook Salmon Redds Using Drones in Region 7

Index redd counts have been used to quantify annual escapement of Chinook Salmon Onchorhynchus tshawytscha to spawning grounds in Idaho for nearly seven decades. These surveys were typically conducted by field personnel on the ground, or from the air via helicopter. The Idaho Department of Fish and Game (IDFG) has recently adopted methods to complete redd counts with greater efficiency and at lower costs using unmanned aerial systems (UAS). Moreover, surveys conducted using UAS allow for the retention and storage of images, lending to long term standardized datasets that can be easily referenced. UAS have been used to monitor Chinook Salmon in the Upper Salmon River Basin in central Idaho since 2017, with the advent of new technology in 2023. With the upgraded UAS fleet, we documented a 54% reduction in survey time during 2023 when compared to 2022, despite a 41% increase in survey distance during this period. As such, timely updates of methodologies and advancing technologies is suggested for natural resource agencies implementing UAS in environmental monitoring. While the need for enumeration of Chinook Salmon redds on the ground may remain in perpetuity for certain drainages, emergent technologies in the field of UAS may allow natural resource agencies to augment or even replace ground or helicopter counts where appropriate.

Noah Frost, Noah.frost@idfg.idaho.gov

4:20 PM

Monitoring and Analysis of River Corridors with UAV LiDAR

Remote sensing has become a crucial tool in understanding and restoring river corridors since the start of the 20th century. This includes wetlands, river channels, floodplains, riparian zones, and fluvial deposits, all of which form a biodiverse ecosystem. Rivers should be viewed as spatially continuous mosaics of information (Fausch, Torgersen, Baxter, & Li, 2002), in which remote sensing and aerial terrain mapping becomes an unparalleled tool for gathering millions of data points. Remote sensing techniques, such as unmanned aerial vehicle (UAV) LiDAR scans, provide engineers and scientists with valuable research and monitoring given their nonintrusive nature, repeatability, cost, and increasing spatial range and ability. A comparison of spatial resolution and extent of UAV LiDAR has shown that the end user cost, temporal resolution, and ease of data analysis often favors UAV LiDAR. With restoring riverscapes as the focal point, LiDAR scans provide essential detail for evaluating spatial and temporal change in fluvial geomorphology. UAV flights provide monitoring of physical change to better inform science and management decisions in understanding sediment and wood transport processes to identify appropriate restoration goals. Repeated monitoring flights allow for analysis of wood mobility, wildfire effects, spatial variability in grain size, and producing reach-averaged streambed maps. UAV LiDAR can further assist in estimating sediment transport rates using overlayed digital elevation models to determine vertical streambed change over time. As UAV technology advances, costs have decreased significantly while the spatial extent and accuracy has increased, making this a more accessible tool for fisheries science and restoration.

Cody Marschner, cody@rivhab.net

Josh Williams, WDFW

Improving Salmonid Adult Escapement Abundance Estimates

Moderator: Neala Kendall

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Wednesday, May 1, 1:40 PM to 5:20 PM

Symposium Abstract

Estimating escapement abundance of spawning salmonids is a core activity of many resource agencies. These estimates are key to conservation and management, but often they lack uncertainty bounds and utilize methods that have not been updated for decades. In this symposium, we will hear about new salmonid escapement abundance estimation methods utilized by a range of groups and their strengths and weaknesses, and we will discuss where we want to be going with these methods.

1:40 PM

Integrating data on the Snake River steelhead fishery enhances reporting of protected natural-origin stocks

Salmon and steelhead fisheries can include co-occurring species or stocks with different management objectives. Managing co-occurring protected stocks and harvestable hatchery stocks is complicated by catch-and-release mortalities and potential negative effects of breeding between natural- and hatchery-origin fish. Quantifying the escapement of both the natural- and hatchery-origin stocks at their breeding locations is key to managing the populations and the associated fisheries. Snake River steelhead consist of both hatchery- and natural-origin fish, where natural-origin, and certain hatchery-origin, steelhead are listed as Threatened under the Endangered Species Act. Therefore, the fishery for Snake River steelhead is an excellent example of managers balancing different objectives across stocks. A multi-agency workgroup developed a model in 2010 to integrate the data collected by each agency and evaluate final steelhead stock dispositions for each spawn year. We extended this model by propagating uncertainty in data inputs using Monte Carlo simulation and by incorporating catch composition and escapement data using maximum likelihood. Both extensions allow for uncertainty estimation in fishery mortality and escapement. Our methods provide a useful framework for quantitatively monitoring Snake River steelhead.

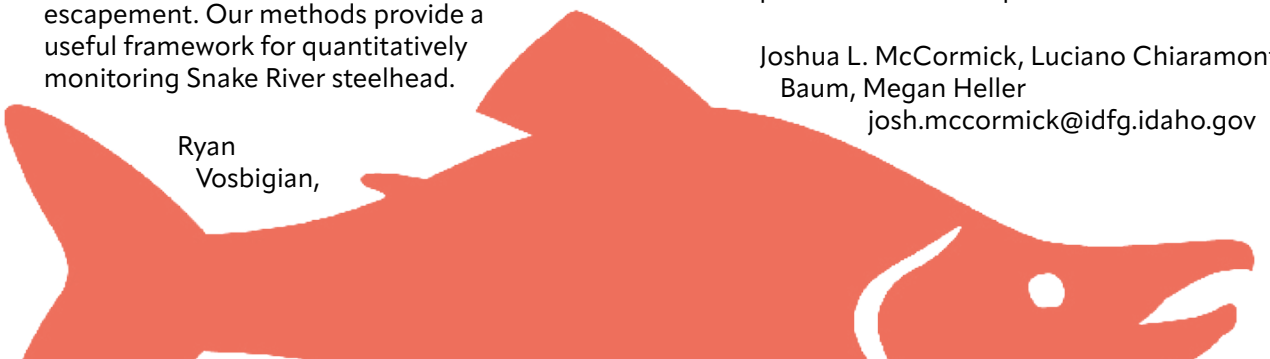
Ryan Vosbigian, rvosbigian@uidaho.edu;
John Powell, john.powell@idfg.idaho.gov;
Matt Falcy, mfalcy@uidaho.edu

2:00 PM

Using an integrated model to estimate Chinook Salmon spawner abundance in the Middle Fork Salmon River basin, Idaho

A majority of the Middle Fork Salmon River basin of Idaho is in the Frank Church Wilderness, making access for conducting fisheries surveys difficult. Consequently, helicopter-based surveys have primarily been used to estimate Chinook Salmon Oncorhynchus tshawytscha spawner abundance. In the interest of staff safety and efficiency, we developed an integrated model that combines historic aerial survey data, contemporary ground-based redd count data, and genetic stock identification data at Lower Granite Dam to estimate spawner abundance in eight populations in the Middle Fork Salmon River basin without the use of aerial surveys. Model-based estimates, where aerial survey data were ignored, were similar to estimates based on aerial surveys for eight populations within the Middle Fork Salmon River basin from 2009 to 2022. The results of this study suggest that the integrated model may provide a suitable replacement for aerial-based surveys.

Joshua L. McCormick, Luciano Chiaramonte, Carli Baum, Megan Heller
josh.mccormick@idfg.idaho.gov



2:20 PM

Estimation of Adult Steelhead in a Coastal River Using SONAR

This talk focuses on estimating winter steelhead adult returns using SONAR in the Dungeness River, offering results and lessons learned. Steelhead spawning ground surveys in the Dungeness River basin on the coast of the Olympic Peninsula in Washington State are inherently challenging due to springtime snow melt and rain events which can lead to high, turbid water and unsafe survey conditions. In most years it is not possible to survey for steelhead through the entirety of the spawning season, and in some years poor survey conditions prevent an adequate number of surveys to estimate redd-based escapement. In 2019 the Washington Department of Fish and Wildlife (WDFW) installed and operated a stationary multi-beam SONAR unit in the lower Dungeness River to enumerate and gather run-timing information on winter steelhead (Onchorhynchus mykiss). Using data from species composition sampling in the lower river, we differentiated species detected with SONAR based on size and day of year. We estimated total upstream, downstream and net upstream abundance using a generalized additive model (GAM) to help interpolate across periods when the SONAR was either inoperable or the data had not been reviewed. As SONAR is an emerging technology being utilized or considered in more and more rivers, we hope to provide some guidance by discussing lessons learned over the past five seasons related to SONAR operation and data analysis, as well as present results from those five spawn years.

Kevin See, Kevin.See@dfw.wa.gov

2:40 PM

Reanalysis of lower Columbia winter steelhead spawning data using a spatio-temporal model

Spawning ground surveys are the primary method used to estimate escapement in many salmonid populations, particularly steelhead. Counts generated on these surveys are often expanded to account for unsurveyed areas, but the methods used to expand these counts are often poor validated and lack estimates of statistical precision (e.g. index expansions) or tend to be inflexible and vulnerable to violations in their assumptions (e.g. mark-recapture, design-based estimators). As such, there is a clear need to develop methods that can be applied to a wide range of data and are resilient in the face of changing monitoring strategies and declining catch rates. The field of spatio-temporal modeling has advanced in the past years and it is now possible to incorporate complex stream networks into the structure of the model. Here we present a reanalysis of winter steelhead abundance from the lower Columbia region in Washington. We show that this model can produce unbiased estimates of redd counts at surveyed and unsurveyed locations. We compare model predictions of redd count to reported values from 2005-2022 and discuss possible patterns in modeled versus traditional estimates. We also outline how this model can extend traditional survey estimates by providing a framework for integrating habitat covariates or other types of data, providing utility to a range of management activities. Last, we discuss the potential implications of these new estimates for steelhead management in the region and how our results can guide monitoring efforts.

Jeremy Harris, jeremy.harris@dfw.wa.gov

3:00 PM

Can mark-recapture methods improve redd based escapement estimates?

Redd counts are the most common method for estimating the abundance of Pacific Salmon and bull trout in the Pacific Northwest. Typical assumptions are that redd counts represent a census (i.e., observer efficiency is 100%) and there are no deletions of redds before they can be enumerated. These assumptions are likely violated due to inexperienced surveyors, long intervals between surveys, freshets that delete redds between survey periods, and surveys that do not cover the entire spawning period or distribution. We developed a redd arrival and longevity model for winter steelhead (O. mykiss) to evaluate the use of an open population mark-recapture model to estimate redd abundance. Results from the simulations indicate: 1)

uncorrected/raw redd counts were negatively biased and bias increased with decreasing observer efficiency, survey frequency, spatial coverage, and the variability in fresh redd life, 2) regardless of observer efficiency (80-100%), Jolly-Seber model abundance estimates were unbiased at survey intervals from 7-28 days, when surveys were truncated for the last 1/3 of the run, and had a slight positive bias (4%) when flooding reduced redd survival, and 3) the precision of abundance estimates increased as abundance, observer efficiency, survey frequency, and spatial coverage decreased. The JS model provides other important estimates for biologists including fresh redd life, observer efficiency, and spawning arrival and departure times. The application of mark-recapture protocols and the unified statistical framework of the Jolly Seber model shows great promise to improve redd abundance estimates.

Dan Rawding, rawdidr@dfw.wa.gov

3:40 PM

A method to compute adult anadromous salmonid abundance by PIT tagging juvenile outmigrants

Abundance estimation of adult anadromous salmonids is sometimes made difficult by environmental conditions (e.g., turbid or high water) or logistical constraints that preclude effective direct counting of adults, redds, or carcasses. To overcome this limitation, we developed an approach to adult abundance estimation based on trapping and PIT tagging juvenile outmigrants and later detecting these tags when the fish return as adults. We present an example of this approach applied to steelhead in the Touchet River in southeastern Washington. Juvenile outmigrant abundance at weekly intervals is estimated using a Bayesian Time-Stratified Population Analysis (BTSPAS), which uses p-splines to interpolate abundance during weeks with missing data due to difficult sampling conditions. Juvenile estimates can be stratified by size and migration timing to account for associated differences in survival and capture probability. Survival of adults from Bonneville Dam to the Touchet River is estimated from detections of these tags at mainstem dams and instream arrays, using a modified Cormack-Jolly-Seber (CJS) model that accommodates multiple ocean ages. These methods are under development as a general-purpose R package expected to enable or improve abundance estimation for a variety of populations.

Jason Neuswanger, jason.neuswanger@dfw.wa.gov

4:00 PM

Estimating Aggregate Coho Salmon Terminal Run and Escapement to the Lower Fraser Management Unit

The absence of reliable and accurate terminal run and escapement estimates for Lower Fraser Coho (LFC) Salmon represents a critical information gap for Southern Boundary Coho Salmon management. LFC run and escapement estimates are currently based on exploitation rates estimated for marked hatchery fish, which may be unrepresentative of natural stocks due to differences in their biological attributes (e.g., migration timing). We develop a stratified Petersen mark-recapture estimator for the abundance of returning LFC populations using stock-composition data from a new assessment fishery in the lower Fraser and from data collected by existing monitoring programs. Two tagged/clipped hatchery stocks and one untagged natural stock identifiable through genetic analysis were designated as the "marked" population, with the remaining stocks designated as "unmarked". Returning coho were then "recaptured" at the assessment fishery and the abundance of the unmarked stocks was estimated by expanding the unmarked catch relative to the catch and run size of the marked population. We propagate uncertainty arising from tag loss/degradation, GSI uncertainty, and other observation error into final estimates of run size using a Bayesian approach.

Steven Rossi*, Wendell Challenger, Michael Arbeider
srossi@lgl.com

4:20 PM - DISCUSSION

We will discuss, with both the audience and speakers, what new escapement estimation methodologies are being used around the Pacific Northwest, what some of the common challenges are, and the pros and cons of standardizing methods.

MODERATOR
Neala Kendall

Fish Passage in the Pacific Northwest

Moderator: Adam Crispin and Zach Sherker

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Tuesday, April 30, 1:40 PM to 5:40 PM

Symposium Abstract

Rivers and streams are amongst the most fragmented systems globally. From large-scale hydroelectric dams to small-scale barriers, such as culverts, floodgates, tidegates, and dykes, in-stream structures have culminated to form an intricate, and poorly quantified, matrix of barriers to movement in salmon-bearing streams. Until recently, there was very little work done to quantify the totality of these barriers and effectively remediate them. In 2022, NOAA awarded $39.8 million dollars to Tribes, communities, and local governments to remove fish barriers and restore salmonid habitat across Washington state. This recognition and allocation has been touted as a major success in the salmon community, and with hundreds of thousands of barriers remaining along the North American range of Pacific salmon, we now need to maximize coordination amongst fish passage agencies and researchers to streamline further restoration of habitat connectivity for Pacific salmon. As federal, state, and provincial governments continue to prioritize fish passage and habitat, fisheries scientists, managers, and advocates play key roles in planning and implementing these projects across our region. This broad symposium would focus on four areas: Prioritization, Laws and Regulatory Frameworks, Barrier Remediation Works, and Effectiveness Monitoring.

1:40 PM

A quick look beyond habitat loss from dams and culverts in the PNW

This presentation looks beyond the habitat losses caused by dams and culverts in the PNW. It is a brief snapshot through time on some of the historic losses of salmonid habitat often not remembered or thought about. While this discussion does not dive into much detail on these items, it is a teaser for other areas of restoration, recovery, and opportunity. As we enter into a few days of discussing salmon habitat, fish passage, and restoring salmonids, it is hoped the audience will remember, we are all part of the problem, and we can all be part of the solution.

Wayne Watne, wwatne@herrerainc.com

2:00 PM

Aquatic Organism Passage (AOP) Solutions at Culverts and Fish Barrier Management in North America

Culverts, bridges, and similar in-water structures rank second only to dams in their obstruction of fish and other aquatic organisms. These structures have a detrimental impact on habitat connectivity for numerous species, as they restrict access to crucial spawning and rearing habitats. Significant efforts have been devoted to the removal and replacement of culverts to enhance aquatic organism passage (AOP). These projects are resource-intensive and may take years to complete. In addition, the number of AOP barriers is so numerous that many will not be addressed in a timely manner, if at all. However, there are many opportunities to improve AOP through barrier modification where removal or replacement is not feasible or timely. This presentation aims to provide an insightful exploration of low-cost, rapid solutions for retrofitting culverts and similar structures to improve AOP. The spectrum of corrective actions will include retrofitting culverts with weirs and floating ramps to improve access and passage through the culvert. Real-world case studies will be presented to demonstrate how barriers can be modified to improve AOP. We will also describe Computational Fluid Dynamic modeling used to quantify the AOP benefits of these culvert modifications. Additionally, we will describe a Fish Passage Barrier Assessment and Prioritization program being used to plan and implement corrective actions to overcome AOP barriers on a watershed scale.

Shane Scott, shane@ssaenvironmental.com

2:20 PM

Lower Boise River Fish Passage Study

The City of Boise (City) owns and operates the West Boise Water Renewal Facility (WRF) that discharges to the south channel of the Lower Boise River (LBR). The warmer discharge has the potential to act as a barrier to migrating fish. Modeling and cross channel field surveys have concluded that the thermal discharge plume is not acting as a barrier. To confirm these results a study was designed to provide data on fish movement in the south channel from downstream to upstream of the WRF outfall using passive integrated transponder (PIT) tags placed in select LBR fish. The PIT tag antenna array was installed upstream of the West Boise WRF in the fall of 2023. Fish were collected and tagged after array installation and returned to the river downstream of the array. This study will also provide fish movement information that is otherwise lacking in the LBR.

Colin Custer, ccuster@cityofboise.org
Dorene MacCoy, dmaccoy@cityofboise.com

2:40 PM

A cost-effective approach to implement and monitor the effectiveness of a fish passage project in the Potlatch River basin in northern Idaho

A key restoration strategy in the Potlatch River is to improve fish passage at barriers to expand wild juvenile steelhead (Oncorhynchus mykiss) rearing habitat. Big Meadow Creek (BMC) is the main tributary to the West Fork of Little Bear Creek, which contains the highest rearing densities of juvenile steelhead in the basin. However, a 160′ concrete lined culvert at the mouth of BMC acted as a velocity barrier that restricted access to an additional 10 km of rearing habitat. In 2018, funding to replace the culvert with a permanent structure, such as a bridge, was unavailable. Instead, we implemented a low-cost alternative by modifying the culvert with steel baffles to enhance steelhead passage. Prior to modification, the population upstream of the culvert were primarily resident O. mykiss while anadromous O. mykiss were found downstream. We hypothesized the genetic composition of juvenile O. mykiss upstream of the culvert would shift from resident to more anadromous characteristics if the culvert modification improved passage. Tissue samples were collected from juvenile O. mykiss upstream of the culvert in 2018 (pre-treatment), and in 2019 and 2020 (post-treatment) and compared to Potlatch River steelhead reference samples. We observed an increase in genetic diversity and ancestry across years, with anadromous signals becoming more dominant upstream. Improved access to BMC by anadromous steelhead was the source of the shift in genetic composition. This study highlighted a successful, cost-effective approach to implementing and monitoring a fish passage project in the Potlatch River.

Brian Knoth, brian.knoth@idfg.idaho.gov

3:00 PM

Potential Solutions to Thermal Barriers in the Lake Washington Ship Canal

The Lake Washington Ship Canal and Ballard Locks fundamentally changed the way water and fish move through the greater Lake Washington watershed. Now, a highly urbanized waterway, and the salmon that depend on it, are at the mercy of climate change, with limited traditional habitat restoration opportunities. During the peak salmon migration, the Ship Canal is above the sub-lethal temperature threshold 100% of the time and poses a migration barrier and is above the lethal threshold up to 51% of the time. The Ship Canal is temperature impaired under the Clean Water Act, critical migratory habitat for Threatened Chinook, and important to satisfying tribal treaty rights. Disease, predation, and pollution further compound the temperature problem. The success or failure of this waterway will be on display with 1.25 million annual visitors to the Locks expecting to see returning salmon in the fish ladder viewing window. The Lake Washington/Cedar/Sammamish Watershed (WRIA 8) Salmon Recovery Council and Long Live the Kings partnered to convene agencies, tribes, and local governments together to reach consensus on the problem, establish a common goal, and explore solutions. Learn more about what it might take to supplement the the flow in the Ship Canal with a cold water source to improve conditions for fish and how that source could bring additional economic value to surrounding institutions.

Lucas Hall, lhall@lltk.org

3:40 PM

Assessing juvenile coho access to critical overwintering habitat through floodgates

Pacific salmon are currently barred from thousands of kilometers of spawning and rearing habitat in BC by ill-fitting culvert and floodgate barriers. Culverts were initially installed to rapidly transport water past roads, but quickly became the most ubiquitous barrier to fish movement globally. Floodgates remain closed for weeks to months at a time, blocking access to over half of the traditional floodplain habitat during critical life stages. Failed culverts and floodgates have culminated to form an intricate, and poorly quantified, network of barriers to fish in BC, with the strongest impact being felt by salmon. Tens of millions of dollars have been spent to remediate barrier sites and reopen invaluable stream and floodplain habitats, though little effectiveness monitoring has been done. To evaluate the efficacy of various culvert remediation strategies, we assessed fish passage at 30 culvert remediations (aged 10-15 years) exhibiting an array of barrier mitigation techniques (e.g. installation of baffles, weirs, fishways, removal, replacement with bridges). We found that full culvert removal and replacement with bridges is the only effective remediation strategy to achieve long-term habitat access. We have innovated new PIT telemetry technologies to assess juvenile salmon passage through floodgates. This is the first study to directly document the effects of floodgates on juvenile salmon habitat access. This research will be used to improve passage by synchronizing automated floodgate operations with the timing of fish movements, and will provide concrete evidence for the need to replace aging floodgates and reintroduce imperiled salmon populations to their historic habitat.

Zachary Sherker, sherkerz@mac.com

4:00 PM

New Solutions for Tide Gates, Fish Passage and Working Landscapes

A contributing factor to the loss of tidal wetlands is dikes, levees, and tide gates that impede the historic function of low-lying coastal floodplains. In Oregon, stakeholders have awakened to the challenge and opportunity presented by tide gate infrastructure. Poor performing tide gates are required by law to be replaced or retrofitted to be fish passage compliant, but it is a considerable expense for landowners. Additionally, the scope and scale of Oregon's tide gate problem was poorly understood. As a result, the Oregon Tide Gate Partnership is working to understand and increase awareness of the size, scope and cost of Oregon's tide gate problem, and harnessing our scientific and technical expertise to pursue solutions. A tide gate inventory of the entire Oregon Coast was completed. In addition, The Nature Conservancy has developed a decision support tool that allows us to optimize among tide gates to help ensure we are focused on repair, retrofitting or replacement of tide gates that maximize private and public investments to the tide gate locations that provide the greatest gains. The results are useful to project planners and decision makers in terms of evaluating the net gain in benefits, estimating return on investments, fundraising and budgeting, and investigating spatial patterns. And to better understand the effectiveness of these projects a Tide Gate Monitoring Handbook was created to provides the framework for an integrated and cohesive state-wide tide gate monitoring strategy by standardizing monitoring practices and protocols for tide gate upgrade and replacement projects of all scales.

Jason Nuckols, jnuckols@tnc.org

4:20 PM

Regulating Fish Passage in Washington State

The state Legislature gave the Department of Fish and Wildlife the responsibility of preserving, protecting, and perpetuating all fish and shellfish resources of the state. To assist in achieving that goal, the state Legislature in 1943 passed a state law now known as the "Hydraulic Code", stating that "Any person, organization, or government agency wishing to conduct a hydraulic project must do so under the terms of a permit issued by the Washington Department of Fish and Wildlife." How does this work in practice? What types of projects are ""hydraulic projects"" and what role does fish passage play in this regulatory environment? Who gets protection under the definition of "Fish Life"? We will touch on all of these topics and talk about the future of regulating fish passage in Washington as well as lessons learned and ways we've learned to streamline processes. Join us to delve into the exciting world of regulations and fish passage in the state of Washington!

Matt Curtis, matthew.curtis@dfw.wa.gov

4:40 PM

Squalicum Creek Barrier Removal and Estuary Restoration

Restoring fish passage in degraded waterways is essential for the preservation of aquatic ecosystems and the species that they support. Squalicum Creek is an exciting example of extensive culvert removal to restore fish passage to the watershed, resulting in significant improvements to habitat connectivity for salmonids and other aquatic species. We will explore many impressive restoration projects spanning the far northwest corner of Washington, showcasing diverse scales, complexities, and types. These projects underscore the importance of interdisciplinary collaboration among hydrologists, geomorphologists, engineers, biologists, and ecologists in achieving long-term conservation objectives. By integrating an array of expertise into our projects, we can create successful salmon enhancement initiatives and bolster the resilience of the surrounding fluvial environment.

Miah Whiteaker, Miah@fainenv.com

5:00 PM

Lessons Learned from Forest Road Treatments with Applications to the PNW Transportation Network

This presentation looks at some of the lessons learned correcting forest roads across Washington State between 2001 and 2021. Unrestricted forest practices began changing in the 1970's, and later through the 1987 Timber, Fish, and Wildlife (TFW) Agreement. Neither did much to address forest roads. With increasing concern for potential ESA listings of salmon, stakeholders from the TFW agreement reengaged and developed the Forest & Fish Report (FFR) signed April 29, 1999. High priority was placed on reducing sediment, minimizing landslides, and correcting fish passage barriers. The FFR produced the Road Maintenance and Abandonment Plan (RMAP) requiring state and industrial landowners in Washington State to inventory and correct those issues over a 15-year timeframe (2001-2016). After a 5-year extension, RMAP was completed in October 2021. State and industrial forestland owners had invested $390 million into RMAP and transformed Washington State. In twenty years, 53,000 miles of forest roads were inventoried, improvements were made to 30,700 miles of roads, 4,000 miles were decommissioned, and over 8,100 fish barriers were corrected opening over 6,200 miles of habitat lost from salmonid production for decades. It is hoped the lessons (some good, some bad, some very creative) learned through 20 years of RMAP can be applied to other segments of the transportation networks in the PNW. Some of what was learned and applied to RMAP can be directly applied to many situations in the transportation network.

Wayne Watne, wwatne@herrerainc.com

Wednesday, 8:00 AM

Resilient Waters - A systems thinking approach to fish passage and flood infrastructure for the Lower Fraser Watershed

In the lower Fraser watershed of BC there are over 150 pieces of flood control infrastructure lining the Fraser River between Vancouver to Hope. Estimates say that these floodgates, pumpstations, and dikes are blocking access to over 1500 kilometres of crucial floodplain habitat for fish, particularly juvenile Chinook and Coho. While this watershed serves as the gateway to one of the most prolific salmon rivers in the world, salmon get very little attention in the face of other human oriented land uses on the floodplain, but that is changing. Since early 2020 we have been taking a systems change approach to improving fish passage on the floodplain. From leading or supporting site scale restoration and research projects to shifting the entire flood management paradigm through collaboration and advocacy. We'll share highlights of our work along with challenges and successes when it comes to restoring access to floodplains for these crucial salmon habitats and our efforts to catalyze broader change for more integrated, principled, and collaborative floodplain planning and fish and community friendly flood resilience.

Dan Straker, dan@resilientwaters.ca

8:20 AM

Washington Department of Fish and Wildlife Fish Passage Resources

The Washington Department of Fish and Wildlife maintains a centralized database (FPDSI) of fish passage, diversion screening, fish use, and habitat information from inventory efforts conducted throughout Washington State. This presentation will be an introduction to utilizing the database to effectively map and plan barrier correction projects. It will cover the 2019 Fish Passage Inventory, Assessment, and Prioritization Manual, training and technical assistance opportunities, and other resources provided by the Washington State Department of Fish and Wildlife Fish Passage Division.

Kaylee Kautz, kaylee.kautz@dfw.wa.gov

8:40 AM

Improving Fish Passage Through Flood Protection - Lessons Learned

Presentation on lessons learned from designing and installing different styles of floodgates through existing dikes and levees to improve fish access to back channel habitats and restore connection to historical spawning, rearing, and sheltering habitat.

Sarah Lawrie P. Eng., slawrie@kwl.ca

9:00 AM

Returning Home Within the Neighborhood – Understanding and Mitigating the Effects of Fragmentation in the Clark Fork - Pend Oreille Basin

Within the inland northwest, much attention is currently focused on restoring anadromous populations to waters above impassable barriers, and rightfully so. However, many native species within the inland northwest that are confined to freshwater environments are also impacted by dams that were constructed without fish passage facilities. Since at least the mid-1990's the Clark Fork -Pend Oreille Basin has been the focus of research attempting to understand and address the effects of habitat fragmentation on native species, especially Bull Trout (Salvelinus confluentus) and Westslope Cutthroat Trout (Oncorhynchus lewisi). We will review the history of this work, highlighting the gained biological knowledge that has led to a better understanding of this system as well as the projects and management decisions that have been implemented to mitigate the effects of fragmentation in this system. We will also attempt to draw some general conclusions about management of migratory species in a fragmented riverine system. Finally, we will highlight demographic trends that have been observed in non-targeted species and consider how fragmentation might be influencing those populations as well.

Paul Spruell, pspruell@ewu.edu

1:40 PM

Fish Passage Improvement Structure (Fishway) Assessment & Maintenance

The Washington Department of Fish and Wildlife (WDFW) owns 100 fish passage improvement structures, or fishways, across Washington State. Most of these fishways were installed between 1950 – 1980 with new fishways occasionally being built at state hatcheries. However, 39 of these fishways are located off agency land where staff do not see them regularly. WDFW previously had a team dedicated conducting routine and preventative maintenance on these facilities. In 2008, with a recession complicating our funding priorities, the decision was made to disband this team. As a result, these remote fishways were not monitored on a regular basis and now require investigation. In 2023 a decision package was submitted to state legislature and fully funded resulting in the fishway maintenance proviso that funds up to five employees and provides funds for minor repairs. This presentation discusses some of the challenges we're facing and future plans for corrections highlighting communication and the utilization of existing resources to provide fish access to habitats.

Danny Didricksen, daniel.didricksen@dfw.wa.gov

2:00 PM

Fishes in Ditches: Fish Removal as a Tool for Identifying Fish Passage Prioritization

For generations, farmers in the Skagit Valley have worked cooperatively to install and maintain ditches, dikes, and floodgates. Eventually, more than 80 Special Purpose Districts (limited purpose local governments) became legally established to manage drainage infrastructure. The Skagit County Drainage and Irrigation Districts Consortium was created to help manage the extensive environmental permitting for annual maintenance work on the marine and freshwater channels that support salmonid species. Since 2016, annual maintenance of drainage infrastructure (dredging) has required fish removal and exclusion when sediment and invasive vegetation have affected surface water volume and habitat availability. These fish removal opportunities allow species data to be collected and evaluated.

Adam Crispin, adam.t.crispin@gmail.com

2:20 PM

Audit of Remediated Culvert Barriers in the Fraser River Watershed

Pacific salmon habitat has been targeted for culvert barrier remediation projects due to broad declines in their populations across their range, attributed in part to habitat fragmentation. Small-scale barriers like culverts fragment more linear stream habitat than dams and are a major issue for Pacific Salmon. In British Columbia, there are over 200,000 barrier culverts that restrict fish passage. Two techniques are used to restore fish passage at barrier culverts (retrofit or replacement), and best practices to restore fish passage have been developed. However, it is unknown whether culvert restorations continue to meet best practices or if fish passage changes through time. To address this knowledge gap, we performed a post-treatment audit on culvert barrier restorations in British Columbia. We hypothesized that the technique applied will affect how a restoration meets best practices and that fish passage will be impacted if not met. Furthermore, we expected retrofit sites to meet best practices less frequently as they will not have addressed the original cause of barrier development. At each site, we collected data on the restoration structure and habitat. We assessed these data against current best practices for culverts and performed a fish passage assessment. We found that the conditions at all sites do not fully meet best practices and that 53% of sites are fish-passage barriers. These results show that the techniques used to restore fish passage at culverts are prone to failure, and that post-restoration monitoring should be prioritized to ensure fish passage is maintained.

Patrick Zubick, pzubick@syilx.org

2:40 PM

Understanding and Prioritizing Aquatic Organism Passage at Watershed Scales

Aquatic connectivity is essential to the resiliency of aquatic ecosystems. In 2023 and 2024 we inventoried 931 road-stream crossings in priority watersheds of Idaho BLM field offices that highlighted a range of fish passage conditions, including severe barriers to passage. We also re-inventoried 84 culverts that were surveyed in 2004 to assess passability changes through time. Nineteen years later, the passability of these culverts decreased at 25% percent of crossings, while up to 35% percent were replaced with new culverts or bridges. This suggests that culvert inventory databases, and thus understanding of passability, have a shelf life. A model was developed to understand how passability is influenced by stream size, gradient, land use, and flood frequency, and the model can be used to understand passability in unsurveyed crossings, such as those on inaccessible private land. We discuss use of road-stream crossing inventory data the context of a science-based framework for understanding and prioritizing improvement of aquatic connectivity at watershed scales.

Daniel Dauwalter, daniel.dauwalter@tu.org

3:40 PM - Panel & Discussion

Since 1991, the Washington Department of Fish and Wildlife (WDFW) and the Washington Department of Transportation (WSDOT) have maintained a partnership to protect and restore salmon populations. WDFW has conducted inventories of fish passage barriers at state, county, and city road crossings and associated habitat assessments to prioritize barrier correction. These efforts helped prioritize barrier corrections and resulted in habitat improvement projects throughout the state. In January 2001, Indian Tribes with treaty fishing rights in Western Washington, along with the United States, filed a lawsuit asking a federal court to declare that the treaty right of taking fish "imposes a duty upon the State of Washington to refrain from diminishing, through the construction or maintenance of culverts under State-owned roads and highways, the number of fish that would otherwise return to or pass through the tribes' usual and accustomed fishing grounds and stations." They alleged the State violated such a duty and asked the court to order the State to fix all its culverts within five years of judgment. This landmark trial US vs. Washington State, also known as the "Culvert Case", stemmed from Treaties in the 1850's (Stevens Treaties) and lead to the 1974 Boldt Decision that determined Tribes were entitled to their fair share of salmon, while ensuring salmon habitat (WSDOT, 2020). In 2013, a permanent injunction was issued for the State of Washington to accelerate the correction of state-owned barriers, and this shifted the focus of state agencies, WSDOT, WDFW, WDNR, and Parks. The injunction stipulated that barrier culverts under state roads must be corrected in the "case area" (Puget Sound watersheds west of the Cascades) From 2001 through 2021, state and private landowners invested $390 million in forest road improvements via the Road Maintenance and Abandonment Plan (RMAP) process and other programs. During this time, landowners removed nearly 9,200 barriers, restored nearly 6,500 miles of historic fish habitat and abandoned over 4,000 miles of roads. The result is the removal or repair of 8,749 barriers to fish migration, which restored 5,347 miles of historic fish habitat. The Family Forest Fish Passage Program (FFFPP), a Washington State cost-share program for small family forest owners, have invested $49.7 million in the repair of 433 barriers resulting in 1,149 miles of reconnected habitat, bringing the total to 9,182 barriers removed and the restoration of 6,486 miles of historic fish habitat (forestandfish.com). The RMAP program concluded in 2021 and resulted in 8,609 barrier correction on timber lands*. State Parks, WDFW, and DNR have completed their court ordered removals with DNR completing approximately 250 barriers in the Injunction area. As of June 2023, WSDOT has corrected 114 injunction barriers resulting in 502 miles of potential habitat (WSDOT, 2023). To better understand the successes and challenges of Washington's Fish Passage programs, this panel will address the following questions and discuss their various perspectives in Washington's fish passage legacy. *Some culverts in forestlands were given a "Life of Pipe" allowance where little upstream habitat was available. When needing correction, fish passage will be required.

PANELISTS:

Tom Jameson,
Fish Passage and Screening Division Manager, Chair FBRB (WDFW Habitat Program)

Susan Kanzler, Environmental Services/Stream Restoration Program Manager (WSDOT Fish Passage and Chronic Environmental Deficiencies)

Wayne Watne, Senior Fisheries Biologist (Herrera Environmental), former Timber, Fish & Wildlife Biologist managing Road Maintenance and Abandonment Plan (RMAP), WDFW

Danny Didricksen, Fish Screening Section Manager (WDFW)

General Session

Moderators: Joe Kozfkay, Jake Hughes, Jenn Vincent

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Wednesday, May 1, 8:00 AM to 5:00 PM

Symposium Abstract

This session contains contributed papers that were not tied to a specific symposium theme.

8:00 AM

Salmon and Climate Initiative: advancing a climate-resilient recovery approach for Pacific salmon throughout their North American range

Robust and resilient salmon populations are necessary to support thriving ecosystems, Indigenous rights and cultures, and local economies; however, many salmon populations are in crisis and salmon fisheries are declining. Our communities are working hard towards salmon recovery, but we are not on a trajectory to achieve success. Rapid climate change is making our path more difficult and demands a broader strategy. To catalyze actions for salmon and salmon-reliant communities, we need a scale of effort that hasn't yet been brought to bear. Long Live the Kings, the Pacific Salmon Foundation, Salmon Defense, and partners are working to develop the Salmon and Climate Initiative (SCI), a collaborative effort with Indigenous and non-Indigenous technical experts, managers, and policy makers focused on advancing climate-resilient recovery approaches for Pacific salmon throughout western North America. The SCI will provide a space to collectively examine what is occurring from California to Alaska, share information and collaborate across boundaries, consider which solutions are working and where more effort and funding are needed. Further, the SCI aims to secure the support of funders and policy makers for the types of actions and resources required to ensure a healthy and thriving future for Pacific salmon and our communities. In December 2023, we convened over 70 experts in Western and Indigenous knowledge and practice to discuss what we can meaningfully do for salmon at this broad geographic scale. We will present the outcomes of this scoping workshop and solicit audience feedback on the initiative.

Lucas Hall, Shaara Ainsley, Liz Duffy, and Jacques White
lhall@lltk.org

8:20 AM

How Do Management Goals for Wild Chinook Salmon Align with Feasibility?

Assessing the effectiveness and efficiency of fisheries management is crucial for supporting harvest opportunities and maintaining viable and diverse fish populations. Management of wild Chinook Salmon (Oncorhynchus tshawytscha) stocks in the Snake River basin exemplifies the intricate balance between these objectives. Considering contemporary smolt production, it is imperative to determine the required smolt-to-adult returns (SARs) to meet management goals. Increased anthropogenic impact on spawning and rearing habitats underscores the necessity for higher SARs to attain these objectives. While wilderness populations exhibit viability and can sustain fisheries with SARs lower than those required elsewhere, populations targeted for habitat restoration demand higher SARs to fulfill goals, indicating a need to enhance egg-smolt survival. However, recent SARs have fallen below the threshold needed for replacement, even with current low population abundances. Despite these challenges, some populations still possess the potential to achieve management goals, emphasizing the importance of strategic interventions to bolster their resilience.

Tim Copeland, Tim.copeland@idfg.idaho.gov

8:40 AM

Integrating research, restoration, and hatchery supplementation to conserve and recover a Snake River Spring Chinook Salmon population

Snake River spring/summer Chinook Salmon Oncorhynchus tshawytscha comprise substantial ecological, economic, and cultural value. Rapidly declining populations led to the 1992 listing of these fish as threatened under the U.S. Endangered Species Act (ESA). Populations in the Grande Ronde basin of northeast Oregon and southwest Washington reached critically low abundances in the mid-1990s. Chinook Salmon were nearly extirpated from the Lostine River, one of many important rivers and tribal fisheries for the Nez Perce Tribe. This presentation highlights management actions the Nez Perce Tribe and co-managers have implemented over the past 25-30 years to recover Lostine River Chinook Salmon and mitigate lost harvest opportunities. The tribe integrated hatchery supplementation, habitat restoration, harvest management, and research in an adaptive management framework to guide management actions. The adaptive management approach proved helpful in refining and prioritizing hatchery supplementation and restoration practices. Management actions directly contributed to accomplishing short-term conservation and consumption goals, including limited harvest opportunities for tribal and sport fisheries. However, factors in and out of the natal watershed, such as the adverse effects of water withdrawals, riparian area management, mainstem Columbia and Snake River dams, and climate-driven changes to ocean conditions, continue to impact this Chinook population, and the future remains uncertain. The persistence and recovery of Lostine River Chinook to healthy and harvestable levels will likely require the continued integration of hatchery supplementation, habitat restoration, and harvest management strategies, as well as mitigating the major out-of-basin factors limiting this and other anadromous fish populations in the region.

Brian Simmons, brians@nezperce.org

9:00 AM

A state-space model for estimating smolt abundance at rotary screw traps

Monitoring of out-migrating juvenile Chinook Salmon Oncorhynchus tshawytscha and steelhead O. mykiss is an essential component of tracking abundance and productivity trends of ESA listed populations in Idaho, USA. Rotary screw traps, strategically placed in streams where juvenile rearing and migrating occur, are a commonly used tool for this purpose. A portion of captured smolts is PIT tagged and released above the trap, allowing for subsequent recapture and estimation of smolt abundance via a time stratified Lincoln-Petersen estimator. During this estimation process, catch and recapture data are often aggregated into time strata (i.e., weeks) to account for periods when no recaptures are present to estimate capture probability, but when unmarked fish are still being caught. Other estimation issues may arise when abiotic conditions preclude trap operation (i.e., high flows or temperatures) during periods of time when fish are still presumed to be out-migrating. Here we present a state-space mark recapture model, comprised of two linked sub-models: (1) the process model describing the true but unknown abundance of migrating smolts and (2) the observation model or capture-mark-recapture of those fish. The flexibility of this model allows for estimation of capture probabilities and abundance on a daily timestep and can include biotic or abiotic covariates for testing of factors hypothesized to affect the process or observation models.

Luciano V. Chiaramonte, Joshua L. McCormick
luciano.chiaramonte@idfg.idaho.gov

9:20 AM

Lasting Effects of Juvenile Life Histories: Freshwater Migratory Diversity and Long-term Consequences in a Population of Spring Chinook salmon (Oncorhynchus tshawytscha)

Migratory behavior enables animals to respond to evolving demands by delivering individuals to novel habitats where they can be more effectively supported. The occupancy of a more productive habitat, even for a limited duration, can boost performance and provide a competitive advantage that benefits an individual for the entirety of their life cycle. However, migration is not without risks, and the tradeoffs inherent to migration have resulted in many populations evolving a diversity of migratory strategies. We studied migratory diversity across 13 cohorts of juvenile Spring Chinook salmon within the Middle Fork Salmon River's largest tributary, Big Creek. Discrete behavior was associated with the timing of migration, with one group (downstream rearing or DSR) migrating to downstream freshwater habitat during their age-0 Summer-Fall, where they rear overwinter before continuing migration to the ocean during their age-1 Spring. Another group (natal-reach rearing or NRR), remains in their natal habitat for the entirety of their juvenile life stages prior to oceanic migration, which also occurs during their age-1 Spring. The goal of this study was to evaluate if this population diversity leads to discrepancies in juvenile performance that in turn influence survival to adulthood. Our results indicate that DSR migrants attain enhanced overwinter growth, and as a result produce larger smolt, and enter the ocean earlier than NRR migrants. We additionally demonstrated that these discrepancies have lasting consequences, as we observed higher smolt-to-adult return (SAR) among DSR migrants.

Sam Owens, owen4108@vandals.uidaho.edu

1:40 PM

Impacts of lake elevation decline on spawning habitat of a critical, native forage species

Lake elevation decline is a global phenomenon stemming from water management practices and climate change that alters nearshore habitat available to lacustrine spawners, impacting recruitment and whole lake food web dynamics. Our objective was to understand the effects of lake elevation decline on spawning habitat for Tui Chub Siphateles bicolor, a lacustrine spawner and critical, native forage species for a native, ad fluvial sportfish, Lahontan Cutthroat Trout Oncorhynchus clarkii henshawi, in Pyramid Lake, Nevada. We explored Tui Chub nearshore spawning habitat requirements with generalized linear mixed effects models associating habitat to fecund Tui Chub gill net catch-per-unit-effort. We also explored nearshore spawning habitat availability at all potential lake elevations, using an elevation-explicit model of the lake basin we developed based on several geospatial datasets. Fecund Tui Chub catch was primarily predicted by temperature, reaching a maximum between 14.2-24.8 °C. We found that with an additional 8 meters of decline, Pyramid Lake will contain the minimum area of spawning habitat out of all lake elevations considered at a 40% decrease from our theoretical maximum. A decrease in lake elevation, or an increase in lake temperatures, both probable events based on future climate scenarios and estimates of water extraction upstream of Pyramid Lake, are likely to further restrict Tui Chub spawning habitat area. Our results have important implications for ecological water demand in Pyramid Lake and provide managers information facilitating a science-based approach to managing hatchery Lahontan Cutthroat Trout to the available prey base.

Sarah Barnes, sarah.barnes.a03@gmail.com

2:00 PM

Interactions Among Yellow Perch, Northern Pikeminnow, and Smallmouth Bass in Lake Cascade, Idaho

Yellow Perch (YEP) Perca flavescens was successfully introduced to Lake Cascade, Idaho in the 1950s. Since then, Lake Cascade has become a nationally recognized destination for YEP angling. Recently, annual surveys have detected declines in juvenile YEP. One possible mechanism contributing to recruitment declines is predation. The three most abundant predators in Lake Cascade are YEP, Northern Pikeminnow (NPM) Ptychocheilus oregonensis, and Smallmouth Bass (SMB) Micropterus dolomieu. Northern Pikeminnow contributed to historic collapses in the YEP population; subsequent removals allowed the YEP population to recover. Conversely, SMB is a recently established predator in Lake Cascade. Gill nets were deployed monthly from April 2022 through May 2023. Diagnostic data were taken from all captured fish, and a subset of five fish per centimeter length bin were sacrificed for otolith (n = 2,519) and stomach (n = 2,273) extraction. Catch rates and food habits of all three species varied spatially and temporally. Diets of YEP and NPM consisted of primarily chironomids in the spring but shifted to predominantly age-0 YEP by the fall. Smallmouth Bass diets were relatively homogenous throughout the year and included invertebrates, crayfish, and juvenile YEP. Stomach content, growth, and temperature data were used to develop to build bioenergetics models. Bioenergetics models were used to elucidate whether predation by YEP, NPM, or SMB contributed to juvenile YEP declines. Findings from this study will be used to support management decisions about the future of Lake Cascade fisheries.

Bryce Marciniak, bmarciniak@uidaho.edu

2:20 PM

Smallmouth Bass response to tournament displacement in a highland Idaho reservoir

Smallmouth Bass are often displaced by fishing tournaments held at centralized weigh-in locations which may have a stockpiling effect that increases vulnerability to angling mortality. It is also unclear whether displaced individuals return to their home ranges. Dworshak Reservoir is a popular Smallmouth Bass fishery in Idaho, United States, where tournament anglers displace fish as far as 80 km. The broad objective of this study was to investigate impacts of tournament displacement on Smallmouth Bass in Dworshak Reservoir, and specifically to assess stockpiling duration and vulnerability to harvest, quantify the percent of displaced Smallmouth Bass that return to original home ranges, quantify the rate and path of return to original home range by displaced fish, and compare home range patterns between displaced and unmoved fish. We deployed acoustic transmitters in 31 Smallmouth Bass in spring 2023, 16 of which were displaced to a popular tournament location. Displacement distance ranged from 7.7 to 63.0 km, and 94% dispersed from the weigh-in location, the majority of which did so within 25 days. Ten displaced fish returned to their original capture location, and this included individuals that were moved as far as 63.0 km. Six of the ten fish that returned did so indirectly. Home range of displaced fish was similar to unmoved fish, indicating that displacement did not impact long-term behavior patterns. Overall, displacement of Smallmouth Bass by tournaments does not appear to be a significant concern in Dworshak Reservoir, and additional restrictions are tournament procedures are unnecessary.

Eli Felts, Ryan Hardy
eli.felts@idfg.idaho.gov

2:40 PM

Abundance and density dependent survival of Burbot in the Kootenai River's hatchery-augmented fishery

Following the population collapse of Burbot (Lota lota) within the Kootenai River, a supplementary hatchery program was launched to reintroduce the species and sustain a fishery. State and provincial managers have documented a substantial rebound in Burbot abundance in the river, but vital rates governing the fishery remain uncertain. Using mark-recapture data compiled from

extensive hoop netting efforts since Burbot restoration began, I use Bayesian methods and a Jolly-Seber open-population model to estimate annual abundance and its effect on subsequent survival. This work is part of a larger effort to build a population model that can be used to identify hatchery production and exploitation strategies that will optimally balance management goals.

Joshua Heishman, jheishman@uidaho.edu

3:00 PM

Seasonal variation in small-bodied fish communities in side channel habitats before and after culvert removal

Cartier Slough Wildlife Management Area (WMA) is adjacent to the lower Henrys Fork of the Snake River, and has over 16 km of side channels. In autumn of 2021 and 2022, culverts were removed in the side channels to improve connectivity with the Henrys Fork, thus improving permanency of side channel habitats. The objective of this study was to determine seasonal variation in small-bodied fish communities within the side channels in Cartier Slough WMA before and after culvert removal. We sampled small-bodied fishes using baited minnow traps in spring and autumn before (2015-2017 & 2021) and after (2022-2023) culvert removal. Spring surveys were dominated by Speckled Dace Rhinichthys osculus and Redside Shiner Richardsonius balteatus, and were more likely to have Longnose Dace R. cataractae and juvenile Green Sucker Pantosteus virescens. Spring surveys showed little variation in fish community assemblage before and after culvert removal. In autumn and prior to culvert removal, as many as 62% of the sites were dry, and the fish community was dominated by Utah Chub Gila atraria and Pumpkinseed Lepomis gibbosus with Yellow Perch Perca flavescens being more likely to be captured. After culvert removal, the improved connectivity resulted in most sites retaining water. Consequently, the small-bodied fish community in autumn shifted to be dominated by Utah Chub and juvenile Utah Sucker Catostomus ardens with higher relative abundance of Redside Shiner and Speckled Dace than prior to restoration. Also, the autumn fish community after culvert removal was more similar to the spring fish community.

Eric Harmon, John Heckel, Eric Billman
ericeharmon@gmail.com

3:40 PM

Shifting climate conditions affect recruitment in Midwestern stream trout, but depend on seasonal and spatial context

Climate change effects on aquatic species will likely differ among populations depending on seasonal and spatial context, which can hinder strategic management actions. We used 26 years of standardized survey data on brook trout (Salvelinus fontinalis) and brown trout (Salmo trutta) in Wisconsin, USA to quantify the influence of seasonal and spatial climate variability (air temperatures and precipitation) on annual recruitment strength (as indexed by young-of-year [YOY] relative abundance in summer). The effects of climate conditions on recruitment varied by species, season, and latitude. Increasing maximum summer temperatures were associated with lower brook trout recruitment, but higher brown trout recruitment. The effect for both species was stronger at lower latitudes. Spring temperatures were positively related to brown trout recruitment at lower latitudes; in mid-latitude and northern streams, they were related to increasing recruitment up to about 1 standard deviation, above which recruitment declined. High and low winter and spring precipitation were associated with precipitous declines in recruitment for both species. By contrast, summer precipitation was positively related to recruitment in northern streams for brook trout and southern streams for brown trout. We show that shifting climate conditions affected recruitment in similar species differently depending on seasonal and spatial (warm, southern regions compared with cool, northern regions) context. Given trout population trends in, and climate projections for, the Midwestern US, location- and species-specific actions are needed that account for this context dependency. Management should aim to maximize the resiliency of populations to extreme climate conditions by buffering negative influences on recruitment.

Bryan Maitland, Alex Latzka
Bryan.Maitland@usda.gov

4:00 PM

Using MYY Brook Trout stocking and manual suppression to eradicate nonnative Brook Trout in Idaho

Established populations of non-native Brook Trout Salvelinus fontinalis in western North America threaten native salmonids and are difficult to eradicate with traditional methods. A new approach uses the stocking of hatchery-produced genetically male Brook Trout (BKT) with two Y chromosomes (MYY). Population simulations predict that, with realistic rates of wild fish suppression, MYY stocking, post stocking MYY survival and reproductive success; MYY BKT may progressively shift the sex ratios of wild populations to 100% male with complete eradication occurring in as little as 4-12 years in streams and 8-20 years in alpine lakes. The Idaho Department of Fish and Game has been studying the use of stocked MYY BKT in conjunction with manual suppression of wild BKT populations in streams and lakes throughout Idaho. After 7-9 years (waterbody dependent) of stocking MYY BKT, our stream which receives annual suppression and stocking of fingerling MYY BKT the adult population is now 96% male. Preliminary findings indicate that shifts in the male sex ratios of the adult population (XY and YY genotypes combined) and MYY offspring production have been higher (1) in streams than in lakes, (2) when stocking fingerlings rather than catchables, and (3) when the wild fish population are suppressed annually. Although complete eradication in some situations appears inevitable, an integrated pest management approach may be more economical for fisheries managers to implement from a practical standpoint.

Jennifer Vincent, jenn.vincent@idfg.idaho.gov

4:20 PM

Evaluation of using biological control to suppress Brook Trout populations in Idaho mountain lakes

Brook Trout Salvelinus fontinalis populations in high mountain lakes (HMLs) tend to exhibit high abundance and stunted size structure due to density dependence mechanisms. Fisheries managers have used a variety of techniques to suppress or eradicate Brook Trout in HMLs, including biological control (i.e., predatory fish introduction). Idaho Department of Fish and Game (IDFG) has introduced reproductively sterile predators such as tiger muskellunge Esox lucius × Esox masquinongy and tiger trout Salmo trutta × Salvelinus fontinalis into select HMLs throughout central Idaho in efforts to decrease abundance and improve size structure of naturally reproducing Brook Trout populations. Within IDFG's Salmon Region, tiger muskellunge were introduced as biological control intro three mountain lakes from low (≤10 fish/ha) to high (≥100 fish/ha) density. Tiger trout were subsequently stocked into one of three study lakes where tiger muskellunge introduction was unsuccessful. In two study lakes, BKT abundance decreased and size structure was improved in years immediately following tiger muskellunge stocking, though years until resurgence of BKT abundance varied depending on tiger muskellunge stocking density (i.e., "high" versus "low"). Our results show that tiger muskellunge can be an effective management tool to decrease trout abundance and improve size structure, but lake characteristics (e.g., littoral habitat availability) of the receiving system and stocking density should be carefully considered. Conversely, tiger trout may be an effective tool, and size at release is likely one of the most important factor in their success. Overall, adaptive management is required for maintaining long term fishery improvements using biological control.

Brett Kelly, brett.kelly@idfg.idaho.gov

4:40 PM

Fish population monitoring in response to the Quagga Mussel treatment in the mid-Snake River

On September 18th, 2023, the Idaho State Department of Agriculture (ISDA) identified and verified the presence of Quagga Mussel Dreissena bugensis in the mid-Snake River near Twin Falls, Idaho. This marked the first confirmed Quagga Mussel detection not only in Idaho but anywhere in the Columbia River Basin. Immediately following the discovery, the Idaho Department of Fish and Game (IDFG) worked collaboratively with ISDA and other state, federal, and local agencies to develop a treatment plan to eradicate the invasive mussels. In addition, IDFG developed a plan to determine the extent of fish mortality associated with the chelated copper treatment. The plan consisted of three different phases including pre-treatment, in-treatment, and post-treatment surveys. Prior to the treatment, fish were collected and marked to develop mark-recapture population estimates. Mortalities were collected during the treatment and assessed for marks. Post-treatment surveys were conducted to determine what species were still present and to compare pre- and post-treatment catch-per-unit-effort data. This talk will describe the survey methodology, observations regarding the fish community during all three phases of the treatment process, and lessons learned during this unprecedented effort. Plans for monitoring and rehabilitation of the fish community in the project area will also be discussed.

Mike Peterson and Eric Stark
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Thursday, 10:00 AM

A stunted Walleye fishery in a southern Idaho reservoir

Built in 1910, Salmon Falls Creek Reservoir is a 1,376-ha irrigation impoundment located on Salmon Falls Creek in Twin Falls County, Idaho. Historically the reservoir has been managed as a mixed species fishery for Black Crappie Pomoxis nigromaculatus, kokanee Oncorhynchus nerka, Rainbow Trout Oncorhynchus mykiss, Smallmouth Bass Micropterus dolomieu, Walleye Sander vitrius, and Yellow Perch Perca flavescens. However, it is primarily recognized as one of only three sanctioned Walleye fisheries in Idaho. While natural recruitment occasionally occurs, the persistence of the Walleye fishery is supported by stocking efforts. The quality of the Walleye fishery has varied over the years, but a survey in 2020 documented a stunted Walleye population with 90% of the fish sampled between 203 – 355 mm and a severely depleted prey base. Age and growth data supports that multiple year classes of Walleye, likely a mix of natural recruitment and hatchery stocking, contributed to the growth bottleneck. A follow up survey, completed in 2023, demonstrated a notable shift in the fishery with only 23% of the Walleye sampled between 203 – 355 mm, indicating fish are starting to move through the growth bottleneck. However, we only observed small shifts in species composition and haven't observed much change to the prey base. Future sampling events should provide better clarity regarding the recovery of the prey base, additional growth improvements for the Walleye population, and determine whether translocating forage fish in the system would help balance this fishery.

Conor McClure, Mike Peterson
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10:20 AM

Response of Macroinvertebrates to Changes in Water Supply and Temperature in the Henry's Fork Snake River

The Henry's Fork Snake River in eastern Idaho is world-famous for its dry-fly fishing. Anglers rank quality of mayfly (Ephemeroptera), stonefly (Plecoptera), and caddisfly (Tricoptera) hatches and number of rising fish as more important to their fishing experience than quantity or size of fish caught. In 2015, we implemented systematic, replicated sampling of benthic macroinvertebrates at six locations in the Henry's Fork. We accumulated a data set of 45 unique site-year

combinations, along with streamflow and water-quality data at each location. We used six environmental variables as potential predictors of invertebrate community metrics and abundance of taxa important to anglers: annual streamflow, 3-day maximum streamflow, 21-day minimum streamflow, conductivity, suspended sediment concentration, and 7-day maximum daily water temperature. Of these, maximum water temperature was the strongest predictor of both community structure and individual-taxa abundance. Hilsenhoff Biotic Index was positively dependent on maximum temperature, and abundance of two of the most popular mayfly genera among anglers—Drunella and Ephemerella—was negatively dependent on maximum water temperature. Annual streamflow was the second most important predictor, with more desirable community metrics and abundances observed following years of higher water supply. However, mean percent EPT over all site-year combinations was high, at 52%, and mean HBI was 4.1, within the qualitative category of "very good." Thus, although the macroinvertebrate community in the Henry's Fork is robust by nearly any measure, the taxa most valued by anglers have likely decreased due to observed decreases in water supply and increased temperatures over the past several decades.

Rob Van Kirk, Brett Marshall, Jack McLaren, Melissa Muradian
rob@henrysfork.org

10:40 AM

The feasibility of Grandparentage testing to monitor genetic risks posed by straying hatchery steelhead in the Snake River Basin

Quantifying hatchery straying in salmonid populations is difficult, particularly for steelhead in the Snake River Basin that return to spawn on the peak of spring snowmelt when water flows are high, and water is turbid. In addition, their iteroparous life-history means that few carcasses are available for recovery. These factors preclude the use of typical monitoring methods such as weir trapping and spawning ground surveys. Even if identifying and enumerating straying hatchery steelhead was possible, the major genetic concerns involve whether those fish successfully spawn with wild fish. If the feasibility of Grandparentage testing technology is demonstrated, it could provide a powerful new tool for monitoring risks posed by straying hatchery fish. Here we describe progress on completing the first proof-of-concept study aimed at testing this technology in the Snake River Basin.

Matthew Campbell, matthew.campbell@idfg.idaho.gov

11:00 AM

Exploitation and catch-and-release of salmonids in Idaho high mountain lakes

Historically, most high mountain lakes in western North America were devoid of fish, but during the last century many have been stocked with salmonids to diversify angling opportunities. Basic information on harvest and catch-and-release (C-R) for such fisheries is lacking. Using angling gear, we captured and implanted T-bar anchor tags into 1,163 salmonids of various species (of wild origin or hatchery fish stocked as fry; they could not be distinguished) in 103 high mountain lakes scattered across Idaho. Angler-reported tag returns were used to estimate annual rates of exploitation and C-R, and a model selection approach was used to investigate factors influencing angler catch of tagged fish. Anglers caught a total of 125 tagged fish from 52 different lakes. Mean days-at-large for tagged and caught fish was 318 days, but days-at-large ranged from 1 to 1,465 days. Annual exploitation was 5.8 ± 7.1% (90% CI), annual C-R was 8.5 ± 8.5%, and total annual catch (i.e., exploitation + C-R) was 14.2 ± 11.0%. Of the predictive factors we investigated, the likelihood of a fish being caught by an angler was primarily a function of shoreline uniformity, with the odds of fish being caught by an angler increasing by 18% for every 1 unit increase in shoreline development index. Our results indicate that exploitation of salmonids in Idaho high mountain lakes is low even with liberal (six fish daily bag limit) harvest regulations, thus angler harvest is unlikely to be affecting abundance or size structure of salmonid populations in these lakes.

Kevin Meyer, kevin.meyer@idfg.idaho.gov

Genetics in Fisheries Management and Conservation

Moderators: Audrey Harris and John Hargrove

Back to Guide

Thursday, May 2, 8:00 AM to 12:00 PM

Symposium Abstract

Genetic techniques play a central role in fisheries management and conservation by providing fundamental information on the distribution of genetic diversity across the landscape and the forces that shape it. This symposium will showcase research harnessing genetic data to make informed management decisions, promote biodiversity conservation, and ensure the long-term resilience of fisheries. The focus of this symposium is intentionally broad to capture the myriad applications of genetic data in modern fisheries management.

8:00 AM

An improved genetic marker panel for conservation monitoring of Upper Kootenay River burbot

Burbot populations in the Upper Kootenay watershed, transecting the US-Canada border, are subject to intense monitoring and management after severe declines beginning in the 1970s. Genetic monitoring is a high-priority goal for the East Kootenay Burbot Scientific Working Group, but managers do not currently have a genetic marker panel with enough resolution to understand genetic population structure and family structure in the Upper Kootenay burbot populations. In this presentation, we detail the process of developing and optimizing a cost-effective GTseq panel to aid in the conservation of Upper Kootenay burbot. The final GTseq panel contains 331 markers with sufficient variation to accurately infer population structure and reconstruct pedigrees.

Audrey Harris, Katharine Coykendall, Heather Lamson, Ryan Kovach, James Dunnigan, Matthew Campbell
audrey.harris@idfg.idaho.gov

8:20 AM

Efficient species identification for Pacific salmon genetic monitoring programs

Genetic monitoring of Pacific salmon using genetic stock identification (GSI) and parentage-based tagging (PBT) involves genotyping tens of thousands of individuals annually. Although rare, these large sample collections inevitably include misidentified species, which exhibit low genotyping success on species-specific GT-seq panels. For laboratories involved in large-scale genotyping efforts, diagnosing non-target species and reassigning them to the appropriate monitoring program can be costly and time-consuming. To address this problem, we identified 19 primer pairs, from existing GT-seq panels, that exhibit consistent cross-species amplification among salmonids and contain 51 species-informative variants. These genetic markers reliably discriminate among 11 salmonid species and two subspecies of cutthroat trout and have been included in species-specific GT-seq panels for Chinook Salmon, Coho Salmon, Sockeye Salmon, and Rainbow Trout. Additionally, we developed a species-calling script to automate the identification of non-target species within routine genotyping pipelines. Following extensive testing with empirical and simulated data, we demonstrated that the genetic markers and accompanying script accurately identified species and are robust to missing genotypic data and low-frequency, shared polymorphisms among species. Finally, we apply

these tools to identify Coho Salmon incidentally caught in a Columbia River Chinook Salmon sport fishery and used PBT to determine their hatchery of origin. These molecular and computing resources provide a valuable tool for Pacific salmon conservation in the Columbia River basin and demonstrate a cost-effective approach to species identification for genetic monitoring programs.

Zachary Robinson*, Jeff Stephenson, Kim Vertacnik, Stuart Willis, Rebekah Horn, Jesse McCane, Katharine Coykendall, Shawn Narum
zrobinson@critfc.org

8:40 AM

Preliminary results of population distribution, genetic structure and diversity of Coastal Cutthroat Trout (Oncorhynchus clarkii) throughout Washington and Oregon states

Understanding population distribution, genetic structure and diversity is important for management and conservation of species. The Molecular Genetics Laboratory at the Washington Department of Fish and Wildlife (WDFW) is working on the development of a baseline genetic dataset for Coastal Cutthroat Trout (Oncorhynchus clarkii) in Washington and Oregon states. We recently generated restriction site-associated DNA (RAD) libraries from 28 populations. Once preliminary evaluation and analysis is completed, the intention is to create a GTseq single nucleotide polymorphism (SNP) panel as a useful tool for population source identification, O. mykiss X O. clarkii hybridization, and population genetic structure. In order to increase the utility of the genetic baseline, WDFW aims to improve baseline representation and resolution.

Amelia Louden, Amelia.Louden@dfw.wa.gov

9:00 AM

How can the genomic history of introduced salmonids inform their native range conservation and management?

Numerous salmonids have been introduced to the Great Lakes, the biological effects of which offer insights into the management and conservation of their native counterparts. Here, we describe the effects of genetic drift and rapid genetic adaptation in pink salmon (Oncorhynchus gorbuscha) that were accidentally introduced to the Great Lakes via a single introduction event 31 generations ago. Using whole-genome resequencing of 134 fish spanning five sample groups across the native (Lakelse River, British Columbia) and introduced range (Lake Superior, Ontario), we estimate that the source population's effective population size was 146,886 at the time of introduction, whereas the founding population's effective population size was just 72—a 2040-fold decrease. As expected for a severe founder event, we show reductions in measures of genetic diversity, specifically a 37.7% reduction in the number of SNPs and an 8.2% reduction in observed heterozygosity. Despite this decline in genetic diversity, we provide evidence for putative selection at 47 loci across multiple chromosomes in the introduced population, including missense variants in genes associated with circadian rhythm, immunological response and maturation, which match expected or known phenotypic changes in the Great Lakes. For one of these genes, our results support a strong response to selection occurring in a period gene (per2) that plays a predominant role in determining an organism's daily clock, matching large day length differences experienced by introduced salmon during important phenological periods. Together, these results inform how populations may still capitalize on adaptive genetic variation in the face of substantial genetic drift.

Morgan M. Sparks, Morgan.Sparks@usda.gov

9:20 AM

Examining the evolutionary history of Rainbow Trout using mitochondrial sequences and nuclear single nucleotide polymorphisms

Broadly distributed species may harbor large amounts of genetic variation between populations, often leading to populations being organized into subspecies or distinct population segments. In many cases, the differentiation between populations is driven by historical isolation. In North America however, much of the continent's northern portion was inhospitable during the last glacial period, especially for freshwater taxa which rely on open water for habitat and dispersal. Salmonids were one fish taxon absent from a large portion of their current range until glacial recession created avenues for recolonization. As such, despite having geographically large ranges salmonids may not exhibit the deep population structure across the entire range compared to species with populations separated on a much longer time scale. Rainbow Trout (Oncorhynchus mykiss) are one salmonid species that recolonized newly accessible areas following glacial retreat, resulting in more recent isolation of populations in their northern range, whereas in the southern portion of Rainbow Trout range populations have been established on a longer time scale. Where genetic studies have been undertaken on regional geographic scales results have varied regarding population divergence and structure, and putative subspecies have been suggested using genetic data, despite an incomplete understanding of intraspecific genetic variation spanning the species range. Our aim for this study was to provide a range wide assessment of genetic variation and population structure among Rainbow Trout populations on a geological time scale using a mitochondrial gene sequence, and on a contemporary time scale via a single nucleotide polymorphism panel for neutral nuclear loci.

Tyler Beech, tylerbreech@isu.edu

10:00 AM

The Effect of YY Male Stocking and Concurrent Electrofishing Suppression on Two Brook Trout Populations in Central Idaho

Eradication of nonnative stream Brook Trout populations is difficult to achieve with standard techniques. A new concept is to stock genetically YY hatchery-reared brook trout repeatedly into invasive populations causing male sex ratio skew over time until all females are eliminated. We document population response to electrofishing suppression of wild Brook Trout and concurrent YY Male stocking in two isolated Idaho streams. Over the past 7 years, the entire lengths of both streams underwent two consecutive days of electrofishing removal annually. Stocking of YY males was initiated 3-4 years into the program. All captured wild Brook Trout were killed (n = 4397), a fin clip taken, and genetic sex was successfully determined using a sex marker for all but 2% collected. We calculate and report 2-pass removal estimates of wild male and female population size through time. Genetic Stock Identification confirmed the successful reproduction of released YY males. In Bear Creek, the female population has been reduced from an estimated 542 fish in 2016 to 22 in 2023, a 96% decrease. Willow Creek experienced a 98% decline in female abundance, with an estimated 2 females remaining in 2023. Female abundance in both streams initially decreased during suppression-only years and sharply dropped following YY Male stocking. While ongoing research is needed, our study suggests that YY Male stocking could be an efficient and effective management tool for the eradication of stream Brook Trout, requiring less annual field effort than sole use of electrofishing removal approaches.

Dan Schill, Matt Campbell, Bart Gamett, Curtis Roth, Jenn Vincent
danjschill@gmail.com

10:20 AM

Interspecific hybridization in a large-river population of Yellowstone cutthroat trout: a 20-year programmatic evaluation

Hybridization between native and nonnative fishes represents a global threat to biodiversity. Understanding how hybridization changes in response to management actions is critical to evaluating the efficacy of conservation efforts. We quantified changes in levels of hybridization and introgression between Yellowstone cutthroat trout (Oncorhynchus clarkii bouvieri) and rainbow trout (Oncorhynchus mykiss) in the South Fork (SF) Snake River watershed, where a multipronged approach has been implemented to protect the evolutionary distinctiveness of one of the last remaining large-river populations of Yellowstone cutthroat trout. Over a 20-year period, we observed a decrease in the percentage of fish classified as hybrids across the SF Snake River watershed; however, we observed contrasting patterns in mainstem and tributary reaches. Hybrid abundance increased at mainstem reaches of the SF Snake River below Palisades Dam, whereas the number of tributary reaches without hybrids was greater in 2022 relative to 2003. Efforts to reduce hybridization in spawning tributaries, including both suppression and selective passage weirs, were effective at preventing the expansion of hybridization in resident and migratory populations. Changes in hybridization in the SF Snake River watershed are likely the result of multiple processes, namely management actions to reduce rainbow trout and hybrids in tributaries as well as demographic changes in rainbow trout in the mainstem river below Palisades Dam. Our results suggest that Yellowstone cutthroat trout populations in the SF Snake River watershed have not experienced widespread interspecific hybridization with rainbow trout, but that proactive management will be necessary to ensure long-term conservation.

John Hargrove, john.hargrove@idfg.idaho.gov

10:40 AM

Introgression in native Redband Trout from a desert watershed

While species introductions have been a tool for management, supplementation, and conservation of natural populations, these practices can lead to hybridization between closely related species and genetically distinct populations. This potential hybridization can lead to outbreeding depression and genetic swamping; threatening many freshwater fish species at risk from a long history of population supplementation and introductions. We assessed the level of introgression between native Redband Trout (Oncorhynchus mykiss gairdneri) populations of the upper Owyhee River in northern Nevada and stocked Rainbow Trout (O. mykiss) using single nucleotide polymorphisms. We sampled individuals from 12 streams and three reservoirs representing native and stocked populations. Reservoirs of the upper Owyhee River have a long history of stocking trout for recreational angling; however, no study has evaluated whether introduced fish have introgressed with remaining native populations. We found that introgression occurred in streams directly connected to reservoir populations, but the proportion of introgressed individuals was low. While all streams studied are connected, the absence of introgression in populations distant from reservoirs suggests dispersal of stocked individuals is restricted. These results suggest that native populations that are geographically distant from stocked areas have a low risk of introgression and even those populations directly connected to reservoirs experience low levels of introgression.

Kyle E. Rufo, kylerufo@isu.edu

11:00 AM

Genetic pedigree analyses reveal differences in movement and growth patterns for 'rescued' young-of-year steelhead

Fish 'rescues', or relocation of fish due to stream drying, are an increasingly common management practice used to address the effects of droughts and water withdrawals. Yet, how fish respond to rescues remains an open question, particularly for young-of-year fish, because so little is known about their movements early in life. In this study we used genetic pedigree analyses to track young-of-year steelhead from rescued and non-rescued families in the Carmel River (California). We found that young-of-year steelhead from non-rescued families disperse to take advantage of highly productive habitats throughout the watershed (median 6 rkm family spread). Individuals grew much larger (~30 mm) in the lower river and lagoon compared to their siblings farther upstream, and these differences in growth resulted in greater variation in body size as a function of movement distance within a family. Individuals from rescued families generally dispersed much greater distances (median 41 rkm spread) but did not grow larger in the lower river and had consistent variation in body size throughout the watershed. Our results suggest that young-of-year movement is a natural process that allows steelhead to take advantage of high-productivity habitats and leads to increased variation in body size that is likely a precursor for life-history diversity. Rescuing fish did not replicate this process, possibly because the timing of rescues did not match the natural timing of dispersal.

Haley Ohms, Carolina Lazari, Carlos Garza, Devon Pearse, David Boughton
haley.ohms@tu.org

11:20 AM

Does habitat extent predict a decline in genetic diversity for fragmented populations of redband trout?

Habitat loss is the leading factor in the worldwide decline in biodiversity, as many historically widespread and abundant organisms are currently limited to small remnant populations where persistence is uncertain. As small, isolated patches of habitat can support fewer individuals with limited gene flow, loss of genetic diversity through genetic drift and inbreeding depression is a concern. In western North America, many watersheds have extensively fragmented habitat, and aquatic organisms are often limited to networks of headwater streams of various sizes and connectivity. To assess how the amount and connectivity of remaining habitat has affected population structure and distribution of genetic diversity in salmonid fish populations, we conducted a field study assessing 34 populations of redband trout, Oncorhynchus mykiss gairdneri, in the Owyhee River, Bruneau River, and Salmon Falls Creek watersheds of southern Idaho and northern Nevada. We found that redband trout populations with small habitat extents had significantly lower genetic diversity than populations with larger habitat extents, but loss of genetic diversity did not occur until a threshold in minimum habitat size was observed. The population structure of redband trout within the study area has been shaped by genetic drift following fragmentation, illustrating cause for concern on the genetic viability of small populations where little to no connectivity to surrounding suitable habitat remains.

Adam Zambie*, adamzambie@isu.edu

Hatcheries: The Need to Know

Moderator: Brian Beckman & Phil Sandstrom

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Tuesday, April 30, 2024 1:40 PM to 5:20 PM

Symposium Abstract

Hatchery propagation as a fish management tool for salmon requires dynamic program management responsive to emergent needs and adapt to unanticipated outcomes. This symposium will include contributions by regional professionals tasked with characterizing the efficacy of hatchery programs and addressing the basic question, "How well is your hatchery program meeting its intended goals?". The organizers hope that this symposium will lead to the development of a community of practitioners better able to field questions surrounding hatchery program evaluation as new roles for this activity are being considered. Hatchery program efficacy represents a complex topic best served by a community comprised of a broad range of expertise, experience, and points of view. Thus, we invite those active in all areas of hatchery program management/evaluation to contribute abstracts for inclusion as presentations in this symposium. Examples of topics might include:

- Implementation of adaptive management strategies considering costs and benefits of hatchery programs,
- Case studies or novel approaches to characterize hatchery program outcomes and impacts,
- Discuss non-conventional roles for hatcheries in the recovery of species, mitigating environmental degradation, sustaining fish dependent communities, or improving the resilience of salmon populations to climate change.
- Illustrating gaps in current knowledge and identify research priorities.

In addition to contributed presentations, we will dedicate a portion of our symposia to a panel discussion where state, provincial, federal and tribal professionals can speak to a variety of issues relevant to the current and future uses of salmon hatcheries in natural resource management.

1:40 PM

Reflections on a 30+ year career in Columbia and Yakima Basin salmon restoration

In June 1947 a committee of federal, state, and public (including tribal) "stakeholders" met for the purpose of determining whether to defer construction of additional hydro-system projects in the Columbia and Snake River Basins for ten years to allow additional time for careful deliberation. By October 1947, the decision was made to proceed. Natural salmon would be sacrificed for the sake of "progress". Hatcheries would be constructed to "ameliorate" the losses. This is the well-documented history of the Columbia River Basin. Development of the Basin and concomitant despoilment of natural habitats has since proceeded to the point that many long-serving experts in Columbia Basin salmon restoration have concluded that, even in the absence of all hatchery production and harvest, overall trends in population abundance would not change substantially. Given this reality, current artificial production in the Basin consists of programs designed to: provide harvest, enhance natural production, and restore extirpated populations. Evaluation of the programs should continue and be consistent with their objectives relative to these purposes. However, rather than focusing evaluations on hatchery impacts to natural populations, we should target limited evaluation resources to learn how we can best adapt hatchery programs to improve overall abundance, diversity, spatial distribution, and survival to the maximum extent practical.

Bill Bosch, bbosch1958@gmail.com

2:00 PM

Columbia River Basin Hatcheries – Mitigation for hydrosystem operations and development of the basin

Assessment of the effectiveness of hatchery facilities and programs requires an understanding of the primary purpose and goals of each program at both the scale of an individual hatchery program and a comprehensive scale that provides context for the entire system of hatchery programs under the same mitigation [funding] umbrella. The system of hatcheries within the Columbia River Basin (CRB) is unusual and unlike other regions of the country and world where artificial production is funded by private or state funding primarily to support harvest and economic benefits. The CRB system of hatcheries is primarily federally funded through legislation and established as mitigation for losses and impacts to fish due to habitat degradation and the construction and operation of hydropower dams. While mitigation is the primary purpose of the CRB hatchery system, hatchery programs themselves are managed to achieve multiple objectives, including supporting harvest, supplementation, and/or reintroduction. Communicating this context of purpose for the CRB hatchery system is a key outcome of outreach tools that are being developed as part of the Northwest Power and Conservation Council's collaboration with state, federal, and tribal partners in the region. This presentation will highlight the outreach tools – 1. A website that communicates the story and importance of fish hatcheries in the altered environment of the CRB to broad audiences, and 2. A mapping tool of the CRB facilities and programs in context to their primary purpose and management objectives, including preliminary compilation of data associated with the Council's CRB Fish and Wildlife Program.

Maureen Hess, mhess@nwcouncil.org

2:20 PM

Using Hatcheries for Conservation: An Overview of the Integrated Chinook Program in Idaho

Naturally produced populations of anadromous salmonids in Idaho and throughout the Pacific Northwest have declined precipitously since the 1950s. In response, extensive hatchery programs were developed to increase abundance and mitigate lost harvest opportunities. Naturally reproducing populations have remained depressed, despite mitigation. As a result, some hatchery programs have chosen to take on conservation objectives (i.e., supplementation). Integrated broodstock programs are a particular type of supplementation strategy where the hatchery broodstock is comprised primarily of natural origin adults to minimize genetic divergence between hatchery donor stocks and recipient natural stocks. The Idaho Department of Fish and Game currently maintains integrated broodstock programs for Chinook Salmon (Oncorhynchus tshawytscha) at the Sawtooth, Pahsimeroi, and the McCall fish hatchery in addition to their original mitigation lineages. Uncertainties remain in terms of the benefits and risks of supplementation. Therefore, the primary objectives of this research are: 1) assess the influence of natural origin Chinook Salmon incorporated into integrated broodstocks on hatchery survival, productivity, and hatchery replacement rates; 2) evaluate the influence of integrated broodstock spawners on naturally reproducing populations and natural replacement rates. Information from this program will provide managers with a more complete picture of the benefits and risks of implementing integrated broodstock programs, which may guide the implementation of future supplementation strategies in Idaho and elsewhere.

David Venditti, david.venditti@idfg.idaho.gov

2:40 PM

Evaluating Mitigation Objectives for Spring/Summer Chinook Salmon Hatcheries in the Snake River Basin

Hatcheries are a common feature of freshwater fisheries management in North America. Salmon fisheries in the Columbia River basin offer a complex example of this management tool. We examined the ability Snake River subbasin hatcheries to achieve regionally accepted hatchery adult Chinook salmon mitigation objectives. To answer questions about the feasibility of achieving objectives, we developed a life cycle model that incorporates smolt release abundance, smolt survival from release to Lower Granite Dam (Srelease), and the smolt-to-adult return ratio (SAR), while linking broodstock requirements to smolt release abundance. Applying this model to eight hatcheries, we found that programs would have achieved objectives for nine of 119 total

releases. The minimum SAR to achieve return objectives at maximum survival (Srelease = 1) varied among hatcheries from 0.38% to 1.00%. Hatcheries exceeded minimum SAR thresholds in 27% of the combined dataset. We also found that some hatcheries may only achieve their objectives for 50% of releases even after quintupling production. Finally, we lowered the objective to "implementing a targeted sport fishery" and found less than half of the hatcheries could reliably support a fishery under current survival rates and two hatcheries may not reliably support fisheries with substantial production increases. Evaluating the linkage between smolt production and SAR is crucial to understanding the potential of hatchery stocks and identifying management options capable of meeting objectives and supporting fisheries on a regular basis. Management that improves SARs and increases current smolt production are needed to reliably achieve Snake River basin hatchery abundance objectives.

Jonathan D. Ebel*, Timothy Copeland, Christopher Sullivan, Joseph W. Feldhaus, Ian A. Tattam, and Joseph D. Bumgarner
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3:00 PM

Evaluating the success of Chinook Salmon and Steelhead hatchery mitigation programs in Idaho: a fishery and harvest perspective

Due to declining returns of adult Chinook Salmon and Steelhead, retention of wild adults in recreational fisheries in Idaho was discontinued in 1979 for Chinook Salmon and in 1987 for Steelhead. Since then, apart from recent fisheries conducted for fall Chinook Salmon, recreational fisheries have been solely dependent on returns of hatchery origin adults. Similar to other anadromous fish hatcheries operated in the Columbia River basin, a number of hatcheries operated within the state of Idaho were constructed to mitigate for diminished returns of adults and lost harvest opportunity resulting from the construction and operation of hydroelectric dams on the Columbia and Snake rivers. While hatchery facilities operated by the Idaho Dept. of Fish and Game in Idaho are managed to provide both harvest and conservation benefits, the bulk of juvenile production from these facilities is managed specifically to provide harvest benefits for both tribal and non-tribal fisheries. To address the question "How well is your hatchery program meeting its intended goals?", we consider risks to wild populations, conservation benefits, consistency of fisheries, and harvest. In this presentation, we address the question primarily from the fishery and harvest perspective but touch on conservation benefits and impacts to wild populations.

Brian Leth, brian.leth@idfg.idaho.gov

3:40 PM

Anticipating and implementing changes in hatchery mitigation programs - Two examples from the Lower Snake River Compensation Plan.

The Lower Snake River Compensation Plan (LSRCP) was formalized in 1975 to replace fish and wildlife losses caused by the construction and continued operation of Ice Harbor, Lower Monumental, Little Goose, and Lower Granite Dams on the Snake River. Annual fisheries compensation goals are 18,300 adult fall Chinook salmon, 58,700 adult spring-summer Chinook salmon, 55,100 adult steelhead to the defined LSRCP project area as well as a component of catchable trout (86,000 pounds) to address lost river fishing locations and effort. Over time, the LSRCP has evolved to address changes in delivery of the compensation goals, Endangered Species Act-listings, as well as specific conservation and recovery needs in the Snake River. Two conservation-focused spring Chinook salmon program releases within the LSRCP portfolio, the upper Grande Ronde River program (OR) and the Tucannon River program (WA), highlight this evolution of the LSRCP over time. Several immediate concerns, including impacts from climate change, currently affect these programs and their future. These programs additionally highlight a need of a hatchery compensation program to be flexible enough to adapt and change due to external factors, needs of the resource managers and essential recovery efforts.

Rod Engle, rod_engle@fws.gov

4:00 PM

Deep River Net Pens- a multifaceted approach to the costs and benefits of bio-programming changes in a remote hatchery rearing site.

Deep River Net Pens (DRNP) is the last remaining remote rearing site in Washington associated with Select Area Fisheries Enhancement (SAFE) in the Lower Columbia River. The SAFE program's intent is to support off-channel commercial fishing opportunity in lieu of the historical main-stem Columbia River Gillnet fisheries. In 2023 only two fisher vessels participated in the DRNP fishery. We were asked to examine two questions: what are the proportional contributions of DRNP production to the Columbia River Gillnet fisheries, and what are the potential results of on/off-station release strategies? We utilized novel methodologies for data extraction, organization and modeling potential impacts of bio programming changes and associated fisheries within the DRNP operation. Coded wire tag (CWT) data was retrieved from the Regional Mark Processing Center's (RMPC) cwt database RMIS. Proportional contributions to fisheries were backcalculated to assess relative impact of changes in bioprogramming based on 7 years of data, and scaled to model different scenarios suggested by regional management and hatchery staff. Preliminary findings show that spring Chinook would not contribute to an off-channel gillnet fishery commensurate with the current Coho program.

Kristopher J. Warner, kristopher.warner@dfw.wa.gov

4:20 PM

Snake Basin In-Season Management of Salmon, Steelhead, and Coho Tribal and State Fisheries

Anadromous fish serve as powerful cultural and social symbols for tribal and non-tribal people of the Pacific Northwest. Despite the significance of these icons, there have been widespread and dramatic declines in their abundance over the last century. These drastic declines have sharply reduced or eliminated, what historically were robust fisheries that sustained the livelihoods of both Tribal and non-Tribal cultures and communities. In the Snake Basin, current fisheries, are intensely managed to not exceed allowable impacts to natural fish, ensure fair equity to all allowed fishing entities, and to ensure hatchery broodstock are met. Coordination and cooperation across all parties requires year around weekly coordination to manage all of these complex issues. This process has been dramatically aided by PIT tag marking programs for hatchery salmon, steelhead, and coho. PIT tags allow comanagers the ability, in-season, to make estimates of returning hatchery fish (starting at Bonneville Dam and following them up eight dams to Lower Granite Dam) that inform allocation of fish to hatchery broodstock, natural spawners, and harvest. . Adult hatchery disposition management requires key manipulations of the raw PIT tag data to deal with issues of representation, tag loss, and detectability, are necessary to make estimates that are within the bounds of the true returns. Additional PIT tag detection locations upstream of Lower Granite Dam, are also utilized, to understand run timing and locations of the harvestable fish, so that managers and fishers are better informed in real time.

Jason Vogel, jasonv@nezperce.org

4:40 PM

Monitoring hatchery success and Chinook salmon recovery in the Nooksack watershed

The Nooksack watershed is home to two genetically distinct populations of endangered Chinook salmon (North Fork/Middle Fork and South Fork), both of which now have established hatchery programs. The Nooksack River Spring Chinook are culturally significant and vital to the way of life for Native tribes and the growing communities of the Pacific Northwest. Monitoring productivity changes in each population simultaneously, along with assessing effectiveness of hatchery programs, creates a complex structure of evaluation projects that require the careful disentanglement of biological monitoring data to determine assess the interactions between hatchery-origin fish, natural-origin fish, and the environment. I will describe our efforts to track population productivity, genetic diversity, and reproductive success to monitor and compare both hatchery and natural origin Chinook salmon.

Zoë Lewis zoel@lummi-nsn.gov

5:00 PM

After the Sunset: A Case Example of the Outcome of Suspending Hatchery Propagation at a Large Regional Scale

The hatchery propagation of anadromous salmonid species is criticized for impacts to natural salmonid populations up to, and including, suggestions that hatchery production poses a significant barrier to the recovery of Pacific salmonid populations. In regions where hatchery propagation is well-established, few opportunities exist to assess the outcome of fully eliminating hatchery production strictly for improving the viability of natural populations. This is especially true in the Northwest United States where hatchery production is often mandated to mitigate habitat lost to dams, is required to fulfill Treaty-Reserved fishing rights, and is essential for preserving and supplementing critically imperiled natural salmonid populations. Despite this, the hypothetical efficacy of suspending hatchery programs in the Northwest to increase viability of natural populations continues to be debated but such an action is currently unrealistic to occur. However, the opportunity to evaluate the outcome of such a significant management action beyond the Northwest is available in the United Kingdom. In 2014, a decision was made by the government of Wales to eliminate releases of hatchery-origin Atlantic Salmon (Salmo salar) in all Welsh river basins the following year. This decision was primarily justified by a prediction that a rapid, positive demographic response would occur in many natural-origin populations due to an absence of hatchery-origin salmon. This case example is examined, highlighting the current status of this contentious and divisive management action taken in Wales that draws strong parallels to the debate over salmonid hatchery management in the United States and Canada.

Tom Chance, tomc@lummi-nsn.gov

Wednesday, 8:00 AM

Genetic monitoring of hatchery salmonids with multi-generational pedigrees

In the Pacific Northwest of the United States, hatchery facilities and programs serve to mitigate for impacts to salmonids due to the construction and operation of hydropower dams, habitat impacts from development and urbanization in addition to the conservation and restoration of natural populations. Monitoring and evaluation of these hatchery fish requires a multi-national, state, and tribal cooperation that is aided by traditional coded wire tags, PIT tags, and a genetic method referred to as parentage-based tagging (PBT). PBT enables highly reliable detection of hatchery-origin fish and inference of multi-generation pedigrees by genetic sampling all adult fish spawned at a hatchery. Multi-generational pedigrees enhance the ability to monitor hatchery populations through not only identification of a fish's parents and hatchery of origin, but also the proportion of natural- and hatchery-origin (pNOB; pHOB) per year, the number of stray fish observed, genetic diversity, relatedness, and age class compositions within broodstocks. Here we present on the PBT baseline data collected for Chinook and Coho salmon from throughout the Pacific Northwest representing over 125,000 interior stream-type Chinook salmon from 24 spawning hatcheries over 11 years and over 32,000 Coho salmon samples from 9 hatcheries over 9 years. We also present case studies in how genetic monitoring with PBT of hatchery stocks is being used for tribal fisheries programs including improvement in escape estimates and the contribution of hatchery raised fish on natural spawning grounds.

Rebekah L Horn, Shawn R Narum rhorn@critfc.org

8:20 AM

Effects of Supplementation in Upper Yakima River Chinook Salmon

To promote recovery of natural salmon populations, hatchery supplementation has been implemented to increase overall spawner abundance throughout the Columbia River Basin. However, studies have provided evidence that captive breeding can result in domestication, as demonstrated by studies that show lower fitness of hatchery-origin compared to natural-origin fish. Supplementation programs, therefore, typically use natural-origin broodstock in an effort to promote genetic diversity and minimize long-term negative fitness impacts to the population as a whole. In this study, we evaluated the upper Yakima River spring Chinook Salmon Oncorhynchus tshawytscha supplementation program, which uses broodstock comprised exclusively of natural-origin fish. Using ten years of genetic data sampled from potential adult spawners, we tested for the effects of hatchery breeding and rearing on reproductive success. Our study revealed that hatchery-origin fish demonstrated reduced reproductive success compared to natural-origin fish, which

was largely driven by a lower likelihood of successfully returning offspring overall. Body length and return timing were also significant predictors of reproductive success in this population, with smaller and later returning fish demonstrating lower reproductive success. Additionally, a small pilot study revealed the potential impact of smolt acclimation site and spawn site on the lower reproductive success of hatchery-origin fish, further prompting the need for expansion of carcass sampling. Follow-up studies estimating multigenerational reproductive success are ongoing.

Ilana J Koch, koci@critfc.org

8:40 AM

Genetic consequences of Chinook salmon strays from hatcheries in Southern British Columbia

Hatchery enhancement of Pacific salmon produces the risk of shifting population fitness distributions away from their natural optima as hatcheries introduce artificial selection pressures within the population. This risk is mitigated by managing the relative gene flow between the hatchery and natural environments. In hatcheries supporting harvest objectives there are typically high numbers of hatchery fish at the expense of long-term fitness risks in the natural component of the population. These consequences may not be fully revealed if hatchery production is maintained. However, stray fish from these populations can still pose substantial genetic risks to the adaptive states of other populations. Furthermore, even low stray rates from major production hatcheries may produce high proportions of stray hatchery-origin fish in smaller systems, resulting in homogenization of among population genetic diversity and loss of fitness. We assessed stray rates from Chinook salmon hatcheries in Southern British Columbia. Overall, stray rates were low, but high proportions of stray hatchery-origin spawners were still observed in smaller populations, particularly on the west coast of Vancouver Island (WCVI). Population structure analyses for the WCVI indicated that straying has resulted in genetic introgression from populations with high hatchery influence into other populations across conservation units. This has homogenized variation among populations, and led to higher hatchery influences than would have been predicted without accounting for straying. These results emphasize the importance of accounting for straying in management of hatchery genetic risks, and highlight a key limitation in current genetic management strategies in complex multi-population and multi-hatchery systems.

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9:00 AM

Hatchery Practices can Increase the Effective Population Size of a Captive Broodstock

Captive broodstock programs aim to protect species at high risk of extinction and can differ significantly in operation from conventional hatchery programs. One main objective of a captive program is to maintain the effective population size (Ne) of the broodstock. Ne is a metric that allows managers to assess the rate of loss for genetic diversity within a population. Populations with lower Ne tend to lose genetic diversity at faster rates resulting in higher levels of inbreeding and hindering their ability to adapt to environmental change. Theoretical guidelines for demographic and genetic management of captive populations have been developed and factors that hatchery managers can manipulate should contribute to increases in effective population size over time. These hatchery management strategies include equalizing contributions from family groups and minimizing relatedness of spawners. Implementing these strategies is intended to preserve and increase Ne, which ultimately reduces the loss of genetic diversity over time. We show how application of these protocols to the captive broodstock of the critically endangered population of Snake River Sockeye Salmon has, in practice, increased their effective population size from an initial estimate of 115 to approximately 400. To our knowledge, this hatchery program is the first breeding program to empirically demonstrate a sustained increase in effective population size of such magnitude in a captive population of conservation interest.

Craig Steele, craig.steele@idfg.idaho.gov

1:40 PM

Contribution of naturally and artificially reconditioned repeat spawning female steelhead to spawning above Lower Granite Dam: repeat spawning pathways and life histories

Steelhead (Oncorhynchus mykiss) are iteroparous. Repeat spawning, like other forms of life history diversity, increases population stability through the portfolio effect. Repeat spawning occurs following reconditioning, a process in which energy stores are recovered after spawning and the annual reproductive cycle begins again. Repeat spawning can occur after 1 year (consecutive spawning) or ≥2 years (skip spawning). Natural origin steelhead that spawn above Lower Granite Dam (LGD) repeat spawn at a rate of ~1.2%. To increase the abundance and diversity of steelhead populations above LGD, the Columbia River Inter-Tribal Fish Commission (CRITFC) has established a research-scale conservation project called "kelt reconditioning". Natural-origin post-spawn female steelhead (kelts) are captured during their downstream migration, held, fed, and released to migrate upstream to spawn a second time. Artificial reconditioning can increase kelt survival from collection through release to greater than 50%. Reconditioned repeat spawners are expected to make the greatest contribution in years when total spawner abundance is low. However, the relative contributions of artificially and naturally reconditioned repeat spawning steelhead to spawning rates above LGD have not been quantified. To understand the contributions of naturally and artificially reconditioned female steelhead to spawning above LGD, we are utilizing monitoring datasets of the Idaho Department of Fish and Game and CRITFC to assess (1) the research-scale kelt reconditioning project's contribution to repeat and total spawning above LGD from spawn years 2018-2022, (2) pathways to repeat spawning (natural and artificial), and (3) consecutive and skip spawning rates of naturally and artificially reconditioned females.

Laura Jenkins, ljenkins@uidaho.edu

2:00 PM

Living life on the straight-and-narrow or a merry-go-round: developing physiological tools to assess juvenile salmonid rearing in circular vessels

Aging infrastructure, water usage, and climate change are driving operational changes in anadromous salmonid hatcheries throughout the Columbia River Basin. Traditional raceways are being replaced with circular tanks using either single-pass water or partial water reuse (pRAS). The shift in vessel geometry and water velocities in these new rearing environments may seem insignificant. However, the newer circular systems induce increased exercise activity in fish compared to the slack-waters of traditional style raceways, and may alter the phenotype of juvenile salmonids. While there is evidence that exercise has benefits to cultured fishes, some hatchery programs are struggling to adjust rearing protocols to harness those benefits. Previous hatchery studies indicate that physiological tools can assess smolt quality and provide valuable biological insights for adjusting or developing rearing protocols to maximize smolt production and optimize adult returns. This talk will explore these physiological tools, their previous use in hatchery studies, and how they are being applied to study continuous exercise in these new rearing environments and the physiological effects on juvenile salmonids.

Dina Spangenberg, dina.spangenberg@noaa.gov

2:20 PM

Developing methods to Improve the homing fidelity of hatchery-reared salmon

Salmon are well known for their ability to home to their natal streams to reproduce. Juvenile salmon imprint on the olfactory signatures of their rearing water and later use this information to home back to their natal site as adults. Here, we describe studies to improve homing by Chinook salmon released from the Elk River Hatchery (ERH), Oregon, USA. A large percentage of these fish do not return to the hatchery but rather spawn in the river, thereby impacting the threatened, wild population. One hypothesis for the poor hatchery homing fidelity is that water released from the hatchery may not provide a unique olfactory signature for returning adults to distinguish it from the Elk River water utilized for rearing. We are exploring methods to create a unique odor signature by adding chemicals to hatchery water at key imprinting periods to improve successful imprinting and homing. Here, we present results determining the profile of odorants in the water entering and exiting the hatchery to determine whether the hatchery environment altered the chemical signature of river water. We then identified candidate odors that salmon can detect and learn that could be used to alter the odor signature. Finally, using physiological indicators of smolting and olfactory function, we deter-

mined developmentally sensitive windows for imprinting to establish the appropriate timing for exposing salmon to added chemicals. Based on these results, we have initiated a multi-year study of homing fidelity in salmon exposed to our unique chemical signature or control hatchery water.

Andrew Dittman, andy.dittman@noaa.gov

2:40 PM

A review of Chinook (Oncorhynchus tshawytscha) and Coho Salmon (Oncorhynchus kisutch) hatchery release practices in British Columbia

Salmon hatcheries are management tools intended to stabilize declining abundance in salmon populations and sustain fisheries. The practices hatcheries employ for rearing and releasing fish are critical to their effectiveness. While a body of literature is growing on hatchery practices, data quantity and quality vary considerably among hatcheries, making it difficult to assess the role of release practices in influencing juvenile-to-adult survival beyond individual experiments. Using a Bayesian hierarchical approach, we analyzed releases and recoveries of Chinook Salmon (Oncorhynchus tshawytscha; 21 hatcheries) and Coho Salmon (Oncorhynchus kisutch; 16 hatcheries) in British Columbia from 1972 to 2017. Higher survival rates were associated with increasing weights-at-release, earlier releases of Chinook Salmon, and later releases of Coho Salmon. The addition of environmental (sea surface temperature, Pacific Decadal Oscillation), and predator (harbour seals, killer whales) covariates did not improve model performance relative to models that used year effects to account for declines in survival and interannual variability in ocean conditions. Depending on the hatchery, optimizing release practices could increase returns by 6%–245% for Chinook Salmon and 5%–160% for Coho Salmon. Using hatchery-specific models, we also analysed return ages of Chinook Salmon (4 hatcheries) and Coho Salmon (7 hatcheries). The effects of release practices on return ages were limited; weight-at-release effects were mixed and day-of-release had no effect. Marine releases at one location yielded younger returns than their hatchery-released counterparts. These results can inform future hatchery practices and guide evaluations of cost-benefit trade-offs of hatchery optimization.

Sam James, sjames@psf.ca

3:00 PM

How does varying age at maturation in hatchery fall Chinook affect evaluation of hatchery releases?

Hatchery releases are commonly assessed by SAR: fish recovered / fish released. This metric assumes all fish released are smolts and all adults recovered are of equal value. CWT recoveries were used to evaluate an experiment on different juvenile rearing strategies for yearling interior Col R fall Chinook salmon. These fish differed in size at release and the experiment was replicated across four year. Pre-release surveys found varying numbers of maturing males (age 2 minijacks) among the smolts being released (5 – 35 %). Assessments of recovery may be biased if differences in recoveries are incorrectly related to differences in post-release survival rather than differences in maturation schedule. Accounting for minijacks within release groups reduced differences in recoveries between treatments and generalized perceptions of survival between these same release groups. Age of recovered fish varied from 2 to 6 years post-release, with size of the fish recovered varying by over an order of magnitude. We split recoveries into two age categories: young/small (age 2 and 3) and old/large (age 4 – 6). By splitting recoveries by age we were able to demonstrate that there was a greater recovery of old/large fish from smaller smolts at release than from bigger smolts. Differences in size at recovery directly relate to both fish value (weight) and brood stock contribution (# eggs). The experiment itself demonstrates that hatchery programs may alter the age composition of fish recovered by altering juvenile rearing strategies. This finding has implications for hatchery rearing strategies.

Brian Beckman, brian.beckman@noaa.gov

3:40 PM - Panel Discussion

At the 2024 WA-BC and Idaho Chapters joint AFS meeting we are initiating what we hope to be an on-going conversation surrounding the topic of hatchery evaluations. To stimulate this process we've invited from various regions and organizations to address: methods and analysis provide the most reliable and actionable information for hatchery evaluations, what topics lack reliable analytical tools and approaches, and how differences in species and/or regions interact to provide different answers about hatchery effectiveness. By comparing responses from the interior and lower Columbia River Basin, the Salish Sea and the BC/WA/OR coast we hope to gain perspective and insights into general issues, identify areas of consensus, and recognize novel approaches. We expect that discussion within and following the panel will provide guidance into the organization of the 2025 meeting and provide the foundation for our hatchery evaluations working group.

PANELISTS

Bill Bosch
Maureen Hess
Rod Engle
Sam James

MODERATORS

Brian Beckman & Phil Sandstrom


Josh Williams, WDFW

Thursday, 8:00 AM

Can reducing smolt size help adult returns? Comparing rearing strategies for a Chinook salmon hatchery program

From previous work we determined that the Deschutes stock of spring Chinook salmon reared at the Round Butte/Pelton Ladder complex on the Deschutes River, Oregon were relatively large throughout the rearing process, had relatively high rates of precocious male maturation (age-2 minijacks), and had high rates of fish returning as age-3 jacks. Along with hatchery managers, we designed an experiment to assess if rearing fish at half the size but about twice the abundance would affect smolt quality, adult return rates, and age structure of returning adults. Two treatment groups ("big" vs. "small") were produced over five consecutive release years. The "big" treatment was raised to a smolt release size of ~8 fish/lb with a density of 80K fish/raceway (low abundance) while the "small" treatment was raised to a smolt release size of ~15 fish/lb with a density of 150K fish/raceway (high abundance). Smolt quality (i.e. gill ATPase, lipid levels, condition factor) was similar for big and small treatments. However, rearing more fish to a smaller body size reduced the rate of early male maturation by 50%. Based on PIT tag detections, big and small treatments had similar age-3 returns but the small treatment produced ~30% more age-4 returns. Neither treatment group produced age-5 fish. Overall, the mean age at return was 2.85 years for the big and 3.13 years for the small treatments. This research provides insights into how changing rearing protocols could help optimize production and improve adult returns.

Deborah Harstad*, Dina Spangenberg, Don Larsen, Ryan Gerstenberger, Shaun Montgomery, Ryan Moon, Brian Beckman
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8:20 AM

Biotic and abiotic factors affecting adult survival of Snake River hatchery fall Chinook salmon

The recovery of Snake River fall Chinook salmon over the past 30 years resulted in significant increases in adult abundance and spawner distribution throughout the basin. Although other restoration actions were implemented and contributed to the recovery, hatchery supplementation likely played a major role. The development and implementation of hatchery supplementation strategies was coordinated through the efforts of multiple Federal, State and Tribal agencies. The focus of this study was to document the efficacy of rearing and release strategies of the hatchery program by investigating factors affecting adult survival as measured by smolt-to-adult survival (SAR). We applied a binomial distribution and a mixed effect logistic model with multiple biotic and abiotic covariates for release years 2001 to 2018. Significant differences in SAR correlated to release site and subyearling verse yearling release stage, with increased adult returns for yearling juveniles released from sites lower in the basin. In addition, lower among-basin verses within-basin correlations of SAR indicated asynchrony in survival across basin that reduced annual variability in adult returns and provided a buffer against environmental stochasticity or variable hatchery survival effects. Thus, the development of a structurally diverse hatchery supplementation program with multiple release groups dispersed across time and space created a diverse portfolio of groups that lowered annual variability and maintained consistent returns over time. These results will inform ongoing adaptive management of the hatchery program and provide a baseline for tracking future changes resulting from climate change or other unseen impacts.

William Young and Ryan Kinzer
billy@nezperce.org

8:40 AM

PBT and PIT tags: Lyons Ferry Hatchery M&E of Snake River Fall Chinook

The Snake River fall Chinook (FCH) program at Lyons Ferry Hatchery (LFH) and Nez Perce Tribal Hatchery (NPTH) have historically relied on Coded Wire Tags (CWTs) for broodstock origin determinations and run reconstruction efforts. A transition towards using

a PBT approach began in 2011 in order to validate estimates generated from CWT and since 2016 all hatchery broodstock have been sampled for PBT. The LFH and NPTH programs include acclimation facilities upstream of Lower Granite Dam (LGR) and LGR has become the broodstock collection and sampling location for Snake River fall Chinook. The utility of PBT in run reconstruction efforts was demonstrated in 2022. Earlier returns in RY 2022 led to a non-representative sub-sample of CWTs and a CWT based run reconstruction model yielding a negative number for natural origin fish. Since PBT samples were collected throughout the run, PBT run reconstruction efforts produced results more consistent with PIT estimates; ultimately, leading to the decision for PBT based run-reconstruction going forward. Additionally, PBT samples were collected from all broodstock collected at LGR and PIT Tags applied to track individuals through the holding and spawning process. Data gathered yielded valuable information about trapping and hauling operations, run timing of individual release groups, brood composition, and spawning practices. Future goals are to obtain PBT assignment prior to spawning to optimize natural origin brood usage, tracking family groups for brood composition, and differentially PBT marked groups for research needs.

Michael Herr, michael.herr@dfw.wa.gov

9:00 AM

Relative post-release performance of Rainbow Trout fry stocked at two target lengths in alpine lakes of Idaho

Fisheries managers often stock Rainbow Trout to establish or supplement fish populations in alpine lakes. In Idaho, there is substantial variability across alpine lakes regarding the proportion of hatchery- and wild-origin fish sampled during routine surveys. Consequently, it may be possible to manipulate rearing and release strategies for fish stocked in alpine lakes to increase abundance of hatchery-origin fish, and ultimately, improve angler satisfaction and catch. The Idaho Department of Fish and Game typically stocks Rainbow Trout fry in alpine lakes from fixed-wing aircraft at a target total length of about 35 mm. Stocking fish at a larger size would increase flight costs due to logistics associated with transporting larger fish, but could improve post-release growth and survival. We sampled 26 lakes stocked with Rainbow Trout of a target release size of 35 mm, and 29 lakes with fish stocked at a target 55 mm release size. Lakes were sampled three years post-stocking for both study groups via gillnet so size and catch could be compared. Mean total length at the time of sampling was 320 mm for fish stocked at the 35 mm target length and 315 mm for fish stocked at the 55 mm target length. Differences in catch are currently being investigated based on release size and numerous environmental characteristics of sampled water bodies. Results from this study will inform decisions regarding the future stocking strategies used for managing alpine lakes in Idaho.

Will Lubenau, will.lubenau@idfg.idaho.gov

9:20 AM

Mobile spontaneous autopolyploidy testing for determining and removing 12n hatchery kootenai river white sturgeon

Kootenai River White sturgeon (KRWS) Acipenser transmontanus, are tested for Spontaneous Autopolyploidy (SA) in a controlled lab setting. Kootenai Tribe of Idaho uses a Z2 Coulter Particle Counter and size Analyzers to analyze SA. Equal blood to buffer solution ratios are analyzed; consistent with normal protocols developed in collaboration with University of California-Davis. Briefly, the Analyzer is equipped with a 100-micron aperture with an upper threshold at 9 µ and lower threshold at 3 µ, with channelizers set to observe sizes between 3.695 µ and 6.664 µ (i.e., white sturgeon red blood cell nuclei). Specimens with readings <5µ are considered 8N and those with readings ≥5µ are categorized as 12N. The purpose of the study was to develop methods to test juvenile fish for SA in the field; and acquire real time results to facilitate removal of 12N Hatchery fish. KTOI staff tested 413 samples at three unique testing sites River Bank, Hatchery Dock and Hotel Room. I will briefly explain benefits and challenges of using the Z2 in the field, results, and plans for future operations and strategies moving forward. The KTOI recognized the need to start the removal process and is taking the initiative to get the program started with the overall health of the entire population being the main focus of our efforts. We will also be utilizing the culled specimens for scientific research purposes and environmental growth and developmental factors.

Mark E. Elliston JR.*, Brian R. Michaels JR, Nathan R. Jensen
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10:00 AM

Initial Results from a Chinook Mass Marking Pilot: Broodstock Management and Mark Selective Fisheries

The Sarita River Chinook salmon population is one of Canada's first enhanced Chinook programs to undergo mass marking (MM). The MM component, initiated in 2018, was primarily aimed at facilitating hatchery genetic management; more specifically, to increase the proportion of natural-origin broodstock (pNOB) and decrease the proportion of hatchery-origin spawners (pHOS), ultimately enhancing the population's productivity and fitness (as measured by the proportionate natural influence (PNI) metric). As part of the 2018 program overhaul, the All-H-Analyzer (AHA) model was employed to evaluate the expected outcomes of MM on PNI and harvest potential, while concurrently varying other parameters such as production size and habitat productivity and capacity. Multiple AHA scenarios were created in collaboration with First Nations and other DFO sectors, with the goal of landing on a program that optimized both biological goals and user group interests. This presentation discusses the initial results of the program, its effectiveness in implementing management levers, and the comprehensive, integrated program review. Moreover, we highlight that the model appears be particularly suitable for small to medium Chinook systems with low to moderate enhancement levels and systems with terminal mark selective fishing opportunities.

Michael Thom, michael.thom@dfo-mpo.gc.ca

10:20 AM

Use of feed rings in reduction of waste of feeding events

Feed training is a crucial period of development, and intensive feeding intervals are required in this stage. However, more stressful is estimating the appropriate amounts of feed to balance the growth of the fish with waste reduction that plagues these few days. Excess feed waste causes multiple problems such as increased ammonia levels and financial loss due to rising feed costs. The idea of experimenting with feed rings came while visiting family and seeing the use of one in a fish pond. The intention of a feed ring is to reduce feed waste by increasing the time the feed is available before floating or sinking out of the normal range where fish eat. The setup will consist of 4 individual tanks: two will have two feed rings while the other two will be used as controls. Results will be determined by weight gained compared to feed amounts set based on body weight percentages. The expected outcome of this experiment is that if juvenile rainbow trout have longer to eat the feed before it passes, growth rates will increase while feed waste is reduced.

Caleb Barclay, kbarclay1@csi.edu

10:40 AM

Evaluation of fall Chinook subyearling and yearling release strategies in Hood Canal

Hatchery program performance is often assessed as the total number of adults returning for given species. We delve into the release strategies of fall Chinook Salmon used at the Hoodsport Hatchery located in Hoodsport, WA by examining coded wire tag data (CWT). Release strategies, such as date, fish size, and methodology (volitional/forced) can all affect the success of a program. Hoodsport Hatchery utilizes two release strategies for Chinook Salmon (Oncorhynchus tshawytscha), yearling and subyearling. CWT data on releases and recoveries pulled from RMIS (Regional Mark Information Systems) were used to evaluate both strategies utilized for fall Chinook for ten years. Groups of approximately 200,000 subyearling and 100,000 yearling CWT-tagged Chinook were released annually for brood years 2007-2017. We evaluated differences in SARs (smolt-to-adult return ratio), age structure, fork lengths, sex ratios, fisheries contributions, disease issues, spawning ground recoveries, and costs associated with each strategy. We also determined the impacts of mini jacks (age 2) returning Chinook have on these programs. Both strategies can be successful in the right application; however preliminary results from this study suggest that the subyearling strategy produces a higher number of returning adult with an older age distribution.. We hope this analysis will help to inform fisheries management in this specific location to ensure the success of the fall Chinook program.

Devin West, Devin.West@dfw.wa.gov

11:00 AM

Evaluation of alternative approaches to hatchery propagation of steelhead to minimize fitness loss.

Conservation hatchery programs support efforts to recover ESA-listed steelhead populations in many regions of the Pacific Northwest. But, traditional rearing and release practices constrain the natural life-history diversity steelhead and compromise migratory success, maturation schedules and reproductive success. In 2008, the USFWS Winthrop National Fish Hatchery implemented a conservation program for summer steelhead in the Methow River using natural-origin broodstock. To maximize smolt quality the program reared juveniles for release at age-2 (S2), to accommodate later spawn timing and colder water temperatures at the hatchery in contrast to the more common practice of producing age-1 smolts (S1). Hatchery- and laboratory-scale experiments comparing five paired (S1 and S2) releases of steelhead raised to smolt resulted in significant effects of release age on juvenile outmigration survival and travel rate, carryover effects of smolt age on ocean survival, and survival during the adult migration back to the Methow River. Smolt age and sex affected the residualism rate and demographic composition of the residual population. Age-at release also resulted in sex-specific differences in the reproductive success of adults returning to the Methow River. We determined that rearing hatchery steelhead to a fixed age of 1 or 2 years did not optimize the production of smolts when using natural-origin broodstock and that there are tradeoffs between the two approaches. Because outcomes appear attributable to variability in juvenile growth rate, hatchery steelhead may benefit from a split-age rearing approach that mimics the phenomenon of cohort splitting (e.g., variable age-at-smoltification) in natural steelhead populations.

Christopher Tatara*, Barry Berejikian, Don Larsen, Matt Cooper, Mollie Middleton, Penny Swanson
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11:20 AM

Age at release affects developmental physiology and sex-specific phenotypic diversity of hatchery steelhead trout (Oncorhynchus mykiss)

Most steelhead hatcheries release yearling smolts by increasing growth during rearing to maximize harvest opportunity, but natural steelhead exhibit variable age of smoltification, so traditional rearing practices reduce life history diversity required for programs focused on recovery of imperiled wild stocks; thus, it's important to investigate alternative rearing methods that can conserve important life history traits. Over five years, the Winthrop National Fish Hatchery on the Methow River, WA evaluated release of paired groups of steelhead raised to smolt at either one (S1) or two (S2) years of age. To understand rearing effects on developmental ontogeny and life-history, fish were sampled prior to release for smolt associated factors (size, gill Na+/K+ ATPase activity, visual smolt index) and a suite of reproductive metrics (sex, pituitary and testis mRNA transcripts, gonadosomatic index, and plasma 11-ketotestosterone). Our objectives were to quantify levels of smoltification and male maturation, estimate residualism (failure to migrate), and compare the treatments by sex. Overall, S2 rearing produced 7.8% more smolts and 44-fold (4.4 vs. 0.1%) more precociously mature males, but S1 rearing produced 31.6% more residuals. While total male residualism was comparable between treatments, S1 rearing produced five-fold more female residuals (20.6 vs. 4.2%). Because residuals contribute minimally to adult returns and the number of returning adult females is critical to supplementation success, developing strategies that maximize migration in females is essential. Physiological assessments are useful for assessing the effects hatchery rearing regimes have on steelhead life-history, and can provide sex-specific guidance for optimizing hatchery supplementation programs.

Don A. Larsen, Mollie Middleton, Christopher Tatara, Barry Berejikian, Chris Pasley, Jon Dickey, Penny Swanson
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Science and Infrastructure modifications for fish passage at mainstem dams: How much has changed?

Moderators: Rebekah Horn and Marika Dobos

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Thursday, May 2, 8:00 AM to 9:40 AM

Symposium Abstract

Passage in both directions through or around a dam is essential for anadromous fish to complete their outmigration to the ocean as juveniles and their return spawning migration as adults. Without fish passage at dams, anadromous fish lose access to critical habitats which can have detrimental effects on population viability. Many different technologies exist for passing fish around or through dams as passage must be tailored to the type of dam, surrounding environment, life history stage, and fish species (e.g., salmonids versus lamprey). Innovative ideas and technological advancements are providing improvements for the passage of fish by mainstem river dams. This symposium will cover how fish passage has changed through time and what improvements are being made to make the passage through and around dams safer and more efficient for fish species.

8:00 AM

Design and Biological Testing of Two New Hydroturbines Installed at Ice Harbor Dam

In 2010, the US Army Corps of Engineers began a design effort to replace aging hydroturbines at Ice Harbor Dam on the lower Snake River, Washington, with a goal of improving fish passage. Fixed- and adjustable-blade (Kaplan) runner types, stay vanes, wicket gates, and draft tube dimensions were re-designed through an iterative process using state-of-the-art Computational Fluid Dynamics and physical models. Both prototypes were installed, and fish passage evaluated with hatchery-reared juvenile spring Chinook salmon via direct release/recapture injury and survival studies. The original Kaplan unit was studied in 2007 at five operating points (lower 1% efficiency, peak efficiency, upper-mid 1% efficiency, upper 1% efficiency, generator limit). Mean malady-free and 48-hour survival estimates for the original Kaplan were 96.2% and 95.3%, respectively. The new fixed-blade runner was installed in unit 2 and tested at three operating points in 2019 (lower 1% efficiency, peak efficiency, generator limit), resulting in mean malady-free and 48-hour survival estimates of 98.5% and 98.2%, respectively. The new Kaplan runner was installed in unit 3 and tested at four operating points in 2023 (lower 1% efficiency, peak efficiency, upper-mid 1% efficiency, generator limit), resulting in mean preliminary malady-free and 48-hour survival estimates of 97.3% and 96.9%, respectively. Mean survival for the newly-designed hydroturbines was approximately 3% higher than the original Kaplan units, while injury rates were approximately 60% lower for the fixed-blade and 30% lower for the Kaplan runner. Overall, the design process successfully estimated and delivered improvements in hydroturbine fish passage at Ice Harbor Dam.

Bradly A. Trumbo, Jon F. Renholds, Karl Anderson, Cory Hoffman, Ashley Picker
bradly.a.trumbo@usace.army.mil

8:20 AM

Restoration elements of the Klamath River renewal project (i.E. Lower Klamath project)

Removal of four hydropower dams (Iron Gate, Copco 1, Copco 2, and J.C. Boyle) on the Klamath River in northern California and southern Oregon represents the largest dam removal and river restoration project in the country. The project will restore free-flowing conditions and volitional fish passage to more than 400 miles of currently cut-off anadromous fish habitat upstream of the lower-most dam, Iron Gate. RES was selected by the Klamath River Renewal Corporation to lead restoration for this ambitious effort, as well as accept liability associated with ensuring

restoration meets ecological and biological performance standards and long-term goals/objectives. RES is leading design and implementation efforts for the restoration of nearly four miles of priority tributary streams and associated fish habitat, as well as vegetation restoration for approximately 2,000 acres of previously inundated lands. Restoring volitional fish passage to hundreds of miles of the Klamath River, once the third largest producer of salmon on the West Coast, will be an important achievement for this large, complex project. Area Tribes have relied on salmon as a vital resource for generations; rehabilitation of salmon and steelhead populations is not only environmentally important but critical to sustaining their culture. RES will rely on native seed propagation for revegetation of upland, riparian, and wetland habitats, and large wood placement to stabilize sediments and improve habitat for native fish and increase river and tributary functionality. This presentation provides an update on the active project, an overview of restoration goals and approach, and key elements of stream, riparian, and wetland restoration for the project.

Daniel Chase, Gwen Santos, Dave Coffman
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9:00 AM

The More, the Merrier: Using Adult Pacific Lamprey Translocations to Increase Passage Rates at Wells Dam, Columbia River

Wells Dam is the last hydropower project on the Columbia River with upstream fish passage facilities for Pacific Lamprey. Previous studies showed that lamprey were able to successfully navigate the fishway, although at low rates. Since 2013, several modifications have been made to the fishways with the goal of improving adult Pacific Lamprey passage. However, evaluation of the effectiveness of these modifications has been hampered by low numbers of adult lamprey approaching and interacting with Wells Dam. Since 2006, Pacific Lamprey larval abundance in the Methow River greatly decreased and they were functionally extirpated from the Okanogan Basin. In 2018, Douglas PUD, in coordination with a team of agencies and tribes, began translocating adult Pacific Lamprey above Wells Dam, with the hypothesis that olfactory/pheromone cues produced by juvenile lamprey are key to upstream motivation of adults and these pheromones may have declined thereby reducing adult passage at Wells Dam. Results from a 2022 – 2023 passage study showed that adult lamprey released downstream of the dam were more likely to interact with Wells Dam than previous studies but only 30.5% of all study fish entered the fishway. Of those that entered the fishway, 95.5% - 100% successfully passed the dam. Additionally, counts of lamprey have shown an increase in passage numbers at Wells Dam. These results indicate that adult translocation has potentially increased Pacific Lamprey passage at Wells Dam, but further studies are needed to evaluate lamprey passage efficiency and identify potential ladder entrance mechanisms (biological/physical) to improve lamprey passage.

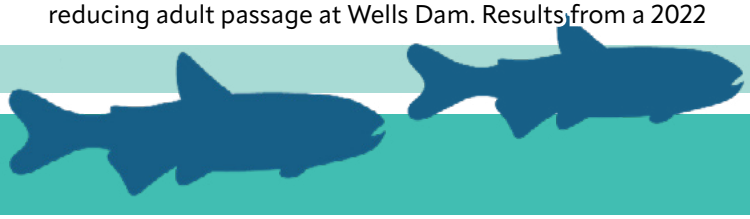
Mariah Mayfield, John Rohrback, Dave Robichaud
mariah.mayfield@dcpud.org

9:20 AM

Native fishes and the Hells Canyon Complex Relicensing

The Hells Canyon Complex is a series of three dams owned and operated by Idaho Power Company. These three dams - Brownlee, Oxbow, and Hells Canyon - are located in west-central Idaho and northeastern Oregon, along more than 95 river miles of the Snake River. These dams were originally licensed for hydropower production in 1955; however, their license expired in 2005. Idaho Power Company has continued to operate these three dams as the Federal Energy Regulatory Commission (FERC) works through the relicensing process, a process that has taken nearly 20 years to complete. Under the Federal Power Act, the U.S. Fish and Wildlife Service (Service) has the authority to provide recommendations and requirements for the new license that pertain to fish and wildlife species protection and conservation. The Service has made recommendations to FERC to improve habitat conditions for bull trout, a listed species under the Endangered Species Act, and to develop and implement a native fish management plan within the Hells Canyon Complex. The Service has also required upstream and downstream passage for bull trout at the Hells Canyon Dam and eventually the Oxbow Dam. The Service continues to work closely with federal partners, Tribes, and Idaho Power Company to relicense this series of dams while also balancing the needs of native species within the area.

Erin Kenison, erin_kenison@fws.gov



Kokanee Population Dynamics and Management

Moderator: Timothy D'Amico and Art Butts

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Tuesday, April 30, 3:40 PM to 5:20 PM

Symposium Abstract

Kokanee salmon Oncorhynchus nerka are landlocked life-history variants of Sockeye Salmon and can be found throughout the western United States and Canada. Fisheries managers may focus on kokanee for a number of reasons, including providing angling opportunities, forage base for piscivores, or broodstock collection; and kokanee populations often function to meet multiple objectives. Due to population demographic effects, including relatively short lifespan and density dependent factors, kokanee management can often prove difficult for fisheries managers. This symposium seeks to provide an opportunity for fisheries managers across Idaho, Washington and British Columbia to share kokanee management successes, frustrations, and collaboration to improve kokanee management tools and techniques.

3:40 PM

Deadwood Reservoir: Managing a kokanee fishery for multiple objectives

Deadwood Reservoir is a 1,260 ha impoundment located on the Deadwood River in Valley County, approximately 40 km southeast of Cascade, Idaho and 85 km northeast of Boise, Idaho. Deadwood reservoir offers a scenic setting at a relatively high elevation (1,615 m above sea level), and is a popular destination during summer. Deadwood Reservoir provides abundant sport fishing opportunities for kokanee Oncorhynchus nerka, resident fall Chinook Salmon Oncorhynchus tshawytscha, Rainbow Trout Oncorhynchus mykiss, and Westslope Cutthroat Trout Oncorhynchus clarkii lewisi. Bull Trout Salvelinus confluentus are present, but at a very low abundance. Historically, the kokanee population has exhibited density dependence, and Idaho Department of Fish and Game (IDFG) has implemented several management actions to improve size and growth of kokanee, including installing a weir and culling spawners to chemical treatments of spawning tributaries. Since 1985, the kokanee population has served as Idaho's primary egg source early spawning kokanee. Typically, this population has provided between two to three million eggs IDFG hatcheries annually. Since 2017, IDFG has struggled to meet egg-take objectives due to low returns of spawning adults and by 2021, managers have observed record low gill net catches and confoundingly small mature fish (<250 mm). In 2023, fishery managers began a series of investigations to evaluate potential abiotic and biotic factors that may have influenced the collapse of the kokanee population. Preliminary findings from these investigations are presented here to promote thoughtful discussion and further evaluation and analysis.

Timothy D'Amico, timothy.damico@idfg.idaho.gov

4:00 PM

A Razors Edge: The Balance of Predator and Prey in Lake Pend Oreille

Historically, Lake Pend Oreille provided the largest sport fishery for Kokanee in Idaho. From 1952 until 1966, it produced an estimated angler harvest that averaged over 1 million Kokanee annually. As a result of this type of production, the Lake also produced the state record Rainbow Trout and Bull Trout. By the mid-1970s, the amount of Kokanee that could be produced in the Lake was significantly reduced by competition with mysis shrimp and the exponential increase in Lake Trout by the mid-1990s. These

two threats nearly collapsed the Kokanee population by the early 2000s. Following a targeted Lake trout suppression effort starting in 2006, IDFG removed over 260K Lake Trout and has seen the outstanding recovery of the kokanee population. This facilitated the return of the world class Rainbow Trout fishery and improved adult Bull Trout survival. Emerging threats to maintaining the balance of these incompatible predators with the adequate amount of Kokanee for fisheries is truly an adaptive management endeavor with fish and anglers alike.

Ryan Hardy, ryan.hardy@idfg.idaho.gov

4:20 PM

Kokanee population trends in an eastern Idaho reservoir

In Ririe Reservoir in eastern Idaho, kokanee Oncorhynchus nerka are a popular sportfish for anglers to catch and harvest. Ririe Reservoir supports higher fish harvest rates by anglers than any other large fishery in the Upper Snake Region. In a creel survey conducted in 2019, 53% of anglers reported that they harvested fish they caught in the reservoir. Spawning habitat for kokanee is limited and the fishery is dependent on hatchery-origin kokanee fingerlings to support the fishery. Annual gill net surveys have occurred in Ririe Reservoir since 2015 to evaluate the population and to forecast to anglers the health of the fishery. Monitoring consists of setting gill nets in the thermocline in June once the reservoir is stratified at ten standardized sites throughout the reservoir. The average CPUE (number of kokanee/net night) prior to 2023 is 61.2 kokanee/net night. Following several years of drought and low reservoir storage, the kokanee population has reached an all-time low abundance of 8.6 kokanee/net night with missing age classes and few adult fish. In addition to changing environmental conditions, illegally introduced Walleye Sander vitreus have experienced a population expansion during the same timeline as the kokanee decline. Stomach contents of Walleye indicated that kokanee are a choice prey source and were identified in 91% of Walleye stomachs that contained identifiable fish species. Increasing kokanee abundance includes strategies involving Walleye management, such as population suppression, encouraging angler harvest to limit Walleye abundance, and conducting a bioenergetics study on Walleye to quantify predation impacts on kokanee.

John Heckel, john.heckel@idfg.idaho.gov

4:40 PM

Improving the growth of kokanee using nitrogen addition: a case study of Dworshak Reservoir.

Kokanee are a keystone species in many lakes and reservoirs of the Western United States and Canada,providing both angling opportunity and an important prey resource for trophy species. Dworshak Reservoir is an impoundment on the North Fork Clearwater River, Idaho. Nitrogen additions were started in 2007 to counteract oligotrophication and improve the size and abundance of kokanee. As a result of a more efficient foodweb, the biomass of Daphnia, a preferred prey of kokanee, doubled given the abundance of kokanee. Daphnia biomass was found to be the primary factor influencing growth of age-1 and older kokanee. As a result of nitrogen addition, we observed a 31% increase in the mean weight of age-2 kokanee and 55% increase in kokanee biomass. Therefore, carefully designed nitrogen addition can be an effective tool to mitigate declining productivity in nitrogen limited systems.

Sean Wilson, sean.wilson@idfg.idaho.gov

5:00 PM - Discussion

Group discussion focusing on range-wide declines in early-run kokanee populations.

Integration of Physiology and Genetics in Aquatic Resource Conservation

Moderator: Michael Phelps

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Tuesday, April 30, 3:40 PM to 5:20 PM

Symposium Abstract

Aquatic organisms in the Pacific Northwest face a growing list of challenges that may impact their future productivity. How these aquatic organisms adapt to these challenges will be determined by their physiology and underlying genetics. It is therefore critical to understand the physiology and molecular biology of aquatic organisms as a window into the inner workings of species, to help guide resource management and conservation efforts. New technologies are facilitating advances in both the physiology and genetics fields and combining these research areas holds great potential to understand aquatic organisms to a level not previously possible. This symposium will highlight the groundbreaking research being conducted in both the physiology and genetics fields that is aimed at understanding fundamental biological mechanisms in aquatic species. The topics will help begin to integrate our understanding of aquatic life spanning the organismal to the molecular level for a more complete picture of essential aquatic organisms in the Pacific Northwest.

3:40 PM

Influence of egg size and parental genetics on the metabolic rate of Chinook and pink salmon embryos

Embryonic development has been shown to influence the overall fitness of the offspring later in life. Surviving embryos help define the genetic diversity of the stock while also providing some level of genetic and epigenetic selection for local environmental conditions. In Pacific salmon, the size of the egg provides valuable yolk deposition for the developing embryo, and the metabolic rate of the embryo plays an important function in the embryonic fitness. To better understand the influence of genetic background on early larval fitness of Pacific salmon, egg size and metabolism were examined for developing Chinook (Oncorhyncus tshawytcha) and Pink Salmon (Oncorhyncus gorbuscha) embryos. Interactions between egg size and oxygen consumption (MO2) were recorded throughout embryonic development and it was determined that egg size was not a reliable predictor of oxygen consumption (MO2) in either salmon species. Average oxygen consumption differed based on parent, suggesting there may be some genetic role which can explain variation in metabolic rates in the embryos. Lastly, hatchery-origin Chinook Salmon had on average larger eggs than their wild counterparts suggesting divergence in evolution of egg sizes based on rearing environments.

Alexander "Tad" Iritani, alexander.iritani@gmail.com

Josh Williams, WDFW

4:00 PM

Managing Smoltification for Improved Outcomes for Anadromous Fish

Any aquatic organism transitioning between life in freshwater to saltwater must address divergent osmoregulatory challenges in these environments to maintain or quickly reinstate homeostasis. Survival following the transition from freshwater to saltwater necessitates a reversal in the functioning of osmoregulatory organs/tissues, such as the gills, gut, and kidney. Among salmonids, these physiological changes are accompanied by morphological and behavioral changes that collectively define a transformation known as "smoltification". Although smoltification is primarily associated with changes in osmoregulatory function, it is also a critical life history waypoint for anadromous salmonids with links to outmigration timing, predation risk, maturation, and adult returns. This presentation will review the physiology of smoltification—what happens, when, and how—and provide insights from recent research involving managed smoltification and post-release performance of hatchery-origin smolts.

Jesse Trushenski, jesse.trushenski@stim.no

4:20 PM

Analysis of changing gene expression across semelparous migration illuminate phenotypes driving end of life histories in Pink salmon gorbuscha

Pacific salmon undertake an incredible journey upriver to natal spawning grounds, where after rigorous competition for reproductive opportunities, they systematically expire, leaving energy-packed bodies to decompose enriching local ecology. Along this journey, their body transitions to adapt to stressors along the way. Notably, salmon encounter extrinsic factors like salinity and temperature changes, elevated pathogen load, or aggression from males, and intrinsic factors such as depleting energy reserves, hypercorticotropism, or ramping sexual maturation. To track these continuous changes that often generate cryptic phenotypes, we extracted tissue transcriptomics at three distinct migratory timepoints of a pink salmon migration natal to the Skykomish river watershed: ocean phase, river phase, and spawning phase. Specifically, by targeting muscle, head kidney, and gonads (testes), we aim to examine endocrine regulation as a key driver in the body changes that result in the coordinated physiological response salmon leverage during a semelparous migration.
Using differential gene expression of the entire transcriptome in sequential order across the timepoints, we generated a matrix of relative expression and classified them into 9 groups (40,756 genes). Next, we ran a Gene Ontology enrichment on each group to identify biological processes that change within each tissue, elucidating molecular mechanisms behind shared or cryptic phenotypes driving tissue activity. At large, we found a significant proportion of genes change in relative expression between the river and spawn, zero significant change from ocean to river, and delved into phenotypes that emerge later during migration leading into peak sexual maturation.

Max Butensky, max.butensky@wsu.edu

4:40 PM

Predicting the likelihood of gas bubble trauma in fishes exposed to elevated total dissolved gas in the lower Clark Fork River, Idaho

Gas bubble trauma (GBT) can occur in fish when water becomes supersaturated with gases, with effects ranging from minor tissue damage to death. Laboratory studies suggest that fish exposure to elevated total dissolved gas (TDG) at depths that compensate for gas supersaturation can result in reduced GBT incidence and that different fish species exhibit varying susceptibility to GBT. Elevated TDG levels associated with spill at Cabinet Gorge Dam in the lower Clark Fork River, Idaho, facilitated describing the incidence and severity of GBT, variables that affect GBT incidence, and the probability of observing GBT in different fish species. Total dissolved gas and GBT data were collected during the typical spill period (i.e., April–July) during eight years. A total of 6985 fish was examined for GBT at TDG of 101–137% saturation.

Incidences of GBT varied with TDG levels, and the greatest incidence of GBT was typically observed near the date with peak daily mean TDG. Logistic regression models indicated that the probability of observing GBT was affected by TDG exposure, temperature, and species, but not length. We suggest that species-specific behavior and habitat composition in the sampled area were factors in our observations. We advocate that fisheries managers use a similar process to develop site- and species-specific GBT probability curves where elevated TDG is an issue. These site-specific curves can help managers evaluate the potential for population-level effects to fisheries and need for TDG reduction or mitigation actions.

Paul Kusnierz, paul.kusnierz@avistacorp.com

5:00 PM

Sex Reversal of Brown Trout Exposed to Differing Estradiol Treatments

Brown Trout are considered one of the 100 worst invasive species worldwide, and manual suppression efforts are difficult and often ineffective. The species thus represents a good prospect for employment of the YY Male approach. During November 2019, a sex reversal trial using Estradiol-17β (E2) on swim-up Brown Trout was initiated at the Colorado Fish Research Hatchery (COFRH), Bellvue, Colorado. Fish were fed E2 top-coated feed at 20 mg/kg for either 30 or 60 days, beginning at first feeding. At 355 DPH, the sex ratio in the Control group was 48.5% female, virtually identical to that in the 30 d exposure group (50%), while the 60 d exposure group was 74.3% female, a statistically significant difference versus Controls. A follow-up trial was initiated at COFRH in Fall 2020 with the primary intent of improving observed female proportions and reducing intersex frequency by increasing E2 exposure duration. Based on input from Novaeel Inc. we also evaluated whether a lower E2 dosage (10mg/kg), when combined with longer treatment duration, would improve female proportions, and thus be more acceptable in the FDA approval process. In the 2020 trials, the longest duration exposure (120 days) at both 20 and 30mg/kg E2 resulted in the highest ratios of phenotypic females (96.5 - 93.5% respectively) along with the lowest proportions of intersex fish. Given the high feminization rates observed in 2020, along with the successful sex marker development, Brown Trout are perhaps the next candidate for YY Male broodstock development and field evaluation, pending FDA approval.

Elizabeth R. J. M. Mamer, erjmmresearch@gmail.com

Josh Williams, WDFW

Pinniped Interactions

Moderator: Kylie DaCunha

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Tuesday, April 30, 1:40 PM to 3:00 PM

Symposium Abstract

Seals and sea lions (collectively known as pinnipeds) play a large role in our marine and aquatic ecosystems, acting as predator and prey for various species. Though populations were once severely depleted due to human impact, numbers seem to have increased in the past two decades. Given that these animals are sheltered under the Marine Mammal Protection Act (MMPA), negative interactions between humans and pinnipeds are avoided whenever possible. However, this becomes challenging in instances such as: where pinnipeds predate on threatened/endangered fish populations particularly at passage "bottlenecks" in riverine environments, when they are caught as bycatch during fisheries operations, or when they damage aquaculture facilities leading to escapements and loss of profit. The purpose of this symposium is to identify the best available research quantifying such interactions, connect those interested in the topic, and gather solutions that prevent human/pinniped conflict.

1:40 PM

Participatory modeling to evaluate pinniped management as a tool for salmon recovery in Puget Sound

Despite huge investments in salmon recovery by state, federal, and tribal entities, Puget Sound salmon stocks haven't significantly recovered. Pinniped predation on salmonids has been documented at most large river mouths in the Puget Sound and has been linked to reduced salmon survival. Myriad management strategies have aimed to reduce pinniped predation, including non-lethal deterrents, capture of problem individuals, and lethal removals. Uncertainty about the potential repercussions from large scale lethal removal programs (like culls) has thus far prevented broad implementation. Pinniped harvest by tribes with treaty rights in Puget Sound could be an effective management structure for balancing these complicated considerations and operating within existing legal and political frameworks. We are creating models to identify the characteristics of tribal pinniped harvest strategies that have the greatest positive impact on the survival of returning salmon through migration bottlenecks ("gauntlets"). Pinniped predation will be modeled through a combination of agent-based and equation-based components to represent different aspects of pinniped behavior, foraging decisions, fear conditioning, individual learning, and social contagion. Using these models of pinniped dynamics at gauntlets, we will simulate pinniped harvest regimes and evaluate the number of salmon who migrate beyond the gauntlet to safety and are therefore available to upriver fishery harvest, hatchery operations, predators and scavengers, and natural spawning opportunities. The results from this study will be used by our partners in tribal resource management agencies to structure pinniped management in their Usual & Accustomed areas and identify data gaps for future monitoring efforts.

Liz Allyn, liz.allyn@makah.com

2:00 PM

Columbia River pinniped predation:
A summary of information gained from a decade-long study

Thirteen Columbia River salmon and steelhead ESU (evolutionarily significant unit) or DPS (distinct population segment) are currently listed as threatened or endangered under the Endangered Species Act and pinniped predation has been identified as having a negative impact on their recovery. Efforts to estimate pinniped predation rates on

Columbia River (CR) salmon and steelhead have been ongoing for decades and yet we have barely scratched the surface with respect to understanding the dynamics of pinniped/salmonid interactions. NOAA Fisheries initiated a study in 2010 to measure survival of adult spring-run Chinook salmon (Oncorhynchus tshawytscha) through the lower CR and estuary. Over the next nine years, researchers implanted adult salmon with Passive Integrated Transponder (PIT) tags as they arrived within the estuary and estimated their survival to Bonneville Dam (Rkm 234). Based on PIT tag detections within the fish ladders at Bonneville, an estimated 51,751 – 224,705 salmon died annually within the study reach from sources other than harvest. Mixed-effects logistic regression modelling identified pinniped predation as the most likely source of this mortality. During 2016-2018, VHF transmitters were implanted into a representative portion of the PIT-tagged group in order to estimate reach level survival within the lower CR and to identify predation hot spots. During 2016 and 2017, VHF transmitters were also attached to California Sea lions in order to monitor their behavior and movement between Bonneville Dam and the CR estuary. This talk will summarize the information gained from these studies.

A. Michelle Wargo Rub, michelle.rub@noaa.gov

2:20 PM

Long-term Tracking of California Sea Lions Using Flipper-mounted SPOT Tags

Tracking movements and distribution of migratory marine predators is critical to understanding their role in coastal ecosystems and their potential impacts to prey species of concern. Male California sea lions (Zalophus californianus), for example, undertake annual migrations from their breeding areas in southern California and Mexico to coastal areas of the northeastern Pacific, where they are important predators on fish and cephalopods, including salmon stocks of conservation concern. While overall dispersal patterns have been broadly characterized using short-term satellite tag deployments and resighting of marked individuals, long-term tracking of individual movement patterns has remained an important knowledge gap for this species. In August 2023, researchers from Washington Department of Fish and Wildlife and Oregon Department of Fish and Wildlife captured 24 male California sea lions in Astoria, Oregon, and attached flipper-mounted Argos SPOT 371-B tags from Wildlife Computers, Inc., to track their movements and habitat use. Three separate tag programs were used to balance frequency of tag check-ins with overall deployment lengths, which is limited primarily by battery life of the tags. Overall tag performance, lifespan, and quality of location data will remain unknown until the tags' batteries have been depleted; however, estimated tag lifespan for the best performing of these tag programs is currently around two years and preliminary results are providing valuable insight into individual- and population-level movements of male California sea lions.

Sarah Colosimo, Sarah.Colosimo@dfw.wa.gov

2:40 PM

Lower River and Estuary Pinniped Monitoring Program

The concurrent decline in productivity of many Pacific salmon stocks and increase in abundance of pinnipeds along the west coast of North America has many pointing to predation as a leading cause for salmon declines. Despite a recent increase in the study of pinniped-salmon interactions, their role in the decline of Pacific salmon remains hotly debated. While salmon make up a relatively small proportion of pinniped diets, that proportion is higher in seals residing in estuaries. In addition, seals have been observed utilizing anthropogenic and natural pinch points in estuaries and lower rivers to forage, impacting salmon migrations and survival. Understanding the activities and abundances of pinnipeds in lower river and estuarine environments and developing quantitative methods of assessment is essential in understanding their impact on out-migrating and returning Chinook (Oncorhynchus tshawytscha) and Coho Salmon (Oncorhynchus kisutch). The Bottlenecks to Survival Program, a partnership between the Pacific Salmon Foundation and the British Columbia Conservation Foundation, is working in collaboration with local First Nation partners to design and implement a lower river and estuary monitoring program. The objective is to develop fine-scale spatial-temporal pinniped abundance data. This, in conjunction with the Bottlenecks PIT-tagged based migration detections of Chinook and Coho Salmon, may provide high-quality data on ecological interactions. Collectively, this work will greatly expand our understanding of pinniped utilization of these environments, which will help inform Chinook and Coho Salmon survival estimates, catalyze strategies to increase productivity, support First Nations-led resource management, and leave a legacy of long-term, effective assessment approaches.

Sam James, sjames@psf.ca

Northern Pikeminnow and Non-Native Predator Fishes in Anadromous Waters

Moderator: Marika Dobos

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Thursday, May 2, 8:00 AM to 11:40 AM

Symposium Abstract

Numerous factors have influenced the decline of salmon and steelhead in the Pacific Northwest and piscivorous predators are one of those contributing factors. The first known intentional stocking event of Smallmouth Bass, Micropterus dolomieu in the Columbia River system was in 1923 in Oregon. Illegal introductions of Walleye, Sander vitreus in the Columbia River system was suspected to have occurred somewhere between the 1940s and the 1950s in Banks Lake and/or Lake Roosevelt in Washington. Currently, Smallmouth Bass and Walleye have extended their distribution in the Columbia and Snake river basins and trends of abundance continue to rise. Additionally, hydrosystem dams have created habitats that favor native Northern Pikeminnow, Ptychocheilus oregonesis that specialize in eating juvenile salmonids. This symposium is intended to bring awareness about the spread of non-native predators in the Columbia River basin and how that might affect ESA-listed salmonids if they continue to widen their distribution in key rearing areas of juvenile salmonids. The symposium will also highlight current management actions and research on piscivorous fish that could aid with developing plans for managing non-native predator fishes in anadromous waters.

8:00 AM

Population dynamics of Walleye in Lake Roosevelt

The Washington Department of Fish and Wildlife, in cooperation with the Colville and Spokane tribes, have conducted Fall Walleye Index Netting in Lake Roosevelt since 2002. The objective of the study is to gather long-term trend data on abundance, age, growth, condition, sex ratio, and age at maturity to better understand the Walleye population through time. Our specific goals for this investigation were to (1) characterize trends in abundance, size and age at maturity, (2) calculate rates of survival and mortality, and (3) evaluate exploitation rates across age groups using existing creel data. Year class strength was highly variable over the study period, with more frequent year classes beginning in 2014 and the highest abundance recorded in 2018. The abundance of young fish (1-3 years old), comprising most of the population, varied dependent on year class size and frequency. Catch rates of larger Walleye (>22 inches) showed a significant, decreasing trend, suggesting that angler harvest is depressing numbers of large Walleye. The age of maturity of males and females decreased significantly over the study period, highlighting a possible increase in reproductive potential of the population. The results of this study demonstrate the vulnerability of older Walleye with low rates of recruitment, while highlighting the resiliency of the Walleye population in Lake Roosevelt to overharvest.

Danny Garrett, daniel.garrett@dfw.wa.gov

8:20 AM

Comparison of Pectoral Fin Rays and Lapilli For Estimating Age of Northern Pikeminnow

Northern Pikeminnow Ptychocheilus oregonensis is a piscivorous cyprinid native to western North America. Northern Pikeminnow has been the focus of extensive research efforts due to its predation of native sport fishes. Various studies have described Northern Pikeminnow diet and movement, however one key knowledge gap is an ageing structure comparison. Scales are

the most commonly used structure to estimate the age of Northern Pikeminnow. However, ages estimated from scales are often inaccurate. Thus, an investigation into alternative ageing structures is warranted. Lapilli otoliths have been used to successfully age a variety of other ostariophysian fishes. Lapilli otoliths were compared to leading pectoral fin rays. In this study, we examined pectoral fin rays and lapilli otoliths from 155 Northern Pikeminnow captured in Lake Cascade, Idaho. Exact percent-agreement of estimated ages between readers was higher for pectoral fin rays (75.3%) than lapilli otoliths (50.0%), with coefficients of variation of 3.5 and 8.7 respectively. Readers also assigned a confidence rating (0-3) of age estimate accuracy to each structure. Readers had higher confidence ratings for fin ray age estimates (1.6 ± 0.57) than lapilli otolith estimates (1.1 ± 0.65). Between structures there was an exact percent-agreement of 26.6%, but a within one year agreement of 80.6% and a coefficient of variation of 9.9. Furthermore, pectoral fin rays were easier to process and age. Our findings suggest that ages estimated from pectoral fin ray are more accurate and easier to obtain. Results from our study will help fisheries managers make informed Northern Pikeminnow management decisions.

Caleb M. Wilson*, wils1139@vandals.uidaho.edu

8:40 AM

Interannual and seasonal diet patterns of sympatric non-native predatory fish inferred through DNA metabarcoding

Understanding diet patterns of non-native predator fish is critical information for salmon recovery efforts. However, our understanding of the interactions between multiple non-native predator fish is limited. This is problematic because multiple non-native predator fish often co-occur in riverine systems along with native predators. To begin to understand joint effects of multiple sympatric non-native predator fish, knowledge of how they interact is needed. In this study, we quantify diets of sympatric non-native Smallmouth Bass (Micropterus dolomieu), Rock Bass (Ambloplites rupestris), Largemouth Bass (Micropterus salmoides), and native Northern Pikeminnow (Ptychocheilus oregonensis) using DNA metabarcoding on stomach contents in the Chehalis River, Washington. We sampled over 1,000 individual fish across two years and focused our sampling within each year during the sub yearling Chinook salmon (Oncorhynchus tshawytscha) outmigration. In this talk, we will describe and compare interannual and seasonal diet patterns for each fish predator highlighting diet overlap and partitioning among predators and specific prey items driving variation in diets for each predator across temporal scales.

John Winkowski, Dr. Julian Olden
jjwink@uw.edu

9:00 AM

Northern Pikeminnow and Non-Native Predator Fishes in Anadromous Waters

Numerous factors have influenced the decline of salmon and steelhead in the Pacific Northwest and piscivorous predators are one of those contributing factors. The first known intentional stocking event of Smallmouth Bass, Micropterus dolomieu in the Columbia River system was in 1923 in Oregon. Illegal introductions of Walleye, Sander vitreus in the Columbia River system was suspected to have occurred somewhere between the 1940s and the 1950s in Banks Lake and/or Lake Roosevelt in Washington. Currently, Smallmouth Bass and Walleye have extended their distribution in the Columbia and Snake river basins and trends of abundance continue to rise. Additionally, hydrosystem dams have created habitats that favor native Northern Pikeminnow, Ptychocheilus oregonesis that specialize in eating juvenile salmonids. This symposium is intended to bring awareness about the spread of non-native predators in the Columbia River basin and how that might affect ESA-listed salmonids if they continue to widen their distribution in key rearing areas of juvenile salmonids. The symposium will also highlight current management actions and research on piscivorous fish that could aid with developing plans for managing non-native predator fishes in anadromous waters.

Marika Dobos, marika.dobos@idfg.idaho.gov

9:20 AM

Biological Trends for Three Piscine Predators During 33 Years of Reward Based Recreational Fisheries for Northern Pikeminnow (Ptychocheilus oregonensis)

The Northern Pikeminnow Management Program (NPMP), a multi-agency collaboration, has been reducing the total population and size structure of Northern Pikeminnow through a recreational reward fishery in the Columbia and Snake rivers as salmonid predation mitigation for the Federal Columbia River Power System, since 1990. The Oregon Department of Fish and Wildlife has been measuring biological metrics for Northern Pikeminnow, Walleye (Sander vitreus), and Smallmouth Bass (Micropterus dolomieu) to evaluate the efficacy of NPMP and monitor for a piscine predator compensatory response. Walleye and Smallmouth Bass are non-native to the NPMP fishery area so tracking biological metrics may provide some information about changing piscine predator dynamics related to the fishery and in the context of ongoing ecological changes. This study presents metrics from these piscine predators across the broad spatial scale of NPMP from select areas in the Columbia and Snake rivers. There were variable patterns in an index of abundance for all three species though there was a general declining trend for Northern Pikeminnow in many areas. Paired with declining trends in an index of abundance for Northern Pikeminnow were increasing trends for Smallmouth Bass and Walleye, in some areas. Additionally, Walleye were detected in this study for the first time above Lower Granite Dam on the Snake River in 2023. Introduced, non-native piscine predators have the potential to negatively impact ecosystems, thereby becoming 'invasive'. In a dynamic and highly modified system like the Columbia River Basin, long-term monitoring data can inform management decisions around piscine predation.

Grant Waltz, Art Martin
grant.t.waltz@odfw.oregon.gov

10:00 AM

Insights from Recent Studies of Smallmouth Bass Predation on Juvenile Fall Chinook Salmon in the Lower Snake River

Recent studies of Smallmouth Bass predation on subyearling Fall Chinook Salmon in the Snake River demonstrate how bass abundance, consumption rates, and consequently Chinook loss, have changed in the last 20 years. From time of the first studies in the 1990s, mean annual predation loss of subyearlings increased more than 15-fold from 1996–1997 to 2013–2015 in Lower Granite Reservoir, despite lower contemporary bass abundances. Significant predation occurs after hatchery releases, but its magnitude and duration vary by release location. Across the years 2013 to 2018, we estimated an average of 869,000 subyearlings could be lost to bass predation each year between the upper reaches of Hells Canyon and Lower Granite Dam. To provide a population-level context for this estimated loss, we provide an illustration to show that up to 16.0% of the potential returning adult run to Lower Granite Dam could be increased had no subyearling predation by bass occurred upstream of the dam. We also discuss how ancillary factors such as alternative prey availability, hatchery releases, predator-salmon habitat overlap, emigration timing, and environmental conditions such as turbidity can affect predation rates and subyearling loss. Considering these factors in future studies will provide a more holistic view salmonid predation and will provide context for interpreting predation results.

Ken Tiffan, John Erhardt
ktiffan@usgs.gov

10:20 AM

A collaborative effort to control the spread of invasive Northern Pike in the upper Columbia River Basin.

Northern Pike Esox lucius is an apex predator, not native to the upper Columbia River Basin. They were first documented at Lake Roosevelt in 2007 and became established in the upper reaches of the reservoir by 2015. Since their establishment, the Lake Roosevelt co-managers have prioritized resources to control the spread of this invasive threat to the resident fishery in Lake Roosevelt and anadromous fisheries downstream in the Columbia River. Collaborative suppression efforts have resulted in the removal of more than 16,000 Northern Pike from Lake Roosevelt since 2015. Standardized gillnet monitoring surveys have documented an 83% reduction in reservoir wide catch-per-unit-effort from 2019 to 2023.

Public outreach efforts have garnered support for the project and provided opportunities for anglers to assist in removal effort through an angler reward program that has resulted in the removal of more than 3,500 Northern Pike. This three-pronged approach of aggressive suppression, standardized monitoring and research, and public outreach has been a successful strategy for reducing abundance, limiting downstream distribution, and informing the public regarding the threat of Northern Pike to important fisheries.

Charles Lee, Holly McLellan, and Marc Terrazas
Charles.Lee@dfw.wa.gov

10:40 AM

Not all those who wander are lost: leveraging PIT tag data to better understand northern pikeminnow movement

Northern pikeminnow are native to the Columbia River, but their increased predation of juvenile salmonids due to habitat modification has led to long-term population control efforts. The Northern Pikeminnow Management Program (NPMP) is a targeted harvest program, comprised primarily of a sport reward fishery, that has been operating in the Columbia and Lower Snake Rivers since 1991. As a result of this sport reward fishery, over 5.5 million piscivorous (≥ 200mm FL) northern pikeminnow have been harvested for cash rewards. Each year data are collected to monitor and evaluate the program. Northern pikeminnow have been PIT tagged through the NPMP since 2003 to calculate the program's exploitation rate, with the goal of reducing the population by 10-20%. The model used assumes closed populations separated by dams and leads to an estimated annual reduction in predation. After being tagged, most northern pikeminnow are never recaptured, but their movement is passively tracked by PIT tag antennas. We combined data from the Columbia Basin PIT Tag Information System (PTAGIS) database with NPMP tagging and harvest data. Initial results reveal that individuals traveled as far as 759 km. Nearly 10% of northern pikeminnow harvested through the NPMP were captured in different reservoirs (or river sections separated by dams) than where they were initially tagged. Understanding northern pikeminnow movement will inform the exploitation rate calculation as one of the key measures of NPMP success. As the NPMP evolves over time, information on northern pikeminnow movement may also inform future management strategies.

Jessica Diallo, jodiallo@uw.edu

11:00 AM

Food Habits and Growth of Walleyes in Lake Pend Oreille, Idaho

Walleye Sander vitreus have been widely introduced into western systems and have negatively affected fish populations, particularly salmonids. Walleyes were recently introduced to the Lake Pend Oreille (LPO) system, Idaho-Montana, which supports robust populations of ecologically and recreationally important salmonids. The goal of this study was to evaluate the effects of a Walleye population in the LPO system. From 2020–2021, 1,157 Walleyes were collected for stomach content and stable isotope analysis (i.e., δ15N, δ13C). Kokanee was the prey item most frequently consumed by Walleyes. We estimated that Walleyes consumed approximately 725,654 kokanee (95% CI = 245,581-1,648,271). Of the kokanee observed in Walleye diets, ~22% were ≥ 200 mm (i.e., approximate minimum size of spawning kokanee in LPO). Stable isotope analysis suggested that, as Walleye aged, δ15N increased and δ13C decreased indicating increased consumption of pelagic prey and prey at higher trophic positions. Kokanee abundance was related to growth of Walleyes and explained 46% of the observed variation. In general, fast-growing Walleyes (i.e., ≥75th percentile of growth) had higher δ15N than slow-growing Walleyes (i.e., ≤ 25th percentile of growth). Similarly, δ13C was more depleted in the fast-growing individuals for all age classes, except age 1 suggesting that age-1 individuals

used higher proportions of littoral prey items relative to other age classes. Our study shows the importance of kokanee to Walleyes and provides further evidence of the potential effects non-native Walleyes on salmonid-dominated systems.

Susan Frawley, susie.frawley@idfg.idaho.gov

11:20 AM

Suppression and Management of an Introduced Walleye Population

Idaho Department of Fish and Game (IDFG) has taken an aggressive management stance to suppress an illegal introduction Walleye population in the Pend Oreille basin of northern Idaho. Monitoring via Fall Walleye Index Netting (FWIN) began in 2011, and by 2017 our FWIN results indicated exponential population growth was occurring. IDFG implemented a suppression program the following year consisting of targeted commercially contracted gill netting, electrofishing, and incentivized angling with the goal of limiting the population's reproductive capacity and reducing adult walleye densities to at or below 2014 levels. These suppression methods complement one another, with gill netting targeting sexually mature fish (age >3), while incentivized angling is most effective in removing immature fish (age <3). Results of the 2023 FWIN survey indicate that the walleye recruitment continues to be sporadic in the system. Despite successful reduction of adult Walleye abundances to pre-2014 levels, overall catch in 2023's FWIN reached an all time high driven by high abundance of age 0 and age 2 walleye. This highlights the importance of commitment to continued suppression efforts, and establishing monitoring trends that allows for reflexive management actions which may need to be taken to limit further population growth.

Eric Geisthardt, eric.geisthardt@idfg.idaho.gov

Josh Williams, WDFW

Salmon Run Predictions

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Organizer: Sean Simmons

Wednesday, May 1, 1:00 PM to 2:20 PM

Symposium Abstract

The Salmon Prize competition is a new initiative to spur discoveries about the mechanisms that drive salmon survival by measuring how well individuals or teams can predict salmon returns. For this unique symposium, presenters will be asked to present their 2024 predictions of salmon returns for any run of salmon whose return is measured by a recognized institution, such as the Pacific Salmon Commission or other public agency. Presenters can be individuals or part of a team and presentations must include the following elements: (1) the model used to make the prediction; (2) the list of variables used in the modeling process; (3) the theory of salmon survival mechanisms that underpin the model; and (4) the independent source that will be used to measure the actual number of returning salmon. Since this will be a competition with prizes as incentives, the first five abstracts submitted will automatically receive $500 (USD) after they present their predictions at the conference. A grand prize of $1,000 (USD) will be awarded to the presenter(s) who most accurately predict the number of returning salmon as measured in percent error. This prize will be awarded once all predicted salmon returns have been measured and are available from the measuring agency, most likely in 2025. If you want to participate but cannot accept a reward, you can dedicate your reward to a student scholarship. If anyone has any questions about the process, please contact the moderator, Sean Simmons, by email (sean@anglersatlas.com). Funding for the prize is from the Salmon Prize project (www.salmonprize.com).

1:00 PM

Introducing a Novel Stock-Specific Indicator of Salmon Survival in the Marine Environment

Brian J Burke

1:20 PM

Winter ichthyoplankton community composition and predicting Columbia River spring Chinook salmon adult returns for 2024

Elizabeth A. Daly and Toby D. Auth

1:40 PM

Assessing the Impacts of Environmental and Ecological Variables on the Performance of Fraser Sockeye Salmon Forecast

Yi Xu, Qi Liu, Caihong Fu, John Holmes

2:00 PM

Incorporating marine climate indicators to predict Chum Salmon Oncorhynchus keta returns in south Puget Sound, Washington

Matthew R. Bogaard*, Mickey Agha

Pacific Northwest Sockeye Salmon

Moderator: Jeff Fryer

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Thursday, May 2, 10:00 AM to 11:40 AM

Symposium Abstract

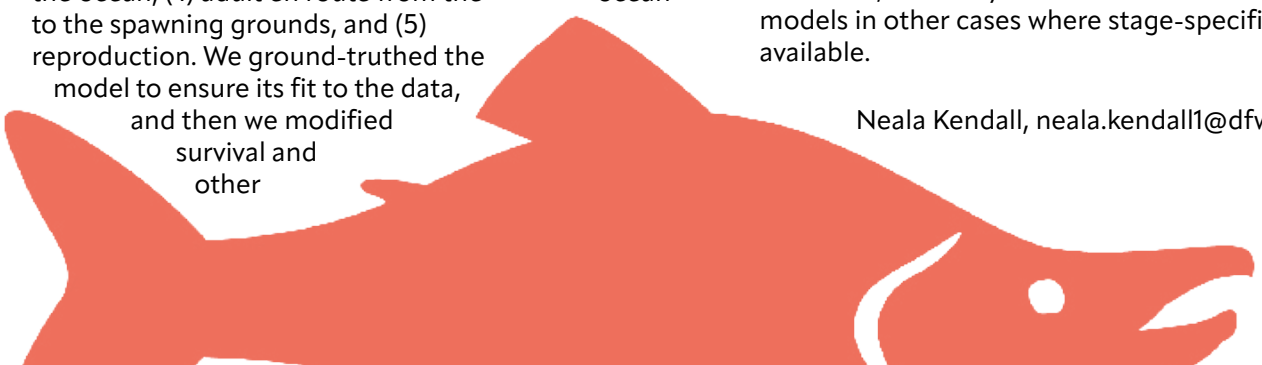
Sockeye Salmon stocks in the Pacific Northwest and British Columbia have been greatly impacted by human development of the region and are threatened by an expanding human population. In addition, these stocks, being at the southern end of sockeye salmon range, are most vulnerable to climate change impacts. Despite these challenges, some stocks have recently staged dramatic recoveries. For example, the 2022 Columbia Basin run had more sockeye counted passing Bonneville Dam than any year since counting began when that dam was completed in 1938 and the highest 7 counts have all been since 2011. Sockeye salmon restoration efforts are currently under way in the Elwha and Skokomish basins in the Olympic Peninsula as well as the Yakima and Deschutes basins of the Columbia Basin and proposed for Wallowa Lake and upstream of Grand Coulee Dam. This symposium will focus on past, present, and possible future management actions to mitigate human impacts. The question to be explored by this symposium is to what extent Pacific Northwest and British Columbia sockeye have been affected from past and present management actions and whether these actions will be sufficient for sockeye in the future.

10:00 AM

Life-cycle model reveals sensitive life stages and evaluates recovery options for a dwindling sockeye salmon population

Population models, using empirical survival rate estimates for different life stages, can help managers explore whether various management options could stabilize a declining population or restore it to former levels of abundance. Here we used two decades of data on five life stages of the population of sockeye salmon in the Cedar River, WA to create and parameterize a life cycle model. This formerly large but unproductive population is now in steep decline despite hatchery enhancement. We gathered population-specific data on survival during five stages: (1) egg to fry, (2) fry to presmolt, (3) presmolt to adult return from the ocean, (4) adult en route from the ocean to the spawning grounds, and (5) reproduction. We ground-truthed the model to ensure its fit to the data, and then we modified survival and other parameters during various stages to examine future scenarios. Our analyses revealed that low survival of juveniles in Lake Washington (stage 2: averaging only 3% over the past 20 years), survival of adults returning to freshwater to spawn (stage 4), and survival of adults on spawning grounds to reproduce (stage 5) are likely limiting factors. Combined increases in these stages and others (specifically, the proportion of fish taken into the hatchery to be spawned) might also recover the population. As in other integrated hatchery populations, managers must weigh options relating to balancing the fraction of natural- and hatchery-origin fish, and our results showed that increasing the fraction of fish taken into the hatchery alone will not recover the population. Our model brings together population-specific data to help managers weigh conservation strategies and understand which stages and habitats are most limiting and how much survival must increase to achieve recovery targets. By extension, our analyses also reveal the utility of such models in other cases where stage-specific data are available.

Neala Kendall, neala.kendall1@dfw.wa.gov



10:20 AM

Bringing the salmon home – Evaluating the feasibility of sockeye salmon reintroduction to historic habitat in the Columbia River upstream of Grand Coulee Dam

The Canadian reaches of the Columbia River were once home to at least three known sockeye salmon-rearing lakes. These sockeye were extirpated by the construction of the Grand Coulee Dam, but once comprised a major proportion of the sockeye salmon production in the Columbia River. Due to the tremendous cultural damage caused by the loss of salmon to the Indigenous Nations of the Upper Columbia, efforts have been undertaken to evaluate the feasibility of salmon reintroduction to the region. In the Canadian Reaches of the Upper Columbia River, these efforts have led to the formation of Bringing the Salmon Home: The Columbia River Salmon Reintroduction Initiative. This is a tri-nation tribal partnership of the Syilx Okanagan Nation, Secwépemc Nation, and the Ktunaxa Nation, along with the Province of British Columbia and Fisheries and Oceans Canada. Through this initiative, we hope to answer key questions surrounding reintroduction feasibility, including: (1) Do juvenile sockeye salmon survive their migration through the Columbia River from upstream of Grand Coulee Dam, and (2) How will adult sockeye salmon behave upon reintroduction to altered historic habitats. Here, we will present the preliminary results from pilot studies led by the Okanagan Nation Alliance (ONA) performing small-scale releases of PIT-tagged sockeye fry and a Bringing the Salmon Home-led study evaluating adult Chinook salmon behaviour in the Upper Columbia River. We will also outline the ongoing studies to continue evaluating the feasibility of reintroducing sockeye salmon to the Upper Columbia.

Patrick Zubick, pzubick@syilx.org

10:40 AM

Snake River Sockeye Salmon Captive Broodstock and Springfield Hatchery Smolt Program: a 10-year perspective

Snake River Sockeye Salmon (Oncorhynchus nerka) were listed as endangered in 1991. Due to extremely low anadromous returns (<10 fish/year) and only one remaining extant population, a collaboration of state, tribal, and federal managers initiated a captive broodstock program to prevent the extinction of this ecologically significant unit (ESU) and rebuild the populations within it. Increased abundance in the Stanley Basin natal lakes has been guided by adaptive management employing a variety of adult and juvenile reintroduction strategies, and rigorous monitoring. Evaluations of the abundance and survival data identified two strategies that produce the highest anadromous returns: 1) release of captive and anadromous adults to spawn in natal lakes, and 2) release of smolts to migrate to the ocean. Natural spawning of captive and anadromous adult releases to volitionally spawn produces the greatest benefits in terms of smolt-to-adult return rate (SAR) while releasing hatchery smolts maximized the number of recruits per spawner (R/S). This presentation highlights the implementation, challenges, and successes using these multiple strategies over the past 10-years to preserve this ESU.

Eric Johnson, Dan Baker, Chris Tatara, Kurt Tardy, and David Venditti
eric.johnson@idfg.idaho.gov

11:00 AM

40 years of Sockeye Salmon Research at Bonneville Dam

2024 marks the 40th year that the Columbia River Inter-Tribal Fish Commission has been conducting Sockeye Salmon research at Bonneville Dam on the Columbia River. What started as a single day of sampling scales and lengths of Sockeye salmon has evolved into a program that samples 5 days a week for not only Sockeye, but also steelhead and Chinook salmon and also includes sampling of genetics material, PIT tagging, as well as information on condition. This presentation will focus on Sockeye, how the program has expanded, and some of what has been learned over the past 40 years.

Jeff Fryer, fryj@critfc.org

The Salmon Prize: Sockeye International Competition

Moderator: Sean Simmons

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Thursday, May 2, 8:00 AM to 9:40 AM

Many Salmon stocks are facing imminent collapse, and we don't yet understand the mechanisms that are driving these changes in survival. The Salmon Prize is designed to address this challenge by recruiting teams of scientists to see who can best predict the number of returning fish. Through this competition, hypotheses and models will be tested against real return numbers to see which methods most accurately predict the returns. The goal is to begin teasing out the mechanisms that are driving Salmon survival by looking at the hypotheses, models and covariates that are used in the best predictions. Sockeye International is our third competition with $5,000 up for grabs. It is being kicked off at the Washington-BC-Idaho AFS conference in Spokane April 29 to May 2. Interested teams will need to predict the 2024 Sockeye returns across 14 distinct runs covering three major systems — Bristol Bay, the Fraser River and the Columbia River. If you have what it takes, sign up at www. SalmonPrize.com and submit your predictions by June 15, 2024. The first five teams to complete their submission will win $200 each. For more information, please contact Sean Simmons by email (sean@anglersatlas.com).

IDFG

Everything Sturgeon

Moderator: Daniel Deng

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Tuesday, April 30, 3:40 PM to 5:20 PM

Symposium Abstract

This symposium covers anything sturgeon, and features a range of talks covering population dynamics, estimation of age and growth, translocation, supporting a sport fishery and behavioral responses to river discharge and water temperature.

3:40 PM

Population dynamics of white sturgeon in the upper Snake River, Idaho: evaluation of management options for a harvest fishery

White Sturgeon ¬Acipencer transmontanus is important recreationally and economically throughout its distribution. In Idaho, managers have increased opportunity for anglers to target an iconic species through a stocking program where the Idaho Department of Fish and Game has established a population upstream of Shoshone Falls, outside its native distribution. From Minidoka Dam upstream to Upper Idaho Falls Dam, around 7,650 White Sturgeon have been stocked since 1990. Increased participation in the fishery by anglers and guides have prompted a thorough investigation of White Sturgeon in the upper Snake River. Information on the population dynamics and demographics is necessary for effective management; thus, this project aims to describe the distribution, abundance, age structure, and growth rate in the upper Snake River system. In total, 340 individual White Sturgeon were captured with 181 recaptures between 2022 and 2023. Individuals were captured, using angling and setlines, throughout the study area and varied in size from 54–205 cm FL. The mean relative weight for captures was 105.3 (SD = 14.4) suggesting relatively high body condition. Capture histories from 261 known-age White Sturgeon were used to inform age and growth analysis and movement trends. Information from this investigation will provide important insight on the ecology of White Sturgeon and can be used to guide management decisions regarding a harvest fishery.

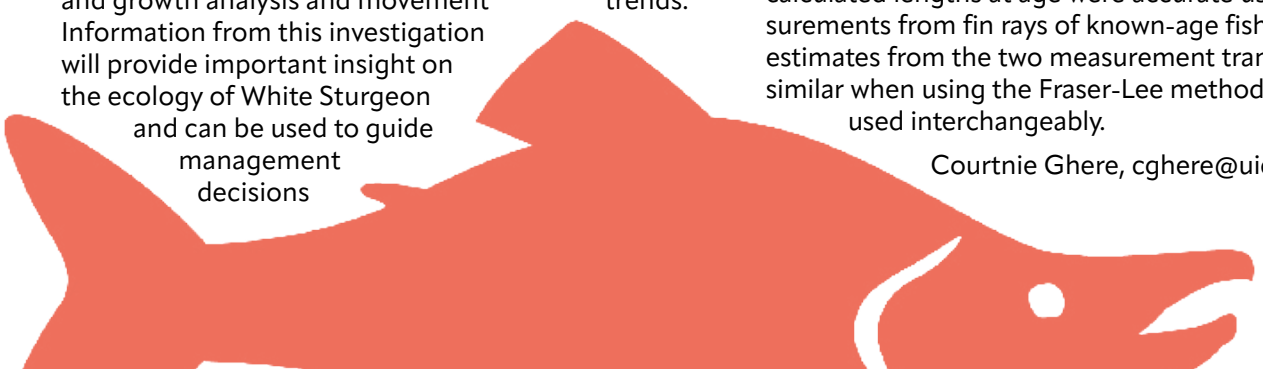
Donavan K. Maude, dmaude@uidaho.edu

4:00 PM

Validation of techniques for estimating the age and growth of known-age White Sturgeon

Successful conservation and management of fishes requires an understanding of their age and growth. However, methods for estimating the age and growth of long-lived fish species are difficult to validate. The mark-recapture history information for White Sturgeon in the Kootenai River allowed the verification and validation of fin rays for age and growth analysis. Age was estimated from pectoral fin rays of known-age White Sturgeon (n = 162) to evaluate ageing accuracy and precision. Back-calculated lengths were calculated using four models and measurements obtained from two measurement transects (i.e., lateral, posterior). Between-reader agreement of White Sturgeon ages was 58.7%. Consensus age agreement with known ages was poor (30.7%) and decreased with age. The Fraser-Lee model provided the lowest root mean square error and percent error of the four back-calculation models. Estimates of mean back-calculated lengths at age derived from the Fraser-Lee model were similar between the two measurement transects. Ageing of White Sturgeon using fin rays was unreliable and accuracy decreased with fish age. Back-calculated lengths at age were accurate using measurements from fin rays of known-age fish. Length estimates from the two measurement transects were similar when using the Fraser-Lee method and may be used interchangeably.

Courtnie Ghere, cghere@uidaho.edu



4:20 PM

Failing to Thrive – Can translocation help rebuild White Sturgeon populations?

Snake River White Sturgeon (WS) residing between Hells Canyon Dam and Lower Granite Dam are one of two population segments in Idaho that are relatively stable and self-sustaining. However, WS in the free-flowing section have extremely slow juvenile growth rates and are pinched in a 50-80 cm fork length (FL) bottleneck that may take decades, if ever, to outgrow. Conversely, WS residing in Lower Granite Reservoir (LGR) exhibit much faster growth rates, surpassing the upriver bottleneck at just 3-4 years of age. From 2021 to 2023, resource managers and Idaho Power Company moved 212 juvenile-size WS from high-density areas in the free-flowing river downstream to LGR to assess if translocation provides resource managers with a WS management tool to overcome growth bottlenecks, reshape stock structures, and increase spawning potential. In 2021, a subset (n=42) received an acoustic tag and passive telemetry monitored gross movement in LGR. Preliminary data indicate a minimum of 16 (38%) acoustic-tagged WS entrained downstream past Lower Granite Dam and a few potentially moved upstream to the free-flowing river. Two translocated WS were recaptured in LGR and demonstrated the tremendous WS growth potential that exists in LGR (19.1 and 22.4 cm FL/year). Furthermore, population sampling during 2024-2025 will hopefully provide a comprehensive assessment of movement and growth metrics. This information will help managers understand whether the loss of translocated fish from this population through entrainment can be offset by their increased growth rates and be used as a strategy to increase the WS spawning potential.

Jacob Hughes, jhughes@idahopower.com

4:40 PM

An evaluation of the White Sturgeon population and sport fishery at C.J. Strike Reservoir in response to an acute, localized mortality event

White Sturgeon Acipenser transmontanus are endemic to several large river systems throughout western North America and are among the world's largest and oldest freshwater fish species. Throughout their range, White Sturgeon have experienced population declines in response to anthropogenic stressors such as water development and overfishing. The Middle Snake River in Idaho has supported a catch-and-release White Sturgeon sport fishery since 1971, but angling effort at C.J. Strike Reservoir has increased considerably in recent years. During summer 2022, approximately 30 wild adult sturgeon carcasses were recovered in C.J. Stike Reservoir within a matter of weeks, resulting in an inaugural temporary closure of the sport fishery. Mortalities occurred in an area of the reservoir where seasonal changes in water temperature and dissolved oxygen may approach or exceed known tolerance limits for White Sturgeon. Angling mortality was also implicated due to angler complaints and social media posts. In 2023, a comprehensive evaluation of the White Sturgeon fishery at C.J. Strike Reservoir was implemented to quantify angler catch and effort, and to characterize patterns associated with the use of fish-finding sonar. Weekly carcass surveys occurred throughout the study to elucidate interactions associated with angler effort, angler catch, and reservoir conditions. Additionally, a long-term acoustic telemetry study was initiated to characterize in-reservoir movements and microhabitat use (e.g., water temperature, depth) of tagged White Sturgeon. Results from this evaluation will serve to benefit the conservation of this trophy fish species and inform future management actions related to the catch-and-release sport fishery at C.J. Strike Reservoir.

Philip Branigan, phil.branigan@idfg.idaho.gov

5:00 PM

15 Years of Shovelnose Sturgeon Monitoring in the Missouri River, Montana: River Discharge and Water Temperature Cue Different Stages of Movement Including Tributary Entrance

Dams alter hydrologic and temperature patterns that cue Shovelnose Sturgeon (Scaphirhynchus platorynchus) movements and spawning. We used radio telemetry to collect 16,000 location observations of 198 Shovelnose Sturgeon over 15 years and related these to discharges and water temperatures in the Missouri and Marias (a major spawning tributary) rivers in Montana. Most female fish made potential spawning movements triennially, but possibly also biennially. Fish moved from spring to late summer and staged at known spawning areas until temperatures maximized embryonic survival or discharges maximized drift distances, but these climactic factors were in opposition and varied annually. Differences between annual peak and previous baseflow discharges and between Marias and Missouri river temperatures were strong predictors of movement and tributary occupation, respectively. Discharge cued initial movements towards spawning areas (i.e., attraction flows) but temperature was a stronger cue for initiating movements into tributaries and mainstem spawning habitats (i.e., attraction temperatures). Movement rates peaked near annual mean peak discharges whereas probabilities of movement continued to increase with increasing discharges. Many fish did not occur in or enter tributaries in certain years suggesting that spawning may have occurred in mainstream habitats or that suitable habitats are limited in tributaries. Chronic dewatering of a historically important spawning tributary (the Teton River) decreased and degraded accessible spawning, recruitment, and foraging habitat. Water management that incorporates potential effects of climate change could support the persistence of this population and those of other species in the Missouri River in Montana.

Brian Tornabene, brian.tornabene@gmail.com

Whooshh Innovations, Inc.
(Not a sturgeon. Still super cool.)

Technological tools and fisheries science techniques: adaptations, evolutions, and advancements in fish monitoring and selective passage

Moderators: Janine Bryan and Alexa Ballinger

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Wednesday, May 1, 8:00 AM to 5:20 PM

Symposium Abstract

With climate change, declining anadromous fish populations, and increasing numbers of opportunistic non-native fish species challenging the watershed ecosystems, there is need for improvement in how we measure, and which fish species are allowed passage. The process of monitoring and managing ESA-listed anadromous fish is time consuming and expensive. Effort and costs towards monitoring salmon and steelhead need to be evaluated to ensure recovery and management goals are met effectively. Understanding the issues from the fish perspective, hydraulic perspective, economic perspective, ease of use perspective, and regulatory perspective are all important aspects and considerations to be addressed within the technology development space. Any seasoned biologist will tell you that a polished, effective technique requires troubleshooting and often adjustment to original sampling design, equipment, methods, or analyses. The opportunities, however, to learn about, test, and adopt new technologies and techniques as they are being developed, commercialized and/or adaptively evolve in practice, are not always easy to come by. We can learn from mechanistic evolution and ultimately save time, money, and potentially, fish lives. This symposium serves as space for sharing adaptations, advancements in technological tools, development of new devices and an opportunity to articulate future aspirations in fish monitoring and selctive passage.

8:00 AM

Juvenile Anadromous Fish Utilization of Side Channels in the Lemhi River, Idaho

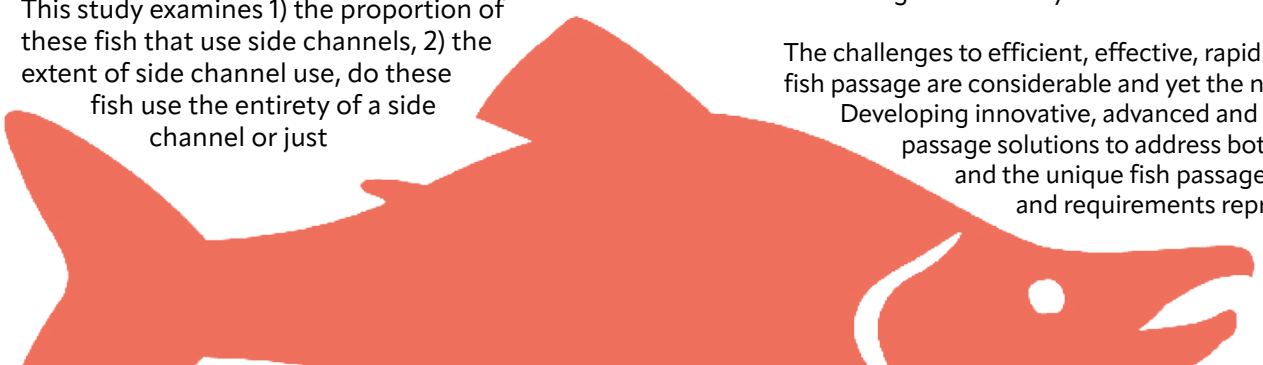
Historical human activities such as channelization, irrigation diversion developments, and floodplain alterations have contributed to declining stocks of wild anadromous fish. The future of endangered anadromous fish may depend on efforts to restore and enhance the stream habitats in their native spawning and rearing areas. The goals of this study are to evaluate movements and behavior of juvenile Chinook salmon and steelhead trout in relation to restoration efforts and side channel utilization. The study area is found on the Lemhi River in east-central Idaho. This study encompasses three side channel complexes within a 4km segment of the Lemhi River. These three side channel complexes consist of two post restoration side channel complexes and one pre-restoration channel. This study examines 1) the proportion of these fish that use side channels, 2) the extent of side channel use, do these fish use the entirety of a side channel or just head/tail, and 3) the residence time within side channels. Tracking of fish movement was accomplished utilizing passive integrated transponder (PIT) tags and PIT tag antenna infrastructure. This includes 18 corded antennas in the side channels and a single channel spanning array on the main channel. To further inform this study, detection data is available from 15 pre-existing PIT tag antenna sites in the Lemhi River Basin. This study has shown that not all side channels are created equal. Side channel usage varies between species, between pre- and post-restoration channels, and even between two side channel complexes within the same restoration project.

Michael Hall, mike.hall1@merck.com

8:20 AM

Modular, adaptive, mechanistic evolution of Whooshh Technologies: How they Work

The challenges to efficient, effective, rapid and safe fish passage are considerable and yet the need is great. Developing innovative, advanced and adaptive fish passage solutions to address both the common and the unique fish passage specifications and requirements represents the core



technologies of Whooshh Innovations, Inc. Identifying the issues, applying creative, at timely, "out of the box" approaches, and demonstrating proof of operation are fundamental to the Whooshh mission to Save the fish, Feed the planet, Grow clean energy and Heal the environment. As no fish passage barrier is like another, as each fish species has specific swim abilities and passage needs, and as barriers have impacted ecosystem composition and balance, the need for modular and adaptive technologies to provide selective fish passage is the way to developing viable solutions. From human assisted to volitional fish passage technologies, Whooshh has developed a host of modular, adaptive, efficient, effective, rapid and safe fish passage solutions. The mechanistic evolution of these technologies, how they work, their versatilities and their benefits, shall be discussed from both an engineering and a fish perspective.

Redwood Stephen, Cole Andrus, Janine Bryan, Marc Bommarito, Leonardo Matamoros, Whitney Goodwin
redwood.stephens@whooshh.com

8:40 AM

Utilizing the Spotting Patterns of Bull Trout to Identify Individuals in Photo Identification Software

Organisms with unique spotting or marking patterns can be identified using photo-identification software as an alternative to traditional marking methods. In this study we tested the potential of photo-identification as an identification method for Bull Trout using I3S Classic, a program that utilizes natural markings to identify individuals. To determine the ability to identify individual Bull Trout from spotting patterns, we used photographs of Bull Trout captured in 2017-2019 by the Idaho Department of Fish and Game at Fourth of July Creek, Idaho. During weir operations, 132 unique Bull Trout were sampled of which 34 fish were recaptured (n = 166 total captures). Using pictures of these fish, we created "spotting fingerprints" in the I3S system for each fish and compared "fingerprints" to identify recaptures. In a blind test, three readers were given the pictures and tasked with creating fingerprints and determining which fish were recaptures and which were not. The three readers were each able to correctly identify 100% of the fish that were not recaptured. For the recaptured fish, the three readers were able to correctly identify 22 fish, 25 fish, and 26 fish of the 34 recaptured fish. Of the fish incorrectly identified, all readers failed to identify the same six fish due to poor image quality. We discovered that photograph quality and spot selection affected the accuracy of identifying recaptures in the I3S system. If standardization of photograph quality and spot selection can be established, photo-identification could be a viable alternative to traditional tagging and could be utilized in fisheries management efforts.

Lonnie Parry-Gillis , sparry@wisc.edu

9:00 AM

Automating Fish Passage Counting Using AI/ML

MarineSitu in collaboration with Four Peaks Environmental Science and Data Solutions is developing a tool for automating fish passage counting at hydroelectric facilities in the Pacific Northwest. This tool is currently deployed in 5 fish counting stations in Washington, Oregon, and Idaho. Since March 2023 data collected at these facilities has been used to develop a model training dataset with over 100,000 images and multiple AI models and model architectures have been evaluated against manual fish counts. Performance evaluations performed to date have shown accuracies within +/- 5% when compared to hourly manual counts across seasonal and facility variations. This presentation will provide a summary of the current system architecture and performance along with plans for continued development and future deployments.

James Joslin and Sam Haffley
James@marinesitu.com

9:20 AM

Metrics for Estimating Strike Injuries During Fish Passage through Kaplan Turbines

Hydropower has been and will continue to play an important role in producing clean and secure energy worldwide. To make hydropower development and operation more environmentally friendly, there is a critical need to predict absolute strike injury rates of turbine-passed fish accurately and cost-effectively.

Accordingly, two velocity- and pressure-based strike metrics were proposed to quantify the biological effects of strikes/collisions between fish and rigid hydraulic objects. Sensor Fish (SF) measurements and the live fish 48-hour survival rates from a study conducted at the Ice Harbor Dam on the Snake River were used to establish a threshold for the two proposed metrics. These metrics and thresholds were then applied to several other SF studies conducted at three hydropower plants with Kaplan turbines within the Columbia River basin. It was found that the predicted results using the two proposed strike metrics agree well with the live fish survival rates reported in the literature. Additionally, the passage regions that potentially have higher risks of fish mortality due to strikes/collisions were identified. Overall, the proposed strike metrics have the potential to reduce the use of live fish and associated costs in fish passage studies.

Tao Huang, huang403@pnnl.gov

1:40 PM

Technology modifications to extend application potential: Eel to Pacific Lamprey

Anadromous Pacific lamprey face considerable challenges as they attempt to navigate the Columbia River Basin. Dams represent significant obstacles as they lack optimized wet surfaces for lamprey to climb, and many fish ladders have hydraulic jumps and/or water velocities that are beyond the swim abilities of lamprey. Columbia River Inter Tribal Fish Commission engaged Whooshh Innovations to modify a novel floating trap designed for juvenile eel capture, to accommodate adult Pacific lamprey. The Elverator™ is a pontoon-supported structure with wetted ramp surfaces that extend down into the water which, floating, can be positioned where the fish are likely to be found. The fish follow the flow and climb up the ramps, at the top of which a rounded apex causes the animals to slide into a chamber and be trapped. As Pacific lamprey return to spawn, they can attach to smooth surfaces with their mouths and will often do so to get past rapids and waterfalls as they continue their upstream migration. They are capable of surviving for periods of time outside of the water. Several groups have successfully shown that migrating lamprey can ascend within a wetted 4″ heavy duty PVC fabric-reinforced hose (smooth tube). It is the goal of the project to produce a prototype floating Pacific lamprey collector that can be combined with a smooth tube to facilitate Pacific lamprey collection and passage. The features and modifications of the Elverator™ to floating Pacific lamprey collector will be presented.

Whitney Goodwin
Whitney.goodwin@whooshh.com

2:00 PM

Next-Generation Miniature Transmitter Development for Fish Passage Monitoring

American shad is a migratory fish native to a large range across the East Coast of the US. In many rivers where shad are present, they must pass upstream and downstream of hydropower facilities multiple times to complete their life cycle. More than 100 US hydropower facilities will have expiring FERC licenses over the next 10 years and are within the native range of American shad. As a part of the FERC hydropower license process, fish passage and mitigation measures for American shad will be routinely and rigorously reviewed by federal agencies and stakeholders. PNNL developed a new acoustic transmitter that can be used to study the behavior and survival of sensitive species such as juvenile American shad to inform hydropower mitigation and species management. It is 8.0 mm in length and 2.0 mm in diameter, weighs 0.05 gram in air and 0.025 gram in water, and lasts about 30 days at 5-second ping rate. We are also evaluating the feasibility of applying this technology to study delta smelt in collaboration with University of California at Davis and ICF International. The ability to implant acoustic transmitters and track the movements of species and life stages of fish that have never been studied before at this level of detail would greatly advance our understanding of fish migration timing and behaviors, habitat use, fishway use and performance, and survival rates at hydropower facilities – resulting in more informed management decisions regarding new and existing hydroelectric facilities.

Daniel Deng, zhiqun.deng@pnnl.gov

2:20 PM

Bottlenecks to Survival for Chinook, Coho, and Steelhead

Many populations of wild Chinook, Coho and Steelhead have experienced steep declines in the Salish Sea. Considering the importance of these iconic species, it is urgent that we increase our understanding of the factors and mechanisms that may be contributing to their declines. There is growing consensus that the first year of marine life plays a key role in regulating productivity for juvenile salmon, and that competition, predation, and a changing environment all contribute to poor salmon and Steelhead returns throughout the Salish Sea. However, given the challenges of studying anadromous species throughout their life cycles, we have yet to fully understand where and when bottlenecks to survival occur. Recent application of Passive Integrated Transponder (PIT) tags on the Cowichan River revealed critical periods of mortality for Chinook salmon during the early marine period. Further, the study found significantly lower survival of hatchery Chinook salmon compared to wild. To expand our understanding of survival bottlenecks to other stocks and salmon species, the Bottlenecks to Survival Program, a partnership between the Pacific Salmon Foundation and British Columbia Conservation Foundation, is establishing an extensive marine and freshwater PIT tagging and monitoring program across the east coast of Vancouver Island. In addition, this infrastructure facilitates comparisons between hatchery and wild survival, investigations into freshwater survival, experimental hatchery releases, improved escapement estimates, refined stock assessments, and more. Herein we provide an overview of our methods and lessons learned from the first four years of the program.

Jamieson Atkinson, jatkinson@bccf.com

2:40 PM

Detection of Environmental DNA using CRISPR-Cas12 Technology

Environmental DNA (eDNA), DNA released from an organism into the environment, is a non-intrusive tool for monitoring species presence. Environmental DNA is used widely for monitoring salmon recolonization and migrations, but current methods require a quantitative polymerase chain reaction (qPCR) in a lab to identify the presence or absence of a target species. While streamside eDNA collection takes only minutes, outsourced sample processing time may take weeks to months. Thus, a rapid and field-deployable eDNA detection system could save researchers resources and time. We developed a CRISPR Cas12a-based assay to detect the presence or absence of 10 salmon species' mitochondrial DNA (mtDNA). An initial loop-mediated isothermal amplification method (LAMP) was developed to amplify a selective region of all salmonid mtDNA. DNA presence is confirmed by using the specific CRISPR "guide" RNA sequences engineered to only identify the target species. Field assays utilize a portable incubator to perform a one-tube LAMP amplification followed by a CRISPR digest, with results analyzed on a lateral flow strip or with UV fluorescence. The assay was piloted on eDNA samples collected from the Snake River and the South Fork Palouse River, and accurately identified expected Chinook presence or absence. Further work includes documenting presence of invasive brook trout in a Puget Sound tributary, monitoring bull trout in the Asotin Creek basin, documenting presence of Chinook salmon in a creek flowing through a U.S. Navy facility, and sampling alpine streams in the Wallowa mountains to detect presence of brook and bull trout.

Tholen Blasko, tholen.blasko@wsu.edu

3:00 PM

Acoustic Telemetry Techniques and Applications for Assessing Juvenile Salmon Passage Behavior at Pacific Northwest Hydroelectric Facilities

Advancements in acoustic telemetry technologies have increasingly offered valuable insight into the behavior of out-migrating juvenile salmon around hydroelectric facilities in the Pacific Northwest. Conducting acoustic telemetry studies requires complex field logistics, yielding large datasets that can fill knowledge gaps surrounding passage dynamics when appropriately analyzed. This presentation provides a comprehensive overview of the methodology applied to an example study, including details on the instrumentation, deployment configurations, data processing, and determining the route of passage through a hydroelectric project. Specific focus is placed on introducing field methods and data processing techniques to inspire future innovative applications of acoustic telemetry for fish behavior studies.

Drew Stang, dstang31@outlook.com

3:40 PM

Effectiveness of Tools used to Evaluate Bull Trout Capture at the Cabinet Gorge Dam Fish Passage Facility

For native salmonids in fragmented systems, successful upstream passage often warrants trapping efforts downstream of hydropower facilities. A robust monitoring and evaluation plan can greatly enhance the performance of such trapping, but requires the appropriate tools to accurately monitor trap performance. We evaluated the accuracy of tools used to quantify Bull Trout attraction, retention, and biomass at the Cabinet Gorge Dam Fish Passage Facility (CGFPF) on the lower Clark Fork River, Idaho. We used many types of passive integrated transponder (PIT) antennas and a Vaki Riverwatcher (Vaki) fish counter to quantify these metrics during 2023 operations. We also utilized underwater camera technology and fish capture data to assess accuracy of these tools. The Vaki estimated daily fish biomass fairly accurately, but tended to overestimate compared to actual captured biomass. Detections at PIT antennas provided a baseline estimate of Bull Trout attraction to the CGFPF. Paired with capture data, PIT detections also provided an estimate of Bull Trout retention. We did not evaluate the accuracy of these estimates with camera technology however, due to extensive video processing time and harsh environmental conditions that limited the technology's application. Camera technology did provide key anecdotal insight on fish behavior and escapement at the trap, which helped explain inaccuracies in the estimated metrics produced from other tools. Our results highlight the trade-offs associated with various monitoring tools. Using a suite of tools to evaluate trap performance is prudent to get an accurate understanding of fish behavior and potential trap inefficiencies.

Tyler Zumwalt, Shana Bernall
tyler.zumwalt@avistacorp.com

4:00 PM

Low head, bidirectional, self-energy generating, continuous passage technology

An innovative, cost-effective, fish passage technology that allows for both upstream and downstream volitional low-head passage of multiple species, is greatly needed. The FishLock technology is based on a patented hydraulic interconnection of two lock chambers operated in opposite directions. The basic operational principles are simultaneous, continuous upstream and downstream fish passage via the interconnected interplay of programmed slide gate openings and closings the two oppositely oriented bypass chamber locks. This design minimizes the intermittent operational interruptions of conventional fish locks and lifts. A pipe bend connects the chambers and a turbine which regulates flow and water exchange between the two chambers, in addition to having the potential to produce a small amount of hydropower to self-support its operation. The fish path, however, is

restricted to the single chamber a fish volitionally enters. By modulating the flow, a downstream-reaching attraction outflow is created that encourages upstream migrating fish to enter, while not overwhelming the swim ability of the fish. At the same time, the upstream gate-opened chamber enables a downstream flow pull attracting downstream migrating fish to volitionally enter the open bypass chamber. The floors of the bypass chambers are designed with a rough nature-like bottom insert, creating variable low flow pockets to facilitate passage of fish with a range of swim abilities. This technology is modular, economical, and ideally designed to address the needs of low dead dam, remote barriers and culvert fish passage.

Mike Messina, Redwood Stephens, Janine Bryan
Mike.messina@whooshh.com

4:20 PM

Using visual recognition technology to automate sonar counts of salmonids returning to spawn

Sonar imagery is being used at many locations throughout the U.S. West Coast, Canada, and Alaska to count and measure the number of salmon returning to spawn. Sonar has many advantages but is dependent on manual review of the imagery filmed. As a result, it is expensive, and deployment is constrained by the cost. What if the imagery could instead be reviewed automatically using the latest in visual recognition and artificial intelligence technology? A team representing Caltech. MIT and UMass, in collaboration with ADFG, NMFS, and CDFG, has developed a prototype system that automatically counts salmon as they migrate upstream to spawn on the Kenai River in Alaska. Our prototype has been shown to come within 10% of human estimates, determined by our collaborators to be acceptable performance for deployment and use. Our system is based on combining three technologies: (a) Sonar camera imaging, (b) Computer vision and machine learning techniques training accurate algorithms to interpret sonar video and detect, track and count fish automatically, and (c) Cloud computing, to collect and annotate an immense body of video from multiple sources to train and test our algorithms, deliver our technology to users through browser interfaces, and deliver trained models to edge or cloud devices that are installed near the cameras in the field for inexpensive real-time computing. To efficiently expand our system to cover salmon rivers on a region-wide basis, we are breaking new ground with a goal of making the computer models generalizable and self-training.

Eric Young, skagitsalmon@gmail.com

4:40 PM

Use of an Acoustic Telemetry Pressure Tag to Evaluate Behavior and Approach Depth of Juvenile Salmonids at Yale Dam

In order to design a successful fish passage facility, it is important to understand how juvenile salmonids approach and explore the dam forebay. Fish approach depth is an understudied aspect of this behavior. We utilized a pressure-sensitive acoustic telemetry tag to provide additional information for the passage facility that PacifiCorp is designing for downstream passage of juvenile salmonids at Yale Dam on the Lewis River, WA. During the 2023 outmigration, juvenile Chinook Salmon, Coho Salmon, and steelhead were implanted with acoustic transmitters, including a subset implanted with an Advanced Telemetry Systems SS300P pressure tag to track the depth of the tagged fish as they moved through and explored the forebay region of the dam. Tags were found to be accurate to within several centimeters. Study fish implanted with pressure tags approached and spent most of their time within the forebay near the surface. For all three species, more than 95% of all detections were within 20 feet of the surface, and half within 6 feet. Both median swimming and maximum sounding depths were greatest among juvenile Chinook, although sounding behavior was also observed among juvenile Coho and steelhead. Most study fish sounded to depths greater than 25 feet, and some dove to 100 feet or more, which likely reflected attempts to seek passage through Yale Dam. This information will be combined with ongoing Computational Fluid Dynamic modeling efforts to help determine the location, orientation, and operational regime of the future downstream collection facility.

Leah Nagel, lnagel@fourpeaksenv.com

5:00 PM

Local hydraulics influence habitat selection and swimming behavior in adult California Central Valley Chinook salmon at a large river confluence

Migratory habitat selection in adult anadromous salmonids occurs in response to a combination of physical, chemical, and biological cues. Migratory behavioral responses to localized hydraulics are not well understood and hydraulic flow features can be particularly complex at confluence junctions. In some cases, confluence hydraulics may play a partial role in migratory routing, with implications for population structure and potential hybridization. Our study investigated two questions about such confluences: (1) Can patterns in migratory microhabitat selection or migratory swimming behavior in adult Chinook salmon be attributed to micro-scale hydraulic conditions driven by discharge magnitude and ratio at a confluence? (2) What is the relative influence of selectivity for hydraulic conditions compared to temperature and/or turbidity in micro-scale habitat selection or migratory swimming behavior at a confluence? A fall 2019 migration of Chinook salmon (Oncorhynchus tshawytscha) at the Feather and Yuba River confluence in northeastern California served as a testbed. Using dual-frequency identification sonars, distinct physical microhabitats throughout the confluence were repeatedly sampled during two periods with differing tributary discharge magnitudes and ratios. A combination of conveyance (m^2/s), temperature, and turbidity best predicted micro-scale detection rate ($p < 0.001$). A combination of all hydraulic variables examined best predicted milling behavior ($p < 0.001$), while backtracking behavior was best predicted by temperature ($p < 0.01$). This study provides evidence that channel hydraulics play an active role in the integrated navigational cues utilized by migrating adult salmon and should be considered in future investigations of homing and straying in anadromous salmonids.

Sean Luis, sean.luis@fishsciences.net

Josh Williams, WDFW

Tribal Perspectives on Aquatic Habitat Restoration

Moderator: Eric Berntsen

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Tuesday, April 30, 1:40 PM to 3:20 PM

Symposium Abstract

Native American Indian Tribes and First Nations people in Canada have been focused on bringing back sustainable populations of culturally significant fish and wildlife species that were severely impacted by colonialization. Land use change, habitat degradation, and introduction of non-native species over the last 100 years has caused significant decline of anadromous salmon and steelhead runs and native resident fish populations within the Columbia River System as well as other water-dependent wildlife. Designing habitat restoration and management to bring back culturally significant species incorporates elements often absent from traditional restoration, including leveraging traditional ecological knowledge, promoting first foods such as camas, huckleberry, and water potato in restoration design, and incorporating tribal youth and tribal membership to bring connection back to the land. Talks in this symposium will highlight restoration and management efforts by different Tribes and First Nations to bring back culturally significant species in a manner that incorporates traditional ecological knowledge, first foods, and the broader, multigenerational tribal/First Nation community.

1:40 PM

Traditional Ecological Knowledge at Work: Adapting Indigenous Practices to Inform Ecosystem-Based Management Decisions for Herring and Salmon in Puget Sound

Pacific herring are a culturally important species for Native American Indian Tribes and First Nations throughout the Salish Sea and play a key role in the marine food web, supporting salmon and many other culturally important species. For salmon, herring are both a key food source as well as a buffer against predation and are therefore integral to their survival and recovery. Beginning in 2021, Long Live the Kings, the Nisqually Indian Tribe, the Port Gamble S'Klallam Tribe, and other partners initiated a study to better understand population dynamics and test recovery strategies for herring in areas of Puget Sound known to support historic and current spawning populations. Oral histories from elders of the Nisqually Indian Tribe describe herring spawning in traditional Nisqually waters, but current spawning locations and timing are unknown and are not well described by western scientists. The Port Gamble Bay herring stock has declined since 2000, and egg predation remains a potential limiting factor in recovery efforts. Since time immemorial, Coast Salish Tribes and Alaska Natives have collected herring eggs for harvest by placing evergreen trees and branches in nearshore waters during spawning season. We adapted this practice to supplement spawning habitat and better understand what is limiting herring spawning success in these areas. This project aims to create a model for incorporating traditional ecological knowledge into local herring and salmon recovery actions across Puget Sound, empowering tribal communities and local stakeholders with recovery tools that connect past to present.

Jayde Essex, jessex@lltk.org

2:00 PM

Aquatic Invasive & Non-Native Species: An Indigenous Perspective

The Nez Perce Tribe's Aquatic Invasive & Non-Native Species Project was established in the fall of 2021. The intention of forming this project was to address the growing concerns of invasive and non-native aquatic species introductions and spread

throughout the usual and accustomed homelands of the Nez Perce Tribe and the impacts these species have on native species, especially those of cultural significance for the indigenous communities.It has become apparent that invasive and non-native species do have significantly negative impacts on indigenous communities, cultural resources, traditional practices, and the inclusion of future generations within their indigenous culture itself. The involvement of indigenous communities and their knowledge systems could be a great asset in the fight against aquatic invasive and non-native species issues because of their extensive knowledge of their homelands and the importance surrounding the interactions between plant and animal species throughout the land and how they support each other which in turn supports tribal and nontribal communities alike. Traditional Ecological Knowledge Systems can be used in creating more effective public educational outreach, preventing invasive and non-native species introductions, early detection, and rapid response plans. Once established, aquatic invasive and non-native species are very difficult, if not impossible to irradicate, requiring significant funding and effort to support ongoing monitoring and removal/restoration projects. In addressing the invasive and non-native species issues, there will be additional ecological benefits that will support current and future natural resources projects, especially those involving anadromous species.

Anthony Capetillo, anthonyc@nezperce.org

2:20 PM

Recent adaptations of the Kootenai river native fish conservation aquaculture program to restore white sturgeon and burbot

The Kootenai River White Sturgeon Acipenser transmontanus and Burbot Lota lota maculosa were once abundant in the Kootenai/ay River Basin in Idaho and Montana, USA, and British Columbia, Canada. Kootenai White Sturgeon remain listed as endangered in both countries, and Burbot natural recruitment remains very low despite recent successes meeting interim goals of warding of extinction / extirpation by filling recruitment gaps and re-building population structures via conservation aquaculture, and ecological restoration actions. The Kootenai Tribe of Idaho's (KTOI) Kootenai River Native Fish Conservation Aquaculture Program (KRNFCAP) goals are, avoid extirpation and rebuild abundance to jump-start natural recruitment, and support cultural and recreational harvest. Beyond rebuilding abundance, the conservation hatcheries also 1) spawn, rear, and release fish in a manner that supports monitoring, research, and evaluations of post-release performance of hatchery White Sturgeon and Burbot; and 2) release early life stages across habitat types/conditions in a manner that allows long-term evaluation of recruitment failure, and habitat restoration outcomes. By doing so, conservation aquaculture is an integral part of a large multi-strategy ecosystem restoration RM&E effort. The presentation will provide a summary of recent program adaptations implemented in response to recent RM&E results concerning the current status of the focal species and to the current ecological state of the Kootenai Basin.

Brian Michaels, brian@kootenai.org

2:40 PM

Benewah Watershed Stream and Floodplain Restoration: Building Climate Resilience for Native Trout

One of the main goals of the Coeur d'Alene Tribe's Fish and Wildlife Program is to increase westslope cutthroat trout populations through restoration of landscape processes that form and sustain riverine habitat diversity. The Program recently completed a geomorphic assessment to determine areas in the upper Benewah Creek Watershed that would have the highest potential for floodplain restoration. The characteristics that were examined included valley type, ratio of valley width to active channel width, land cover type, land use, proximity to important spawning and rearing habitat, and Tribal ownership. Three main project sites were prioritized for restoration resulting from this effort. The prominence of floodplain attributes and processes at restored sites may help buffer channel networks from disturbance and instill greater resilience to climate change. The objectives

for the projects are to (1) restore capacity of wetlands to mitigate drought by increasing the water table and improving hyporheic connectivity, (2) enhance fish refugia, (3) provide habitat for culturally important wetland plant and wildlife species, and (4) provide meaningful engagement of Tribal youth interns through monitoring of project outcomes. Two projects are scheduled to be completed over the next 2-3 years that will aid in this effort.

Stephanie Hallock, stephanie.hallock@cdatribe-nsn.gov

3:00 PM

Towards a Prioritization Approach for Aquatic Habitat Restoration Projects that Incorporates Indigenous Interests

The Kalispel Tribe of Indians Water, Habitat, & Environment Program has developed a prioritization approach for aquatic habitat restoration projects on aboriginal lands in Northeast Washington and North Idaho. Criteria and ranking scores quantify whether a potential project addresses Indigenous interests, impairments to habitat forming processes and hydrologic connectivity, and climate resilience through promotion of environmental variability and spatial heterogeneity. Other criteria include degree of landowner support, cost, likelihood of obtaining funding, certainty of project success, difficulty of design and permitting, and proximity to other projects and at-risk fish populations. Based on ranking scores, a planning, construction, and monitoring schedule can be developed for each approved project. Real-life examples of applying the approach will be provided, along with lessons learned and potential areas for improvement.

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AMERICAN FISHERIES SOCIETY

Washington - British Columbia Chapter

2025 Conference, Vancouver, BC

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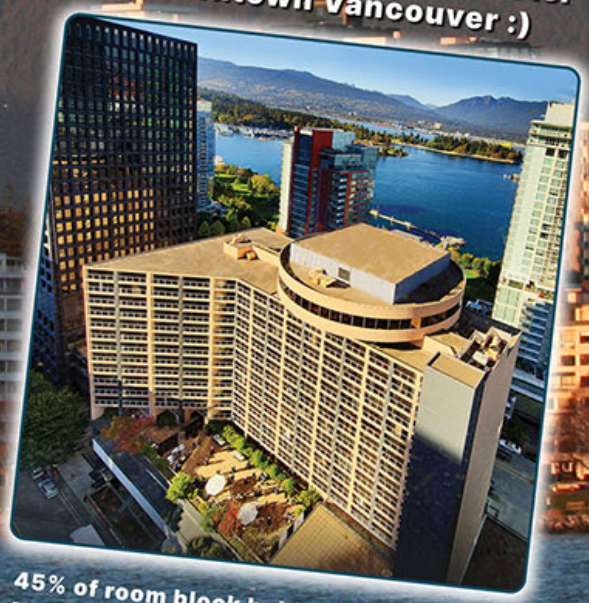

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