Tuesday Morning

Room	**DISCOVERY HALL – HORIZON (All) (No Video Available)**			
8:30 - 9:00	Welcome Remarks			
9:00 - 10:00	Plenary Session – Chairwoman Carol Evans, Spokane Tribe of Indians			
10:00 - 10:30	Break (Light Refreshments Provided)			
Room	**VISTA (YouTube)**	**HORIZON A (YouTube)**	**HORIZON C (YouTube)**	**HORIZON D (YouTube)**
Symposia Session	Middle Columbia River: Restoration of tributary confluences, cold water refuge, and sediment management	Innovative technological solutions for fish and fisheries management and conservation in Africa	Watershed approaches to fish passage: Past, present, and future 1	Current trends and knowledge of aquatic organism passage through culverts 1
Session Chair(s)	*Bill Sharp & Josh Epstein*	*Céline Hanzen & Matthew Burnett*	*Melanie Gange & Michael Bailey*	*Shane Scott*
10:30 – 10:50	EPA Columbia River Cold Water Refuge Plan	Temporal and spatial ecology of an iconic Labeobarbus spp. in a socio-economically important river	Creating a Watershed Moment for a Watershed Approach to Fish Passage	Effects of environmental and behavioural factors on New Zealand fish swimming performance and upstream passage success
10:50 – 11:10	Cool Project on a Hot River: A Basin Approach to Restoration of the Yakima Delta	Impact of irrigation practices on Gilgel Abay, Ribb and Gumara Fisheries, Tana Sub-Basin, Ethiopia	Partnering for a Future of Fish Friendly Stream Crossings	Washington's Fish Passage Barrier Inventory & Assessment Program – An Overview
11:10 – 11:30	Evaluation of Movement and Survival of Juvenile Steelhead and Coho in the Klickitat River, Washington, 2018-2019	Slippery customers for conservation: diversity, distribution and spatial ecology of freshwater eels (*Anguilla* spp.) in South Africa.	Managing Region Wide Remediation Programs	Monitoring and Assessment Protocol for Aquatic Organism Passage at Water Crossings
11:30 – 11:50	Managing Sediments Released from Dam Removal to Enhance Ecological and Cultural Values	Monitoring the efficacy of a lowland instream barrier on the Thukela River and the importance of river connectivity	Applying a Strategic Watershed Approach to the Fish Passage problem in British Columbia, Canada	Fish Passage Barrier Correction at State Highways in Washington State
11:50 – 12:10	Thermal Enhancement at the Horsetail Creek - Columbia River Confluence	The current status of DNA barcode reference databases for native and introduced freshwater fish in South Africa	A Tale of Two Rivers	
12:10 – 12:30			Facilitating fish passage at a watershed scale—opportunities and challenges for federal programs	
12:30 – 13:45	Lunch (Catered)			

Tuesday Early Afternoon

Room	**VISTA (No Videos Available)**	**HORIZON A (YouTube)**	**HORIZON C (YouTube)**	**HORIZON D (YouTube)**
Symposia Session	Charting a course for interagency coordination on fish protection R&D under the U.S. federal hydropower MOU	Is there a silver bullet for silver eels? 1	Watershed approaches to fish passage: Past, present, and future 2	Current trends and knowledge of aquatic organism passage through culverts 2
Session Chair(s)	*Dana McCoskey, Connie Svoboda, Locke Williams*	*Jesse Waldrip*	*Melanie Gange, Michael Bailey*	*Shane Scott*
13:45 – 14:05	Overview of the Federal Hydropower MOU and the DOE Water Power Technologies Office's fish passage and protection R&D priorities	Understanding and Estimating Turbine and Total Project Survival of Silver Eels	Scaling Migratory Fish Population Benefits from Dam Removals	A passage for all: Including wildlife habitat connectivity elements into fish passage projects.
14:05 – 14:25	Advancing Environmental Research Priorities at the Bureau of Reclamation	Direct observation and assessment of American eel passage through a Restoration Hydro Turbine	Reconnecting the Kootenai River Floodplain to Restore Burbot Lota lota maculosa	Use of Flexible Baffles to Improve Aquatic Organism Passage (AOP) through Culverts in North America
14:25 – 14:45	USACE-ERDC Capabilities for Fish Passage	Reviewing a Decade of American Eel Passage at Roanoke Rapids, NC: Lessons Learned from Monitoring Efforts	Beyond the Thalweg, Fish Passage in 2-D	Culvert Baffles – A low-cost fish passage solution
14:45 – 15:05	Spurring Innovation through Prize Competitions	Behavioral guidance to improve downstream passage survival of American Eel on the St. Lawrence River	The sustainability challenge between irrigated agriculture and sustainable inland fisheries. Using otolith microchemistry in infrastructure planning.	When Culvert Replacement is Not an Option: Current Rehabilitation Technologies
15:05 – 15:25	Overview of the Justice40 Initiative and Pathways to Achieving a More Environmentally Just and Equitable Clean Energy Transition	Comparison of bubble curtain and net barrier for the downstream guidance of *Anguilla anguilla*	Channel incision, a watershed scale disturbance influencing fish passage and the role of in-stream wood	Catering to different forms of fish locomotion
15:25 – 15:45	Collaboration Between Private Industry and DOE's National Laboratories	Hydrodynamic influences of a novel bypass on approaching migrating silver European Eels	Remediating Barriers and Restoring Salmonid Habitat in Watersheds with Legacy Logging Impacts in Coastal Northern California	
15:45 – 16:15	Break (Light Refreshments Provided)			

Tuesday Late Afternoon

Room	VISTA (No Videos Available)	HORIZON A (YouTube)	HORIZON C (YouTube)	HORIZON D (YouTube)
Symposia Session	Charting a course for interagency coordination on fish protection R&D under the U.S. federal hydropower MOU	Is there a silver bullet for silver eels? 2	Watershed approaches to fish passage: Past, present, and future 3	New and emerging technologies in fish passage 1
Session Chair(s)	*Dana McCoskey, Connie Svoboda, Locke Williams*	*Jesse Waldrip*	*Melanie Gange, Michael Bailey*	*Lucas Stiles*
16:15 – 16:35	Fish Protection Prize 2020: Center Sender	Using the Migromat ® biomonitoring system to predict downstream migration of Anguillid eels	Flood Control Improvements within the Lower Fraser Watershed	Innovative concept and weir control optimization for the highest fish pass in the Netherlands
16:35 – 16:55	Deal with the Devilfish: A Nature-Inspired Fish Protection Screen	Monitoring of silver eel's downstream migration based on acoustic images: automatic and operational counting method	RADical fish passage	Hydraulic study of auxiliary flow in a pool-type fish pass
16:55 – 15:15	Material enhancement for extended life and monitoring of net diversion systems for aquatic species at dams.	Not just the pump; broader considerations for downstream migrating silver eels at a 'fish-friendly' pumping station	Negotiating the future of dams through a systems-based role-play simulations	The Fish Migration River in the Netherlands – from vision to realization
15:15 – 15:35	Town Hall Q&A	Maximising the performance of an alternative downstream passage route for silver European eel at pumping stations	Integrated Calapan Lake and Baruyan River, Oriental Mindoro, Philippines Watershed Development	Assessing Aquatic Fragmentation across Political Boundaries: Building a Regional Aquatic Barrier Inventory and Prioritization Tool that Incorporates Local Relevance and Leads to Implementation

Wednesday Morning

Room	**DISCOVERY HALL – HORIZON (https://youtu.be/9Cmmw0NW1gA)**			
8:30 - 8:45	Presentation of the 2022 Career Achievement Award to Dr. Alexander Haro, USGS			
8:45 – 9:45	Plenary Session – Dr. Gordon O'Brien, University of KwaZulu-Natal			
9:45 – 10:15	Break (Light Refreshments Provided)			
Room	**VISTA (No Videos Available)**	**HORIZON A (YouTube)**	**HORIZON C (YouTube)**	**HORIZON D (YouTube)**
Symposia Session	When fish passages did not work as intended: Lessons learned and future perspectives 1	Fish passage challenges and innovation: High head and diversion dams 1	Hydropower & Fish 1	New and emerging technologies in fish passage 2
Session Chair(s)	*Lisiane Hahn, Luiz Silva*	*Tobias Kock*	*Marcell Szabo-Meszaros & Daniel Deng*	*Lucas Stiles*
10:15 – 10:35	Effective Fish Ladders in Hydro Dams in Himalayan Region: Is it Possible?	Safe Passage at Big Bar, Canada	Evaluation of the two different type fish passages in River Ceyhan, Turkey in terms of biological and hydrological aspects	10 years experiences and optimizations of the fish lift/lock "der Wasserwirt"
10:35 – 10:55	Fish passage: when the barrier needs to be reinforced	Improving Fish Migration at the Shannon Hydro-Electric Scheme in Ireland	Efficiency of bypasses associated with inclined or angled low bar-spacing racks to protect Atlantic salmon smolts and European silver eels at small to medium hydropower plants	A Scaled Denil Fishway for Upstream Passage of Arctic Grayling
10:55 – 11:15	The efficiency of fishways for long-distance migratory species in large dams in the Amazon Basin	Big Dam on the Little River: Designing a Technical Fishway for the Papermill Pond Dam	Numerical assessment of fish injury risk combining agent-based fish behavior with turbine blade-strike detection	A successful upstream passage system for European eel Anguilla anguilla on the Tirso River (Sardinia, Italy) as a functional and replicable model on low head dams
11:15 – 11:35	Homing and temporal fidelity: additional challenges to the use of passages as a conservation tool for Neotropical freshwater fishes	Feasibility of upstream and downstream fish passage of salmon and steelhead at high-head dams on the Tuolumne River, California	Fish-related Performance Evaluation of Turbines in Industry Settings	Evaluation of the Whooshh Fish Transport System for Passing American Shad Upstream at Hydropower Dams
11:35 – 11:55	Downstream passage constraints and floating weir collector use at a medium-sized dam in California	Designing a Fish Collector That Fluctuates 183 Feet in Elevation: The Floating Fish Collector for Cougar Dam	Design and Biological Testing of a New Turbine Runner Installed at Ice Harbor Lock and Dam	Fishheart a hydraulic fishway
11:55 – 12:15		The unique fish passage at Cle Elum	Characterization of the Ice Harbor Improved Fish Passage Turbine	Design and future implementation of selective fish passage research at FishPass
12:15 – 13:30	Lunch (Catered)			

Wednesday Early Afternoon

Room	VISTA (No Videos Available)	HORIZON A (YouTube)	HORIZON C (YouTube)	HORIZON D (YouTube)
Symposia Session	When fish passages did not work as intended: Lessons learned and future perspectives 2 Statistical methods for evaluating fish passage and its effects on fishes 2*	Fish passage challenges and innovation: High head and diversion dams 2	Hydropower & Fish 2	New and emerging technologies in fish passage 3
Session Chair(s)	*Lisiane Hahn, Luiz Silva* *Russell Perry, Dalton Hance, James Faulkner*	*Tobias Kock*	*Marcell Szabo-Meszaros & Daniel Deng*	*Lucas Stiles*
13:30 – 13:50	Recovery of river connectivity in the Czech Republic: enormous effort along with intensive financial support versus hard reality	Howard Hanson Dam, High Head, Steep Slope, Downstream Fish Passage	Ecological Impact Scorecard of Hydropower Plants and Mitigation Measures	Experimental investigations of lighting to improve passive sorting of invasive Sea Lamprey from desirable fishes in support of selective fish passage
13:50 – 14:10	An open discussion about uncertainties in fish passage science.	Speed Kills…. or does it? Howard A Hanson Dam (HAHD) Steep Slope Bypass Design	Utility of environmental DNA (eDNA) in hydropower-impacted riverine systems for fish biodiversity and ecosystem assessments, and fish passageways.	Selective Passage: Automating invasive removal at fish passage facilities
14:10 – 14:30	Advances in statistical analysis of fish passage: from instantaneous events to life cycles	North Fork Dam Juvenile Collection System Performance	A three-phase numerical model to predict TDG downstream of Hells Canyon Dam	Acoustic Tag Signal Identification Using Deep Learning Techniques
14:30 – 14:50	Why Should I Care About Better Statistical Models for Fish Passage Evaluations and What Do Better Models Look Like?	Does the passage through a bypass installed in hydropower plant affects the physiological and health status of Atlantic salmon smolts?	Development of replicable exploitation cursors implemented to improve silver eel migration at HPP facilities	Optimising environmental DNA (eDNA) metabarcoding through replication; achieving confidence in the presence/absence of European eel in pumped river catchments
14:50 – 15:10	Jointly Modelling Covariate Effects on Survival and Mortality	Farmers Horizontal Flat Plate Fish Screen at Derby Dam in Sparks, Nevada	Direct turbine passage survival and injury of adult American eels and river herring at a hydropower project in Maine	Results from First Deployment of Fathom Vision: A Novel AI-based Real-Time Fish Detection and Species Classification System
15:10 – 15:40	Break (Light Refreshments Provided)			

Wednesday Late Afternoon

Room	VISTA (No Videos Available)	HORIZON A (YouTube)	HORIZON C (YouTube)	HORIZON D (YouTube)
Symposia Session	Fish passage for diverse audiences	Statistical methods for evaluating fish passage and its effects on fishes 2	Hydropower & Fish 3	New and emerging technologies in fish passage 4
Session Chair(s)	*Alison Colotelo*	*Russell Perry, Dalton Hance, James Faulkner*	*Marcell Szabo-Meszaros & Daniel Deng*	*Lucas Stiles*
15:40 – 16:00	Salmon Power: Generating Excitement in Students	Modeling Passage and Survival of Juvenile Salmon through Hydroelectric Dams	Snake River Steelhead Overshoot and Overwintering in the Upper Columbia River Basin	An Introduction to BAFF Systems and Applications in Fish Passage
16:00 – 16:20	Once Upon a Stream: How to Recruit Heroes to a Future Fish Passage Workforce	An evaluation of factors affecting powerhouse passage of spring migrant smolts at federal dams of the lower Snake and Columbia rivers	Trials and tribulations in estimating fish escapement at a dam where migrating fish do not always use the fish ladders	Development and Evaluation of Underwater Acoustic Deterrent Systems (uADS) to Control Invasive Carps
16:20 – 16:40	Engaging the Future Fish Passage Workforce through their Teachers	Direct and Carryover Effects of Freshwater, Marine and Fish Conditions on Juvenile, Ocean, and Adult Survival of Snake River Chinook Salmon	Movement behavior of brown trout (Salmo trutta) parr during simulated hydropeaking – An imaging-based tracking approach	Fish behavioral responses to direct current pulse patterns for use at electric barriers
16:40 – 17:00	Communicating Fish Passage Science in a Digital Age	Which Way Did It Go? Continuous Time Multi-state Markov Models Applied to Fish Passage Data	Benefits, Distribution, and Costs of Fish Passage, Fish Protection, and Flow Mitigation Requirements Created During the US Hydropower Licensing Process	Hydraulic Characterization and Live Fish Bio-Testing of Natel Energy's Restoration Hydro Turbine
17:00 – 17:20	History and Process for a Distinguished Project Award – focus on evaluations	Multidirectional, multistate models for resolving adult steelhead migration pathways past dams		Tobique Narrows Downstream Fish Passage

Thursday Morning

Conference Room	**DISCOVERY HALL – HORIZON (YouTube)**			
8:30 - 8:45	Presentation of the 2022 Distinguished Project Award			
8:45 – 9:45	Plenary Session – Dr. Evelyn Habit, Universidad de Concepción in Chile			
9:45 – 10:15	Break (Light Refreshments Provided)			
Room	**VISTA (No Videos Available)**	**HORIZON A (YouTube)**	**HORIZON C (YouTube1 Youtube2)**	**HORIZON D (YouTube)**
Symposia Session	Cross-continental fish passage and conservation research network	Fish passage challenges and innovation: High head and diversion dams 3	Dam decommissioning and removal: State of the practice and future perspectives 1	Design, application, and performance of nature-like fishways
Session Chair(s)	*Daniel Zielinski & Ana Silva*	*Tobias Kock*	*Michael Burke, Martin Melchior, Mackenzie Butler*	*Tim Brush, Michael Burke, Mackenzie Butler*
10:15 – 10:35	Introduction to the Cross-Continental Fish Passage and Conservation Research Network	Derby Dam Fish Screen Project Design	Dam Decommissioning and Removal Symposium Overview	Modifying a Nature-Like Fishway on the Cape Fear River, NC
10:35 – 10:55	The influence of flow characteristics on the upstream movement of Sea Lamprey at different spatiotemporal scales.	Fish passage improvements at diversion dams on the Yakima River, Washington	Restoring the Ottaway, Part I: Boardman River Dam Removal and Ecosystem Restoration through Tribal and Local Stakeholder Motivation	Hydrodynamics of a Nature-like Step-pool Fishway
10:55 – 11:15	Hydraulic impact on fish migration in Sariakandhi fish pass of Bangladesh	Survival implications for entrainment by juvenile salmonids at diversion dams on the Yakima River, Washington	Restoring the Ottaway, Part II: Boardman River Dam Removal and Ecosystem Restoration - Infrastructure, Engineering, and Construction Perspectives	Innovative Designs Require Innovative Approaches: CFD-based Design of the Saccarappa Falls Nature-Like Fishway
11:15 – 11:35	The fishpath project: A new idea for fish downstream guidance	The Nelson Dam Project: A multi-benefit approach to diversion dam replacement on the Naches River, WA	Dam Removal in the Carmel River Watershed, California *Split between two YouTube Videos	Hydraulic roughness parameterization in an NLF design - a post-project review
11:35 – 11:55		The New Sacramento River Weir: A Complex Fish Passage Facility Integrated Into A Modern Floodway Project	Carmel River Reroute and Dam Removal Project: Challenges in Design and Construction of a Step-pool Channel	Biological effectiveness monitoring of nature-like fishways; a design perspective
11:55 – 12:15				The Atlantic Coast Nature-Like Fishway Guidelines – derivation, use, and plans for the future
12:15 – 13:30	Lunch (Catered)			

Thursday Early Afternoon

Conference Room	**VISTA (YouTube)**	**HORIZON A (YouTube)**	**HORIZON C (Youtube)**	**HORIZON D (YouTube)**
Symposia Session	Fundamental Science	Biotelemetry for fish passage: Current capabilities, applications, and future advances 1	Dam decommissioning and removal: State of the practice and future perspectives 2	Nature-like fishways: Current philosophy and innovative design 1
Session Chair(s)	*TBD*	*Daniel Deng, Ted Castro-Santos, Lee Baumgartner*	*Michael Burke, Martin Melchior, Mackenzie Butler*	*Randy Beckwith*
13:30 – 13:50	Modeling upstream orientation of trout in a wide laboratory flume	A new, non-invasive fish backpack biologger to measure the physical conditions experienced by swimming fish during downstream passage	Willingness to Pay for Small Dam Removal: A Hedonic Analysis of Plymouth, Massachusetts	Energy Dissipation in Nature-Like Fishways – a 2D Perspective
13:50 – 14:10	A matter of scales: addressing allometry when predicting passage performance through velocity barriers	Preliminary findings on the efficacy and performance of the Innovasea V3D predation tag	Cost Drivers of Dam Removal	A new approach to steep channel design
14:10 – 14:30	Passage through a fishway entrance at various velocities - results from flume experiments with small non-salmonids	Lab-on-a-Fish	Smarter Not Harder: Dam Removal and Sustainable Infrastructure	Examples of Nature-Like Fishway Design Considerations in Steep/High Energy Channels
14:30 – 14:50	Factors affecting Northern Pike (Esox lucius) leaping ability: implications for barrier design in invaded systems	A Miniature Radio-Frequency Transmitter and 3D tracking	Overcoming challenges for floodplain and channel restoration with dam removal	Overcoming Constraints to Design the Island Farm Weir NLF
14:50 – 15:10		Development of implantation methods for acoustic transmitters in juvenile American Shad	Reconnaissance-Level Studies for Dam Removal	
15:10 – 15:40	Break (Light Refreshments Provided)			

Thursday Late Afternoon

Conference Room	**VISTA (YouTube)**	**HORIZON A (YouTube)**	**HORIZON C (Youtube)**	**HORIZON D (YouTube)**
Symposia Session	Global policies on fish passage: Barriers and opportunities for successful policy and management of freshwater resources	Biotelemetry for fish passage: Current capabilities, applications, and future advances 2	Dam decommissioning and removal: State of the practice and future perspectives 3	Nature-like fishways: Current philosophy and innovative design 2
Session Chair(s)	*Luiz Silva & Chris Henderson*	*Daniel Deng, Ted Castro-Santos, Lee Baumgartner*	*Michael Burke, Martin Melchior, Mackenzie Butler*	*Randy Beckwith*
15:40 – 16:00	Actions to restore fish passage in New Zealand: From science to policy and back again	Making Large Scale Telemetry Projects Repeatable and Efficient with Open-Source Software	Albright Power Station Dam Removal: Reconnecting 74.6 miles of the Cheat River	Restoring the Continuity of Two Rivers in Southern Poland - 2022 Distinguised Project Award
16:00 – 16:20	Laws, regulations and policies may contribute to weak decision-making processes for fish passages	Downstream passage of JSATS-tagged European silver eels through 10 hydropower projects on the Lahn River, Germany to evaluate suitability of using out-of-basin fish to supplement sample size in depressed populations.	Opportunities for Training Dam Removal Practitioners (Cut Along This Line?)	Nelson Dam Removal – Use of physical and numerical modeling to design of a nature-like roughened channel fishway
16:20 – 16:40	Using Structured Decision Making to Assess the Consequences of Connectivity: A Case Study in Northwest Michigan	Development, Installation and Assessment of the World's Largest RFID Fish Detection System	Building a national movement to advance fish passage through barrier removal	Nelson Dam Replacement Project: Final Design, Material Sourcing, and Construction Methods
16:40 – 17:00	Cross-Disciplinary Research Perspectives on Fish Passage Policy and Community Engagement	High speed spillway PIT-Tag detection at Lower Granite Dam, Snake River	Identifying and Overcoming Issues with the Removal of Hydroelectric Dams	Middle Fork Nooksack Dam Removal, River Modification to Restore Fish Passage, and Water Supply Improvement

Tuesday
Frontier
5:30:00 PM
In Person: Poster Presentation

Poster Session

Poster Title
A study of fish flow field preference behaviour based on 3D trajectory observations
Biological Performance Assessment toolset for evaluating downstream passage of hydroturbines
Composite fishway
Deep Learning for Fish Identification from Sonar Data
Floodplain restoration downstream of a flood control/hydroelectric dam in the Willamette Valley, Oregon
Large Scale Particle Image Velocimetry (LSPIV) within a Rock Ramp Fishway
Mitigating mainstem thermal passage barriers with cool water refuge – Amon Creek Pilot Project on the Yakima River, Richland, Washington
Process-based Fish Passage Restoration after Dam Removal Under Climate Extremes: York Creek, Napa County, California
Restoration of the longitudinal connectivity at hydro power plant chain at Drava River in Austria
Test of effectiveness of the Coanda intake screens on the Aude and Aiguette rivers for the downstream migration of trout.

Tuesday
Frontier
5:30:00 PM
In Person: Poster Presentation

Abstracts for Poster Session

A study of fish flow field preference behaviour based on 3D trajectory observations

Xiaotao Shi (sxtshanghai@163.com; China Three Gorges University); Yongmeng Wang (2317652984@qq.com; China Three Gorges University);Junjun Tan (310342841@qq.com; China Three Gorges University); Fansen Ke (574048802@qq.com; China Three Gorges University)

Within the “Innovation project”, an old non-functioning fishway made of wood in the River Alterälven in northern Sweden was replaced with a vertical slot fishway made of composite. The fishway is 51 meters long with a water volume of 650 m3 s-1 and a slope of 6%. The lower part is auto adjustable to the downstream water surface. Construction of fishways in composite creates the opportunity to easily adapt it to nearby environments. The sections are modularly built industrially in a controlled environment and it is possible to use the same models for several fishways so they can be made at a lower cost than conventional on site-built fishing routes. The sections consist of a sandwich construction which is vacuum injected thereby achieving a homogeneous laminate without pores. The construction is light, rigid and has high strength. The sandwich construction consists of directional fiberglass, diviny cell and vinyl ester. Within the project, fish migration control was carried out with an installed fish counter (Simsonar Oy). Registered species were Roach, Perch, Pike, Bream, Bleak, Common Dace and Crayfish. Surveys were carried out and the results indicate that fish of different species and sizes passes through the composite fishway.

Tuesday
Frontier
5:30:00 PM
In Person: Poster Presentation

Mitigating mainstem thermal passage barriers with cool water refuge – Amon Creek Pilot Project on the Yakima River, Richland, Washington

Marcella Appel (marcella-appel@bentoncd.org; Benton Conservation District); Derek Stuart (DStuart@nhcweb.com; Northwest Hydraulic Consultants);Jaron Brown (jbrown@nhcweb.com; Northwest Hydraulic Consultants); Rebecca Wassell (becca@midcolumbiafisheries.org; Mid-Columbia Fisheries Habitat Enhancement Group)

The lower Yakima River is a migration corridor connecting spawning habitats in the headwaters of the Cascade Mountains to the Middle Columbia River. Located in an arid region, the lower Yakima waters are wide, shallow and too hot (> 23□C) for salmon migrants during late spring to early fall. Over the past decade, Benton Conservation District and Mid-Columbia Fisheries Habitat Enhancement Group investigated novel solutions for mitigating the lower river's thermal barrier through the development of small-scale cool water refuge habitats. Pockets of cool water on the lower Yakima may provide respite for thermally stressed adult salmonids entering the river when temperatures are suboptimal for summertime migration. In collaboration with Northwest Hydraulic Consultants, we will present a small-scale (1000 m2) cold water refuge project in development at the mouth of Amon Creek, the lowest tributary on the Yakima River. Temperature modeling results and design features for optimization of the thermal refuge habitat will be presented. Climate change is anticipated to exacerbate the already warm mainstem river conditions found within this arid region. Protecting and restoring small scale thermal refuge habitats will be an important tool to help mitigate fish passage barriers created by inhospitable river temperatures.

Tuesday
Frontier
5:30:00 PM
In Person: Poster Presentation

Biological Performance Assessment toolset for evaluating downstream passage of hydroturbines

Rajesh Singh (rajesh.singh@pnnl.gov; Pacific Northwest National Laboratory); Alison Colotelo (Alison.Colotelo@pnnl.gov; Pacific Northwest National Laboratory);Lara Aston (lara.aston@pnnl.gov; Pacific Northwest National Laboratory); Marshall Richmond (marshall.richmond59@gmail.com; Pacific Northwest National Laboratory)

Hydropower is currently the largest source of renewable energy globally. Hydropower plants can have detrimental impacts on the environment and ecology, including direct impacts to the population of anadromous fish. The computational fluid dynamics (CFD)- based Biological Performance Assessment (BioPA) toolset is used for biological evaluations of fish passage through hydropower plants and is one method of transforming knowledge derived from laboratory studies to achieve safe and efficient fish passage. The hydraulic environment of a hydropower plant was evaluated using high fidelity CFD-Discrete Element Method (DEM) simulations. The DEM approach enables to detect collision events of particles as well as computation of hydraulic stressors that a fish can experience in hydropower plants. The predicted particle collision rate was first validated against the experimental data in a water flume that has an idealized hydroturbine distributor model. Next, flow simulations were conducted to evaluate the hydraulic stressors, such as nadir pressure, fluid shear, runner collision, in a prototype of Kaplan turbine in a hydropower plant. Note that these stressors are responsible for injury and mortality of fish in a downstream migration, therefore, the exposure probability of these stressors was also evaluated. The cumulative exposure probability for the nadir pressure and runner collision in the hydropower plant was found to decrease with increased discharge rate. The lowest discharge rate shows the higher value of shear exposure probability. Further, the collision velocity of particles while colliding with runner is computed which is a key factor for evaluating the injury and mortality of fish for different biological response models. The maximum value of collision velocity increases with increased discharge rate. Outcome of the present investigation will enhance the understanding the various hydraulic stressors for biological assessment of hydroturbine passage.

Tuesday
Frontier
5:30:00 PM
In Person: Poster Presentation

Deep Learning for Fish Identification from Sonar Data

Xiaoqin Zang (xiaoqin.zang@pnnl.gov; Pacific Northwest National Laboratory); Adam Meyers (adam.meyers@pnnl.gov; Pacific Northwest National Laboratory);Zhangshuan Hou (zhangshuan.hou@pnnl.gov; Pacific Northwest National Laboratory); Robert Mueller (robert.mueller@pnnl.gov; Pacific Northwest National Laboratory); Daniel Deng (zhiqun.deng@pnnl.gov; Pacific Northwest National Laboratory); Paul Jacobson (pjacobson@epri.com; Electric Power Research Institute);

A machine-learning-based method is developed to detect American eels from ARIS sonar data through several analyses: (1) utilize wavelet transform to filter noises and enhance sonar images; (2) extract individual targets from the training image data with a screening and threshold approach; (3) identify multiple candidate objects from training and testing images using the selective search method; (4) train and apply convolutional neural network models to classify objects into four categories – background, eels, moving sticks, and other objects (e.g., bubble clouds). With laboratory control experiments, favorable conditions for applying the designed detection and classification method are identified. The applicability to the field data, collected at the Iroquois Water Control Dam on the St. Lawrence River, is also evaluated. The machine-learning-based method yields classification accuracy commensurate with human-supervised classification, providing an automated and efficient way to monitor fish migration and passage through hydropower facilities.

Poster Session

Tuesday
Frontier
5:30:00 PM
In Person: Poster Presentation

Floodplain restoration downstream of a flood control/hydroelectric dam in the Willamette Valley, Oregon

Rebecca Flitcroft (becky.flitcroft@oregonstate.edu; USDA Forest Service Research Lab);

Construction of mid-sized hydroelectric and flood control dams may involve the staging of construction materials in adjacent downstream valley-floor locations. This staging area can be degraded for perpetuity, compounding ecological effects of altered patterns of temperature and discharge that result from the dam itself. On the South Fork McKenzie River, OR, a large-scale restoration project was developed to recover ecological processes to the 7-km river section below Cougar Dam that had been used as a staging area for construction of this large rockfill dam designed for hydroelectric power generation and as part of a larger flood control system in the broader Willamette Valley. While this project does not specifically address fish or organism passage at Cougar Dam, it does directly inform ecological recovery of heavily impacted processes associated with dam construction. The goal of the restoration is to reset the geomorphology of the site to a Stage 0 condition, which is characterized by dynamic, multi-threaded channels that are re-shaped over time by river flow and in response to the growth of vegetation. Monitoring of this restoration site has demonstrated patterns of use and recovery in macroinvertebrate and fish communities, and re-positioning of large wood and sediments in response to river flows. Development of spatially varying thermal and water depth characteristics has also been recorded. Work at this site demonstrates the potential for the recovery of ecological processes at heavily impacted staging areas below a dam, and also frames expected responses of process-based restoration below water control devices. In particular, the rate of long-term channel development at this site may be slower compared with sites without hydrological controls (that allow for higher flood events), and ongoing sediment will likely need to be added over time to continually rejuvenate habitats.

Tuesday
Frontier
5:30:00 PM
In Person: Poster Presentation

Restoration of the longitudinal connectivity at hydro power plant chain at Drava River in Austria

Helmut Mader (helmut.mader@boku.ac.at; University of Natural Resources and Applied Life Sciences, Vienna); Sabine Kaefer (sabine.kaefer@verbund.com; Verbund Hydro Power GmbH)

Based on the EU Water Framework Directive (WFD), member states are required to maintain or establish the "good ecological status" for water bodies. Therefore, the restoration of the longitudinal connectivity of rivers is of highest importance for achieving the goal. Over the past decade, Verbund Hydro Power has built migration facilities for fish and other aquatic fauna at all migration obstacles of the Drava River Hydro Power Plant (HPP) chain of 10 HPP's. As a result, the longitudinal connectivity of the Drava River in the southern part of Austria in the large epipotamal fish region will be re-established upon completion of the last fish pass at HPP Feistritz-Ludmannsdorf. Seven of the ten HPP´s are equipped with an enature® Fishpass, (Austria patent No. 507195, EU Patent No. 2157243). At the remaining three HPP´s combinations of pool type Fish passes and nature-like fishways or vertical slot passes has been established. At HPP Annabrücke in the middle of the HPP chain, the highest Vertical Slot fish pass in Europe with a drop height of 26 m (85 ft) with 174 pools and slots was built. At seven of the 10 fish passes, the monitoring, which was done by FishCam Video monitoring, is completed resulting in a score of fully functional between 1.0 and 1.3. All fish species present in the large Epipotamal fish region of the Drava River were able to swim up the fish ladders. Danube salmon (Hucho hucho) with up to 1,200 mm and European catfish (Silurus glanis) with up to 1,360 mm have been documented in videos, proving that the enature® Fishpasses as well as the combined systems are passable for these species and fish sizes. Two monitoring's are still ongoing. With the finalization of the fish pass at HPP Feistritz – Ludmannsdorf in June 2022, the river continuity of the Drava River will be re-established over a total length of 170 km.

Tuesday
Frontier
5:30:00 PM
In Person: Poster Presentation

Test of effectiveness of the Coanda intake screens on the Aude and Aiguette rivers for the downstream migration of trout.

Vincent Mataix (vincent.mataix@edf.fr; EDF CIH, Pôle Énergies Renouvelables); Thierry Lagarrigue (thierry.lagarrigue@ecogea.fr; ECOGEA);Aurélien Frey (aurelien.frey@ecogea.fr; ECOGEA);

TBD

Poster Session

Tuesday
Frontier
5:30:00 PM
In Person: Poster Presentation

Composite fishway

Stefan Stridsman (stefan.stridsman@lansstyrelsen.se; County Administrative Board of Norrbotten); Minna Brodin (minna.brodin@lansstyrelsen.se; County Administrative Board of Norrbotten);Andreas Broman (andreas.broman@lansstyrelsen.se; County Administrative Board of Norrbotten);

Within the “Innovation project”, an old non-functioning fishway made of wood in the River Alterälven in northern Sweden was replaced with a vertical slot fishway made of composite. The fishway is 51 meters long with a water volume of 650 m3 s-1 and a slope of 6%. The lower part is auto adjustable to the downstream water surface.

Tuesday
Frontier
5:30:00 PM
In Person: Poster Presentation

Large Scale Particle Image Velocimetry (LSPIV) within a Rock Ramp Fishway

Amiana Manser (amanser@nhcweb.com; Northwest Hydraulic Consultants);

Rock ramps are a type of nature-like fishway consisting of boulders, cobbles, and other streambed sediments. They are designed to create hydraulically and physically diverse fish passage corridors, and often resemble natural riffles. The purpose of this investigation is to understand velocity distributions within a rock ramp using large scale particle image velocimetry (LSPIV). LSPIV is a remote sensing technique that uses video, captured using a drone in this study, to measure the surface velocity of flowing water. After constructing a rock ramp designed for passing Chinook Salmon, steelhead, and Pacific Lamprey, we utilized LSPIV to analyze the hydraulic complexity of the surface velocities within the rock ramp. The LSPIV results showed clear velocity trends within the fast-moving thalweg, slower flow areas closer to the banks, and within eddies near emergent boulders. We were able to compare the resulting LSPIV velocity map with swimming speeds generally associated with the targeted species of anadromous fish. Understanding these relationships help to inform how the design of rock ramps influence flow patterns and how certain parts of the rock ramp may persuade or dissuade fish passage.

Tuesday
Frontier
5:30:00 PM
In Person: Poster Presentation

Process-based Fish Passage Restoration after Dam Removal Under Climate Extremes: York Creek, Napa County, California

Virginia Mahacek (mahacek@wra-ca.com; WRA, Inc.); Brian Bartell (bartell@wra-ca.com; WRA, Inc.);Jenn Hyman (jennifer.hyman@wra-ca.com; WRA, Inc.);

Process-based restoration of fish passage relies on anticipated natural forces and system responses. Climate extremes recently produced an informal experiment out of the Upper York Creek Ecosystem Restoration and Aquatic Habitat Enhancement Project. The project removed a 50 foot high, 100-year old earthen dam to restore access for steelhead trout (Oncorhynchus mykiss) to approximately 1.6 miles of high-quality spawning and rearing habitat upstream. The design approach left about half of the accumulated sediment in the former reservoir zone in place to be mobilized naturally and distributed downstream to replenish and rebuild geomorphic features. The project installed 36 log structures downstream in York Creek between the dam site and the City of St. Helena. The log structures were intended to retain sediment, support channel rebuilding and floodplain reconnection while also establishing spawning habitat. The dam removal and log structures were complete in September 2020 and subjected to a devastating wildfire just three days later. Remedial repairs/reinforcements were made to six of the log structures based on the extent of their fire damage. Since then, the watershed experienced both extreme drought and record rainfall, including a major atmospheric river event in October 2021. This one season of rain events greatly advanced the restoration process, creating new gravel bars, floodplains, and debris snags downstream of the former dam site. Our poster will describe and explore the post-construction morphological and fish habitat changes through the former reservoir and downstream corridor with a focus on the progress of the process-based restoration.

Tuesday
Horizon A
10:30:00 AM
In Person: Oral Presentation

Abstracts for Innovative technological solutions for fish and fisheries management and conservation in Africa

Temporal and spatial ecology of an iconic Labeobarbus spp. in a socio-economically important river

Matthew Burnett (BurnettM@ukzn.ac.za; University of KwaZulu-Natal); Gordon O'Brien (Gordon.Obrien@ump.ac.za; University of Mpumalanga);Graham Jewitt (g.jewitt@un-ihe.org; IHE Delft); Colleen Downs (Downs@ukzn.ac.za; University of KwaZulu-Natal)

Understanding the biological response to anthropogenic stressors is an important consideration to make when evaluating ecosystem well-being. Fish are effective ecological indicators as they are mobile and can be monitored relatively easily. The socio-economically important uMngeni River in South Africa is a highly regulated 'working river' and has seen a reduction in the numbers of its iconic KwaZulu-Natal yellowfish Labeobarbus natalensis. To understand how this species has adapted to these anthropogenic changes we evaluated the reach-scale movements and habitat use of L. natalensis (n = 43) from August 2018 to August 2019 at Albert Falls Dam and included monitoring environmental parameters using radio telemetry methods. We found L. natalensis showed facultative movements and typically exhibited diurnal activities. Habitat availability was important and appeared to be dependent on refugia during the austral winter and spawning or body condition during austral summer. Spatial movements were cued by water temperature and hindered by semi-permeable instream barriers in the study area. Maintaining adequate flows during critical periods of movement and spawning is important and will assist in maintaining the population of L. natalensis. Improved flow and removal of redundant barriers will improve ecosystem resilience and reduce the impacts associated with increasing anthropogenic stressors on aquatic ecosystems.

Tuesday
Horizon A
10:50:00 AM
In Person: Oral Presentation

Impact of irrigation practices on Gilgel Abay, Ribb and Gumara Fisheries, Tana Sub-Basin, Ethiopia

Dagnew Mequanent (dagnewm5@gmail.com; Bahir Dar University and Amhara Design and Supervision Works Enterprise (ADSWE)); Minwyelet Mingist (minwyeming@gmail.com; Bahir Dar University);Abebe Getahun (abebe12002@yahoo.com; Adiss Ababa University); Wassie Anteneh (wassie74@gmail.com; Bahir Dar University)

In Ethiopia, particularly in Tana Sub-Basin, irrigation development practice is increasing. However, this development ignored the fisheries; no, enough information about its effects. The sub-basin is rich in fisheries, including the 17 Labeobarbus species (the only remaining cyprinid species in the world). Fishing also supports over 6000 fishers. Hence, this study investigated the impact of irrigation practices on the Gilgel Abay, Ribb, and Gumara fisheries. Methods include fish sampling below and above the weirs, expert interviews, key informant interviews, secondary data, and impact significance matrix methods. The data collection time was from July 2019 to June 2020. The analysis of the data was qualitative and quantitative. The existing irrigation system affects fisheries by blocking upstream spawning migration routes (Gilgel Abay Weir and Ribb Dam, for sure catch below the Gilgel Abay Weir, significantly higher than above the weir, Shannon Index (H'), $P < 0.001$). Besides, according to local sources, after 2007, the Gumara and Ribb Rivers became seasonal because of excessive water abstraction for irrigation, resulting in mass fish-killing and the failure of juvenile recruitment to the lake. In one instance, we recorded the deaths of over 930 adults and juveniles on the Gumara and the Ribb Rivers. Because of the low water volume, even non-fishers collect fish from the pools; and during spawning season, fishers target spawning migratory species at the weirs where the catch is prime, which is also a problem. Other threatening elements can also aggravate the impact. Hence, these impacts need to be ameliorated by practicing efficacious water use, catchment treatment, fishery management, fish ladder development, and factor alleviation can be solutions.

Tuesday
Horizon A
11:10:00 AM
Virtual Presentation

Slippery customers for conservation: diversity, distribution and spatial ecology of freshwater eels (Anguilla spp.) in South Africa.

Céline Hanzen (HanzenC@ukzn.ac.za; University of KwaZulu Natal, Pietermaritzburg, RSA); Martyn Lucas (; Durham University);Gordon O'Brien (; University of Mpumalanga); Colleen Downs (; Center for Functional Biodiversity, School of Life Sciences, University of KwaZulu Natal)

Four freshwater eel species (Anguilla spp.) occur in the south and east flowing rivers of southern Africa. From sea to source and back, these facultatively catadromous species are exposed to multiple stressors including migration barriers, habitat alteration and deterioration, pollution and alien and invasive species. These fish are important components of the region's aquatic ecosystems and contribute to the livelihoods of vulnerable human communities. Knowledge regarding the occurrence, abundance, diversity and ecology of anguillids in southern Africa is poor. From 2016, the spatial ecology and distribution of these four species were investigated in South Africa. A noticeable decline and contractions in the spatial distribution of the eel species were observed at different geographic scales in the region. The fate of Anguilla bengalensis is of particular concern with a decline in 80 % of its range in the province of KwaZulu-Natal. Spatial behavior of A. bengalensis, A. mossambica and A. marmorata was investigated using radio telemetry. Tracked eel species exhibited individual variability in 90% home range size, ranging from 1860 m2 to 36000 m2, and core area size representing up to 38% of their home range size. All species had relatively low activity in winter. A lack of territoriality at both inter- and intraspecific level was observed with individuals sharing a high proportion of their respective home ranges. However, some partitioning of their niches was observed through partially differential selection of mesohabitats within our study reach. Finally, barcoding (COI) was found to be adequate to separate the four African eel species and should be used in parallel with traditional morphological identification methods. The present study has improved our understanding of the ecology of African eel species. In this presentation, we will also cover our upcoming studies focusing on their recruitment and escapement ecology along the east coast of Africa.

Tuesday
Horizon A
11:30:00 AM
Virtual Presentation

Monitoring the efficacy of a lowland instream barrier on the Thukela River and the importance of river connectivity

Bradley Van Zyl (bvanzyl1997@gmail.com; University of KwaZulu-Natal); Colleen Downs (Downs@ukzn.ac.za; University of KwaZulu-Natal);Matthew Burnett (BurnettM@ukzn.ac.za; University of KwaZulu-Natal); Celine Hanzen (hanzenceline@gmail.com; University of KwaZulu-Natal)

The development of dams and weirs for South Africa is planned to ensure water security for a growing population in a water-scarce country. Such infrastructures disrupt river connectivity and threatens the well-being of migratory fish species in the region. The Lower Thukela Bulk Water Transfer Scheme (LTBWSS) is an abstraction weir located in the lower Thukela, the second largest catchment in the country. A vertical slot fishway was designed with the structure, to alleviate the effects of the impairment of ecological connectivity. Because of its location, the presence of the LTBWSS both impact the life of the river, the estuary and potentially disrupt the marine ecosystem, including the Thukela MPA. Here, we evaluate the efficacy of the fishway is assessed by its ability to accommodate the upstream movement of migratory fish in passing the barrier. To do this, a Passive Integrated Transponder (PIT) telemetry system was used to monitor upstream movements of PIT-tagged fish past the LTBWSS weir. 157 fish were tagged and8were detected in the fishway. Preliminary results show that river connectivity for tagged fishes is poorly maintained. The novelty of this study highlights the need for further research on this topic within Africa.

Tuesday
Horizon A
11:50:00 AM
Virtual Presentation

The current status of DNA barcode reference databases for native and introduced freshwater fish in South Africa: Foundational knowledge for future eDNA applications

Mahlatse Mashaphu (fortunate.mashaphu@gmail.com; University of KwaZulu-Natal); Colleen Downs (Downs@ukzn.ac.za; University of KwaZulu-Natal);Gordon O'Brien (Gordon.Obrien@ump.ac.za; University of Mpumalanga); Sandi Willows-Munro (willows-munro@ukzn.ac.za; University of KwaZulu-Natal)

DNA barcoding continues to play an important role in the rapid identification of species. In freshwater research, this molecular tool has been used to identify and monitor species of both native and introduced fishes using environmental DNA (eDNA) approaches. However, such methods rely on a barcode reference database linking DNA sequences to species descriptions. South Africa is well-known for biologically diverse ecosystems and eDNA technology could rapidly accelerate species discovery and monitoring. This study reviews the availability of DNA barcode reference data for all native and introduced South African freshwater fish available on the Barcode of Life Database (BOLD) and GenBank. A list of all freshwater fish found in South African rivers was obtained through Fishbase. For each species we noted the availability of the two main molecular markers used for fish eDNA research: the cytochrome oxidase I (COI) and 12S ribosomal RNA (12S rRNA). Of the 180 fish species (159 native species and 21 introduced species), COI data is available for 116 native species and 20 for introduced species on BOLD, while GenBank houses data for 69 native species and 20 introduced species. Much less 12S RNA was available, with reference sequences only available for 58 native and 20 introduced species. Although 73% of native species have COI reference data, a key goal should be the production of a complete reference library for the country. COI may not be variable enough to detect closely related species and so research efforts should also be focussed on improving the 12S rRNA reference library. Developing a complete DNA barcode reference database for all freshwater fishes in South Africa will contribute greatly to developing an eDNA metabarcoding protocol specifically for South African freshwater systems, thus helping in monitoring both native and introduced species in the region.

Tuesday
Horizon A
1:45:00 PM
In Person: Oral Presentation

Abstracts for Is there a silver bullet for silver eels?

Understanding and Estimating Turbine and Total Project Survival of Silver Eels

Steve Amaral (samaral@aldenlab.com; Alden Research Laboratory LLC);

Downstream passage of silver eels athydropower damshas been the focus of considerable researchwith respecttoinjury and mortality suffered during turbine passage and the developmentof technologies and approachesfor reducing turbine entrainment.Not surprisingly, unique behaviors, morphology,and physical attributes that are specific to silver eels have separated them from other species when it comes to estimating turbine survivaland developingeffective fish passage facilities.To understand the level of protection required for silver eels passing downstream at hydropower projects, it is important to determine baseline total project survival rates. This presentation will explore what has been learned from field evaluationsof silver eel turbine passageanddiscuss desktop models for estimating turbine and total projectsurvival.This will include examination of the effectsof turbine type and various design parameters on eel survival rates, as well as why theoretical blade strike probabilityand mortality models used for other fish species (e.g., salmonids, clupeids, andvarious freshwater fishes) are not applicable to silver eels.The use ofappropriate survival modelsshould facilitate the selection anddesign ofpassage facilities capable of achievingtarget survival ratesfor silver eels at any given project.

Tuesday
Horizon A
2:05:00 PM
In Person: Oral Presentation

Direct observation and assessment of American eel passage through a Restoration Hydro Turbine

Sterling Watson (sterling@natelenergy.com; Natel Energy); Abe Schneider (abe@natelenergy.com; Natel Energy)

Freshwater eels are exceptionally vulnerable to injury and mortality at hydropower plants due totheir elongated shape and large size during downstream migration. Laceration, severing, andcontusions have been observed in eels that pass through conventional Kaplan and Francisturbines in the field; however, the dynamics of passage and mechanisms of injury for eelspassing through turbines are not well understood. We will present the results of 33.9 to 65.5 cmlong American eel (Anguilla rostrata) passage testingthrough a 55 cm diameter RestorationHydro Turbine (RHT) operating at its maximum design head of 10 meters and 667 rpm. TheRHT runner was designed to enable safe through-turbine passage of fish with a low bladecount, unique blade shape, and absence of converging pinch points. The tests were conductedwith an acrylic runner housing to enable high-speed video capture of the passage event. Eelswere held for a minimum of 48 hours after passage to assess latent mortality effects, and asubset were examined with X-ray to assess internal injuries. We present the study techniquesas a template for further study of through-turbine fish passage, and share implications offish-inclusive hydropower design for fishery management and hydropower operations.

Tuesday
Horizon A
2:25:00 PM
In Person: Oral Presentation

Reviewing a Decade of American Eel Passage at Roanoke Rapids, NC: Lessons Learned from Monitoring Efforts

Kevin Mack (kevin.mack@noaa.gov; ERT); Twyla Cheatwood (twyla.cheatwood@noaa.gov; NMFS)

Data collected during monitoring of passage operations is used to evaluate success, but also helps resource managers understand fish populations and migration patterns. On the Roanoke River in NC, monitoring efforts have been in place for a decade or more to evaluate how American eel Anguilla rostrata move through the gateway dams on the river: Roanoke Rapids Dam and Gaston Dam. We analyzed upstream eel passage at Roanoke Rapids Dam and examined the relationships between captures and select environmental variables. Additionally, we reviewed a number of monitoring studies associated with fish passage efforts in order to determine if the influx of juvenile eels provided by fish passage are making use of upstream habitats and completing their life-cycle. Over two million eels were captured during the last decade at the Roanoke Rapids Dam, 99% of them in the rewatered stretch of river known as the bypassed reach. High water flows into the bypass reach appear to be strongly associated with upstream movements. Our results support the current passage operations at Roanoke Rapids Dam, however, we also note a decline in eel abundance at the project, and that eels > 200mm in length infrequently make use of eel ladders to move upstream.

Tuesday
Horizon A
2:45:00 PM
In Person: Oral Presentation

Behavioral guidance to improve downstream passage survival of American Eel on the St. Lawrence River

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The American Eel (Anguilla rostrata) is a species of management concern due to substantial declines in indices of abundance over the last several decades. Hydropower is considered to be an important contributing factor in the decline in eel abundance, because turbine passage mortality at hydropower projects can range from 6% to >50%, depending on site-specific factors. Protection of downstream migrants has focused on turbine shutdown and spills, or exclusion from intakes and guidance to alternative, safe passage routes. The morphology (body size and shape) and behavioral characteristics (rheotaxis, thigmotaxis) of eels during downstream migration make turbine passage protection and guidance to alternative passage routes challenging at operating hydropower plants. This is especially true on the St. Lawrence River given the high flows (7,400 m3/s at the outflow of Lake Ontario and 12,000 m3/s at Quebec City); large, unscreened intakes at two large generating stations (Moses-Saunders: 1.96GW, Beauharnois: 1.90GW); and high debris transport during the extended outmigration season. The bi-national Eel Passage Research Center has been researching eel guidance technologies for eel protection since 2013. Our research indicates light is likely to be most effective for eel guidance, and we have designed a large-scale, experimental, above-water eel guidance light array for temporary deployment at the Iroquois Water Control Dam on the St. Lawrence River in 2022. Approximately 400 large eels (>800mm) will be implanted with 180 kHz, high resolution acoustic telemetry tags to observe their behavior as they approach and encounter the guidance array to be operated from July-December. This presentation will summarize the results of our research conducted to date and describe the large-scale study planned for 2022.

Tuesday
Horizon A
3:05:00 PM
In Person: Oral Presentation

Comparison of bubble curtain and net barrier for the downstream guidance of Anguilla anguilla

Velizara Stoilova (velizara.stoilova@kau.se; Karlstad University); Larry Greenberg (larry.greenberg@kau.se; Karlstad University);Eva Bergman (eva.bergman.1868@kau.se; Karlstad University); Olle Calles (olle.calles@kau.se; Karlstad University); David Aldven (david.aldven@vattenfall.com; Vettenfall AB); Rachel Bowes (rbowes@emporia.edu; Emporia State University);

The loss of longitudinal river connectivity has been identified as one of the leading factors for the ongoing decline of migratory fish populations. Downstream passage solutions are more limited than upstream, particularly at larger facilities. Directing downstream migrating fish towards points of safe passage remains a challenge. Amongst the worst impacted species is the critically endangered European eel, thus measures for its protection are imperative. We compared the guidance efficiencies of bubble curtain, net barrier and no barrier control for adult Anguilla anguilla (n.171) at four velocities (0.1 m/s, 0.4 m/s, 0.7m/s, 1m/s) in a large experimental flume. The net barrier showed a higher mean passage rate (51%) compared to control (37%), while no significant difference in passage rates was seen between the bubble curtain (33%) and control. The net barrier passage rate peaked at 0.7m/s velocity (73%) and had a considerably higher (>60%) passage rate compared to the bubble curtain and control treatment at 0.4 m/s. The bubble curtain was inadequate for eel guidance compared to the more efficient net barrier and future solutions involving nets may be effective even at velocities >0.5 m/s.

Tuesday
Horizon A
3:25:00 PM
In Person: Oral Presentation

Hydrodynamic influences of a novel bypass on approaching migrating silver European Eels

Stephen Collier (S.J.Collier-2019@hull.ac.uk; University of Hull); Liam Carter (L.J.Carter-2018@hull.ac.uk; University of Hull);Jonathan Bolland (J.Bolland@hull.ac.uk; University of Hull); Robert Thomas (r.e.thomas02@members.leeds.ac.uk; University of Hull); Rosalind Wright (ros.wright@environment-agency.gov.uk; Environment Agency); ;

Pumping stations impact the safe downstream passage of seaward migrating, critically endangered, silver European eel (Anguilla anguilla). Alternative downstream passage routes could improve escapement but knowledge of eel behaviour at the bypass entrance is required. Since eels sense pressure with a lateral line system, velocity and pressure gradients should have implications for eel behaviour. This study has three objectives: 1.Use Computational Fluid Dynamics (CFD)to examine velocity and pressure fields at thebypass entrance; 2. Use Adaptive Resolution Imaging Sonar to visualise eel responsesto a bypass; and 3. Link eel responses to the hydrodynamics. CFD modelling reveals velocities accelerate from ~0.15 m s-1 (baseflow) to 1.5 m s-1in the 0.3m upstream of the bypass entrance. In thisregion, isovels aresymmetrical and hemispherical, centred on the bypass entrance. Of the 73 eels imaged within 0.3 m of the bypass entrance, 22 (30.1%) appeared to respond to altered pressure and velocity fields, which led to 59.1% of these eels retreating, while 40.9% entered the bypass. Forty-seveneels (64.4%) made physical contact with the bypass entrance; 63.8% of these subsequently entered and 36.2% retreated. Only four (5.5%) eels approached the bypass without non-physicalor contactreactions.

Tuesday
Horizon A
4:15:00 PM
In Person: Oral Presentation

Using the Migromat ® biomonitoring system to predict downstream migration of Anguillid eels

Audrey Thompson (audrey.thompson@kleinschmidtgroup.com; Kleinschmidt Associates);

Hydropower projects are a ubiquitous and permanent feature of the freshwater aquatic landscape in developed areas across the globe. Some of the regions with the most demand for hydropower also correspond to essential freshwater habitat and migratory corridors for endangered aquatic species such as Anguilla. Hydropower development and demand for clean energy will only grow, so finding the best way to generate power while protecting sensitive species is critical. In many cases, continued operation and license renewal are contingent on concerted efforts to protect these species through improved fish passage, fish protection, and other guidance or fish protecting operation modes. Increasingly, models based on environmental variables are developed and implemented to predict downstream movement of eels. The MIGROMAT ® system acknowledges that predictive models are limited by our understanding of how these myriad variables impact behavior of Anguillid eels. Instead of analyzing environmental variables to predict eel migration, the MIGROMAT ® allows biologists to analyze captive eel behavior to predict migratory behavior and allows hydropower owners to manage their operations to protect downstream migrating eels. This presentation will describe the design and operation of the system and review results of monitoring studies that corroborate the results of the MIGROMAT ®.

Tuesday
Horizon A
4:35:00 PM
In Person: Oral Presentation

Monitoring of silver eel's downstream migration based on acoustic images: automatic and operational counting method

Azénor Le Quinio (azenor.le-quinio@edf.fr; EDF R&D/ INRAE); Eric De Oliveira (eric.de-oliveira@edf.fr; EDF R&D);François Martignac (francois.martignac@inrae.fr; INRAE); Alexandre Girard (alexandre.girard@edf.fr; EDF R&D); Fabrice Zaoui (fabrice.zaoui@edf.fr; EDF R&D); ;

European eels (Anguilla anguilla) are one of the most endangered species. Their socio-economic interest is leading to important conservation policies that needs knowledge on eel's migration behavior to be carried out. Recordings of fish passage by acoustic cameras in section of rivers can therefore help to improve turbine management by adapting it to an almost immediate observation of fish passage, and thus enhance the escapement rate. However, despite their multiple advantages, the analysis of acoustic cameras data is very time consuming. To overcome this limit and handle almost real-time counting of eels, an automatic computer vision algorithm has been developed to detect and identify anguilliform fish, based on a morphological analysis using image-processing tools. This method has been developed on ARIS (Sound Metrics Corp., Bellevue, WA, USA) data, providing a reliable classification rate (Recall = 83.5%, Precision = 73.8%). BLUEVIEW (Teledyne Technologies Inc., Thousand Oaks, CA, USA) data have then been processed by the method which scores similarly (Recall = 74.3%, Precision = 70.2%) showing its transposability and the reliability of the results to study the peaks of migration. These satisfactory results encourage us to pursue these works by adapting this method to other fish species of interest.

Tuesday
Horizon A
4:55:00 PM
In Person: Oral Presentation

Not just the pump; broader considerations for downstream migrating silver eels at a 'fish-friendly' pumping station

Oliver Evans (O.Evans-2016@hull.ac.uk; University of Hull); Jonathan Bolland (J.Bolland@hull.ac.uk; University of Hull);Liam Carter (L.J.Carter-2018@hull.ac.uk; University of Hull); Thomas Hutchinson (thomas.hutchinson-2015@hull.ac.uk; Hull international fisheries institute); Stephen Collier (S.J.Collier-2019@hull.ac.uk; University of Hull); Andrew Don (andy.don@environment-agency.gov.uk; Environment agency); Rosalind Wright (ros.wright@environment-agency.gov.uk; Environment Agency); Rosalind Wright (ros.wright@environment-agency.gov.uk; Environment Agency); Jeffrey Tuhtan (Jeffrey.tuhtan@taltech.ee; Centre for biorobotics, tallin university for technology); Gert Toming (Gert.toming@taltech.ee; Centre for biorobotics, tallin university for technology)

The European eel, Anguilla anguilla, is critically endangered after a severe decline in recruitment, partly attributed to entrainment at intakes including pumping stations. Fish-friendly pumps may provide a downstream passage solution but considerations of when eels approach the pumping station and the impact of non-pump ancillary infrastructure on eel passage (e.g. weedscreens) and their physical health (e.g. outfall) can be overlooked. Here, adaptive resolution imaging sonars (ARIS) was used to image eels approaching the weedscreen upstream of a fully shrouded Archimedean screw pump (ASP). The number of eel approaches per day was influenced by duration of pumping and eels predominantly approached during darkness, only 2.41% of eels approached during daylight. Increasing trash rack bar spacing from 100mm to 212mm increased the percentage of imaged eels that passed through the trash rack from 34.8% to 53.9%. Deployment of passive sensors revealed that passage through the ASP was largely benign, however they identified that collisions with a top-hung flap on the outfall may cause harm to eels. This investigation demonstrates how the fish-friendliness of the entire pumping station should be considered and assessed, not just the pump, especially given the wide variety of site configurations and ancillary structures in the real-world.

Tuesday
Horizon A
5:15:00 PM
In Person: Oral Presentation

Maximising the performance of an alternative downstream passage route for silver European eel at pumping stations

Jonathan Bolland (J.Bolland@hull.ac.uk; University of Hull); Liam Carter (L.J.Carter-2018@hull.ac.uk; University of Hull);Stephen Collier (S.J.Collier-2019@hull.ac.uk; University of Hull); Rosalind Wright (ros.wright@environment-agency.gov.uk; Environment Agency); Robert Thomas (R.E.Thomas@hull.ac.uk; University of Hull); Oliver Evans (O.Evans-2016@hull.ac.uk; University of Hull); David Powell (davidj.powell@environment-agency.gov.uk; Environment Agency); David Powell (davidj.powell@environment-agency.gov.uk; Environment Agency); ;

European eel (Anguilla anguilla) are critically endangered after a multi-decadal decline, partly attributed to entrainment at intakes, including pumping stations. Providing a safe alternative downstream passage route at pumping stations is inherently challenging because water needs to be pumped against gravity. A novel downstream passage route was installed at two pumping stations over two years; bypass location, orientation, entrance shape and guidance structure were altered to maximise the number of eels that approached and entered the bypass. Multi-beam sonar was used to image eel movement and behaviour. Over the entire investigation, 79 eels passed through the bypasses, with the highest attraction efficiency (64.9%) found for a mid-channel bypass with shallow-angle and sub-surface guidance structures. A vertically orientated bypass with a 360° letterbox entrance installed immediately upstream of the weedscreen had an attraction efficiency of 46.9% for eels approaching from upstream and 26.1% for eels retreating from the pumping station. The bypass with the highest entrance efficiency (51.5%) had an otter guard with horizontal bars. These findings represent a step-change in knowledge required to provide safe eel passage at all types of hazardous intakes globally.

Tuesday
Horizon C
10:30:00 AM
In Person: Oral Presentation

Abstracts for Watershed approaches to fish passage: Past, present, and future

Creating a Watershed Moment for a Watershed Approach to Fish Passage

Stacie Smith (stacie.smith@noaa.gov; NOAA Fisheries);

NOAA's watershed approach to fish passage was developed in response to a 2018 independent external review for two of NOAA's key national fish passage programs, the Office of Habitat Conservation's Community-based Restoration Program and the Hydropower Program. The NOAA watershed approach is a conceptual framework to help guide fish passage for NOAA Fisheries' trust resources. This conceptual framework relies on two guiding principles (or tenets) that provide NOAA Fisheries with a consistent framework to implement a watershed approach with external partners. These tenets are: 1) An iterative and adaptive process that is, 2) supported by a foundational understanding (or pillars) of the natural and human environment. Sounds simple, but creating a holistic approach (headwaters to ocean) is anything but. Overview and insight into the making of a watershed approach to inspire your own watershed moment.

Tuesday
Horizon C
10:50:00 AM
In Person: Oral Presentation

Partnering for a Future of Fish Friendly Stream Crossings

Deborah Hart (coordinator@sealaskafishhabitat.org; Southeast Alaska Fish Habitat Partnership);

The Southeast Alaska Fish Habitat Partnership (www.SEAKFHP.org) is one of 20 nationally recognized partnerships (National Fish Habitat Partnership, www.fishhabitat.org) working across the nation to actively engage collaborative regional networks to protect and restore fish habitat across the US. Through this collaborative partnership lens, this presentation will explore examples of past challenges and successes, it will take a deep dive into the recent push to do more (i.e., the Bipartisan Infrastructure Bill!), explore audience engaging ideas at how fish friendly stream crossings just might become the new normal and how we all do business; and ends with a list of tasks to set us all on a course for a future of fish friendly stream crossings.

Tuesday
Horizon C
11:10:00 AM
In Person: Oral Presentation

Managing Region Wide Remediation Programs

Kelly Hughes (kellyh@ats-environmental.com; ATS Environmental);

This presentation highlights the opportunities for a paradigm shift in the way the fish barrier remediation programs can be delivered.Focusing on New Zealand, the development of low-cost, low-impact, yet very effective interventions, has brought about a toolbox of solutions that now sees authorities undertaking watershed, or region-wide programs to restore fish passage.It is no longer a protracted negotiation and design process on a case-by-case basis, seeing just a small handful of projects completed in any given jurisdiction each year.This has brought about a new challenge in as much as managing a significant amount of data from desktop analysis to pre-assessment field surveys through to monitoring.Funding, planning and permitting processes have also needed to change in order to streamline the remediation of 100s if not 1000s of structures per year.

Tuesday
Horizon C
11:30:00 AM
In Person: Oral Presentation

Applying a Strategic Watershed Approach to the Fish Passage problem in British Columbia, Canada

Craig Mount (craig.mount@gov.bc.ca; Province of British Columbia); Simon Norris (snorris@hillcrestgeo.ca; Hillcrest Geographics)

Fish Passage at resource road crossings continues to be large problem in British Columbia (BC), Canada. With a land mass larger than California, Oregon and Washington combined, BC has a massive legacy of roads (>550,000 km) on the landscape. Conservative estimates place the number of culverted crossings on these roads at more than 400,000 - many of which represent a barrier to fish passage. As a result, assessment and remediation of improperly designed / installed / maintained closed-bottom culverts requires a strategic approach, maximizing the habitat de-fragmentation benefits per restoration dollar.

Tuesday
Horizon C
11:50:00 AM
In Person: Oral Presentation

A Tale of Two Rivers

Twyla Cheatwood (twyla.cheatwood@noaa.gov; NMFS); Kevin Mack (kevin.mack@noaa.gov; ERT)

The Santee Basin supports large populations of diadromous fishes on the east coast of the United States. Within the sixteen-thousand-acre basin, the Santee and Cooper rivers are naturally distinct drainages anthropogenically linked by dams and diversions. Constructed in 1942 and rediverted in the 1980's, the Santee Cooper Power and Navigation Project (Santee)impounded the Santee River, diverted water into the Cooper River, and then back to the Santee River. Years of rerouting the natural river flows of the Santee and Cooper rivers has fundamentally changed the way NOAA Fisheries trust species use the rivers. Passage is possible through gateway dams, but the system is heavily impounded with nearly 100 artificial structures blocking fish passage. Santee is undergoing relicensing, providing an opportunity to improve fish passage through the Federal Power Act and Endangered Species Act. With license issuance, Santee will begin studies to inform construction of a fishway on the Santee River, implement adaptive water release schedules to improve sturgeon spawning habitat, and operate a trap/transport facility to relocate sturgeon from the Cooper to the Santee River. Current efforts at the Santee in conjunction with efforts upstream are helping NMFS protect, restore, and enhance diadromous fishes in the Santee Basin.

Tuesday
Horizon C
12:10:00 PM
In Person: Oral Presentation

Facilitating fish passage at a watershed scale—opportunities and challenges for federal programs

Melanie Gange (melanie.gange@noaa.gov; NOAA Fisheries); Michael Bailey (michael_bailey@fws.gov; USFWS, National Fish Passage Program)

This presentation addresses the opportunities and challenges that two voluntary federal programs encounter when funding within a watershed approach to fish passage. The Community-based Restoration Program in NOAA Fisheries began in 1996, and funds a variety of restoration types across the US. The USFWS National Fish Passage Program began in 1999 and focuses on fish passage and aquatic connectivity projects. Both programs have a long history of providing financial and technical assistance, and will provide additional assistance through the Infrastructure Investment and Jobs Act (IIJA). Over time, both programs have supported the restoration community in completing "low hanging fruit"-type projects and have grown to fund complex projects requiring higher levels of technical expertise from both the federal agencies and local project partners. Continued conservation success on the landscape requires synergistic approaches, such as those achieved through a watershed approach. Watershed approaches are important because they conceive, plan, and implement fish passage in a context that incorporates the human and natural elements within a watershed, including a backdrop of a changing climate. The framework includes developing a foundational understanding of the watershed (biotic and abiotic factors, social feasibility, resource balancing, and other aspects unique to the watershed), steps to mitigate project risks, identifying priorities, and evaluating progress. Restoration funders are interested in the benefits that result from such an approach, but may find it difficult to implement or report outcomes within the programs' constraints. In this talk, we will described the matches and mis-matches between using financial assistance and implementing restoration at a watershed scale. Solutions to these mis-matches will be proposed, and opportunities provided by the increased funding under the IIJA will be discussed.

Tuesday
Horizon C
1:45:00 PM
In Person: Oral Presentation

Scaling Migratory Fish Population Benefits from Dam Removals

James Turek (James.g.turek@noaa.gov; NOAA Restoration Center); Gail Fricano (gfricano@indecon.com; Industrial Economics, Inc.);Daniel Hayes (hayesdan@msu.edu; Michigan State University); Adrian Jordaan (ajordaan@umass.edu; University of Massachusetts, Amherst); Mary Baker (marybaker57@gmail.com; NOAA NOS (retired)); Jason Murray (jason.murray@noaa.gov; NOAA-NOS Assessment and Restoration Division); Brandon Kulik (brandon.kulik@kleinschmidtgroup.com; Kleinschmidt Group, Inc.); Brandon Kulik (brandon.kulik@kleinschmidtgroup.com; Kleinschmidt Group, Inc.); ;

NOAA and co-trustees involved in natural resource damage (NRD) cases are responsible for identifying restoration alternatives to address injuries to fish and other biota resulting from contaminant releases. Dam removals are known to restore a suite of ecological services including migratory fish passage and habitats associated with free-flowing rivers. Our interdisciplinary team developed a predictive model to scale fish population recovery benefits for restoration planning in Northeast and Great Lakes regions. The model is founded on both resource and habitat equivalency analysis, employing changes in habitat area, habitat suitability and improvements in fish abundance and density with passage barrier removals. Predicted benefits account for baseline, initial pre-restoration river conditions, dam removal implementation year, annual benefits, and calculated present-value of accrued benefits over a recovery period based on an applied discount rate. Model input includes the quantified weighted usable area in the future restored (impounded) reach, opened river upstream of restored reach, and the reach at and downstream of a targeted dam removal. Example models have been developed for diadromous and potamodromous fish species, with flexibility for users to refine model inputs based on species-specific data for rivers targeted for restoration. An example model run with inputs and output will be presented.

Tuesday
Horizon C
2:05:00 PM
In Person: Oral Presentation

Reconnecting the Kootenai River Floodplain to Restore Burbot Lota lota maculosa

Shawn Young (young@kootenai.org; Kootenai Tribe of Idaho); Nathan Jensen (njensen@kootenai.org; Kootenai Tribe of Idaho)

Re-establishing ichthyoplankton passage to and from off-channel nursery and rearing habitats is a main strategy of the Kootenai Tribe of Idaho's Kootenai River Habitat Restoration Program (KTOI KRHRP). KTOI and collaborative partners aim to restore water and associated nutrient transport to and from off-channel habitats to boost overall ecosystem productivity. By allowing ichthyoplankton access to off-channel habitats that have increased phytoplankton and zooplankton abundance, and increased temperatures, early life stage development and growth should improve, reversing the current situation of persistent recruitment failure of several native fish that remain culturally and spiritually significant to KTOI. As recent as 2009, Burbot were functionally extirpated from the Kootenai/y River and Lake in Montana, Idaho, and British Columbia. A conservation aquaculture program was initiated in 2003, and the first hatchery Burbot were released during 2009. Since those first releases, KTOI has significantly increased the scale of Hatchery Burbot production and releases by way of their Twin Rivers Sturgeon and Burbot Hatchery, operating since 2015. By combining increased production with an extensive Parental Based Tagging protocol, KTOI has released Burbot early life stages, fertilized eggs to fingerling juveniles, across habitat types, including re-connected floodplain wetlands, tracked survival, and correlated survival to environmental conditions at release sites. The early life releases have successfully rebuilt population abundance while simultaneously evaluating habitat dynamics. Kootenai River Burbot restoration strategies now take full advantage of recent re-connections to floodplain wetlands, and are a prime example of successful application of restoring natural fish passage dynamics in floodplains. The outcomes from these restoration activities will presented to illustrate the importance of restored fish passage to large river floodplain and off-channel habitats.

Tuesday
Horizon C
2:25:00 PM
In Person: Oral Presentation

Beyond the Thalweg, Fish Passage in 2-D

William Norris (bill@moreredds.com; Parr Excellence);

1-D hydraulic models provide a widely used tool to assess fish passage that works well until results do not match evidence. The 1-D models only look at thalweg depths and average velocities, but fish can use alternate pathways and use velocity breaks to hold and rest. Alternate pathways and opportunities to rest can influence use of burst verse sustained swimming speeds for evaluating fish passage. 2-D hydraulic models provide a better tool to evaluate fish passage that can evaluate multiple pathways and identify velocity breaks that fish may use.

This 2-D modeling approach was used on Nason Creek where historic observations noted prodigious runs of anadromous salmonids. Although, there is no reference to the presence of anadromous salmonids upstream of the confluence of Mill Creek (~RM 20). Results from an initial analysis of passage contrasted with agency staff and fisherman observations. This prompted more detailed analyses of passage evaluating multiple pathways based on the logic that changing flow levels create varying migration paths adjacent to the thalweg. Multiple migration pathways were identified and analyzed before finding a route that provides successful passage. The findings of these second level analysis show that steelhead can pass reaches previously identified as barriers.

Tuesday
Horizon C
2:45:00 PM
In Person: Oral Presentation

The sustainability challenge between irrigated agriculture and sustainable inland fisheries. Using otolith microchemistry in infrastructure planning.

John Conallin (jconallin@csu.edu.au; Gulbali Institute, Charles Surt University); Lee Baumgartner (lbaumgartner@csu.edu.au; Gulbali Institute, Chalres Sturt University);Vu Vi An (anria2@yahoo.com; Gulbali Institute, Charles Sturt University); Lauren Stoot (lstoot@csu.edu.au; Gulbali Institute, Charles Sturt University); Zau Lunn (zau.lunn@fauna-flora.org; Fauna and Flora International); Nyein Chan (skybirds1986@gmail.com; Fauna and Flora International); Nyi Nyi Tun (nyihtun7@gmail.com; Myanmar Department of Fisheries); Nyi Nyi Tun (nyihtun7@gmail.com; Myanmar Department of Fisheries); Bronwyn Gillanders (bronwyn.gillanders@adelaide.edu.au; Adelaide University); Gabriel Enge (gabriel.enge@anu.edu.au; Australian National University); Aye Myint Swe (ayemyintswe153@gmail.com; Irrigation and Water Utilization Management Department); Maung Maung Lwin (akthar.mgmglwin@gmail.com; Myanmar Department of Fisheries);

Irrigated agriculture and maintaining inland capture fisheries are both essential for environmental sustainability, and food and nutrition security in South East Asia. However, irrigated agriculture through water control infrastructure is increasingly blocking off migration routes, leading to a degradation of inland capture fisheries. In Myanmar several key commercial-cultural species such as the Hilsa Shad (Tenualosa ilisha) are under threat from increasing regulation. However, very little is known about their migration routes, and their freshwater-sea migration patterns. This project focussed on using otolith (fish's earbone) microchemistry to assess if the majority of Hilsa spread throughout the Ayeyarwady River system were anadromous (i.e. spawn in freshwater and migrate to sea). Results of the study showed that Hilsa spawn in freshwater and migrate to the sea as juveniles before returning to the freshwater to spawn, and that these cyclic patterns occurred over distances of 100's of kilometres and are not confined to the main stem of the Ayeyarwady. Migratory fish pose challenges for reaching a sustainable compromise between irrigation expansion and maintaining freshwater fisheries. Solutions are available and range from selection of irrigation areas, placement of infrastructure, mitigation of existing barriers with fish passage, and possible offsetting of free-flowing river sections.

Tuesday
Horizon C
3:05:00 PM
In Person: Oral Presentation

Channel incision, a watershed scale disturbance influencing fish passage and the role of in-stream wood

Tim Abbe (tim@naturaldes.com; Natural Systems Design); Evan D'Oro (evan.doro@naturaldes.com; Natural Systems Design);Michael Ericsson (mike@naturaldes.com; Natural Systems Design); Susan Dickerson-Lange (susan@naturaldes.com; Natural Systems Design); David French (davey@naturaldes.com; Natural Systems Design); ;

Observations from around Washington State, USA has found widespread channel incision that directly impacts instream hydraulics influencing fish passage and habitat. The direct and passive removal of in-stream wood is sufficient to trigger incision even in large channel networks. We present evidence from several rivers in different regions such as the South Fork Nooksack, the Hoko River, the West and Middle Forks of the Teanaway and the Newaukum River. We also describe the hydraulic function of wood and how it inhibits bed scour, not only preventing incision but protecting salmonid eggs. We present a technical framework and empirical evidence on how wood reduces bed scour and thus channel incision. By compiling empirical research into bed scour and the hydraulic effects of wood, we constructed a framework describing how wood could reduce scour depth. We then developed a methodology in which wood is treated as an immobile fraction of the substrate grain size distribution thereby altering bed roughness and the dimensionless shear stress defining bed mobility. This provided a means to predict and compare scour depths in channels with and without wood.

Tuesday
Horizon C
3:25:00 PM
Virtual Presentation

Remediating Barriers and Restoring Salmonid Habitat in Watersheds with Legacy Logging Impacts in Coastal Northern California

Anna Hallligan (ahalligan@tu.org; Trout Unlimited);

This presentation will provide an overview of Trout Unlimited' s North Cost Coho Project which has been working with private and public land managers for over 20 years in the forested watersheds of coastal Northern California to restore habitat for protected species of salmon and trout. These watersheds have been impacted by decades of historical logging practices and in many instances are still managed today as industrial timber lands. Watershed-scale restoration efforts have been focused on removing fish passage barriers, reducing road-related sediment sources, improving instream habitat through the introduction of large wood, and restoring connectivity to floodplain features. Through collaborative partnerships, established by shared goals between public and private industries, Trout Unlimited and its partners have improved or eliminated over 886 miles of logging roads, removed over 15 major fish migration barriers, reconnected over 130 miles of stream habitat, and improved instream habitat in over 115 miles of stream.

Tuesday
Horizon C
4:15:00 PM
Virtual Presentation

Flood Control Improvements within the Lower Fraser Watershed

Dan Straker (dan@resilientwaters.ca; dan@resilientwaters.ca); Patrick Lilley (plilley@kwl.ca; dan@resilientwaters.ca)

In the lower mainland of British Columbia there are over 150 pieces of flood control infrastructure that line the Fraser River between Richmond and Hope. These floodgates, pumpstations, and dikes are estimated to be blocking access to over 1500 kilometres of crucial floodplain habitat for fish, especially 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.

Tuesday
Horizon C
4:35:00 PM
Virtual Presentation

RADical fish passage

Abigail Lynch (ajlynch@usgs.gov; U.S. Geological Survey, National Climate Adaptation Science Center);

Most aquatic conservation and management approaches look to the past for precedent. Restoring connectivity has been stalwart strategies of aquatic conservation, effectively employed to recover degraded, damaged, or even destroyed ecosystems. But, what happens when the past doesn't reflect the future? With climate change and other stressors, aquatic systems are transforming, making many of these approaches increasingly untenable. The RAD (Resist-Accept-Direct) framework can help navigate the unfamiliar territory of 'what comes next' while still using some familiar tools and strategies (e.g., adaptive management). This presentation will introduce the RAD framework and discuss how fish passage, predominately as a resist management strategy, can complement a portfolio of RAD approaches that can be utilized across a landscape. The utility of the RAD framework is that it presents these options deliberately. These conversations are often uncomfortable but, at some point, we do need to ask "Resist until when?" If we wait well past when restoration and rehabilitation efforts are effective, we've likely missed opportunities to prepare for adapting to ecosystem change under any RAD strategy and it will likely come at higher economic costs, greater losses of ecosystem services, and more significant consequences to natural systems.

Tuesday
Horizon C
4:55:00 PM
Virtual Presentation

Negotiating the future of dams through a systems-based role-play simulations

Catherine Ashcraft (catherine.ashcraft@unh.edu; Department of Natural Resources and the Environment, University of New Hampshire); Weiwei Mo (; Civil and Environmental Engineering Department, University of New Hampshire);Natallia Diessner (; Natural Resources and Earth Systems Science, University of New Hampshire); Cuihong Song (; Civil and Environmental Engineering Department, University of New Hampshire); Theresa McCarty (; Department of Natural Resources and the Environmenta, University of New Hampshire); ;

In rivers with multiple dams, a decision about one dam ripples across the larger spatial and temporal scales at which river systems function. By considering the impacts of decisions across system elements, natural resource managers and users can optimize across tradeoffs between fish passage and hydropower generation, while also providing benefits for cultural identity, public safety, and recreation. Such decisions are often highly contested and, to be successful, should engage a diverse range of interested and affected parties in forums to share knowledge, consider alternatives, and build consensus around decisions. We implemented a novel participatory approach to bring together diverse participants in several workshops in New England, the Pearl River Dam Negotiation Simulation, which combines a system dynamics model and fictionalized role-play negotiation. In the workshops, participants were faced with a decision scenario involving a river system with multiple dams and were provided with a model to consider how their decision would affect fish passage, hydropower generation, and project cost. Negotiators could decide to focus on one or on multiple dams and choose among multiple dam management options. In contrast to the way many decisions are often made, in the workshops all negotiating groups adopted a systems-based approach that included management actions for multiple dams in the river system. Through a collaborative problem-solving approach, each group negotiated tradeoffs between management objectives, for example between overall financial cost and fish passage, and reached a decision that provided significant benefits over the current situation. Most workshop participants reported an increase in their understanding of both the factors that go into dam decisions and who is involved in dam issues. Our findings highlight the potential of this structured forum to foster representation of diverse participants and increase political capabilities through sharing knowledge and dialogue about dammed river systems.

Tuesday
Horizon C
5:15:00 PM
Virtual Presentation

Integrated Calapan Lake and Baruyan River, Oriental Mindoro, Philippines Watershed Development

Marius Panahon (mlpanahon@yahoo.com; University of Batangas); Alcantara Antonio (aja_uplb@yahoo.com.ph; University of the Philippines Los Banos)

The study aims to determine the sustainability of the lake water quality for aquaculture and eco-tourism that depends on the integrity of head water, area around Calapan Lake and Baruyan River. A socio-economic baseline survey questionnaire was administered to assess the anthropogenic activities that might be contributory to the present state and to measure with greater accuracy and efficiency the population of the study area. Data on the socio-economic status of residents were also obtained to have a better picture in terms of pressures exerted by the communities on the resource under study. Secondary information, such as the Comprehensive Land Use Plan was used. The headwater and the area around the lake are generally used for agriculture. The soil materials, fertilizers and pesticides from the farm are being transported by the runoff water and animal waste and garbage from the households and commercial establishments disposed into the creek/waterways that drain into the lake could alter the lake water quality overtime. Soil clay materials resulted from clearing and erosion of the stream bank increased the suspended sediment in the surface water. Policy makers should formulate programs and activities such that the resources and people around the watershed would be able to adapt to changing social, economic and adverse natural disturbances. The level of awareness and interests of the constituents of Calapan City on the protection of services provided by this watershed must be continuously undertaken by the stakeholders. The latter must be involved to work collaboratively in the planning, monitoring and evaluation as well as sharing the cost and benefits of the development of the lake, river and the nearby coastal area.

Tuesday
Horizon D
10:30:00 AM
In Person: Oral Presentation

Abstracts for Current trends & knowledge of aquatic organism passage through culverts

Effects of environmental and behavioural factors on New Zealand fish swimming performance and upstream passage success

Rachel Crawford (rachelmbcrawford@gmail.com; University of Waikato & NIWA); Paul Franklin (Paul.Franklin@niwa.co.nz; NIWA);Eleanor Gee (Eleanor.Gee@waikatoregion.govt.nz; Waikato Regional Council); Eimear Egan (eimear.egan@niwa.co.nz; NIWA); Peter Williams (Peter.Williams@niwa.co.nz; NIWA); Rochelle Petrie (Rochelle.Petrie@niwa.co.nz; NIWA); Debora Dupont (Deborah.Dupont@niwa.co.nz; NIWA); Debora Dupont (Deborah.Dupont@niwa.co.nz; NIWA); Brendan Hicks (hicksbj@waikato.ac.nz; University of Waikato);

Native New Zealand fish exhibit a range of life history strategies, swimming methods, and morphologies that differ from those of salmonids. It is important to understand and compare a range of species' swimming speeds to inform future fish passage design criteria to ensure the structures are fit for a wide range of species. Our research takes an experimental approach to quantify swimming abilities of juvenile fish and explores the relative influences of environmental factors that may determine upstream passage success. We compared the swimming abilities of several native migratory species (three galaxiids, two Gobiomorphus species, and one anguillid). A particular species of interest was the New Zealand longfin eel, an endangered species that is culturally significant to Māori. We measured critical swimming speed of both individual elvers (110 – 130 mm) and groups of ten, and endurance swimming at speeds above the critical swimming speed. The average critical swimming speed was 34.09 cm/s. The endurance trials revealed that even at low speeds (20 cm/s), elvers did not swim longer than three minutes. Relative to body size, elvers were the weakest swimmers of all species compared. We highlight the importance of understanding fish swimming abilities and behaviours in designing fish passage solutions.

Return to Presentation Schedule

View Document Bookmarks

Tuesday
Horizon D
10:50:00 AM
In Person: Oral Presentation

Washington's Fish Passage Barrier Inventory & Assessment Program – An Overview

Christy Rains (Christy.Rains@dfw.wa.gov; Washington Department of Fish & Wildlife);

It is well established that a complete barrier inventory is the foundation to fish passage restoration planning and prioritization efforts. To create a robust and accessible barrier dataset, Washington State Department of Fish and Wildlife (WDFW) employs a variety of approaches, including collaborations with conservation partners across the state. WDFW manages a Fish Passage Barrier Inventory and Assessment program (I&A), which has existed since at least the 1990s. Protocols detailed in WDFW's Fish Passage Barrier Inventory, Assessment, and Prioritization Manual (2019) contain barrier assessment and habitat survey protocols used by WDFW staff and the 1,000+ partners instructed through the I&A training program. WDFW staff and external partners have assessed nearly 58,000 fish passage features statewide. Fish passage data are stored and maintained in the Fish Passage and Diversion Screening Inventory (FPDSI) database. Inventory and assessment data are publicly available through the Fish Passage Map application, which includes tools to view, query, analyze, and compare sites, therebysupporting fish passage barrier prioritization and correction planning. By working in collaboration with groups across the state towards a complete barrier inventory, WDFW's I&A dataset will continue to be a fundamental tool in statewide salmon habitat recovery and pivotal to future success.

Return to Presentation Schedule

View Document Bookmarks

Tuesday
Horizon D
11:10:00 AM
In Person: Oral Presentation

Monitoring and Assessment Protocol for Aquatic Organism Passage at Water Crossings

Casey Kramer (ckramer@naturalwaters.design; Natural Waters); Jim Neighorn (james.g.neighorn@dot.gov; FHWA WFL);Sven Leon (sven.leon@dot.gov; FHWA WFL); Stephan Morrow (stephen.morrow@dot.gov; FHWA WFL); Justin Lennon (justin.lennon@wsp.com; WSP); ;

Providing effective AOP at water crossings represents a significant investment and management priority for various agencies across the country. As billions of additional dollars are made available to replace our aging infrastructure, monitoring the effectiveness of water crossings over time becomes increasingly more important in ensuring passage goals are achieved and maintained. With design approaches varying across the world, a consistent protocol for collecting performance data becomes essential in helping environmental agencies, infrastructure owners, and tribal entities in understanding failures and successes. Recognizing the lack of consistent performance data and a standardized monitoring protocol, the Western Federal Lands Highway Division, supported by WSP and Natural Waters, conducted a research study that consisted of two phases. This presentation will provide a summary of the phase 1 and 2 efforts that includes the development and implementation of the rapid geomorphic, visual assessment portions of the protocol, tools and gear used, and the mobile application used during field assessments. A discussion will include lessons learned, common observations of AOP water crossings from the states visited, feedback from state DOTs and permitting agencies, other beneficial applications of the protocol, and database challenges.

Tuesday
Horizon D
11:30:00 AM
In Person: Oral Presentation

Fish Passage Barrier Correction at State Highways in Washington State

Beth Rood (beth.rood@hdrinc.com; HDR Engineering, Inc.); Julie Heilman (heilmaj@wsdot.wa.gov; WSDOT)

The Washington State Department of Transportation (WSDOT) has been working for many years to correct fish passage barriers under state highways to improve fish passage and restore access to prime spawning and rearing habitat, ultimately protecting and restoring fish populations. Approximately 2,000 culverts on the statewide highway systems are currently classified as barriers to fish passage, of which approximately 1,500 have more than 200 meters of upstream habitat.

In March of 2013, a federal court injunction required Washington State to significantly increase the effort for removing state-owned culverts that block habitat for salmon and steelhead by 2030. Around 1000 of WSDOT's culverts are subject to the injunction. Through the end of 2021, WSDOT has approximately 400 remaining barriers to replace by 2030 to meet the 90% habitat potential.

This presentation will focus on WSDOT's fish passage program, summarizing the program history and goals, the programmatic assessment of prioritizing the barrier removals, and discuss current techniques they are applying to increase habitat complexity in water crossings. This presentation will detail current habitat complexity measure in use and lessons they have learned so far in the program. Mitigation measures will be illustrated using recent fish passage projects.

Tuesday
Horizon D
1:45:00 PM
In Person: Oral Presentation

A passage for all: Including wildlife habitat connectivity elements into fish passage projects.

Brian Stewart (bstewart@conservationnw.org; Conservation Northwest);

Natural systems, widlife and habitats are experiencing extreme stressors from Climate change, development, and land conversion. This is true for nearly every species and habitat types from terrestrial species to aquatics, all will require networks of connected habitat to adapt and persist. Roadway infrastructure is a major contributor to the fragmentation of the landscape, we have seen a lot of progress for fish passages and connected waterways in recent years. However, where highways and interstates fragment rivers and streams, they also fragment the landscape. In Washington state 85 percent of all species utilize riparian corridors, in addition, these corridors act as a network of corridors that tend to lead refugia and into protected areas. This offers an opportunity to not just improve fish passage, but to add small amounts of money to increase the projects scope, while increasing positive ecological benefit and climate resiliency.

By leveraging policy, advocacy and interdisciplinary science, it is possible to include project additions that can facilitate the passage of ecological processes, including flora and fauna, into fish passage projects. We hope to articulate the science, design and advocacy necessary to create passages that benefit multiple species.

Tuesday
Horizon D
2:05:00 PM
In Person: Oral Presentation

Use of Flexible Baffles to Improve Aquatic Organism Passage (AOP) through Culverts in North America

Shane Scott (shane@sscottandassociates.com; SSA Environmental LLC);

Culverts and other conveyances are second only to dams in blocking passage of fish and other aquatic organisms. These barriers impede passage to spawning grounds and adversely affect habitat connectivity for many species. High water velocities and/or shallow water depths create hydraulic conditions that limit aquatic organism passage (AOP). Culvert weirs and baffles have long been used to improve hydraulic conditions in culverts and other conveyances to improve AOP. However, these structures are typically rigid which reduces the hydraulic capacity of the conveyance. Also, debris is often trapped in the culvert behind the baffle which requires costly and expensive maintenance. Recent advances in materials have allowed development of a flexible yet very durable culvert baffle that improves AOP similar to solid baffles but allows passage of debris at higher flows with a minimal effect on the hydraulic capacity of the culvert. In this presentation we will provide information on the use of flexible culvert baffles to improve AOP. We will also demonstrate how Computational Fluid Dynamic modeling is being used to properly size and configure the flexible baffles to meet conservation needs.

Current trends & knowledge of aquatic organism passage through culverts.

Wednesday
Horizon D
2:10:00 PM
In Person: Oral Presentation

Acoustic Tag Signal Identification Using Deep Learning Techniques

Tracey Steig (tracey.steig@innovasea.com; Innovasea); Jean Quirion (jean.quirion@innovasea.com; Innovasea);Frank Smith (frank.smith@innovasea.com; Innovasea); Oliver Kirsebom (oliver.kirsebom@dal.ca; DeepSense, Dalhousie University); Kayalvizhi Thanigainathan (ky251416@dal.ca; DeepSense, Dalhousie University); Santosh Medisetty (santosh.medisetty@innovasea.com; Innovasea);

Acoustic telemetry is routinely employed to detect and quantify behaviors of aquatic animals. The ability to acoustically tag and release fish and aquatic animals allows researchers to monitor their presence/absence and fine-scale spatial movement. One method of identifying individual tags employs a period signal encoding (HTI signal type) method, which utilizes the full transmitted acoustic energy for both detection and identification, providing significantly greater detection ranges than encoded BPSK signal types. However, identifying period encoded tags typically requires manual data review by trained human analysts, resulting in increased processing cost and a lack of scalability.

Innovasea conducted a project to determine the efficacy of applying Deep Learning techniques to automatically identify animals implanted with period encoded acoustic tags. Specifically, the well-known U-Net model was adapted and trained to detect period encoded acoustic tag signals from raw acoustic telemetry data. The raw data is first transformed into a spectrogram-like image representation and the U-Net learns an image mask that separates actual tag detections from noise and interference.

The trained U-Net achieved greater than 95% acoustic signal tag identification accuracy when compared to tag identification performed by human analysts. Numerous examples of the U-Net performance will be presented, including 3D positioning comparisons.

Tuesday
Horizon D
2:25:00 PM
Virtual Presentation

Culvert Baffles – A low-cost fish passage solution

Nick Scribner (nick.scribner@wyo.gov; WY Game and Fish);

Road crossings of streams are ubiquitous across Wyoming and the entire U.S. and have substantial impacts on aquatic organism movement. Undersized and improperly placed structures are common characteristics of these crossings that also affects sediment transport and debris passage. Complete replacement is the ideal remedy for such situations to improve stream function and connectivity, but there are financial and labor constraints to replacing structures. Identifying low-cost solutions could increase the number of crossings that can be improved for fish passage thereby reducing habitat fragmentation. In 2020, 22 road crossings in the Laramie Range of Southeast Wyoming were inventoried to document their impact on fish passage, structural condition, and sites to test the use of rubber baffles. In October 2021, these baffles were installed in eight culverts with diameters ranging from 3-7 ft and both concrete and metal material. Velocity and water depths were recorded in the larger culverts (n = 4) before and after baffle installation. Velocities decreased an average of 81.3% from 3.3 ft/s to 0.7 ft/s and depths increased 2 to 3 fold. Anecdotal evidence of improved passage was also documented at three sites where fish were observed resting in the culverts during and after installation.

Wednesday
Horizon D
2:30:00 PM
In Person: Oral Presentation

Optimising environmental DNA (eDNA) metabarcoding through replication; achieving confidence in the presence/absence of European eel in pumped river catchments

Nathan Griffiths (nathangriffiths484@gmail.com; University of Hull); Bernd Hänfling (Bernd.Haenfling.ic@uhi.ac.uk; University of the Highlands and Islands);Rosalind Wright (ros.wright@environment-agency.gov.uk; Environment Agency); Marco Cattaneo (marco.cattaneo@usb.ch; University of Basel); James Macarthur (J.MACARTHUR-2017@hull.ac.uk; University of Hull); Sara Peixoto (S.Peixoto-2019@hull.ac.uk; University of Hull); Jonathan Bolland (J.Bolland@hull.ac.uk; University of Hull); Jonathan Bolland (J.Bolland@hull.ac.uk; University of Hull); ;

The European eel is critically endangered with declines attributed, in part, to anthropogenic impacts. These include pumping stations, which are barriers to upstream migration and can cause mortality during downstream migration. Indeed, Council Regulation (EC) No. 1100/2007 includes requirements for eel passage and screening of water intakes abstracting >20 m3/day. With over 900 pumping stations in England, knowledge of current eel distribution is urgently required. However, detecting the presence and confirming the absence of rare and elusive species is challenging. This study applied eDNA metabarcoding to 10 water samples from upstream of 52 pumping stations to assess statistical confidence in eel presence/absence. Eels were detected at 17 sites, with the number of positive samples ranging from 1 to all 10 (average = 4.7). These findings are related to catchment size and overall fish species richness, the latter ranging from 0 to 15. In addition, 10 samples from a site with 5 eel positive samples were each replicated 10 times in the lab; achieving 2 to 7 positive detections from each sample extract (average = 4.1). This highlights the importance of understanding factors that influence detectability when designing eDNA sampling strategies, to rule out “false negatives” and enable high confidence decision-making.

Tuesday
Horizon D
2:45:00 PM
In Person: Oral Presentation

When Culvert Replacement is Not an Option: Current Rehabilitation Technologies

Cassie Jordan (cassie.jordan@piperelinesolutions.com; Pipe Reline Solutions);

Many jurisdictions are implementing recommendations and guidelines for improving fish passage through culverts and other conveyances. Experts tend to agree that the most effective solution for creating unobstructed fish passages is to replace problem culverts with new crossing structures such as bridges. However, in many circumstances, due to the number of culverts and the limited amount of funds available, it is unlikely or impractical that every culvert that impairs fish passage will be removed and replaced. This is where culvert rehabilitation become an option for improving fish passage. Culvert relining is a simple process where various methods can be used to either repair or slipline the existing culvert with minimal road closures or traffic delays. There are numerous products available that can be used to rehabilitate the existing pipe and include methods for safe fish passage through the culvert. In this presentation we will describe current culvert rehabilitation technologies. We will also discuss options for fish passage mitigation and erosion control.

Wednesday
Horizon D
2:50:00 PM
In Person: Oral Presentation

Results from First Deployment of Fathom Vision: A Novel AI-based Real-Time Fish Detection and Species Classification System

Matt Richard (matt.richard@innovasea.com; Innovasea); Santosh Medisetty (santosh.medisetty@innovasea.com; Innovasea);Vishnu Kandimalla (vishnu.kandimalla@innovasea.com; Innovasea); Rod MacLean (rod.maclean@innovasea.com; Innovasea); Frank Smith (frank.smith@innovasea.com; Innovasea); Tracey Steig (tracey.steig@innovasea.com; Innovasea);

The OceanAware project, led by Innovasea and funded through Canada's Ocean supercluster, is developing the next generation of underwater observation systems to transform fisheries management, aquaculture, and marine energy. One facet of this project is developing innovative methods for real-time tracking of untagged fish and species at risk around man-made infrastructures, such as hydropower dams, that present barriers to fish passage. The system, branded Fathom Vision, is based on applying modern Artificial Intelligence (AI) techniques to automatically detect fish and classify fish species from both imaging sonar and underwater optical cameras. In this talk, we present exciting results from the deployment of our first-generation Fathom Vision system at the White Rock Dam hydroelectric facility located on the Gaspereau river in Nova Scotia Canada. We demonstrate a unique and novel capability that provides our partner Nova Scotia Power Inc. with both real-time, and historical, fish detection and counting statistics that are accessible from anywhere via Innovasea's proprietary Cloud/Mobile platform. We additionally show the accuracy of the Fathom Vision fish detections by validating them against traditional but well accepted manual fish counting methods.

New and emerging technologies in fish passage.

Tuesday
Horizon D
3:05:00 PM
In Person: Oral Presentation

Catering to different forms of fish locomotion

Kelly Hughes (kellyh@ats-environmental.com; ATS Environmental); Charl Naude (charln@mail.com; ATS Environmental);Tim Olley (timolley222@gmail.com; Olleycology);

New Zealand shares with a few other countries, fish species that have various interesting means of locomotion. This means that novel approaches to fish passage remediation can be employed. The presentation details a toolbox of innovative solutions that has been developed in order to facilitate fish passage by accommodating to the needs of various swimmers, wrigglers and climbers. The knock-on effects of this low-cost toolbox of solutions have seen a change in the way large fish passage remediation programs can be delivered in a short space of time, along with the emergence of specialist fish passage practitioners.

Wednesday
Horizon D
4:00:00 PM
In Person: Oral Presentation

Development and Evaluation of Underwater Acoustic Deterrent Systems (uADS) to Control Invasive Carps

Theodore Castro-Santos (tcastrosantos@usgs.gov; USGS-Conte Lab); Marybeth Brey (mbrey@usgs.gov; USGS--UMESC);Christa Woodley (christa.m.woodley@usace.army.mil; USACE-RDC); Andrea Fritts (afritts@usgs.gov; USGS-UMESC); Jessica Stanton (jstanton@usgs.gov; USGS-UMESC); ;

Bigheaded carp (Hypophthalmichthys spp.) are invasive ostariophysan fishes that are expanding their range in the Mississippi River Basin. Recent research has demonstrated that these fish are sensitive and responsive to underwater acoustic signals, and these signals could be engineered to elicit behavioral responses – potentially stopping fish from entering uninfested areas or moving upstream in rivers. Testing of underwater acoustics signals at large, management-relevant scales is necessary to determine the feasibility of an underwater Acoustic Deterrent System (uADS) to influence bigheaded carp movement while limiting effects on native species. We discuss the process from concept and construction to evaluation of a large-scale uADS at Lock 19 on the Mississippi River and provide an overview of the statistical approaches that will be used to evaluate the efficacy of this experimental deterrent. Results of ongoing acoustic deterrent research will help managers understand the effectiveness of acoustic deterrents and the potential for the technology to be transferred and deployed in other locations.

Tuesday
Vista
10:30:00 AM
Virtual Presentation

Abstracts for Middle Columbia River: Restoration of tributary confluences, cold water refuge, and sediment management

EPA Columbia River Cold Water Refuge Plan

John Palmer (palmer.john@epa.gov; EPA Region 10);

EPA issued the Columbia River Cold Water Refuge Plan in January 2021, which focuses on how adult salmon and steelhead use cold water refuges (CWR) in the Lower Columbia River (RM 0-325) during their upstream migration to avoid warm mainstem summer temperatures. EPA identified 23 CWR associated with cool inflowing tributaries in the Lower Columbia River, 12 which were identified as primary CWR due to their size and documented use. The Plan characterizes and quantifies how summer steelhead and fall Chinook salmon use the CWR, which are the main two species that use the CWR. EPA developed a HexSim model that simulates fish migration and estimates the benefits of CWR in terms of reduced exposure to harmful river temperatures (e.g., above 21C). The Plan concludes that the existing amount of CWR along with a cooler Umatilla River would meet Oregon's CWR narrative temperature water quality standard. The Plan includes recommended actions in 13 tributary watersheds to maintain and cool tributary temperatures and flow to protect and enhance the CWR, which EPA predicts will be used more extensively as climate change continues to warm the Lower Columbia River.

Tuesday
Vista
10:50:00 AM
Virtual Presentation

Cool Project on a Hot River: A Basin Approach to Restoration of the Yakima Delta

Merritt Mitchell-Wajeeh (merritt@midcolumbiafisheries.org; Mid-Columbia Fisheries Enhancement Group);

Construction of fishways in composite creates the opportunity to easily adapt it to nearby environments. The sections are modularly built industrially in a controlled environment and it is possible to use the same models for several fishways so they can be made at a lower cost than conventional on site-built fishing routes. The sections consist of a sandwich construction which is vacuum injected thereby achieving a homogeneous laminate without pores. The construction is light, rigid and has high strength. The sandwich construction consists of directional fiberglass, diviny cell and vinyl ester.

Tuesday
Vista
11:10:00 AM
In Person: Oral Presentation

Evaluation of Movement and Survival of Juvenile Steelhead and Coho in the Klickitat River, Washington, 2018-2019

Nicolas Romero (nromero@ykfp.org; Yakama Nation Fisheries Program); Scott D. Evans (sdevans@usgs.gov; U.S. Geological Survey, Western Fisheries Research Center);David Lindley (dlindley@ykfp.org; Yakama Nation Fisheries); Tobias Kock (tkock@usgs.gov; US Geological Survey, Western Fisheries Research Center); Amy C. Hansen (achansen@usgs.gov; U.S. Geological Survey, Western Fisheries Research Center); Russell Perry (rperry@usgs.gov; US Geological Survey, Western Fisheries Research Center); Joseph S. Zendt (jzendt@ykfp.org; Yakama Nation Fisheries Program); Joseph S. Zendt (jzendt@ykfp.org; Yakama Nation Fisheries Program); ;

A 2-year telemetry study was conducted April–July in 2018 and 2019 to evaluate migration behavior and survival of juvenile steelhead (Oncorhynchus mykiss) (n=612) and coho salmon (O. kisutch) (n=400) in the Klickitat River, Washington. Natural-origin steelhead and hatchery-origin coho were tagged, released, and monitored as they outmigrated through the Klickitat River (17 and 68 kilometers (km), respectively) and in the 52 km Columbia River reach between the mouth of the Klickitat River and Bonneville Dam. Migration rates were slowest for both species in the Klickitat River Delta compared to upstream reaches of the free-flowing Klickitat River and downstream reaches of the Columbia River. Median elapsed time from release to Klickitat River exit ranged from 1.4 to 1.5 days for steelhead and 5.1 to 12.9 days for coho salmon. Ten percent of the tagged coho salmon remained in the Klickitat River for 21.9–29.2 and 36.0–45.5 days before entering the Columbia River in 2018 and 2019, respectively. Similarly, reach-specific survival was highest in free-flowing reaches of the Klickitat River and lowest near the Klickitat River delta. Cumulative survival from release to sites located downstream of the Klickitat River delta were 0.78 for steelhead in both 2018 and 2019, and 0.57 and 0.61 for coho salmon in 2018 and 2019.

Tuesday
Vista
11:30:00 AM
In Person: Oral Presentation

Managing Sediments Released from Dam Removal to Enhance Ecological and Cultural Values

Josh Epstein (jepstein@interfluve.com; Inter-Fluve); Gardner Johnston (gjohnston@interfluve.com; Inter-Fluve);David Lindley (dlindley@ykfp.org; Yakama Nation Fisheries); William Sharp (shab@yakamafish-nsn.gov; Yakama Nation Fisheries)

The Condit Dam on the White Salmon River in Washington was removed in 2011 using the "Blow and Go" method, where a tunnel was blasted at the base of the dam releasing over 1 million m3 of sediment. The 38-m tall dam had blocked salmon passage since 1913, and at the time of its removal was the largest dam removal in US history. The massive release of sediment affected the historical tribal village at the river's mouth, Nánšuit. Nánšuit had previously been impacted by the creation of Bonneville Dam in 1938, which inundated a portion of the village and flooded the former river delta and its salmon habitat. In 2011, dam removal sediments blocked boat access used by Tribal fishermen. In 2018, the Yakama Nation implemented a project to 1) re-establish culturally significant fishing access, and 2) restore elements of the former river delta.

Tuesday
Vista
11:50:00 AM
In Person: Oral Presentation

Thermal Enhancement at the Horsetail Creek - Columbia River Confluence

Matt Cox (mcox@interfluve.com; Inter-Fluve); Keith Marcoe (KMarcoe@estuarypartnership.org; Lower Columbia Estuary Partnership)

During the past century, a combination of factors has degraded Columbia River water quality, including its thermal regime. Currently, summer migrating adult and juvenile salmonids using the Columbia River are exposed to mainstem temperatures that average well above critical thresholds for survival and are expected to increase further with climate change. Numerous studies have documented adult summer migrants seeking refuge in cooler embayments at mid-Columbia tributary confluences for periods of weeks to months during July, August, and September. Additionally, a large spatial gap of nearly sixty miles exists in the upper estuary (upstream of the Lewis River confluence) where no thermal refuge is presently available. A prior study by the Estuary Partnership evaluated the potential for creating thermal refuge zones at smaller confluences within this gap area through the enhancement of existing physical features, essentially replicating conditions seen at some of the mid-Columbia refuges such as the confluences of Eagle Creek and Herman Creek. High resolution hydrodynamic and water quality modeling identified the confluence with Horsetail/Oneonta Creeks as one of three potential confluence zones capable of providing suitable refuge conditions for migrating salmonids. Based on depth, temperature, and size criteria that we established from existing literature and field observations of similar mid-Columbia refuge zones, this confluence has been selected for a potential pilot project to establish a thermal refuge zone for migrating salmon, through enhancement of the existing site. Here, we present results of the feasibility assessment to date, including a review of the predicted physical performance of the modeled embayment, alternatives considered, and the associated regulatory and implementation challenges. If successfully implemented in the future, this project may serve as a model for implementing a climate change adaptation strategy that would help summer-migrating salmon populations continue navigating the mainstem Columbia River in the coming decades.

Tuesday
Vista
1:45:00 PM
In Person: Oral Presentation

Abstracts for Fish protection R&D: Interagency coordination under the US Federal Hydropower MOU

Overview of the Federal Hydropower MOU and the DOE Water Power Technologies Office's fish passage and protection R&D priorities

Dana McCoskey (dana.mccoskey@ee.doe.gov; Water Power Technologies Office, DOE);

An overview of research supported by the U.S. Department of Energy's (DOE) Water Power Technologies Office (WPTO) will be presented focusing on the Hydropower Program's priorities for fish passage and protection. The WPTO strives to ensure that hydropower's contributions towards meeting U.S. energy needs are consistent with the objectives of environmental stewardship and water use management identified in the 2017 Hydropower Vision Report. A case study on alignment of federal resources to identify solutions for fish protection as outlined in the 2020 Federal Hydropower Memorandum of Understanding between the DOE, the U.S. Bureau of Reclamation and the US Army Corps of Engineers will be provided to highlight ongoing efforts to improve coordination and advance research, development, and technology demonstrations. Additional information on how to work with WPTO will be overviewed in terms of funding structures such as cooperative agreements, Small Business Innovation Research grants, prizes, national laboratory collaborations, and new programming resulting from the 2021 Bipartisan Infrastructure Law.

Tuesday
Vista
2:05:00 PM
In Person: Oral Presentation

Advancing Environmental Research Priorities at the Bureau of Reclamation

Connie Svoboda (csvoboda@usbr.gov; Bureau of Reclamation);

The Bureau of Reclamation's Science and Technology Program supports research on mission-related scientific and technical challenges. Program outcomes enable reliable water delivery and power generation, improve safety, limit invasive species impacts, and ensure Reclamation can meet its environmental compliance responsibilities. Research needs are identified through input from regional Reclamation staff, partners, and stakeholders. Reclamation's Environmental Issues for Water Delivery and Management Research Roadmap and annual Innovation Strategy Implementation Plan guide and identify research priorities to address fish and other environmental issues that may affect Reclamation projects fulfilling their authorized purposes. Reclamation shares research activities and priorities among federal MOU partners to leverage funds with other research entities, reduce duplication of effort, and promote technology transfer.

Tuesday
Vista
2:25:00 PM
In Person: Oral Presentation

USACE-ERDC Capabilities for Fish Passage

Locke Williams (Locke.M.Williams@erdc.dren.mil; U.S. Army Corps of Engineers, Engineer Research and Development Center);

An overview of the projects related to fish passage completed by the U.S. Army Engineer Research and Development Center (ERDC) Coastal and Hydraulics Lab (CHL) and Environmental Lab (EL) will be presented. The CHL and EL provide helpful information to requesting agencies regarding fish passage using numerical modeling and physical modeling capabilities. The CHL has expertise in building and testing scaled hydropower turbine models to improve the fish passage through the turbine and the efficiency of the turbine. The EL has expertise in using physical testing and numerical modeling to learn about fish behavior due to environment changes. Information of previous studies and capabilities of the technologies which were developed and proven at CHL and EL to study fish passage and behavior will be shared.

Tuesday
Vista
2:45:00 PM
In Person: Oral Presentation

Spurring Innovation through Prize Competitions

Jennifer Beardsley (jbeardsley@usbr.gov; Bureau of Reclamation);

The Bureau of Reclamation utilizes Prize Competitions to engage new thinkers to spur innovation ion challenge topics related to water and power infrastructure, water supply, and environment. Beginning in 2015, Reclamation initiated its Prize Competitions Program to complement its traditional research and make advancements on Reclamation's most persistent challenges related to the environment, infrastructure, and water supplies. Reclamation has launched 32 competitions, paid out over $4.5 million in prizes, partnered with more than 45 different entities, and continued to advance 19 winning solutions through research and cooperative agreements. Reclamation has conducted five fish related prize competitions. In 2020, Reclamation partnered with the Department of Energy's Water Power Technologies Office on the Fish Protection Prize.

Tuesday
Vista
3:05:00 PM
In Person: Oral Presentation

Overview of the Justice40 Initiative and Pathways to Achieving a More Environmentally Just and Equitable Clean Energy Transition

Katie Morrice (katherine.morrice@ee.doe.gov; U.S. DOE, Water Power Technologies Office);

In the first year of the Biden administration, the Justice40 Initiative was established with the signing of Executive Order 14008, Tackling the Climate Crisis at Home and Abroad. The Justice40 Initiative aims to deliver 40% of the overall benefits from Federal investments in climate and clean energy to disadvantaged communities. Relevant activities include investments in renewable energy, energy efficiency, workforce development, legacy pollution reduction and remediation, and clean water and wastewater infrastructure. Federal agencies working on climate and energy issues were tasked with quantifying benefits of programs, and offices across the U.S. Department of Energy have responded to this call. Progress is being tracked across multiple metrics ranging from reductions in emissions to energy resiliency and energy democracy to the clean energy job pipeline, all with an eye towards a more environmentally just and equitable clean energy transition that benefits disadvantaged communities. This presentation will provide an overview of the Justice40 Initiative and how the U.S. Department of Energy is working towards more equitable research, development, and deployment activities.

Tuesday
Vista
3:25:00 PM
In Person: Oral Presentation

Collaboration Between Private Industry and DOE's National Laboratories

Brett Pflugrath (brett.pflugrath@pnnl.gov; PNNL);

To help meet the United States' need for reliable and affordable hydropower, the US Department of Energy has various means by which private industry can collaborate with National Laboratories to conduct research. This includes sponsored research, where private industry funds the national laboratories to conduct work for the company using specialized DOE facilities, services and technical expertise; Collaborative Research, where companies and National Labs conduct R&D together under a joint statement of work; Licensing, where companies obtain rights to National Lab patents and technologies, copyrighted software, or open source tools; and facility use, where companies conduct research at National Laboratory facilities. Additionally, DOE provides several funding opportunities to collaborate with the National Labs, including competitions such as the fish protection prize. Research through these opportunities and collaborations have led to significant advancements in fish passage and river connectivity and are likely to continue to guide the development and operation of hydropower.

Tuesday
Vista
4:15:00 PM
In Person: Oral Presentation

Fish Protection Prize 2020: Center Sender

Sterling Watson (sterling@natelenergy.com; Natel Energy); Abe Schneider (abe@natelenergy.com; Natel Energy)

The 2020 DOE Fish Protection Prize sought ideas to improve fish protection at hydropower damintakes and water diversions. The third-place concept from the competition was an electrifiedcantilevered bar rack intended to guide downstream-passing fish to the safest route through ahydropower facility, named the Center Sender. Potential use cases for the Center Senderinclude installation along the circumference of turbine intake pipes to guide fish toward the hub(where blade velocities are lowest), and general in-stream implementation to direct fish tobypasses while automatically shedding debris.This presentation will share the results of prototype testing of a Center Sender module within ahydraulic flume, performed by a team from Natel Energy and the University of Innsbruck.Rainbow trout were inserted upstream into the flume and their coordinates of passage past theCenter Sender module were documented with cameras under two flow velocities. The effects ofmodule configuration and electrification mode on fish passage coordinates were compared to acontrol baseline. In addition to sharing the results of the test, we will describe the process ofconcept creation to prototype testing, as well as next steps for the technology.

Tuesday
Vista
4:35:00 PM
In Person: Oral Presentation

Deal with the Devilfish: A Nature-Inspired Fish Protection Screen

Benjmain Mater (bmater@aldenlab.com; Alden Research Laboratory, LLC); Charles Coutant (ccoutant3@comcast.net; Coutant Aquatics)

This talk presents a novel fish-protection screen intended to prevent entrainment of small aquaticorganisms. The prototype screen resembles conventional, slotted fish-protection screens with parallelbars; however, the prototype bars are shaped to mimic the filter elements in the mouths of the filter-feeding devil ray (Mobula tarapacana). Millions of years of evolution have perfected these structures to provide energetically-efficient and clog-resistant filtering of zooplankton from seawater. The prototype screenexploitsthese mechanisms for the protection of small organisms in settings where flowsweepsparallel tothe screen face and perpendicular to the screen bars.The screen concept was awarded the U.S. Department of Energy's 2020 Fish Protection Prize which provided financial and technical support for concept testing. Using computer modeling and laboratory flume testing, the prototype screen was compared to a conventional wedge-wire screen. The interactions of 1-mm surrogate fish eggswith the screen faceswere of primary focus. The study did not reveal meaningful differences between the prototype and the conventional analog; however, a wealth of information was generated to aid design refinement. Broad-impact findings related to entrainment risk versus flow velocityfor similarscreentypes in sweeping flow will be presented.

Tuesday
Vista
4:55:00 PM
Virtual Presentation

Material enhancement for extended life and monitoring of net diversion systems for aquatic species at dams.

Kenneth LaBry (kjlabry@cox.net; Prometheus Innovations, LLC); Nicholas LaBry (nlabry@cox.net; Prometheus Innovations, LLC)

Netting implementation solutions for fish diversion at dams are a veryeffective current methodology for fish diversion. The net systems are primarily polymer structures which are pliable and durable but susceptible to damage and biofouling. They have a short replacement cycle.This is due to exposure to biofoulingand damage as well as current limitations on the inspection capability for these systems, especially in compromised visibility. Our methodology makes the netting systems visible to commercial sonar and allows for more efficient and detailed examination of the nets while also providing the potential for real-time net monitoring andreduced personnel risk in net maintenance through the application of amultibeam sonar imaging inspectionmethod.This innovation also provides fouling and bio-fouling resistance for the polymer net structures.This would lead to an increase in the life cycle of the net systems, as well as increased safety during inspection, reducing the facility operational cost for the owner. Our discussion will present the development achieved during the Fish Protection Prize collaboration with PNNL and the further development outcomes that are ongoing.

Tuesday
Vista
5:15:00 PM
In Person: Oral Presentation

Town Hall Q&A

Dana McCoskey (dana.mccoskey@ee.doe.gov; Water Power Technologies Office, DOE); Connie Svoboda (csvoboda@usbr.gov; Bureau of Reclamation); Locke Williams (locke.m.williams@erdc.dren.mil; U.S. Army Corps of Engineers, Engineer Research and Development Center)

Representatives from DOE's Water Power Technologies Office, the US Bureau of Reclamation, and the US Army Corps of Engineers will have a discussion with the Fish Protection Prize solvers and the broader audience to share what was learned under the Federal Hydropower MOU's Fish Protection collaboration, what is next for Prize's solvers and agencies, and to identify what else is needed and who else should be involved to advance fish protection R&D.

Wednesday
Horizon D
4:20:00 PM
In Person: Oral Presentation

Fish behavioral responses to direct current pulse patterns for use at electric barriers

Anita Moldenhauer (moldenhauer@vaw.baug.ethz.ch; ETHZ); Oliver M. Selz (Oliver.Selz@eawag.ch; EAWAG);Manuel Keller (manukell@vaw.baug.ethz.ch; ETHZ); Ismail Albayrak (albayrak@vaw.baug.ethz.ch; ETH VAW); Robert Michael Boes (boes@vaw.baug.ethz.ch; ETH VAW);
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Fish guidance racks with a small bar spacing can protect fish larger than the bar spacing from turbine passage at hydropower plants (HPPs) and guide them towards a safe bypass. However, they have a high risk for clogging leading to operational problems. Electrifying racks with low-voltage pulsed-direct current may permit enlarging the bar spacing and hence reduce clogging. The efficiency of such an electrification depends on: (1) pulse pattern, (2) electric field strength and orientation, and (3) fish properties such as size and physiology. We performed a systematic evaluation of these parameters to determine optimal settings to elicit controlled avoidance reactions of a wide size range of different fish species. Horizontal and vertical homogeneous electric fields were created in an aquarium and eight different direct current pulse patterns were evaluated. The behavioral tests were carried out with Brown trout (Salmo trutta), Chub (Squalius cephalus) and Barbel (Barbus barbus). Each fish was exposed to a stepwise increasing electric field strength with different pulse patterns. Behavioral differences among pulse patterns, fish size and species as well as the minimum electric field strength to elicit a given response were determined. This allowed to compose recommendations for pulse patterns at electric fish guidance barriers.

Wednesday
Horizon A
10:15:00 AM
In Person: Oral Presentation

Abstracts for Fish passage challenges and innovation: High head and diversion dams

Safe Passage at Big Bar, Canada

Vincent Bryan (v3@whooshh.com; Whooshh Innovations Inc); Steve Dearden (steve.dearden@whooshh.com; Whooshh Innovations Inc)

High head and diversion dams present seemingly insurmountable problems for the fish and for those charged with making a fishway. Years of study, design, reviews, permitting and civil construction before a single fish moves over the dam is typical, all to the detriment of the threatened and endangered fish below. The passage of time is not given much weight. More often than we would like to admit, the fish are often on the brink of extinction or extirpated before action is taken. Too often, the system does not work as well as hoped. Recovery for these fish is uncertain at best. What if the rules were instantly changed by Mother Nature? At Big Bar, in British Columbia, a massive rockslide suddenly created a 180' wide dam that blocked passage on one of the most prolific salmon rivers in the world. Millions of migrating adult salmon would be wiped out in less than 90 days unless fish passage could be re-established, in a place where there were no roads, no internet, and no power. So massive, blowing up the rock and removing it was not feasible. What would you do? What happened? What did the Whooshh Passage Portal really do?

Wednesday
Horizon A
10:35:00 AM
In Person: Oral Presentation

Improving Fish Migration at the Shannon Hydro-Electric Scheme in Ireland

Marq Redeker (Marq.Redeker@cdmsmith.com; CDM Smith Consult GmbH);

The development of the Shannon Hydro-Electric Scheme and its diversion weir in the 1920s were important events in the creation of an independent Irish State. Its scale (100 ft head, 14,125 ft³ design flow, 86 MW installed capacity and 10.5 mi diversion) and importance made it a centrepiece for national development. However, this came with an environmental cost. Up to the 1920s salmon ran the River Shannon in huge numbers, but implementation of the Scheme had an immediate effect on fish migration. Despite a fishway at the diversion weir and retrofitted fish lift at the Station, today only around 2% of the river's self-sustaining stock are recorded. As part of the River Basin Management Plan (RBMP) 2018 - 2021 for Ireland a comprehensive review and options study was undertaken. The aspects included upstream fish passage, downstream migration and fish protection, and environmental flows. The presentation will outline a) the Scheme and fish passage status quo, b) the proposed improvement options applying stateof-the-art fish passage technologies and E-Flow best practice and their impact on the operation of the Scheme and other water uses, and c) the roadmap of actions that is foreseen in the RBMP 2022- 2027.

Wednesday
Horizon A
10:55:00 AM
In Person: Oral Presentation

Big Dam on the Little River: Designing a Technical Fishway for the Papermill Pond Dam

Rachael Weiter (rweiter@eaest.com; EA Engineering, Science, and Technology, Inc., PBC); Amy Hunt (ahunt@eaest.com; EA Engineering, Science, and Technology, Inc., PBC)

The Papermill Pond Dam, a 30-foot-tall run-of-river dam on the Little River in Sprague, CT, has blocked upstream fish passage for 150 years. In 2019, the Thames Valley Chapter of Trout Unlimited, in partnership with EA, applied for and received funding from the NFWF Long Island Sound Futures Fund to design a fishway for the site to facilitate passage of American shad and river herring. Design challenges include sheer streambank slopes downstream of the dam; limited equipment access; Superfund site adjacent to the dam and legacy contaminated sediments; the shallow downstream channel; legacy electrical and wastewater infrastructure crossing the project site; the height of the dam and subsequent depth of the fishway; and the determination by the project partners that technical fishway design could not incorporate switchbacks. Despite these challenges, EA and TU have worked effectively with the project partners (USFWS, NOAA DMF, and Connecticut DEEP) to design the proposed Denil fish ladder, which will have a maximum depth of 25 feet and will extend over 300 feet in length. Post-construction monitoring has been proposed by the USFWS to assess the effectiveness of the design. The presentation will discuss lessons learned and next steps for the project.

Fish passage challenges and innovation: High head and diversion dams.

Wednesday
Horizon A
11:15:00 AM
In Person: Oral Presentation

Feasibility of upstream and downstream fish passage of salmon and steelhead at high-head dams on the Tuolumne River, California

John Ferguson (jferguson@anchorqea.com; Anchor QEA, LLC);

Fish passage feasibility at La Grange (lower) and Don Pedro (upper) dams was assessed; both volitional passage and collection and transportation alternatives were considered. Feasibility-level design focused on collecting adult salmonids below La Grange and releasing fish above Don Pedro and collecting juvenile salmonids near the head of Don Pedro and releasing them below La Grange. The study highlighted challenges associated with developing two-way trap and haul programs at high-head dams, which included 1) no feasible alternatives for at-dam collection of juveniles, 2) a 160-foot forebay range and long (42 km), sinuous, warm, Don Pedro reservoir with high predation potential, and 3) a wild and scenic river above the reservoir that eliminated this site from consideration. Adult collection was judged to be feasible; collecting juveniles appeared feasible at this stage of concept development. For juvenile collection, a novel head-of-reservoir concept was developed that incorporated successful Columbia River collection strategies into a hybrid design: a bulk-flow corner collector and vertical slots and surface flow designed into a new flow-control dam. The study provided information on fish passage that can be combined with information on potential habitat available to salmonids in the upper Tuolumne River to inform fish reintroduction strategies.

Wednesday
Horizon A
11:35:00 AM
In Person: Oral Presentation

Designing a Fish Collector That Fluctuates 183 Feet in Elevation: The Floating Fish Collector for Cougar Dam

Aaron Litzenberg (aaron.d.litzenberg@usace.army.mil; USACE Portland District);

Cougar Dam, McKenzie River, Oregon, USA is a high-head dam owned and operated by the U.S. Army Corps of Engineers (USACE). This presentation discusses the design of a floating screen structure (FSS) to collect juvenile salmonids in the forebay and transport them safely downstream. The Cougar Dam forebay range is 183 feet, which was a major design challenge when developing a juvenile collector that relies on constant water levels and gravity flow for attraction.

Fish passage challenges and innovation: High head and diversion dams.

Wednesday
Horizon A
11:55:00 AM
In Person: Oral Presentation

The unique fish passage at Cle Elum

Jason Wagner (jwagner@usbr.gov; US Bureau of Reclamation);

In partnership with various stakeholders, and managed by the Bureau of Reclamation, new projects were created to restore fish passage at Cle Elum Dam in Washington state. This contains a facility for upstream passage of adult salmonids and also contains a one of a kind helical downstream fish passage system. The presentation will cover how the history behind the one of a kind helix used for downstream passage. The history includes alternative analysis, numerical modeling, hydraulic modeling, multi stakeholder collaboration, and the contributions of nearly 200 engineers and scientists. This project has been under construction for approximately five years. Some construction photos will be shared showing the construction progress.

Wednesday
Horizon A
1:30:00 PM
In Person: Oral Presentation

Howard Hanson Dam, High Head, Steep Slope, Downstream Fish Passage

David Doll (david.a.doll@usace.army.mil; USACE);

Howard Hansen Dam (HAHD), Green River, Washington USA, is owned and operated by the U.S. Army Corps of Engineers (USACE). HAHD is a high-head multi-purpose dam with fluctuating reservoir elevation levels. The only route for water and fish to pass the dam is through tunnels deep in the reservoir. Disconnection and flow regime change have severely reduced the capacity of the Green River watershed to maintain salmon and steelhead populations. To avoid jeopardizing Endangered Species Act (ESA)-listed salmon and steelhead populations, and to restore their adversely modified critical habitat in the watershed, a permanent downstream fish passage system must be designed and constructed at HAHD. The system must provide safe downstream fish passage for Chinook salmon and steelhead. The engineering design challenges are numerous and include debris management, site space constraints, seasonally fluctuating reservoir elevations of nearly 100 feet, and a reservoir to tailwater drop of 170 feet. This presentation will review the project history, fish passage design challenges, and the proposed feasibility design of a multiport steep slope volitional bypass.

Wednesday
Horizon A
1:50:00 PM
In Person: Oral Presentation

Speed Kills…. or does it? Howard A Hanson Dam (HAHD) Steep Slope Bypass Design

Ryan Laughery (ryan.o.laughery@usace.army.mil; USACE); David Doll (david.a.doll@usace.army.mil; USACE);Travis Ball (travis.d.ball@usace.army.mil; USACE);

Howard A Hanson Dam (HAHD), Green River, Washington, USA is owned and operated by the U.S. Army Corps of Engineers (USACE). This presentation discusses the development of multiple bypasses to restore downstream fish passage past HAHD. HAHD forebay range during downstream fish passage is 98 feet resulting in hydraulic head differentials of 66 to 172 feet when compared to downstream tailwaters.

Biological evaluations of existing bypasses having slopes greater than 1V:1H and velocities more than 50 fps were compared to determine potential for adapting a design using a steep slope. Hydraulic numerical models were developed of these existing bypasses and compared to biological thresholds associated with pressure change and strain rates. Designs of steep slope bypasses for HAHD were developed to convey fish from the multiport collector to the downstream tailrace based on improving hydraulic conditions compared to existing steep slope bypasses. Preliminary evaluation of computational fluid dynamic models indicates the capability of steep slope bypasses to maintain conditions significantly below biological thresholds while improving upon historical designs.

Wednesday
Horizon A
2:10:00 PM
In Person: Oral Presentation

North Fork Dam Juvenile Collection System Performance

Nick Ackerman (nick.ackerman@pgn.com; Portland General Electric); Brian Pyper (brianpyper@gmail.com; Fish Metrics)

North Fork Dam was built on the Clackamas River, Oregon in 1958. Over the ensuing 57 years downstream passage was provided with a surface collection system providing 200 cfs of attraction flow. In 2015, as part of a new FERC License, Portland General Electric added a floating surface collector to the forebay providing an additional 1,000 cfs of attraction flow. Both collectors transition fish into a pipeline that bypasses the three-dam project, discharging into the Clackamas River 7 miles downstream. Between 2016 and 2021 PGE released 7,004 PIT-tagged Chinook, coho, and steelhead juveniles and 226 acoustic-tagged Chinook juveniles to determine the effectiveness of the collection system. Fish collection efficiency varied by species, ranging from 83-94% among species. The partition of collections between the 200 cfs and the 1,000 cfs collectors varied substantially by species. Chinook were almost exclusively collected in the 1,000 cfs collector whereas nearly 40% of steelhead used the original 200 cfs collector. Our analysis revealed seasonal patterns in collection efficiency for Chinook, as well as covariate effects on both travel time and collection probability for all three species. This presentation will focus on key results of the collection system performance evaluation.

Wednesday
Horizon A
2:30:00 PM
In Person: Oral Presentation

Does the passage through a bypass installed in hydropower plant affects the physiological and health status of Atlantic salmon smolts?

Julie Lucas (julie.lucas@unamur.be; ILEE - UNAMUR); Jerome Lambert (jerome.lambert@unamur.be; URBE, University of Namur (Belgium));Robert Mandiki (robert.mandiki@unamur.be; URBE, University of Namur (Belgium)); Patrick Kestemont (patrick.kestemont@unamur.be; URBE, University of Namur (Belgium))

Atlantic salmon is anadromous species migrating from the upper-reach nursery in rivers to the oceanic feeding areas at smolt stage and inversely at adult stage requiring unimpeded migration routes. In many river systems such as in Meuse River (Belgium), Atlantic salmon are confronted to many hydroelectric power plants (HPP) which disrupt river connectivity and affect fish movement and survival. One possibility to reduce the impact of HPP is to install bypass to facilitate fish downstream migration. The aim of this study was to assess if the passage through Grands Malades bypass (Meuse River, Belgium) can affect survival, the physiological and immune status of Atlantic salmon smolts. Various key stress and immune biomarkers were studied at 24h, 72h and 120h after passage. We hypothetized that the passage through the bypass had a reduce impact on physiological and health status of fish.

Wednesday
Horizon A
2:50:00 PM
In Person: Oral Presentation

Farmers Horizontal Flat Plate Fish Screen at Derby Dam in Sparks, Nevada

Daniel Kaler (daniel.kaler@fcasolutions.org; Farmers Conservation Alliance);

Derby Dam, located on the Truckee River outside of Reno, Nevada USA, is the oldest capital project owned and operated by the U.S. Bureau of Reclamation. The dam was built in 1905 without provisions for upstream or downstream fish passage. This hasblockedaccess to spawning and rearing habitat forLahontan cutthroat trout(LCT). LCTare endemic to the Truckee River and are listed under the U.S. Endangered Species Act. To restore aquatic connectivityand provide fish passage around the dam,a three-part fish passage projectwas planned. First, an upstream fish waychannelwas designed and constructed. Second, selected gates on the dam were replacedincorporating autonomous control.Third, a horizontal fish screen facility was designed tosafely bypass fishdownstream of the dam.The fish screen facility is 5 screen array ofFarmers Conservation Alliance patented horizontal fish screens, designed toaccommodateup to 600 cfs. This talk will focus on the third and final part of the fish passage project, and will include expandedbackground, an introduction to the FCA screen system, design development, engineering challenges, construction, and an operational update. The project was deemed substantially complete September 2020.

Wednesday
Horizon A
3:40:00 PM
In Person: Oral Presentation

Modeling Passage and Survival of Juvenile Salmon through Hydroelectric Dams

James Faulkner (jim.faulkner@noaa.gov; NOAA Fisheries);

Threatened and endangered stocks of salmon from the Snake River Basin must pass through multiple hydroelectric dams during their seaward migration. Behavioral responses to dam structures or operations can cause delay in the forebays of dams, slowing migration and increasing exposure to predation. Similarly, the route of passage taken through a dam can be influenced by river conditions and dam operations, and survival can differ by passage route. Hydrologic dynamics in the tailraces of dams can create currents that entrap fish and delay their migration, increasing exposure to predation. Active telemetry tags allow researchers to accurately track the passage behavior of fish and their route of passage at dams. We develop novel statistical models that jointly model the forebay passage time, selection of passage route, tailrace passage time, and associated survival at each stage using telemetry data from these active tags. We use a Bayesian modeling framework that operates on a probability model for the passage process and allows for imperfect detection and missing data. We demonstrate how these models can be used to assess the effects of a range of dam operations and environmental conditions on the passage behavior and survival of migrating juvenile salmon.

Statistical methods for evaluating fish passage and its effects on fishes.

Wednesday
Horizon A
4:00:00 PM
In Person: Oral Presentation

An evaluation of factors affecting powerhouse passage of spring migrant smolts at federal dams of the lower Snake and Columbia rivers

Ryan Harnish (ryan.harnish@pnnl.gov; Pacific Northwest National Laboratory); Kenneth Ham (kenneth.ham@pnnl.gov; Pacific Northwest National Laboratory);John Skalski (skalski@uw.edu; University of Washington); Rebecca Buchanan (rabuchanan@uw.edu; University of Washington)

Operations of eight federal dams on the lower Snake and Columbia rivers have undergone alterations in recent years, including increases in the proportion of the river that is spilled, to reduce smolt passage through powerhouses. However, diverting water from the powerhouse decreases hydroelectricity production, which must be offset with an energy source that may have greater carbon emissions. High spill levels also delay adult salmon upstream passage while increasing TDG levels and the potential for gas bubble trauma. During acoustic telemetry studies conducted at 7 of the 8 dams from 2008–2018, a total of 100,794 tagged smolts were tracked to their route of dam passage. Passage events were associated with biological, operational, and environmental conditions and multivariable logistic regression modeling was used to evaluate the factors affecting powerhouse passage. Results indicated powerhouse passage probability was positively correlated with discharge, negatively correlated with temperature and fish size, and higher for fish that passed at night and for those that approached from the powerhouse side of the river, suggesting powerhouse passage is a function of swimming ability and activity level. This information can be used to develop dam- and time-specific spill patterns that optimize smolt passage, power generation, and adult passage.

Wednesday
Horizon A
4:20:00 PM
In Person: Oral Presentation

Direct and Carryover Effects of Freshwater, Marine and Fish Conditions on Juvenile, Ocean, and Adult Survival of Snake River Chinook Salmon

Jennifer L Gosselin (gosselin@uw.edu; Aquatic & Fishery Sciences, University of Washington); Eric R. Buhle (eric.buhle@noaa.gov; Mount Hood Environmental; affiliate status at Northwest Fisheries Science Center, NOAA Fisheries);Lisa G. Crozier (lisa.crozier@noaa.gov; Northwest Fisheries Science Center, NOAA Fisheries); Brian J. Burke (brian.burke@noaa.gov; Northwest Fisheries Science Center, NOAA Fisheries)

Determining which factors are most effective for mitigative strategies in conservation management can be difficult for species with complex life cycles. Salmon (Oncorhynchus spp.) migrating through a hydroelectric power system experience conditions that can affect their survival directly within a life stage, and indirectly in subsequent life stages through carryover effects. We quantified over 20 covariate effects on survival across life stages of Chinook salmon (O. tshawytscha): juveniles migrating downstream, juveniles in the estuary, subadults in the ocean, and adults migrating upstream. We applied a hierarchical Bayesian Cormack-Jolly-Seber (CJS) mark-recapture model to ~400,000 wild Snake River Chinook salmon (Pacific Northwest, USA). We fitted candidate models to the capture histories of passive integrated transponder (PIT)-tagged Chinook salmon using Hamiltonian Monte Carlo algorithm implemented in Stan (mc-stan.org). Modeled covariates of survival included migration timing, river temperature, flow, percent of water spilled over dams, snow water equivalent, juvenile fish transportation, juvenile fish length, dam powerhouse passage, sea surface temperature (SSTarc), and the North Pacific Gyre Oscillation. By analyzing the covariates in a unified model, we evaluated their relationships to survival within and across life stages in a common currency. The strongest marginal effect sizes indicated that marine conditions, represented by the SSTarc index, had a strong negative relationship with ocean survival, yet juvenile fish length in the river had comparable and positive marginal effect sizes with ocean survival. Fish length and river temperature had important associations to river and ocean survival; and an index of dam powerhouse passage showed a negative but uncertain influence on ocean survival. As conditions in freshwater and marine environments continue to change, it is important to continue existing monitoring programs, to understand underlying mechanisms, and to not rely on correlations between environmental indices because they break down over time. In our presentation, we will also briefly cover two other studies: one that covers perspectives related to climate teleconnections, pre-conditioning, and carryover effects; and one about the importance of integrating biological mechanisms into our models. Along with modern statistical methods that help handle the complexity in estimating survival of migratory species across life stages, understanding the biological mechanisms should also allow us to identify which mitigative strategies are likely to be robust under a changing climate. We hope that our presentation helps to continue discussions on applying advanced statistical methods with biological mechanisms.

Wednesday
Horizon A
4:40:00 PM
In Person: Oral Presentation

Which Way Did It Go? Continuous Time Multi-state Markov Models Applied to Fish Passage Data

Adam Pope (apope@usgs.gov; US Geological Survey, Western Fisheries Research Center); Russell Perry (rperry@usgs.gov; US Geological Survey, Western Fisheries Research Center);Michael Dodrill (mdodrill@usgs.gov; US Geological Survey, Western Fisheries Research Center); Tobias Kock (tkock@usgs.gov; US Geological Survey, Western Fisheries Research Center)

Space-for-time Cormack-Jolly-Seber and multi-state mark recapture models commonly used to analyze salmonid movement and survival assume unidirectional movement through a river system. While this assumption is generally sound for migrating salmonids at a larger scale (>10 km), at finer scales salmonids frequently move both upstream and downstream (e.g. in tidal environments as juveniles, or in exploring tributaries as returning adults). In these systems, space-for-time models can only draw inference on the ultimate fate of migrating salmonids. In addition, these models can only make use of a single covariate value at the time of detection at a telemetry station. In contrast, continuous time (or time to event) multi-state Markov models do not rely on a unidirectional movement assumption and can incorporate time-varying covariates over the entire observation history. While retaining the ability to infer ultimate fate at a route junction, these models can also be used to predict ways in which management actions affect migration routing at each visit, particularly when that routing depends on drivers that can change quickly. In this talk I will explore the use of these models in case studies in the Sacramento-San Joaquin Delta in California and the Cowlitz and Yakima Rivers in Washington.

Wednesday
Horizon A
5:00:00 PM
In Person: Oral Presentation

Multidirectional, multistate models for resolving adult steelhead migration pathways past dams

Markus Min (mmin@uw.edu; School of Aquatic and Fishery Sciences, University of Washington); Mark Scheuerell (scheuerl@uw.edu; USGS Washington Cooperative Fish and Wildlife Research Unit, University of Washington);Rebecca Buchanan (rabuchan@uw.edu; Columbia Basin Research, School of Aquatic and Fishery Sciences, University of Washington);

Adult Steelhead returning to spawn in tributaries of the Columbia River Basin undergo a complex migration between entering freshwater in the summer and spawning the following spring. Previous studies of this migration have focused on estimating the frequency of movements such as tributary overshoot, where individuals travel past the mouths of natal streams and ascend upstream dams, and fallback, where pre-spawn individuals descend dams and potentially move back to tributaries. These studies have found highly variable rates of overshoot and fallback (indirect homing) depending on year and population, indicating that some adult Steelhead interact with the hydrosystem considerably more (via additional dam ascensions and descensions) than if they homed directly to their natal tributaries. However, these studies focused on only certain parts of the full adult migration. We used detection histories from over 50,000 tagged Steelhead across the entire basin from 2005-2021 to analyze the full adult movement history using a Bayesian multidirectional and multistate model, which included the effects of temperature, spill, and rear type (hatchery versus wild). We will address the environmental and operational covariates found to be significantly associated with movement probabilities, identifying opportunities for management actions to help Steelhead successfully migrate to spawning grounds.

Wednesday
Horizon C
10:15:00 AM
Virtual Presentation

Abstracts for Hydropower & Fish

Evaluation of the two different type fish passages in River Ceyhan, Turkey in terms of biological and hydrological aspects

Ahmet Alp (aalp46@gmail.com; Kahramanmaras Sutcu Imam University); Orhan Bulbul (bulbul@gmail.com; government);Serhat Kucukali (kucukali78@gmail.com; Universtity);

The performances of the pool and orifices fish passage in Dağdelen Hydropower Plant (HPP) and vertical slot fish passage in Hacınınoğlu HPP in River Ceyhan were evaluated. The depth and velocity in the fish passage of Dağdelen HPP were 100-110 cm and 1.84 m/s. They were 30-40 cm and 1.54 m/s in the fish passage of Hacınınoğlu HPP. Fish passage of Dağdelen HPP was suitable according to the standards however fish passage of Hacınınoğlu HPP was not apropriate because the bottom structure of the pools were not suitable and this caused discontinuity in the flow. So, the fish passage of Hacınınoğlu HPP didn't allow enough migratory fish to pass. A total of 2073 fish ascended on the fish passage of Dağdelen HPP and 911 individulas of these were Capoeta damascina, 878 Alburnus adanensis, 125 Squalius kottelati, 144 Garra rufa and 15 Capoeta erhani. Totally, 98 fish ascended on the fish passage of Hacınınoglu and 27 individuals of these were C. damascina, 7 A. adanensis, 62 S. kottelati and 2 C. erhani. In the fish passage of Dağdelen HPP, fish migration kicked off 21 May and continue 70 days until August. Fish migration in fish passage of Hacınınoglu kicked off 01 July and continue 27 days. Total lengths of the fish ascending on Dağdelen fish passage varied from 2.8 to 49.0 cm, while they varied from 13.7 to 41.5 cm in the fish ascending on Hacınınoglu fish passage. During the first days of the migration, the males dominated but at the end of migration females became dominant. To sum, Dağdelen fish passage was found suitable for migratory fish and it was used by 5 potamodrom species successfully. However, Hacınınoğlu fish passage was found unappropriated for fish migration and not enough potamodrom fish species could ascend on this fish passage.

Wednesday
Horizon C
10:35:00 AM
Virtual Presentation

Efficiency of bypasses associated with inclined or angled low bar-spacing racks to protect Atlantic salmon smolts and European silver eels at small to medium hydropower plants

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Atlantic salmon and European eel, both endangered species in Europe, are particularly concerned by entrainment into hydroelectric power plants (HPP) water intakes, and subsequent damages due to turbine passage, during their downstream migration. In France, the solution mainly implemented at small to medium HPP (< 100 m3/s) consists in so-called "fish friendly intakes": installation of bypass(es) associated with low bar-spacing racks (20 mm), 26° horizontally inclined orangled to the flow (< 45°). Recent study confirmed their efficiency to protect salmon smolts at small HPP (up to 23 m3/s, Tomanova et al., 2018). Here, we address the efficiencies of fish friendly intakes assessed from 2017 to 2019 by radiotelemetry, at 4 sites for salmon smolts (199 individuals; 15.9-19 cm) and at 5 sites for silver eels (194 individuals; 55-95 cm), with intake capacities from 28 to 50 m3/s. All possible passage routes were surveyed with a multiple-antennas array (dams, bypasses and turbines). From 86% to 96% of smolts entering the intakes were successfully protected and guided to the bypass. For eels, the efficiencies reached 100% at 4 sites and 93.3% at the fifth. Passage time was usually short, few minutes, for both species. The influence of bypasses discharge on efficiency and passage duration is highlighted.

Wednesday
Horizon C
10:55:00 AM
Virtual Presentation

Numerical assessment of fish injury risk combining agent-based fish behavior with turbine blade-strike detection

Dennis Powalla (dennis.powalla@ovgu.de; Otto-von-Guericke University Magdeburg); Stefan Hoerner (stefan.hoerner@ovgu.de; Otto-von-Guericke University Magdeburg);Dominique Thevenin (thevenin@ovgu.de; Otto-von-Guericke University Magdeburg);

There exists an urgent need for methods replacing live animal tests deployed for fish compatibility assessment of hydropower facilities in order to address ethical concerns and the high economic costs of the current praxis. Our tool combines fish surrogates (particles with corresponding inertia) in a numerical framework with agent-based fish behaviour models. It tracks the pathway of each fish surrogate in an unsteady flow field, while capturing contact interactions with walls, in particular turbine blades. The fish behaviour is described by combining pre-defined rules of conduct based on ethohydraulic observations. Fish naturally prefer staying in specific regions, i.e. close to obstacles, or near the ground, which is explained by the intention of predator avoidance, search for food, or simply on hydraulic conditions leading to the most efficient locomotion. In order to take species-specific behaviour into account, explicit rules of conduct were developed and implemented in the previously introduced numerical framework. This new implementation allows for species-specific parametrization while accounting for the real geometry of the investigated facility. The developped numerical method extends and refines previous etho- and ecohydraulics investigations. It is a significant step forward in replacing live fish testing concerning hydropower facility assessment.

Wednesday
Horizon C
11:15:00 AM
In Person: Oral Presentation

Fish-related Performance Evaluation of Turbines in Industry Settings

Pedro Romero-Gomez (Pedro.Romero-Gomez@andritz.com; Andritz HYDRO GmbH); Rudolf Peyreder (rudolf.peyreder@andritz.com; Andritz HYDRO GmbH);Daniel Deng (Zhiqun.Deng@pnnl.gov; PNNL);

Since the introduction of stricter regulations to increase fish survival rates during turbine passage, both experimental and numerical techniques have emerged to quantify hydraulic stressors detrimental to fish. These methods have been primarily developed in research centresand academic institutions. Evaluation campaigns are usually executed by independent consultants specialized in deploying sensors or live fishto test turbines directly onsite,or in simulating turbine flows with numerical approaches to extract information relevant to fish passage. Fish-related evaluations of turbines conducted by the very same industry teams that design new runners and ancillary components canpotentiallyaccelerate theiterative process for enhancing turbines biologically. This presentation summarizes the ongoing years-longprocess of integrating such fish passage evaluations inside thepraxis of turbine design teams in industry. This task has required an adaptation ofmodelling and test rig protocols to accommodate the new demands for environmentally enhanced turbines. After a brief description of the turbine design processto make the audience acquainted with the challenge in questionfrom the designer's standpoint,the fish-related evaluations at two phases that constitute the backbone of a design project will be explained.First, fundamentals and applications of the technique used at the stage of proposal engineering (orfish-relatedlayout) willbe presented. This phase seeks to yieldrough-and-ready estimates with technically sound concepts. Second, we willdescribe thetest rig experimentation with miniaturized sensors (Sensor Fish Mini)that is conducted formore matured, consolidatedcandidate designs. The driving force behind the integration process is the need to accelerate the development of fish-passage enhanced turbines; the earlier measures to this purpose are undertaken, the higher the certainty about the effectives of the measures will be.

Wednesday
Horizon C
11:35:00 AM
In Person: Oral Presentation

Design and Biological Testing of a New Turbine Runner Installed at Ice Harbor Lock and Dam

Jon Renholds (Jon.F.Renholds@usace.army.mil; US Army Corps of Engineers); Brad Trumbo (bradly.a.trumbo@usace.army.mil; US Army Corps of Engineers)

In March of 2010, the US Army Corps of Engineers' (USACE) awarded a contract to Voith Hydro to design and supply new turbine runners for installation at the Ice Harbor Lock and Dam located on the Lower Snake River within the State of Washington, USA. The contract included design and supply of both fixed- and adjustable-blade turbine runners for replacement of 3 units within the six-unit powerhouse. The new turbine runners have been designed for "safer" fish passage as a primary goal and increased operating efficiency as a secondary goal. The hydraulic design of both runner types was a collaborative effort by the USACE Walla Walla District (NWW), Hydroelectric Design Center (HDC), Engineer Research and Development Center (ERDC), and Voith Hydro. The two runner types were designed through an iterative process of Computational Fluid Dynamics Model analysis, performance model testing for power generation, efficiency and cavitation, and physical hydraulic model evaluation of the turbine fish passage environment. The first of these new runner designs, the fixed blade runner, was installed and tested for fish passage performance in 2019. This presentation provides an overview of the design process, methods for testing fish passage performance, and the testing results compared to modeling results.

Wednesday
Horizon C
11:55:00 AM
In Person: Oral Presentation

Characterization of the Ice Harbor Improved Fish Passage Turbine

Jayson Martinez (jayson.martinez@pnnl.gov; PNNL); Daniel Deng (Zhiqun.Deng@pnnl.gov; PNNL);Tao Fu (tao.fu@pnnl.gov; PNNL); Cecily Wang (jingxian.wang@pnnl.gov; Pacific Northwest National Laboratory); Robert Mueller (robert.mueller@pnnl.gov; PNNL); Joanne Duncan (joanne.duncan@pnnl.gov; Pacific Northwest National Laboratory); Scott Titzler (scott.titzler@pnnl.gov; Pacific Northwest National Laboratory); Scott Titzler (scott.titzler@pnnl.gov; Pacific Northwest National Laboratory); Jun Lu (jun.lu@pnnl.gov; PNNL); Aljon Salalila (aljon.salalila@pnnl.gov; PNNL); Brad Trumbo (bradly.a.trumbo@usace.army.mil; US Army Corps of Engineers); Karl Anderson (karl.r.anderson@usace.army.mil; US Army Corps of Engineers); Jon Renholds (Jon.F.Renholds@usace.army.mil; US Army Corps of Engineers); Martin Ahmann (martin.l.ahmann@usace.army.mil; US Army Corps of Engineers); ;

Turbines at existing hydro dams within the Columbia River Basin are aging and plans have begun to replace them with improved designs. The U.S. Army Corps of Engineers and Voith Hydro Inc. developed two improved fish passage (IFP) turbine designs for Ice Harbor Dam: a fixed-blade runner design for Unit 2 and an adjustable-blade runner design for Units 1 and 3. The Unit 2 runner began operating in 2019, followed by evaluating the turbine passage environment using the Sensor Fish (SF) device, a small, neutrally buoyant autonomous sensor package capable of measuring and collecting in situ motion and force data. SF were released into intake Slot B of Unit 2 at three different elevations to holistically characterize conditions among the different regions of the runner: blade tip, middle blade, and blade hub. Data were collected at three different operating conditions. A total of 720 SF releases returned valid data for the characterization study, which occurred simultaneously with a separate biological study that utilized both live fish and SF (additional 213 SF releases). Nadir pressures below atmospheric pressure (14.7 psia) in the turbine environment may negatively affect fish and the affect increases at nadir pressures below 12.5 psia. The percentages of nadir pressure below 14.7 and 12.5 psia measured across operating points for the Unit 2 turbine were: 0.4% and 0.0% for Lower 1%, 1.4% and 0.0% for Peak efficiency, and 0.9% and 0.0% for Upper 1%-Generator limit, respectively. The percentage of SF releases that contained severe (>95 G) acceleration events during runner passage were: 3.7% (Lower 1%), 1.8% (Peak), and 4.4% (Upper 1%-Generator limit). Overall, SF data was critical for field-validating the improvements seen during the Unit 2 fixed-blade runner design. The runner performed as expected with substantial improvements over the baseline turbine at Unit 1. Nadir pressures are unlikely to impact juvenile salmonids or lamprey even when the turbine is operating at the Upper 1%-Generator limit, and blade strike was reduced through the runner. Sensor Fish data and turbine characterization studies are important tools to inform and validate turbine runner design improvements.

Wednesday
Horizon C
1:30:00 PM
Virtual Presentation

Ecological Impact Scorecard of Hydropower Plants and Mitigation Measures

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Hydropower plants interrupt river continuity, fish migration, and change downstream flow regime during operation. For a case study, Çataloluk Hydropower plant's, which has been in operation in the Ceyhan River Basin in Turkey, ecological impact has been assessed. The ecological impact scorecard of the facility reveals that there are significant gaps relative to basic good practice for hydropeaking, downstream fish passage, and sediment management. The following mitigation measures are proposed: enhancement of the environmental flow, construction of pool-riffle morphologies for hydropeaking, installation of fish-friendly fine screens at the water intake, installation of brush blocks and substrate in the pools of vertical slot fish pass, and the usage of hydro-suction technology for sustainable sediment management. After the installation of brush blocks and substrate, the passage of efficiency of Capoeta damascina increased from 15.4% to 66.1%. The passage efficiency of Alburnus adanensis was found as 52%. Also, the biotelemetry monitoring data revealed that the structural modification provides passage for small-bodied fish in a high-gradient channel. It is shown that bristles as flexible hydraulic elements are beneficial for migrating fish. The proposed innovative design has been found to be cost-efficient and easy to implement in existing vertical slotted fish passages.

Wednesday
Horizon C
1:50:00 PM
In Person: Oral Presentation

Utility of environmental DNA (eDNA) in hydropower-impacted riverine systems for fish biodiversity and ecosystem assessments, and fish passageways.

Kristine Moody (moodykn@ornl.gov; Division of Environmental Sciences, Oak Ridge National Laboratory); Jeffrey Simmons (jwsimmons0@tva.gov; Tennessee Valley Authority);Katherine Sparks (katiedidsparks@gmail.com; Science Undergraduate Lab Internships, Oak Ridge National Laboratory); Lily Fenton (lafenton@email.wm.edu; Science Undergraduate Lab Internships, Oak Ridge National Laboratory); Kimberly Fenin (kfenin@gmail.com; Science Undergraduate Lab Internships, Oak Ridge National Laboratory); Brenda Pracheil (pracheilbm@ornl.gov; Division of Environmental Sciences, Oak Ridge National Laboratory);

Hydropower regulation frequently requires fish biodiversity assessments to better understand and mitigate environmental impacts. Yet, these assessments are typically time-consuming, costly, and hazardous conventional capture-based fisheries methods that introduce biases with respect to fish size, age, and species. Environmental DNA (eDNA)— DNA deposited into the environment during reproduction and senescence, can be amplified and sequenced to identify how many and which species are present —has the potential to transform biodiversity assessments. To assess eDNA utility and spatio-temporal variation in a hydropower-impacted system, we conducted an eDNA study in Melton Hill Reservoir in Oak Ridge Tennessee. We detected 59 fish species across 14 families, with greater detection further upstream of the dam and during the spring, spawning season. However, eDNA relative abundance estimates were not correlated with catch per unit effort, underscoring the need for further evaluation of eDNA limitations. To build on this work, we are examining if eDNA can be used inside fish passageways to catalog which species and how many individuals are using the passageways. Our research will contribute to the growing confidence in eDNA and help to delineate inherent uncertainties in its utility so that it can be appropriately applied as a tool for biomonitoring.

Wednesday
Horizon C
2:10:00 PM
Virtual Presentation

A three-phase numerical model to predict TDG downstream of Hells Canyon Dam

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One environmental concern of hydropower is the supersaturation of Total Dissolved Gas (TDG), which may cause gas bubble disease in fish. This paper presents a numerical model, based on the open-source code OpenFOAM, to predict TDG uptake and distribution. Air dissolution downstream of spillways depends not only on the number and size of entrained bubbles but also on the depth reached by those bubbles in the tailrace, therefore a proper model for TDG prediction must account for the three-phase flow in the tailrace (water, air and mixture bubbles/water) and the mass transfer between bubbles and water. The interface air-mixture bubbles/water is solved with the VOF method and the bubbles/water mixture is computed with a Eulerian two-phase flow model. A novel air entrainment model, based on the physical processes involved in the entrainment of bubbles, was implemented in OpenFOAM. The model was used to understand the main processes leading to elevated TDG in Hells Canyon Dam. The model included the 3 spillway bays, 2 sluiceway bays, 3 powerhouse units, fish trap, diversion tunnel and about 2 km of the tailrace. The presentation will describe the model, validation against field data, and future steps on the study to mitigate supersaturation.

Wednesday
Horizon C
2:30:00 PM
In Person: Oral Presentation

Development of replicable exploitation cursors implemented to improve silver eel migration at HPP facilities

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Recent projects targeting European silver eel protectionat HPP started by a diagnostic step combining measurement of direct mortality of turbine with fish passage telemetry studiesestablishingtherebya reference situation.Onthe River Meuse, the LIFE4FISH project repeated the same telemetric protocol after implementation of pilot solutions.First,an electrical fish fence reduced significantly eelturbine passage by 50% in low discharge conditions, the majority of eels already escaping bydam passages at higher discharge. Second, thedevelopment of theSilveR Peak model succeeded to predict 50 to 80% of the eel passagesdepending on the prediction timeframe.Onthe River Seine, the use of the SilveR Peak model applied on the telemetry dataset was used on telemetric data to simulate the effect of turbine partial shutdownand timeframe of this operation on eel turbine passage.Eel migration prediction thresholds, dam escapement modelandefficiency of the electrical barrierhave beenused as cursors on the telemetry dataset with as final output an available daily river discharge for HPP respecting eel protection targets. Filling scientific gapson silver eel migration by field studies also helped the productors to propose proofed solutions accepted by authorities and transferableinto permits.

Wednesday
Horizon C
2:50:00 PM
In Person: Oral Presentation

Direct turbine passage survival and injury of adult American eels and river herring at a hydropower project in Maine

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Direct turbine passage survival and injury rates ofadultAmerican Eelsand river herring were quantified at a hydroelectricproject in Maine using the HI-Z Tag recapture technique. The HI-Z recapture study estimated delayed survival of turbine passed American Eels at90.0%and river herring at96.0%. Malady-free estimateswere 84.8% for American Eels and 93.9% for river herring. Additionally, ARC 800 Sensor Fish were used to measure the physical and hydraulic conditions (i.e., pressure, acceleration, and rotation) that fish encounter during downstream passage. Sensor Fish data wereused to determine the range of nadir pressuresfish are exposed to during passageandwereevaluated relative to available dose-response relationships to quantify the barotrauma-related effects of turbine passage at the Project.SensorFishdata werealso used to quantify the occurrence ofsevere acceleration events to examine the type (i.e., shear or strike) and relative location of each event.Results from this studysuggest the use ofbiological models to estimate the effects of turbine passage for American Eels should not be considered at present, as these types of models can either over or under-estimate mortality associated with turbine passage for this unique species of fish.

Wednesday
Horizon C
3:40:00 PM
In Person: Oral Presentation

Snake River Steelhead Overshoot and Overwintering in the Upper Columbia River Basin

Joshua Murauskas (jmurauskas@fourpeaksenv.com; Four Peaks Environmental Science & Data Solutions); Catherine Willard (catherine.willard@chelanpud.org; Chelan PUD);Elizabeth Ng (eng@fourpeaksenv.com; Four Peaks Environmental Science & Data Solutions);

We analyzed a decade of adult Snake River steelhead Oncorhynchus mykiss passage to quantify the proportion that overwinter in the Upper Columbia River (UCR) hydroelectric system prior to spawning the following spring. Juvenile releases from 2009 to 2018 yielded 23,437 adults, of which 478 (2.0 %) were subsequently detected at one or more UCR hydroelectric projects. The probability of converting to the upper Snake River was significantly lower for steelhead that ascended the UCR, though apparent losses (n = 232 or 1.0% of all study fish) were often detected following the overwinter period indicating a considerable but unquantified level of survival. Escapement to the uppermost passable project on the Snake River, Lower Granite Dam, was 90.1% SE = 0.2% for all study fish and 90.9% SE = 0.2% when excluding steelhead that overwintered in the UCR, a majority of which (60.3%) were observed beyond the overwintering period. Considering that undetected strays and undocumented harvest cannot be easily disentangled from conversion rates, these results suggest that overwintering in the UCR has a minimal effect on Snake River steelhead populations.

Wednesday
Horizon C
4:00:00 PM
In Person: Oral Presentation

Trials and tribulations in estimating fish escapement at a dam where migrating fish do not always use the fish ladders

Jeff Fryer (fryj@critfc.org; Columbia River Inter-Tribal Fish Commission); Sonya Schaller (Sonya.Schaller@colvilletribes.com; Colville Confederated Tribes)

Zosel Dam is located on the Okanogan River in the Columbia Basin and is a key site for estimating escapement of salmon into Canada, including Sockeye Salmon which is often the largest natural-origin salmon run in the Columbia Basin. This dam has two fishways, and video was used to estimate escapement in the early 1990s and again from 2005 through 2017. However, both times counting was ultimately discontinued, in part because at high flows fish could migrate through the spillways, thus evading being counted. Since 2009 Passive Inductive Transponder (PIT) tags have been used to assess Sockeye salmon escapement using detections of adult salmon PIT tagged at downstream dams subsequently detected at Zosel Dam. This works in some years, however in other years fish have again passed through the spillways undetected. Floating PIT tag arrays were installed, and then upgraded, and were successful at detecting PIT tagged downstream migrating juveniles but were a failure at detecting upstream migrating adults. In fall, 2021, a PIT tag antenna was installed across the spill bay which within 2 weeks showed both great promise and potential serious shortcomings. Successes, failures, and lessons learned regarding all these tools and techniques will be discussed.

Wednesday
Horizon C
4:20:00 PM
In Person: Oral Presentation

Movement behavior of brown trout (Salmo trutta) parr during simulated hydropeaking – An imaging-based tracking approach

Robert Naudascher (naudascher@ifu.baug.ethz.ch; ETH Zurich); Luiz Silva (silva@ifu.baug.ethz.ch; ETH Zürich)

High head storage hydropower is deemed to be the ideal renewable energy source to meet the increasing demand for daily peak electrical energy. However, downstream of such facilities abrupt discharge alterations due to hydropeaking cause spatial relocation of habitats that disturb aquatic biota, including the early life-stages of riverine fish . Fish may drift unintentionally or get stranded during hydropeaking events. To avoid downstream displacement or stranding, fish have to navigate hydrodynamic gradients and identify cues associated with the temporal variation of water depth and flow velocities. Experimental approaches using hydraulic flumes have been employed to rank the severity of flow ramping rates causing fish drift or stranding. However, these studies have used the number (count) of drifted and stranded individuals as a proxy to determine severity, disregarding the movements and location of the fish during hydrodynamic changes. . Here we directly observe behavioural reactions of 2-month-old brown trout (Salmo trutta) exposed to simulated hydrpeaking. We combined imaging-based tracking techniques with a novel translucent gravel bed in a laboratory flume. Imaging quality was sufficiently high to quantify hydrodynamic space use, head orientation angle and tailbeat frequency for two distinct hydropeaking scenarios. Preliminary results show that combinations of flow-depth and flow velocity trigger relocation and we were able to derive lateral relocation time scales. This work contributes to provide a mechanistic understanding of fish movement behavior and determine hydrodynamic conditions that trigger fish relocation during hydropeaking events.

Wednesday
Horizon C
4:40:00 PM
In Person: Oral Presentation

Benefits, Distribution, and Costs of Fish Passage, Fish Protection, and Flow Mitigation Requirements Created During the US Hydropower Licensing Process

Brenda Pracheil (pracheilbm@ornl.gov; Division of Environmental Sciences, Oak Ridge National Laboratory);

As part of the US hydropower licensing process, stakeholders work together to determine the environmental impacts of a hydropower project and how to study and/or mitigate them. The protection, mitigation, and enhancement (PM&E) measures negotiated as part of the license are highly variable, ranging from species protection measures like fish passage and habitat restoration to recreational improvements and protection of cultural and historic properties. Of all the environmental mitigations required as part of the US Federal Energy Regulatory Commission (FERC) licensing process, fish passage, fish protection, and flow requirements are the three most expensive measures and flow requirements are the most common. In this talk, we use datasets created by Schramm et al. (2015), Oladosu et al. (2021), and Pracheil et al. (2021) to describe the spatial distributions, types, and monetary costs of environmental measures associated with fish passage, fish protection, and environmental flow requirements from US FERC hydropower licenses. While these three datasets do not contain information on the same hydropower projects, we can gain insight into larger patterns in hydropower mitigation from examining all three simultaneously.

Wednesday
Horizon D
10:15:00 AM
Virtual Presentation

10 years experiences and optimizations of the fish lift/lock “der Wasserwirt“

Bernhard Monai (office@der-wasserwirt.at; der Wasserwirt-Projektmanagement GmbH); Anna Gaibinger (anna.gaibinger@der-wasserwirt.at; der Wasserwirt-Projektmanagement GmbH)

In the last 10 years, the fish lift/lock, system “der Wasserwirt”, has been implemented at a total of eight locations in Austria. The lifting heights range from approx. 2.0 to 12.0 m. The system was designed in a wide variety of combinations: integrated in a defensive wall or power house; combined with basin pass or Enature® fish pass; used when upper water level and lower water level fluctuate. The fish continuity was proved within strict monitoring concepts (Woschitz et al. 2003). The downstream fish passage was measured too. In all these years, no parts of the system had to be replaced due to wear - one exception: hydraulic slides have been used instead of electromagnetic drives, as these ensure faster opening and closing times as well as more reliable and more permanent functionality. No problems have been identified with debris. The system is self-cleaning and equipped with special protections in case of flooding or icing.

The fish lift/lock has been approved as a special structure where space is limited. In the current guide to the construction of fish ladders of the government of Austria (2021), the system is presented.

Wednesday
Horizon D
10:35:00 AM
In Person: Oral Presentation

A Scaled Denil Fishway for Upstream Passage of Arctic Grayling

Katey Plymesser (kathryn.plymesser@montana.edu; Montana State University); Matt Blank (mblank@montana.edu; Montana State University - Western Transportation Institute);Megan Conley (megan.con11@gmail.com; Montana State University); Kevin Kappenman (kevin_kappenman@fws.gov; US Fish and Wildlife Service); Joel Cahoon (joelc@montana.edu; Montana State University); David Dockery (dockery.david@gmail.com; US Fish and Wildlife Service); Alexander Zale (zale@montana.edu; USGS Montana Cooperative Fishery Research Unit); Alexander Zale (zale@montana.edu; USGS Montana Cooperative Fishery Research Unit); ;

We tested a reduced (0.6) scale prototype of the standard-sized Denil fishway to determine if the smaller fishway, which requires less water flow, would successfully pass Arctic Grayling. The scaling factor was informed by analyzing previously published scalable Denil fishway rating equations. A prototype was tested in an open-channel flume using 8 treatments with 3 trials per treatment and 8 fish per trial. Each treatment had a prescribed combination of headwater and tailwater depths. Overall, 93% (178/191) of the fish volitionally entered the fishway and of these 91% (162/178) passed successfully. Entrance and passage were reduced only in treatments with the highest hydraulic slopes (i.e., with high headwater depths and low tailwater depths). The 0.6-scaled Denil fishway is probably a good alternative to standard-sized Denil fishways to enhance upstream mobility of Arctic Grayling in small, water-limited streams.

Wednesday
Horizon D
10:55:00 AM
Virtual Presentation

A successful upstream passage system for European eel Anguilla anguilla on the Tirso River (Sardinia, Italy) as a functional and replicable model on low head dams

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For over a century, the construction of 55 barriersimpede the free movement ofEuropean eel Anguilla anguilla along Sardinian river network.A defragmentation project for improving upstream accessibility was carried out in 2015 onthe Tirso river (central western Sardinia) by providing safeand effective eel passagefacility to overcome a 5.20 m high weir of Santa Vittoria.One climbing ramp,consisting of a synthetic "carpet" 9.0 x 0.25 m, were placed on the outer face of the barrier, where eels and, above all, elvers and glass eels can find favourable conditions for their upstream migration by moving easily against the current between tufts of bristles.The carpet is a structurally simple device; it does not require particular maintenanceand createseffective and functional artificial passageswith a low environmental impact. Such system can be installed quickly and is not expensivetoo.The purpose of this work is to present a comprehensive description of Santa Vittoria passage, to discuss the increase of 8.7% in the number of juvenile eels (less than 12.0 cm total length) observed upstream five months after its construction, and to illustrate the replicability of similar connectivity restorations for other low head dams of the island.

Wednesday
Horizon D
11:15:00 AM
In Person: Oral Presentation

Evaluation of the Whooshh Fish Transport System for Passing American Shad Upstream at Hydropower Dams

Steve Amaral (samaral@aldenlab.com; Alden Research Laboratory LLC); Kim Capone (kcapone@aldenlab.com; Alden Research Laboratory LLC);Jenna Rackovan (jrackovan@aldenlabl.com; Alden Research Laboratory LLC); Jake LaFontaine (jlafontaine@aldenlab.com; Alden Research Laboratory LLC); Chad Holbrook (chad.holbrook@santeecooper.com; Santtee Cooper); Janine Bryan (janine.bryan@whooshh.com; Whooshh Innovations); Paul Jacobson (pjacobson@epri.com; EPRI); Paul Jacobson (pjacobson@epri.com; EPRI); ;

Providing effective passage facilities for American Shad and river herring at hydropower dams is a priority for resourceagencies due to declining stocks and ongoing restoration efforts. Fish passage can be problematic for these species with respect to biological, engineering, and project operation considerations, as well as being costly to installand maintain. As an alternative to traditional designs, Whooshh Innovations has developed a low cost technology designedto safely, autonomously, volitionally, and efficiently pass fish upstream. The Whooshh Passage Portal (WPP) moves fish through a tube using water mist for lubrication anddifferential air pressure.To providedataon the performance of a complete system (i.e., volitional entrycomponents,imagescanner, accelerator, and passage tube), we conducted a field evaluation of American Shad passage through a WPP installed at a hydropower project on the Santee River in South Carolina.To the extent possible, the study investigatedvolitional entry,sorting,and passage ofshadwith respect totransport-associated injury andmortality.The studyresultswill provide damowners and resource agencies with information to assess the suitability of the WPP asa low cost and effective alternative to conventional fishwaysthat are typically usedfor shad.

Wednesday
Horizon D
11:35:00 AM
In Person: Oral Presentation

Fishheart a hydraulic fishway

Mika Sohlberg (mika@fishheart.com; Fishheart Ltd.); Magnus Breitenstein (magnus@fishheart.com; Fishheart Ltd.)

Fishheart Ltd. has developed the Fishheart, a hydraulic floating fishway to enable fish migration in built rivers. The Fishheart suits all species of fish, it is remarkably water efficient, and it represents an affordable investment compared to traditional solutions. The floating Fishheart unit is designed to be installed on the downstream side of a dam. Fishheart unit connects to tubes passing over the dam with inlet and outlet lines. Water from the upstream side of the dam is fed into the tubing through the inlet line using the siphoning effect. The attraction flow tubing atop Fishheart also runs on siphoned water. The Fishheart control unit is inside a separate shipping container. The system can be operated remotely. The unit automatically operates pumps and valves to provide fish an opportunity to pass over the dam. A large pump helps the elevation process. The water collection tubing can be connected to a downstream migration solution. Fishheart system is pre-programmed and works automatically. Programs are devised to suit local fish, time of the year, and type of body of water. Fishheart system is in use at Taivalkoski hydropower station, Kemiriver, Finland and Leppikoski hydropower station, Kiehimänriver, Finland.

Wednesday
Horizon D
11:55:00 AM
In Person: Oral Presentation

Design and future implementation of selective fish passage research at FishPass

Daniel Zielinski (dzielinski@glfc.org; Great Lakes Fishery Commission); Andrew Muir (amuir@glfc.org; Great Lakes Fishery Commission);Reid Swanson (rswanson@glfc.org; Great Lakes Fishery Commission);

Selective connectivity—passing desirable species while blocking undesirable species—could provide a solution for restoring connectivity in rivers fragmented by barriers while not compromising on-going management of undesirable (invasive) species populations. The challenge of selective fish passage is fundamentally one of sorting an assortment of things, but sorting systems for live organisms without manual intervention do not exist. For this reason, we developed an approach to selective fish passage that integrates fish ecology and biology with engineering which will be implemented at FishPass, an adaptive fish-sorting facility on the Boardman (Ottaway) River in Traverse City, MI. Key to the future success of FishPass is the development of operational and hydraulic criteria that facilitate rapid assessment and optimization of an integrated suite of fish sorting mechanisms. The result of a multi-year, multi-national collaboration of researchers, is a unique in-stream facility where water flow, depth, direction, velocity, and turbulence can be strategically adjusted in concert with behavioral stimuli and other sorting technologies to influence fish approach, entry, and passage at the site. Herein we summarize the hydraulic design of FishPass and introduce early results of innovative selective fish passage approaches and technologies that are anticipated for evaluation at FishPass once constructed (2023).

Wednesday
Horizon D
1:30:00 PM
Virtual Presentation

Experimental investigations of lighting to improve passive sorting of invasive Sea Lamprey from desirable fishes in support of selective fish passage

Rob McLaughlin (rlmclaug@uoguelph.ca; University of Guelph); McLean Smith (msmith76@uoguelph.ca; University of Guelph);Emily Fields (efields@uoguelph.ca; University of Guelph); Aliana Hellmuth (ahellmut@uoguelph.ca; University of Guelph); Gale Bravener (Gale.Bravener@dfo-mpo.gc.ca; Fisheries and Oceans Canada); Tom Pratt (thomas.pratt@dfo-mpo.gc.ca; Fisheries and Oceans Canada); Ryan Booth (Ryan.Booth@DFO-MPO.GC.CA; Fisheries and Oceans Canada); Ryan Booth (Ryan.Booth@DFO-MPO.GC.CA; Fisheries and Oceans Canada); ;

Removing dams can enhance the productivity of desirable fishes, but also facilitate the spread of invasive species and their unwanted impacts on desirable fishes (the connectivity conundrum). Selectively passing desirable fishes while blocking invasive fishes at in-stream barriers could resolve the connectivity conundrum if desirable and invasive fishes can be sorted efficiently. The only efficient sorting mechanism available is manual trapping-and-sorting of fishes, which can be impractical in many situations. Innovations in passive methods of sorting are needed. We experimentally tested if the addition of light into two-chambered, trap-and-sort fishways could improve passive sorting of desirable from invasive fishes at sites on Lake Ontario and Lake Superior, Canada. Lighting the downstream chamber was expected to attract desirable fishes and encourage nocturnal migrating Sea Lamprey (Petromyzon marinus) to seek refuge in the upstream chamber. Changes in sorting efficiency in response to light were small overall and varied considerably among species of desirable fish. There may be a role for light in the development of passive sorting systems, but it will need to be combined with other sorting mechanisms to meet the needs of selective fish passage.

Wednesday
Horizon D
1:50:00 PM
In Person: Oral Presentation

Selective Passage: Automating invasive removal at fish passage facilities

Steve Dearden (steve.dearden@whooshh.com; Whooshh Innovations Inc);

Human activity has resulted in the introduction of invasive fish species globally. In many cases these invasive fish have few natural predators in their introduced range, and have dramatic impact on habitat and native species. Dams present barriers to both native fish and upstream invasive spread, but can also serve as useful bottlenecks where an effective technology-based removal strategy could be deployed. The absence of technology-based solutions ito date in the US is illustrated in extreme examples, where invasives are passed along with the native fish with no attempt to impede them, situations where native fish are blocked completely to prevent further invasive spread, and other examples where expensive, annual hand sorting is performed to separate native from invasive fish.

Wednesday
Horizon D
3:40:00 PM
In Person: Oral Presentation

An Introduction to BAFF Systems and Applications in Fish Passage

David Lambert (david.lambert@fgs.world; Fish Guidance Systems Ltd);

The presentation will outline the main features of a BAFF (BioAcoustic Fish Fence) system, and the design considerations when planning a system. It will also highlight two case studies of BAFF systems in the USA where the BAFF has been used for different fish passage objectives, blocking the passage of invasive carp, and also where it is being installed to aid the downstream migration of salmon smolt.

Wednesday
Horizon D
4:15:00 PM
In Person: Oral Presentation

Abstracts for New and emerging technologies in fish passage

Innovative concept and weir control optimization for the highest fish pass in the Netherlands

Marq Redeker (Marq.Redeker@cdmsmith.com; CDM Smith Consult GmbH); Julia Gatzweiler (Julia.Gatzweiler@cdmsmith.com; CDM Smith Consult GmbH)

An innovative fishway with 54 pools was built at the 16.5 ft high weir on the mouth to the IJssel River to restore fish passage into the 463 mi² Oude IJssel River basin. The site-specific conditions are long periods of low flows, a heavily fluctuating tailwater level and a predicted water level reduction of 2.75 ft in the IJssel River within the next 50 years. To ensure good attraction flow, the fishway was designed for tailwater fluctuations of almost 4 m. Thus, a new fishway entrance concept with two auxiliary water systems was implemented. CFD simulations of various components, e.g. entrance, auxiliary flow systems and turning pool helped to determine in the design stage that sufficient flow velocities will prevail in the migration corridor in all flow and tailwater level conditions. In the first year of its operation, strong turbulences and high flow velocities were observed near the fishway entrance, depending on the weir operation. Such conditions can affect fishway efficiency. We analysed the energy dissipation in the weir stilling basin for different discharge conditions and investigated flow patterns in the tailwater using 2D flow simulation. As a result we developed a new weir control concept to improve fishway attraction.

Tuesday
Horizon D
4:35:00 PM
Virtual Presentation

Hydraulic study of auxiliary flow in a pool-type fish pass

Rachel Indira (rachel.indira@cdmsmith.com; CDM Smith Consult GmbH); Julia Gatzweiler (Julia.Gatzweiler@cdmsmith.com; CDM Smith Consult GmbH);Marq Redeker (Marq.Redeker@cdmsmith.com; CDM Smith Consult GmbH);

To create adequate attraction flow, fishways are occasionallysupplemented by auxiliary water. So far, auxiliary water systems (AWS) have been placed at/near fishway entrances. Yet, fluctuating tailwater levelscan impair the passability and thus the effectivenessof fishwaysdue to decreasing flow velocity in the migration corridor when tailwater levels rise.Therefore, in certain conditions, additional AWS can be necessary further upstream in the fishway. This study aimed to examine the flow in poolsof a vertical slot fishwayby variation of AWSin terms of type, position, geometryincl. outlet cross-section,and discharge rate.The flow in the AWS and fishway poolswasmodelled using 3D CFD. The flow properties, e.g.,velocities, patternand turbulence were analyzed upstream, downstream and in the AWS discharge pool, and assessed with regard to fish behavior. The analysis revealed that AWS improvethe passability in the migration corridor downstream ofthe AWS discharge pool regardless of theAWSgeometry. An increase in auxiliary flowdoes not necessarilylead to an increase in velocity of the main fishway flow. A narrow AWS outlet width induces an irregular orthogonal flow velocity distribution in the AWS outlet cross-section that may disorient the fish.

Wednesday
Horizon D
4:40:00 PM
In Person: Oral Presentation

Hydraulic Characterization and Live Fish Bio-Testing of Natel Energy's Restoration Hydro Turbine

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Pacific Northwest National Laboratory (PNNL) conducted hydraulic characterization and live fish bio-testing of Natel Energy's Restoration Hydro Turbine (RHT) at the Monroe Drop facility in Oregon in September 2020. The hydraulic characterization was conducted using Sensor Fish (SF) technology. The live fish bio-testing was conducted using balloon-tag technology. Hatchery-reared rainbow trout (200-400 mm) were used under two conditions: control and treatment at the normal plant operating condition near the turbine best efficiency point. Sixty treatment fish and 59 control fish were released and held for a period of 48 hours. All 119 fish were recovered alive with a recapture rate of 100%. There was no mortality in the treatment group and only one mortality in the control group. Preliminary 48-hr survival rate based on the balloon-tag technology (a good measure for immediate injuries due to strike, shear and turbulence) is 100% with a SE of 0.017. For SF, 34 valid treatment samples and 16 control samples were obtained. Eight SF Mini Cluster samples were obtained. None of SF experienced any severe acceleration events (>95G) in the draft tube region but increased to 11.7% in the runner and 17.6% in the guide vane region. The nadir pressure was also computed and found to have a mean value of 6.78 psia. PNNL will conduct follow-on testing with larger trout (up to 585 mm) in May 2022.

Tuesday
Horizon D
4:55:00 PM
In Person: Oral Presentation

The Fish Migration River in the Netherlands – from vision to realization

Wilco de Bruijne (wilco@oakconsultants.nl; CDM Smith Consult GmbH); Erik Bruins Slot (e.bruinsslot@fryslan.frl; Friesland Province);Wilco de Bruijne (wilco@oakconsultants.nl; OAK consultants BV); Katja Philippart (katja.philippart@nioz.nl; Waddenacademie); Marq Redeker (Marq.Redeker@cdmsmith.com; CDM Smith Consult GmbH); ;

The “Afsluitdijk”, a 20 mi long dike completed in 1932, disconnected the IJssel River estuary from the North Sea and created a freshwater basin. This measure improved flood protection and freshwater supply but had a negative impact on ecology. Fish, e. g. salmon, eel and smelt, could no longer migrate through the Afsluitdijk from the sea to their freshwater habitats. As from 2012, a unique tidal river concept - the Fish Migration River (FMR) - was developed to restore fish passage at the Afsluitdijk, and its funding secured. The ~2.5 mi long design includes two entrances at the Afsluitdijk’s outlet works stilling basin, a 130 yd long open culvert with vertical slot fishway, 2.2 mi long meandering river, and inflow structure. CFD modelling was used to assess water levels, flows and salinity in different tidal conditions, and to optimize the culvert fishway. Physical modelling helped to appraise erosion of the sand that will be used to build the channel. The FMR construction started in 2021 with the culvert and a test section of the river in Lake IJssel. The presentation will outline the design, the main elements of the FMR, construction progress, the timeline for completion and anticipated research program.

Wednesday
Horizon D
5:00:00 PM
In Person: Oral Presentation

Tobique Narrows Downstream Fish Passage

Alexander Coulling (alex.coulling@kleinschmidtGroup.com; Kleinschmidt Associates);

NB Power's Tobique Narrows Generating Station (Tobique Narrows) is located on the Tobique River just upstream of its confluence with the St. John River. The Tobique River is a major producer of Atlantic salmon. This drove an interest in providing a downstream fish passage system with the ability to trap and transport fish. In 2016-2017 NB Power constructed a novel downstream fish passage system at Tobique Narrows, with facilities to protect fish from entrainment, provide safe passage immediately downstream of the generating station, or allow trapping, sorting, and transporting of fish past the three dams downstream before the ocean. The downstream fish passage system includes a new floating fish guidance boom in the headpond; the replacement of an existing spillway gate with a new gate to allow surface discharge of flows; a new adjustable fish collection screen to separate the downstream migrants from the spillway flow; and a new catch pool, transport pipe and a sorting and transport facility. This presentation will review the significant efforts in planning, research, and analysis that were undertaken prior to design, as well as the technical details of the downstream fish passage facility that was installed and the results of its operation to date.

Tuesday
Horizon D
5:15:00 PM
Virtual Presentation

Assessing Aquatic Fragmentation across Political Boundaries: Building a Regional Aquatic Barrier Inventory and Prioritization Tool that Incorporates Local Relevance and Leads to Implementation

Kathleen Hoenke (kat@southeastaquatics.net; Southeast Aquatic Resources Partnership); Jessica Graham (jessica@southeastaquatics.net; Southeast Aquatic Resources Partnership);Brendan Ward (bcward@astutespruce.com; Astute Spruce);

Fragmentation of river habitats by anthropogenic barriers is one of the primary threats to aquatic species in the United States. In an effort to address this issue, SARP has been working with partners including USFWS, USFS, state agencies and non-profits to identify, prioritize, and remove barriers to aquatic organisms through its Aquatic Connectivity Program. SARP has developed a comprehensive living inventory of dams and assessed road-stream crossing barriers as well as detailed indicator data fed into a user-friendly online tool to prioritize these barriers for removal or remediation. Over the past year, both this inventory and prioritization tool have expanded westward into an additional 14 states with collaboration and consultation with hundreds of partners and organizations. The Aquatic Barrier Prioritization Tool provides summaries of barrier densities within user specified areas of interest and allows users to prioritize barriers for removal or remediation based on ecological metrics using various filters. The results provided by the tool help identify high priority projects to implement and allow resource managers to access information regarding barrier locations and attributes that were not readily accessible in a one stop shop prior to SARP's work. Using these results and allowing editor access to the living barrier inventory, SARP has been working with partners to incorporate local on the ground information into the inventory to create a community of practice of barrier remediation that leads to on the ground project implementation. In the Southeast, over the past 10 years, this inventory and tool process has resulted in or contributed to the remediation of 20 road crossing barriers and 19 dam removals, a positive example of success as the inventory and tool expands further into the western United States.

Wednesday
Vista
10:15:00 AM
Virtual Presentation

Abstracts for When fish passages did not work as intended: Lessons learned and future perspectives

Effective Fish Ladders in Hydro Dams in Himalayan Region: Is it Possible?

Tek Gurung (tek_fisheries@hotmail.com; Agriculture and Forestry University);

Fish ladder also known as a fish way, fish pass or fish steps, is civil structure built for the fish to migrate upstream and downstream of the barrier in the river. There are bunches of fish ladders constructed in Nepal's Himalayan rivers for hydropower and irrigational dams with the objectives to facilitate fish movement along the up and down streams. However, many of these dams constructed have been reported to be non-functional due to several technical reasons, thus has been criticized for their ineffectiveness. So, a question was asked, is it not possible to construct an effective fish ladder for moving fish up and downstream in Himalayan region? In an attempt to analyze the reasons behind the ineffective dams, possible mechanisms to acquire adequate knowledge on fish passages engineering and socio-economic issues have been discussed for constructing effective fish passage in Himalayan Region.

Wednesday
Vista
10:35:00 AM
Virtual Presentation

Fish passage: when the barrier needs to be reinforced

Angelo Antonio Agostinho (agostinhoaa@gmail.com; Universidade Estadual de Maringá); Fernando Mayer Pelicice (fmpelicice@gmail.com; ETH-Zurich);Paulo dos Santos Pompeu (pompeu@ufla.br; Universidade Federal de Lavras);

The reduction in habitats quality and availability imposed by dams, both by fragmentation and flow regulation, is among the main threats to biodiversity. The literature shows that dams and biological invasions constitute the main threats to the aquatic ecosystems. Although fish passages are frequently used to minimize the impacts of habitat fragmentation, this strategy can decisively contribute to the dispersion of non-native species to the upper segments of the basin, increasing threats. Then, passages built to become the dams permeable to fish can facilitate species' access to areas they had no previous access to, either for historical reasons (natural barriers such as waterfalls) or that arrived in the basin after the construction of the dam. Furthermore, the reservoirs that receive these fish are recognized for their facilities for establishing and proliferating many of these species, contributing to the dispersion and invasion of upstream stretches (stepping-stone habitats). In this topic, in addition to considerations about the undue native fish pass (one-way passages, ecological trap), will be discussed the risks of these structures in the dispersion of non-native species to areas upstream of the dams and the perspectives for taking decision making for constructed or planned fish pass systems, including barrier reinforcement.

Wednesday
Vista
10:55:00 AM
Virtual Presentation

The efficiency of fishways for long-distance migratory species in large dams in the Amazon Basin

Lisiane Hahn (lisianeneotropical@gmail.com; Neotropical Environmental Consulting);

The Amazon Basin harborsthe highest freshwater biodiversityon Earthwith 2,406 speciesof those at least 172 are migratory, such as the goliath catfish Brachyplatystomarousseauxii, known to perform the longest strictly freshwater migration in the world (>5,700km). The Amazon Basin is considered the last frontier for dam construction in South Americawhich combined with the high diversity and the limited knowledge about fish behavior severely restrict the establishment of effective management strategies for their conservation.Theconstruction of fish passage has been used in new dams in the Amazon Basinas a management tool to facilitate dam passage. In the Madeira River, the longest tributary of the Amazon River, two large damsnamed Santo Antônio (SAEHPP) and Jirau(3,568 MW and 3,750 MW, respectively) started to run on 2011/2013. The SAE HPP fishway isa 1,400m long semi-natural channel monitored by a long-term program using biotelemetry to assess the efficiency of passage forgoliath catfish.Despite the constant efforts to improve the system, based on data gathered so far, the fishway have failed to promote the upstream passage of goliath catfish. The findings raised the concern about the cost-benefit on building fishways in the Amazonian dams.

Wednesday
Vista
11:15:00 AM
Virtual Presentation

Homing and temporal fidelity: additional challenges to the use of passages as a conservation tool for Neotropical freshwater fishes

Paulo dos Santos Pompeu (pompeu@ufla.br; Universidade Federal de Lavras); Alexandre Peressin (alexandre.peressin@gmail.com; Universidade Federal de Lavras);João Magalhães Lopes (joaomagalopes@gmail.com; SANEAGO); Carlos Bernardo Mascarenhas Alves (cbmalves@ufmg.br; Bio-Ambiental Consultoria em Meio Ambiente,)

Fish passages in South America have failed in maintaining long term viable migratory fish populations. New information on the migratory behavior of two South American migratory fish¸ has pointed out that movement patterns may be more complex than previously thought, further limiting the use of fish passages as a conservation strategy. Telemetry studies have been performed at the Upper São Francisco river, Brazil, since 2014, in order to better understand the migratory patterns of Prochilodus costatus and P. argenteus. Both species have shown a highly synchronic reproductive cycle, relying on environmental cues to perform upstream migration, spawn and return to their feeding grounds. P. costatus have also shown a high degree of temporal and spatial fidelity for spawning and feeding sites. These patterns helps to explain the failure of fish passages since: (i) in general, such mechanisms cause great delays in migration; (ii) return to feeding grounds is a fundamental but neglected aspect; (iii) in several rivers with cascading dams there is a high chance that most of the spawning and feeding sites have been eliminated. Therefore, only the maintenance of significant stretches of non-regulated rivers and the connectivity with critical habitats would maintain viable populations of the studied species.

Wednesday
Vista
11:35:00 AM
Virtual Presentation

Downstream passage constraints and floating weir collector use at a medium-sized dam in California

Haley Ohms (haley.ohms@gmail.com; UCSC / NOAA); Dereka Chargualaf (dereka.chargualaf@noaa.gov; NOAA SWFSC);Gabriel Brooks (gabriel.brooks@noaa.gov; NOAA Fisheries); Cory Hamilton (cory@mpwmd.net; Monterey Peninsula Water Management District); Eric Palkovacs (epalkova@ucsc.edu; UC Santa Cruz); David Boughton (david.boughton@noaa.gov; NOAA SWFSC);

Downstream fish passage at dams is an on-going challenge with significant conservation implications. Floating weir collectors are a recent innovation for downstream passage, but their efficacy has not been widely studied. We investigated several aspects of downstream passage for steelhead (O.mykiss), including floating weir collector use, at a medium-sized dam and reservoir on the central California coast.We found that downstream passage for juveniles and post-spawn adults was limited by four factors: migration delay, loss of fish in the reservoir, avoidance of the floating weir collector, and water depths on the spillway. 64%of juvenile outmigrants and 98 %of adults that passed downstream used the spillway instead of the floating weir collector. Juvenile outmigrants and adults stopped passing over the spillway when spillway-crest water depths dropped below 4.9 cm and 8.5 cm, respectively. Based on these depth thresholds, the ability for fish to pass downstream has been limited to only half of the migration season in many (40-55%)of the past 20 years (2002-2021). Our results show that increasing the floating weir collector use would improve downstream passage in dry years, but that reservoir loss poses an even bigger challenge for downstream passage that must also be addressed.

Wednesday
Vista
1:30:00 PM
In Person: Oral Presentation

Recovery of river connectivity in the Czech Republic: enormous effort along with intensive financial support versus hard reality

Jiri Musil (jiri.musil@vuv.cz; T.G. Masaryk Water Research Institute, p.r.i.); Zdeněk Vogl (zdenek.vogl@nature.cz; Agency for Conservation and Landscape Protection);Pavel Marek (pavel.marek@nature.cz; Agency for Conservation and Landscape Protection); Miloš Holub (milos.holub@nature.cz; Agency for Conservation and Landscape Protection)

In order to restore river connectivity, (1) the Committee on Measures for Ensuring Fish Migration (CMEFM) was established in 2000 as multidisciplinary advisory body (consultancy and project review for stakeholders and engineers, > 300 reviewed projects till date) by the Ministry of Environment of the Czech Republic under the Agency for Conservation and Landscape Protection (ACLP). Since 2009 (2) Ministry of Environment „national strategy to improve river connectivity“ was initially developed (governmental support of ACPL, T.G. Masaryk Water Research Institute and CMEFM). This strategy (regularly updating based on the current knowledge) deals with monitoring, progress evaluation and planning and working in 3 recognized dimensions covering international river corridors (target species include diadromous fishes, respectively eel and salmon), national river corridors (target species include potamodromous fishes) and corridors of locally importance (target species include aquatic species of conservation interest). Apart of other issues (e.g. biomonitoring and its standardization), the strategy is specifically adressing where and when restoration actions should take place and linking with River Basin Management Plans. Despite enormous effort along with intensive financial support/dotation, however, there is still less than 300 fishways in operation compare to 9 ths barriers higher than 1m, wherever possible associated with hydropower.

Wednesday
Vista
1:50:00 PM
In Person: Oral Presentation

An open discussion about uncertainties in fish passage science.

Luiz Silva (lumartins@ethz.ch; ETH-Zurich);

In the last three decades, there has been growing debates about fish passage science. Scientists have questioned the efficiency of fishways as a tool to restore riverine connectivity for migratory fish populations globally and devoted efforts to discuss frameworks for future fish passage management and research. However, some basic questions and ecological knowledge needed to underpin fish passage are still poorly understood in many regions globally, leading to uncertainties that arguably compromise fish passage efficiency. Some knowledge gaps have plausibly hindered the assessment of fishways more broadly, particularly when considering factors beyond movements through the fish passage itself. A holistic approach is rarely considered in fish passage monitoring, leading to uncertainties about the efficiency of fishways to contribute to the conservation of migratory fish populations. In this talk, I will use examples of research from the Global South to incite an open discussion about pitfalls in fish passage management and science. It will include topics such as: i) unintended passage of species; ii) unaccounted two-way (up and downstream) movements; iii) movement requirements of different life-stages. It will serve to contribute to the debate of fishway research and monitoring.

Wednesday
Vista
2:10:00 PM
In Person: Oral Presentation

Abstracts for Statistical methods for evaluating fish passage and its effects on fishes

Advances in statistical analysis of fish passage: from instantaneous events to life cycles

Russell Perry (rperry@usgs.gov; US Geological Survey, Western Fisheries Research Center); Michael Dodrill (mdodrill@usgs.gov; US Geological Survey, Western Fisheries Research Center);Dalton Hance (dhance@usgs.gov; USGS); John Plumb (jplumb@usgs.gov; USGS); Adam Pope (apope@usgs.gov; US Geological Survey, Western Fisheries Research Center); ;

Human activities that impound, divert, and regulate water bodies influence fish movements word wide. These activities often affect fish passage at particular locations along migratory pathways, impeding movements, influencing passage probabilities, or altering migratory pathways. Although fisheries managers are often interested in factors that affect fish passage at a particular place and time, the event of fish passage itself may affect an individual's survival long after the passage event. Here, we provide an overview of the presentations in this symposium, highlighting advances in statistical methods for analyzing fish passage data. These advances cover methods to understand factors affect passage events of individuals, as well as methods to quantify effects of passage on survival of individuals over their life cycle. The common theme of these advances is the use of tagging and tracking technologies such as passive integrated transponder (PIT) tags, acoustic telemetry, and radio telemetry that provide detailed spatial and temporal data to link environmental and operational covariates to passage and survival. Such technologies support sophisticated statistical modeling techniques for following the fates of individuals through time to understand both the instantaneous event of fish passage and its subsequent effect on survival of individuals over their life cycle.

Wednesday
Vista
2:30:00 PM
In Person: Oral Presentation

Why Should I Care About Better Statistical Models for Fish Passage Evaluations and What Do Better Models Look Like?

Dalton Hance (dhance@usgs.gov; USGS);

Resource managers have invested significant capital in engineering (e.g. surface collectors and fishways) and evaluations to improve passage for migratory fish in regulated rivers. Evaluation of fish passage success and ecological effects of fish passage or non-passage often rely on costly telemetry studies. Given these outlays, the value of these data should be maximized. Modern statistical methods can improve the accuracy, precision and efficiency of inference obtained from these investments. In this talk, I will discuss the consequences for inference of some common practices such as aggregating or segregating data. I will review modern methods for achieving inference on migrating populations monitored over time. For example, temporally-stratified mark-recapture models can offer more precise and direct estimates of time-period specific survivals than approaches based on data subsetting. Finally, I will lay out the principles of a data analysis strategy based on comprehensive generative models and simulation. Statistical modelling is an important component of fish passage management, one that cannot exist without monitoring infrastructure or a management decision framework, but which can also improve the design and function of both.

Wednesday
Vista
2:50:00 PM
In Person: Oral Presentation

Jointly Modelling Covariate Effects on Survival and Mortality

Quinn Payton (quinn@realtimeresearch.com; Real Time Research);

Identifying where, when, and how many animals live and die over time is principal to understanding factors that influence population dynamics. Capture–recapture–recovery (CRR) models are widely used to estimate animal survival and, in many cases, quantify specific causes of mortality (e.g., harvest, predation, starvation). Previously, we developed a model to jointly estimates cause-specific mortality and survival probabilities, across multiple spatial and temporal scales, incorporating recoveries from indeterminate temporal or spatial origin. We have since begun to assess the capabilities of this modelling approach to assess the relationship among various sources of mortality and account for the possible effects of covariates on survival probabilities both biotic (e.g., fish size and rearing-type) and abiotic (e.g., spill and water transit times). Here, we present case studies of the survival and mortality of Upper Columbia River Steelhead Trout smolts during their outmigration over the past decade and a half using both Passive Integrated Transponder tags and Juvenile Salmon Acoustic Telemetry tags. These studies demonstrate the advantages and disadvantages of each type of data collection scheme and illustrate the capabilities of this new modelling framework.

Wednesday
Vista
3:40:00 PM
In Person: Oral Presentation

Abstracts for Fish passage for diverse audiences

Salmon Power: Generating Excitement in Students

Rachel Little (rachel-little@conservewa.net; Benton Conservation District);

The "Salmon in the Classroom" program connects student to the natural environment. In the Columbia Basin, salmon are important to the ecosystem and regional culture. Salmon in the Classroom provides hand-on experience to learn about salmon and how they move through the river. The program provides a combination of online resources and classroom activities to excite kids about STEM and salmon. Classrooms raise salmon from eggs, watch their development, and become curious about their migration. Even children are aware of hydropower dams in our community but they do not understand how they function. A recent widely viewed children's movie villainized dams. Fourth-graders recognize they are consumers of electricity, but do not realize that 80% of the local fuel mix is hydropower, or even how hydropower works. An educational program called "Salmon Power" was developed to fill these knowledge gaps. Salmon Power is supported by a partnership of Benton Conservation District and electric utilities. Benton Conservation District is a local agency with the mission of encouraging wise stewardship of natural resources and serves as the local sponsor for Salmon in the Classroom program. The Salmon Power program provides a guest speaker who visits classrooms. Elements of the visit include the demonstration of a simple model of falling water lifting weight, teaching the anatomy of a dam, and explaining fish passage technologies in use at local dams. Students examine data from fish passage experiments at these dams and are encouraged to draw their own conclusions about which passage is safest for salmon. At the conclusion of the lesson, students demonstrate fish passage around paper dams, with a fish analog of a Swedish fish candy. After raising and then releasing actual living salmon, students are thrilled to see the data as tagged fish migrate downstream through the hydropower system.

Wednesday
Vista
4:00:00 PM
In Person: Oral Presentation

Once Upon a Stream: How to Recruit Heroes to a Future Fish Passage Workforce

Rachel Little (rachel-little@conservewa.net; Benton Conservation District);

The “Salmon in the Classroom” program connects student to the natural environment. In the Columbia Basin, salmon are important to the ecosystem and regional culture. Students need to learn how this keystone species supports a healthy watershed. Salmon in the Classroom provides hand-on experience to learn about salmon and how they move through the river. The program provides a combination of online resources and classroom activities to excite kids about STEM and salmon. Classrooms raise salmon from eggs, watch their development, and become curious about their migration. The program culminates with the Salmon Summit field trip, where each student releases a salmon. Salmon Summit has become a rite of passage for 3,000 elementary students annually. COVID restrictions cancelled the 2020 event. In 2021, we brought one Salmon Summit activity back to students by live streaming into 40 classrooms in central Washington. The live streaming event enabled students to observe and engage with PNNL researchers and communications experts while they explained how they study salmon movement. Compared to the in-person event, this technology allowed us to reach more classrooms, as well as classrooms further away, thereby spreading the impact of the event and the work. Building upon that success, Salmon Summit returned as an in-person event in 2022, but we continued and expanded the live streaming option, to include almost 150 additional classrooms. Accessibility challenges led us to innovation in how we share the magic of Salmon Summit with more classrooms, furthering the efforts to educate our students about fish passage challenges, as well as what we are doing to research and expand this work. Students are not inspired by unfamiliar, dry job titles, but rather by the challenge of a problem to solve, and seeing people working together to meet those challenges.

Wednesday
Vista
4:20:00 PM
In Person: Oral Presentation

Engaging the Future Fish Passage Workforce through their Teachers

Alison Colotelo (alison.colotelo@pnnl.gov; Pacific Northwest National Laboratory); Elizabeth Stephens (elizabeth.stephens@pnnl.gov; Pacific Northwest National Laboratory);Megan Nims (Megan.Nims@pnnl.gov; PNNL); Kelsey Adkisson (kelsey.adkisson@pnnl.gov; Pacific Northwest National Laboratory); Erin McCann (erin.mccann@pnnl.gov; PNNL); Margarita Magana (margarita.magana@pnnl.gov; PNNL);

Workforce development is a critical need for STEM fields as the demand for STEM professionals and a STEM capable workforce continues to grow. Furthermore, STEM literacy, the ability to think in a scientific-minded way about issues that impact life and the community, for all students is a priority. Activities and efforts to develop a more diverse and inclusive STEM workforce are needed at all levels of education. Specifically, project-based learning is a teaching method where students can learn both content and thinking strategies, which is more similar to how STEM occupations function. Teachers serve a critical role in supporting workforce development and STEM literacy; however, many teachers have limited exposure to current STEM career opportunities and struggle to find ways to bring real-world science to their classrooms. Pacific Northwest National Laboratory (PNNL), in partnership with Education Services District 123, are taking a unique approach to fish passage workforce development through the execution of a week-long, adult-oriented learning experience focused on the challenges and innovation of fish passage within the Columbia River Basin. PNNL fish passage experts in fish biology, data science, and science communications are working with STEM education professionals to develop a real-world inspired challenge for teachers to solve. During this experience, teachers will embrace the role of “learner” and engage in hands-on research activities that show them how science is done at a national laboratory – in teams and across disciplines. They will leave the experience with tools to integrate problem-based, fish passage learning into their classrooms. Participation in this program will increase teacher and, subsequently, student awareness of career opportunities in fish passage.

Wednesday
Vista
4:40:00 PM
In Person: Oral Presentation

Communicating Fish Passage Science in a Digital Age

Kelsey Adkisson (kelsey.adkisson@pnnl.gov; Pacific Northwest National Laboratory); Alison Colotelo (Alison.Colotelo@pnnl.gov; Pacific Northwest National Laboratory)

Fish passage can be contentious and effective communication requires developing carefully planned goals from the inception of research efforts given the high visibility and accessibly to diverse audiences. Effective communication also entails robust and regular collaboration between technical and communication experts. Pacific Northwest National Laboratory has been leaders in fish passage research for decades, contributing to the understanding of how fish are affected by passage at hydropower facilities and developing new technologies and methodologies to efficiently monitor fish movement through river systems. However, over the past decade this area of research has expanded to include novel approaches to communicate research findings to technical and non-technical audiences. This talk will highlight techniques and strategies for how to effectively engage with diverse audiences, including stakeholders and the media. It will also spotlight the lessons learned and successes on several technical and communications projects.

Wednesday
Vista
5:00:00 PM
In Person: Oral Presentation

History and Process for a Distinguished Project Award – focus on evaluations

Jon Mann (jonathon.mann@wildlife.ca.gov; California Department of Fish and Wildlife);

The EWRI-AFS Joint Committee on Fisheries Engineering and Science Project Award Task Group has overseen, and will continue to oversee, soliciting and reviewing submissions for the Distinguished Project Award given at each of the Fish Passage conferences. The award is for projects that use innovation and technical excellence to achieve ecological gain for fish passage, river connectivity and improved habitat for endangered and native species. An ideal project for the award is one that has exemplified success and inspired greater application of fish passage restoration. It does not need to be a newly implemented project, in fact, projects that have had enough time to demonstrate effectiveness are more likely meet the evaluation criteria and have the highest chance of being selected. This presentation will briefly review the project award history, outline the evaluation criteria with its scoring rubric, and emphasize how important it is for any fish passage project to conduct excellent monitoring and fish passage assessments that demonstrates the project goals are achieved. Conundrums of applying the project award evaluation criteria for different types of fish passage projects will also be presented.

Thursday
Horizon A
10:15:00 AM
In Person: Oral Presentation

Derby Dam Fish Screen Project Design

Kevin Jensen (jensen@mcmjac.com; McMillen Jacobs Associates);

Derby Dam, located on the Truckee River outside of Reno, Nevada USA, is the oldest capital project owned and operated by the U.S. Bureau of Reclamation. The dam was built in 1905 without provisions for upstream or downstream fish passage. This has blocked access to spawning and rearing habitat for Lahontan cutthroat trout (LCT). LCT are endemic to the Truckee River and are listed under the U.S. Endangered Species Act. To restore aquatic connectivity and provide fish passage around the dam, a horizontal fish screen facility was designed and constructed to safely bypass fish downstream of the dam at a screening capacity of 600 cfs. In this second of two talks on the Derby Dam Horizontal Fish Screen Project, we build on the discussion of engineering design and provide an in-depth presentation of the canal and screen hydraulics, whose interactions were simulated by coupling 1D and 3D hydraulic models. The discussion will also cover other engineering design aspects of the project, including specific challenges associated with site access, dewatering, and the safe and timely return of fish to the river.

Thursday
Horizon A
10:35:00 AM
In Person: Oral Presentation

Fish passage improvements at diversion dams on the Yakima River, Washington

Patrick Monk (pamonk@usbr.gov; Bureau of Reclamation);

Prior to Euroamerican development the Yakima River Basin produced regionally significant runs of Chinook, Sockeye, Coho, steelhead trout, lamprey and other fishes. Total salmon runs were estimated at 800,000 fish returning annually. Irrigation development began in the mid-1800's and today exceeds 200,000 hectares with nearly 2/3 of the annual basin water supply diverted for agricultural production. Unscreened canals diverted migrating salmon smolts which perished in fields decimating salmon runs as early as 1900. Washington State required fish passage and protective facilities on diversion dams and by the early 1920's experiments in fish screening led to the rotary drum fish screen design, which was installed on numerous canals of various sizes. Research into salmonid fry swimming performance led to further refinements in screen designs. Most fish screens in the basin were rebuilt to meet these criteria in the 1980's. Recent studies have found sources of mortality associated with current fish bypass and other canal facilities. These data have led to new facility designs intended to eliminate most sources of juvenile fish mortality associated with diversion dams.

Thursday
Horizon A
10:55:00 AM
In Person: Oral Presentation

Survival implications for entrainment by juvenile salmonids at diversion dams on the Yakima River, Washington

Tobias Kock (tkock@usgs.gov; US Geological Survey, Western Fisheries Research Center); Patrick Monk (pamonk@usbr.gov; Bureau of Reclamation);Michael Porter (Michael_Porter@Yakama.com; Yakama Nation); Russell Perry (rperry@usgs.gov; US Geological Survey, Western Fisheries Research Center)

Entrainment at diversion dams is an important topic in managed river systems worldwide. Many fish species and life stages are susceptible to entrainment which can cause movement delays, route fish into manmade channels, and result in substantial mortality. In the Yakima River, Washington, juvenile salmon and steelhead encounter multiple diversion dams as they move downstream toward the ocean. Telemetry studies conducted since 2012 in the Yakima Basin have provided information about route-specific passage probabilities, flow-related entrainment probabilities, and route-specific survival probabilities at diversion dams. These studies have provided insights in the effects of diversion dams on outmigration behavior and survival which have led to recent efforts to develop systems that reduce entrainment. This presentation will summarize key findings from telemetry studies, discuss how results from these studies are being used by resource managers, and describe new exclusion devices that are being tested.

Thursday
Horizon A
11:15:00 AM
In Person: Oral Presentation

The Nelson Dam Project: A multi-benefit approach to diversion dam replacement on the Naches River, WA

Mike Garello (mike.garello@hdrinc.com; HDR Engineering, Inc.); David Brown (david.brown@yakimawa.gov; City of Yakima)

Nelson Dam is an 8-foot tall by 180-foot wide channel-spanning concrete structure originally constructed in the 1940's across the Naches River near Yakima, Washington. The current structure facilitates the diversion of irrigation water over 8,000 residents and commercial farmers connected to the City of Yakima's distribution system and along the Naches-Cowiche Canal. Nelson Dam is a known barrier to upstream migrating fish and has altered the profile of the river for miles, causing decreased sediment continuity and increased flooding potential upstream. Throughout over two-decades of planning, stakeholder engagement, and design, the City of Yakima is now replacing Nelson Dam with a new roughened channel, a modern diversion structure consolidating four points of diversion at the existing location and adding pilot channels within the north floodplain. This multi-phased project will result in improved water supply reliability, restored fish passage, and enhancement of natural river processes meeting numerous regional and local objectives for the Naches River and Yakima Basin. This presentation will provide an overview of the project development, design, and construction currently underway to accomplish this multi-benefit landmark project while emphasizing the diverse funding plan, unique design methods, creative material sourcing strategies, and robust construction methods used.

Thursday
Horizon A
11:35:00 AM
In Person: Oral Presentation

The New Sacramento River Weir: A Complex Fish Passage Facility Integrated Into A Modern Floodway Project

Robert Chase (robert.d.chase@usace.army.mil; U.S. Army Corps of Engineers); Gabe Kopp (gabriel.kopp@hdrinc.com; HDR);Mike Garello (mike.garello@hdrinc.com; HDR Engineering, Inc.); Sean McNeil (sean.t.mcneil@usace.army.mil; U.S. Army Corps of Engineers); Adam Bier (adam.j.bier@usace.army.mil; U.S. Army Corps of Engineers); ;

The United States Army Corps of Engineers (USACE) is proactively finding solutions for our aging infrastructure to prepare for greater flow conveyance anticipated from climate change. The American River Common Features Project or (ARCF) represents a component of an over $1 billion federal authorization to improve flood conveyance in the American River that converges with the Sacramento River in the heart of the capital city of Sacramento, California. The Project also provides a new passive weir. The complex multibenefit flood safety project undertook a number of challenges with one especially unique aspect, fish passage.HDR worked with USACE leaders, the California Department of Water Resources, Sacramento Area Flood Control Agency, and regulators to collaboratively develop a hybrid fish passage facility to be constructed at the site of the new ‘Sacramento Weir’. For California, the facility is first of its kind, as it is designed to effectively pass native sturgeon, along with salmon and steelhead. An innovative split design provides two pathways for passage. Finally, a modern fisheries monitoring system including ARIS cameras, PIT scanners, and acoustic hydrophones will serve as the sentry to document fish behavior and passagesuccess. Altogether, the project represents a progressive example for future projects.

Fish passage challenges and innovation: High head and diversion dams.

Thursday
Horizon A
1:30:00 PM
In Person: Oral Presentation

Abstracts for Biotelemetry for fish passage: Current capabilities, applications, and future advances

A new, non-invasive fish backpack biologger to measure the physical conditions experienced by swimming fish during downstream passage

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The RETERO project aims to reduce live fish experiments for the physical evaluation of injury and mortality risks during downstream passage through turbines, weirs or bypasses and to improve the predictions of numerical models. The focus of this presentation is on the design of a new “backpack sensor” for downstream passage studies which does not use invasive attachment methods. The fish backpack sensor provides a new source of data of the physical conditions experienced by live fish during HPP passage and can be compared to passive sensors and numerical models to develop behavioral rules. Results from field studies with live fish to estimate mortality and injury rates during downstream passage can differ widely from empirical models. One cause of this difference is that fish behavior influences the probability of injury or mortality. To evaluate this, passive sensors were compared to sensors on live fish. This data provides new insights into the differences in physical conditions experienced by a passive sensor and an actively swimming fish. First results from the lab and field on the effects of the sensors on the fish and the difference between passive and active sensor data show substantial differences between actively swimming fish and passive sensors.

Thursday
Horizon A
1:50:00 PM
In Person: Oral Presentation

Preliminary findings on the efficacy and performance of the Innovasea V3D predation tag

Michael Sears (Michael.sears@innovasea.com; Innovasea); Michael Hellmair (michaelhellmair@fishbio.com; FishBio);Brian Slusher (brianslusher@fishbio.com; FishBio);

The rate and location of predation in aquatic environments is difficult and time-consuming to estimate, often introducing ambiguity in migration and survival studies, particularly of threatened or endangered species. We recently conducted a study to evaluate the performance of the V3D predation tag (Innovasea), which are specialized acoustic transmitters equipped with a trigger mechanism designed to dissolve in the event of predation. We used tagged rainbow trout (Oncorhynchus mykiss) and largemouth bass (Micropterus salmoides) to evaluate baseline trigger rates, time to trigger following a predation event, and time to expulsion of the V3D tags by the predator. Trials occurred under two different temperature regimes (18.5oC and 23.5oC) to evaluate the influence of water temperature as a proxy for digestive rate on V3D trigger times. Transmitters implanted in consumed prey triggered in 100% of our trials, while no false-positive triggers occurred in the control group of tagged O. mykiss. Time to trigger was influenced by water temperature and relative prey size. Overall, the results of this controlled study suggest that V3D tags are a valuable tool to quantify predation within freshwater aquatic ecosystems.

Thursday
Horizon A
2:10:00 PM
In Person: Oral Presentation

Lab-on-a-Fish

Jun Lu (jun.lu@pnnl.gov; PNNL); Yang Yang (yang@pnnl.gov; PNNL);Huidong Li (huidong.li@pnnl.gov; PNNL); Jayson Martinez (jayson.martinez@pnnl.gov; PNNL); Brett Pflugrath (brett.pflugrath@pnnl.gov; PNNL); Daniel Deng (Zhiqun.Deng@pnnl.gov; PNNL);

Biotelemetry tag - a recording or transmitting tags to collect and information of fish physiology, physics or environmental parameters - is an emerging technology that provides an unprecedented capability into biological processes and leads to otherwise unattainable discoveries. Current biotelemetry tags are constrained to limited types of measurands all integrated on the single device as well as relatively large dimension and weight.We report the first-ever biotelemetry tag (Lab-on-a-Fish) that can measures in situsimultaneously the electrocardiogram and electromyogram, the two dominant physiological parameters of the fish in literature as well as its behavior (motion sensor) and environmental parameters (temperature, pressure, and magnetic sensor) with a weight of only 2.4 g and a dimension of 5.5 mm × 6.5 mm × 33 mm. The developed working prototype is capable of transmitting the collected and on-board processed data in real-time as well as storing the raw data using on-board Flash memory for locations that are challenging for acoustic communications or for complex post data processing. Because the Lab-on-a-Fish can provide the 3D locations of the tagged animal, the proposed device can also act as an autonomous mobile sensor package that can associate sensor readings with specific river locations. The tag's ability to store and transmit historical sensor data on both environmental parameters and the tagged animals' bioactivity will provide valuable information for studying fish behavior and accelerating hydropower deployment.

Thursday
Horizon A
2:30:00 PM
In Person: Oral Presentation

A Miniature Radio-Frequency Transmitter and 3D tracking

Hayden Whitbread (hayden.whitbread@pnnl.gov; PNNL); Jun Lu (jun.lu@pnnl.gov; PNNL);Corey Duberstein (corey.duberstein@pnnl.gov; PNNL); Jayson Martinez (jayson.martinez@pnnl.gov; PNNL); Bingbin Wu (bingbin.wu@pnnl.gov; PNNL); Huidong Li (huidong.li@pnnl.gov; PNNL); Tao Fu (tao.fu@pnnl.gov; PNNL); Tao Fu (tao.fu@pnnl.gov; PNNL); Mitchell Myjak (mitchell.myjak@pnnl.gov; PNNL); Xinya Li (xinya.li@pnnl.gov; PNNL); Jie Xiao (Jie.Xiao@pnnl.gov; PNNL); Daniel Deng (Zhiqun.Deng@pnnl.gov; PNNL);

We advanced the state-of-the-art of radio-frequency (RF) transmitters by developing three new RF transmitter options that address the research needs for key bat species and help to better understand wind turbine impacts. Option 1 minimizes transmitter size and weight (0.16 gram, 8 km range) to study bats that may be too small to use commercially available RF transmitters. Option 2 prioritizes service life (0.40 gram, 1 year tag life at 15 second ping rate, 16 km range) over the transmitter size, weight, and detection range. Option 3 focuses on achieving the longest detection range (0.57 gram, 35 km range) while keeping the transmitter size and weight reasonable. We also developed a 3D localization algorithm for these transmitters that can provide high-resolution behavioral information of tagged bats. The detection range of the three RF transmitter designs and the accuracy/ efficiency of the 3D tracking algorithm were validated in an operational wind farm. The small transmitter design can be used for juvenile fish and the long-detection range/ long-service life designs can be used for larger fish in a shallow water environment. In addition, the 3D localization algorithm can be used to study fine-scale behavior of migratory fish ina shallow water environment.

Thursday
Horizon A
2:50:00 PM
In Person: Oral Presentation

Development of implantation methods for acoustic transmitters in juvenile American Shad

Kate Deters (katherine.deters@pnnl.gov; PNNL); Robert Mueller (robert.mueller@pnnl.gov; PNNL);Stephanie Liss (stephanie.liss@pnnl.gov; PNNL); Huidong Li (huidong.li@pnnl.gov; PNNL); Daniel Deng (Zhiqun.Deng@pnnl.gov; PNNL); ;

American shad (Alosa sapidissima) 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. American shad are an economically valuable fishery, but their populations have been declining throughout their historic range. As a part of the Federal Energy Regulatory Commission hydropower license process, fish passage and mitigation measures for American shad will are routinely and rigorously reviewed by federal agencies and stakeholders. PNNL is developing an 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. As part of the development, we need to establish a tagging protocol that minimizes the time required for implantation and reduces biological effects in juvenile American shad. We first identified optimal transport methods, holding/rearing conditions, and a handling method appropriate for both handling and surgery. Using results from those evaluations, we identified a prototype tag and implantation method that maximizes survival and tag retention. We then conducted an initial study comparing survival of 40 fish implanted with a proposed tag design to 40 control fish. Survival after a 14-d post-tagging holding period was 75% for the tagged fish and 87.5% for the control fish. In the second year of study, we used an updated tag design. There was a clear tank effect with one tank having much higher mortality than the other tank. Survival for the healthy tank of fish was 70% for the control group (n=19) and 81.5% for the tagged group (n=54) with average growth of 10 mm over 60 d. This research has made great advancements in the handling and tagging procedures for American shad in the lab but further study is needed to determine if these methods will be effective in actively migrating juvenile American shad in the field.

Thursday
Horizon A
3:40:00 PM
In Person: Oral Presentation

Making Large Scale Telemetry Projects Repeatable and Efficient with Open-Source Software

Kevin Nebiolo (Kevin.Nebiolo@KleinschmidtGroup.com; Kleinschmidt Group); Theodore Castro-Santos (tcastrosantos@usgs.com; United States Geological Service);Thomas Meyer (thomas.meyer@uconn.edu; University of Connecticut);

Modern acoustic and radio telemetry fish-tracking projects are getting larger and more complex, are capable of modeling movement in 1, 2 or 3 dimensions, and commonly track large sample-populations throughout entire river basins. Acoustic and radio telemetry projects are also fraught with false positive detections and multipath, which are insidious errors capable of causing significant bias. Traditional data management, filtering, and analytical approaches are no longer capable of handling the vast quantities of data these studies produce. Further, the final round of many traditional filtering techniques still relies upon expert opinion, which calls into question the repeatability of many academic and NEPA studies. For these reasons and more, we present BIOTAS and jsats3D for the analysis of radio and acoustic telemetry projects in 1, 2, or 3 dimensions, briefly explain their capabilities, defend the use of Python and decision to go open source, and make an open call for collaborators.

Thursday
Horizon A
4:00:00 PM
In Person: Oral Presentation

Downstream passage of JSATS-tagged European silver eels through 10 hydropower projects on the Lahn River, Germany to evaluate suitability of using out-of-basin fish to supplement sample size in depressed populations.

Audrey Thompson (audrey.thompson@kleinschmidtgroup.com; Kleinschmidt Associates);

Passage of downstream-migrating silver eels on waterways in Europe is often interrupted or precluded by the presence of run-of-river hydropower facilities, many of which are not equipped with fish-friendly turbines or alternative passage routes. Hydropower owners are increasingly required to evaluate survival past their projects and implement eel-protecting operations. On the River Lahn in Germany, a large-scale passage project was designed to document migration timing and survival of acoustic-tagged silver eels. Results were to be used to develop a model to predict migrating timing and intensity. However, collecting a sufficient sample size of eels from the Lahn was not feasible, so the study population was supplemented with eels from the nearby Main River. Migration behavior was compared between populations, and we found that surrogate eels did not behave differently than native Lahn eels, suggesting that supplementing depressed Anguillid populations may be an effective tool to access passage survival.

Thursday
Horizon A
4:20:00 PM
In Person: Oral Presentation

Development, Installation and Assessment of the World's Largest RFID Fish Detection System

Gordon Axel (gordon.axel@noaa.gov; NOAA Fisheries); Gabriel Brooks (gabriel.brooks@noaa.gov; NOAA Fisheries)

Passive integrated transponder (PIT tag) technologies are a fundamental tool utilized throughout the Columbia River Basin, USA to understand and monitor fish movement and survival. These tagging technologies rely completely on the ability to detect tags at specific locations. Bonneville Power Administration funding has allowed NOAA Fisheries to be at the forefront in helping develop and adapt technologies enabling PIT tag detection in many environments, from remote locations to main-stem dams. Such work is essential to determine the effectiveness of all types of restoration programs on stock recovery. However, many juvenile salmonids utilize spillway and turbine passage routes during their outmigration and researchers have been unable to monitor them in these locations. Consequently, we are collecting fewer data points for survival models that inform regional fisheries agencies. Over the course of a decade, a team consisting of NOAA, Biomark, and Pacific States Marine Fisheries Commission personnel developed and tested many iterations of transceivers, antennas and various components that would be capable of detecting fish passing through a spillway at speeds approaching 80 fps. The Lower Granite Dam spillway detection system was successfully completed in December 2019. A summary of the necessity, evolution and assessment of this system will be presented.

Thursday
Horizon A
4:40:00 PM
In Person: Oral Presentation

High speed spillway PIT-Tag detection at Lower Granite Dam, Snake River

Steve Anglea (steve.anglea@merck.com; Biomark, LLC); Alex Artyukhov (Biomark, LLC;)

Increased passage of juvenile salmonids through spill at Snake River hydroelectric facilities decreased the number of fish passing into the juvenile bypass facility at Lower Granite Dam. Detections of PIT-tagged fish in the juvenile bypass system are used to determine migration timing and partition fish into in-river and bypass groups for estimating a suite of survival metrics. Regional fish managers wanted the ability to directly monitor fish passing through spill. Spill Bay 1 at Lower Granite Dam was identified as the location to install a spillway PIT-tag detection system due to the relatively shallow water, < 1.5 m deep, and high relative abundance of fish passage. Water in Spill Bay 1 travels at approximately 21 m/sec.

Biomark, with funding from the Bonneville Power Administration, and in coordination with NOAA Fisheries, developed a reader and designed antennas to be installed in Spill Bay 1 at Lower Granite Dam. The reader is capable of driving antennas at significantly higher current then traditional Biomark readers, providing adequate read range and read speed for this application. The various reader processes (i.e., Exciter, Auto-tuner, Detector and CPU) are housed in separate modules to optimize performance. The flat-plate antennas were to provide a more consistent detection range across the width of the antennas. The antennas were arranged on the ogee to provide duplicate detection among rows of antennas. Each of the 11 antennas is controlled by a separate FS3001 reader and the exciter frequencies of all readers are synchronized to eliminate interaction among reader/antenna pairs.

Thursday
Horizon C
10:15:00 AM
In Person: Oral Presentation

Abstracts for Dam Decommissioning and removal: State of the practice and future perspectives

Dam Decommissioning and Removal Symposium Overview

Michael Burke (mburke@interfluve.com; Inter-Fluve); Mackenzie Butler (mbutler@interfluve.com; Inter-Fluve);Martin Melchior (mmelchior@interfluve.com; Inter-Fluve);

Dam decommissioning and dam removal are increasingly common management strategies motivated by a broad array of objectives that may include least-cost management of aging infrastructure, public safety, reduction of environmental hazard potential, and restoration of aquatic habitat and watershed connectivity, to name a few. Associated with pending infrastructure recovery funding and initiatives such as the Uncommon Dialogue, it is anticipated that dam removal will accelerate. Although no two projects are alike, future removals may be even more complex than the removals to date. A central thread throughout is restoration of aquatic organism passage and habitat connectivity to support life history needs. With looming impacts to habitat distribution in response to climate change, connectivity is essential to avoid species extirpation and loss of biodiversity. The symposium represents a range of dam removal planning, design, implementation and monitoring aspects and experiences. Symposium presentations include case studies, post-implementation evaluations and research, and examinations of and insights into future directions. This overview talk will provide a brief general overview of dam decommissioning and removal, reiterate the themes for the symposium, and provide a preview of the symposium to follow.

Thursday
Horizon C
10:35:00 AM
In Person: Oral Presentation

Restoring the Ottaway, Part I: Boardman River Dam Removal and Ecosystem Restoration through Tribal and Local Stakeholder Motivation

Brett Fessell (Brett.Fessell@gtb-nsn.gov; Grand Traverse Band of Ottawa and Chippewa Indians); Carl Platz (Carl.A.Platz@usace.army.mil; U.S. Army Corps of Engineers);Frank Dituri (fdituri@traversecitymi.gov; City of Traverse City, MI); Kimberly Balke (kim@rivercare.org; Conservation Resource Alliance); Dan DeVaun (devaund@michigan.gov; Michigan Department of Environment, Great Lakes, and Energy); Troy Naperala (troy.naperala@aecom.com; AECOM); Martin Melchior (mmelchior@interfluve.com; Inter-Fluve); Martin Melchior (mmelchior@interfluve.com; Inter-Fluve); ;

The largest river restoration project in Michigan to date and one of the most significant in the Great Lakes basin, removal of the Brown Bridge, Boardman and Sabin Dams on the Boardman River reconnected 160 miles of river and tributary habitat, restoring native coldwater fisheries habitat and hundreds of acres of wetlands across the valley bottom which included both public and private lands. The former hydroelectric facilities were decommissioned based on dam safety and economic factors in addition to strong desire to restore the ecology of this native water of the Grand Traverse Band of the Ottawa and Chippewa Indians, factors identified by a community-wide feasibility evaluation. The project required unique and innovative techniques for stakeholder participation and engagement, project facilitation and funding, engineering challenges, and ecological recovery strategies. This presentation will describe 1) Native American and local motivation for restoration, 2) benefits of local partnership with a Native American Nation to secure diverse funding and realize implementation over a 15-year timeframe, and 3) a synopsis of ecological benefits and impacts.

Thursday
Horizon C
10:55:00 AM
Virtual Presentation

Restoring the Ottaway, Part II: Boardman River Dam Removal and Ecosystem Restoration - Infrastructure, Engineering, and Construction Perspectives

Troy Naperala (troy.naperala@aecom.com; AECOM); Carl Platz (Carl.A.Platz@usace.army.mil; U.S. Army Corps of Engineers);Frank Dituri (fdituri@traversecitymi.gov; City of Traverse City, MI); Dan DeVaun (devaund@michigan.gov; Michigan Department of Environment, Great Lakes, and Energy); Kimberly Balke (kim@rivercare.org; Conservation Resource Alliance); Brett Fessell (brett.fessell@gtb-nsn.gov; Grand Traverse Band of Ottawa and Chippewa Indians); Marty Melichior (mmelchior@interfluve.com; Inter-Fluve); Marty Melichior (mmelchior@interfluve.com; Inter-Fluve); ;

The largest river restoration project in Michigan to date and one of the most significant in the Great Lakes basin, removal of the Brown Bridge, Boardman and Sabin Dams on the Boardman River reconnected 160 miles of river and tributary habitat, restoring native coldwater fisheries habitat and hundreds of acres of wetlands across the valley bottom which included both public and private lands. The former hydroelectric facilities were decommissioned based on dam safety and economic factors in addition to strong desire to restore the ecology of this native water of the Grand Traverse Band of the Ottawa and Chippewa Indians, factors identified by a community-wide feasibility evaluation. The project required unique and innovative techniques for stakeholder participation and engagement, project facilitation and funding, engineering challenges, and ecological recovery strategies. This presentation will describe 1) considerations in design and sequencing of multiple large-scale dam removals and local infrastructure projects in close proximity over a 15-year timeframe, 2) engineering design considerations in dam removal and river restoration returning a river to a combination of relic and relocated channel patterns, and 3) construction logistics including control of water and sediment management.

Thursday
Horizon C
11:15:00 AM
Virtual Presentation

Dam Removal in the Carmel River Watershed, California

Seth Gentzler (seth.gentzler@aecom.com; AECOM); Jon Stead (jon.stead@aecom.com; AECOM);Aman Gonzalez (Julio.Gonzalez@amwater.com; California American Water); Thomas Christensen (Thomas@mpwmd.net; Monterey Peninsula Water Management District); Steven McNeely (steven.mcneely@aecom.com; AECOM); ;

California American Water (CAW) owned and operated two dams (San Clemente Dam and Los Padres Dam) on the Carmel River upstream of Carmel-By-the-Sea, in Monterey County, California. One of those dams, the 106-foot-high concrete arch San Clemente Dam, was removed in 2015 through a public private partnership between CAW, the California State Coastal Conservancy, and the National Marine Fisheries Service. The 148-foot-high embankment Los Padres Dam is located approximately 6 miles upstream from the former San Clemente Dam site, or approximately 25 miles upstream of the river mouth into the Monterey Bay National Marine Sanctuary. Los Padres Dam and reservoir has a significant amount of accumulated reservoir sediment (over 2 million cubic yards) and currently utilizes its storage capacity to store winter flows and then release flows in the dry season to augment river flows for the benefit of downstream aquatic resources. This presentation examines post-removal conditions at the former San Clemente Dam site and within the downstream river channel, and how those conditions, along with a mixture of other complex considerations, are helping to determine the future of Los Padres Dam, which is now under study to either modify or remove the dam.

Thursday
Horizon C
11:35:00 AM
Virtual Presentation

Carmel River Reroute and Dam Removal Project: Challenges in Design and Construction of a Step-pool Channel

Robert Mussetter (bob.mussetter@tetratech.com; Tetra Tech); Shawn Chartrand (shawn_chartrand@sfu.ca; Simon Fraser University);Brian Cluer (brian.cluer@noaa.gov; NOAA Fisheries); Michael Burke (mburke@interfluve.com; Inter-Fluve); Marcin Whitman (water@terraserve.net; California Department of Fish and Wildlife (retired)); ;

The bulk of the Carmel River Reroute and Dam Removal (CRRDR) project was constructed in 2014 and 2015. As part of this project, the river through the former San Clemente reservoir was rerouted into the downstream reach of San Clemente Creek via a cut through the approximately 300-foot high bedrock ridge that separates the river and the creek. Construction of the new channel, that consisted of a series of step-pool sequences, plane-bed reaches and resting pools, was completed in late-2015. Three floods with recurrence intervals of 2-, 15- and 45-years occurred during the next two winters, causing significant alteration of the constructed channel. The channel reconstruction design was driven by detailed technical specifications that included a range of flood-frequency design criteria for various project elements and stringent criteria for in-channel hydraulic conditions to ensure fish passage (focused primarily on steelhead) over a broad range of low to high flows. The constrained design criteria, challenges during construction and the subsequent behavior of the river under flood conditions provide an interesting set of circumstances and outcomes that may benefit planning and execution of future, similar projects in steep, semi-confined, coarse-grained rivers. Subsequent channel and riparian habitat evolution will also be noted.

Thursday
Horizon C
11:55:00 AM
Virtual Presentation

Increasing the scale and pace of dam removal in Massachusetts

Beth Lambert (beth.lambert@mass.gov; Commonwealth of MA);

With more than 3000 dams in the state, the Massachusetts Division of Ecological Restoration (DER) strives to bring a programmatic approach to dam removal, systematically addressing regulatory, technical, and capacity barriers that make removing aging dams difficult. DER works with federal, state, and local agencies and organizations and consultants to plan, fund, and implement dam removals around the state. DER also provides training and support to other organizations seeking to lead dam removals and other restoration projects. This presentation describes the actions DER has taken over the last 10+ years to raise awareness of the need for and multiple benefits of dam removal, the barriers to dam removal that DER has identified and worked to address, and DER's current initiative to expand the pace and scale of dam removal to restore rivers, help communities adapt to climate change, and deal with the legacy of obsolete infrastructure.

Thursday
Horizon C
1:30:00 PM
Virtual Presentation

Willingness to Pay for Small Dam Removal: A Hedonic Analysis of Plymouth, Massachusetts

Mike Cahill (mcahill1@umassd.edu; Town of Plymouth, MA); Nikolay Anguelov (nikolay.anguelov@umassd.edu; University of Massachusetts Dartmouth)

In response to the loss of ecological services, public safety risks, and proactive climate change resource management, the frequency of dam removal is increasing. However, insufficient socioeconomic research has contributed to contentions between stakeholders and the public on dam management decisions. Based on these facts, this study investigates how the removal of small dams, and subsequent river restoration investments, affects residential housing prices in Plymouth, Massachusetts. Since 2002, 5 dams have been removed in Plymouth along a 1.67-mile first order coastal stream called Town Brook. Following the dam removals, riverine restoration was completed, leading to improved public safety for downstream infrastructure, fish passage, and better water quality. Hypothetically, such benefits ultimately would result in higher property values. Therefore, we conduct a hedonic property value analysis to determine consumer willingness to pay for dam removal as reflected by sale prices of residential properties before and after the dam removals along Town Brook. Utilizing individual characteristics and sale prices for 9,961 single-family residential properties, a hedonic price function has been generated to quantify the Plymouth housing market. Preliminary analysis has shown that dam removal and restoration efforts have yielded increased willingness to pay for properties within varying proximities to the previous dams.

Thursday
Horizon C
1:50:00 PM
Virtual Presentation

Cost Drivers of Dam Removal

Desiree Tullos (desiree.tullos@oregonstate.edu; Oregon State University); Jeff Duda (jduda@usgs.gov; USGS);Jennifer Bountry (jbountry@usbr.gov; US Bureau of Reclamation); Tim Randle (TRandle@usbr.gov; US Bureau of Reclamation); Kyle McKay (Kyle.McKay@usace.army.mil; US Army Corps of Engineers); Susan Bailey (Susan.E.Bailey@usace.army.mil; US Army Corps of Engineers); Al Jansen (ajansen@usbr.gov; US Bureau of Reclamation); Al Jansen (ajansen@usbr.gov; US Bureau of Reclamation); ;

Within the project, fish migration control was carried out with an installed fish counter (Simsonar Oy). Registered species were Roach, Perch, Pike, Bream, Bleak, Common Dace and Crayfish. Surveys were carried out and the results indicate that fish of different species and sizes passes through the composite fishway.

Thursday
Horizon C
2:10:00 PM
In Person: Oral Presentation

Smarter Not Harder: Dam Removal and Sustainable Infrastructure

April McEwen (amcewen@americanrivers.org; American Rivers);

While the past three decades have seen the removal of many small obsolete and abandoned dams, there has been a shift to removing larger and functional dams that provide beneficial services or have dependent useful infrastructure. The complexity of these projects can cause people to question their feasibility or ability to be completed in a timely manner or at all. This presentation explores several multi-benefit projects that demonstrate how increasing sustainability of water resource infrastructure and removing functional dams is not only feasible but can be done efficiently. Specialized leadership in strategic project development, key partnerships, and an integrative project management approach is required, but these projects can provide greater benefits to society.

Thursday
Horizon C
2:30:00 PM
Virtual Presentation

Overcoming challenges for floodplain and channel restoration with dam removal

Martin Melchior (mmelchior@interfluve.com; Inter-Fluve); Michael Burke (mburke@interfluve.com; Inter-Fluve)

Dam removals frequently require management of impounded sediment, either through passive transport during drawdown, or through active removal. Dam removal costs are influenced by sediment volume, sediment grain size, and adherent or associated contaminants. Restoration following removal often involves excavation of impounded sediment to uncover historic floodplain and river bed and bank surfaces previously identified through historic records and soils investigations. Because funding for restoration is often limited, full restoration of pre-dam valley cross-sections are not always possible. In addition, channel modifications and incision downstream of dams can create discontinuity between existing channel bed elevations downstream and pre-dam channel bed elevations upstream. This talk examines strategies used in floodplain and channel restoration, and discusses examples that incorporate short term and long-term stability in mobile boundary channel design, substitutions for geologic control, and passive and active sediment management.

Thursday
Horizon C
2:50:00 PM
In Person: Oral Presentation

Reconnaissance-Level Studies for Dam Removal

Michael Chelminski (michael.chelminski@stantec.com; Stantec Consulting Services Inc.);

Dam removal is an effective and efficient means to improve aquatic habitat and connectivity and public safety and reduce liabilities and costs associated with dam ownership. The objective of this presentation is to present the basis and approach for preliminary, or "reconnaissance-level", studies for dam removal with a focus on smaller dams. The goal is to provide dam removal proponents with information that can generate support and funding for dam removal projects that improve aquatic resources and public safety. This presentation is based on experience gained mostly from preliminary studies for removal of smaller dams but includes studies for removal of large dams. While large dam removal projects can result in positive large-scale ecosystem benefits, removal of smaller dams can result in proportional benefits and foster skills and experience for dam removal practitioners and proponents. This presentation covers the scoping, implementation, and applicability of reconnaissance-level studies for dam removal and contrasts this approach with more detailed "feasibility" studies. Specific emphasis is placed on identification of critical issues as part of the reconnaissance-level study and use of these studies to rank and triage amongst potential dam removal opportunities.

Thursday
Horizon C
3:40:00 PM
Virtual Presentation

Albright Power Station Dam Removal: Reconnecting 74.6 miles of the Cheat River

Madison Ball (madison@cheat.org; Friends of the Cheat);

Dam removal is gaining traction globally as a critical restoration activity necessary to restoring river systems, but is known to be complex and challenging work. In West Virginia, a local non-profit watershed organization, Friends of the Cheat, has built unique partnerships to pursue the removal of the Albright Power Station Dam on the Cheat River. Removal of the Albright Power Station Dam would result in reconnecting 74.6 miles of the Cheat River, which is all but 3.7 miles of the river's entire length. The Cheat River, once named in American River's "Most Endangered Rivers" list in 1995 for acid mine drainage, was historically considered biologically "dead" in the reach downstream of the Albright Power Station Dam. Now, the river ecosystem has rebounded with over 35 species of fish noted, and species sensitive to acidity such as Walleye and Eastern Hellbender have been detected within this reach, making removal of the Albright Power Station Dam vital to holistic restoration of the Cheat River ecosystem. A myriad of challenges have presented themselves during the project, but creative problem solving amongst diverse partners has led to new strides and a bright future for completing the removal of the Albright Power Station Dam.

Thursday
Horizon C
4:00:00 PM
In Person: Oral Presentation

Opportunities for Training Dam Removal Practitioners (Cut Along This Line?)

Michael Chelminski (michael.chelminski@stantec.com; Stantec Consulting Services Inc.);

Dam removal is a multidisciplinary endeavor that is interesting, engaging, and singularly effective for restoration of fish passage. There are no textbooks dedicated to dam removal, however, and opportunities for training are limited, dated, and can be regionally specific. While large-scale dam removal projects can have funding to support large, multidisciplinary teams, most dam removal projects have limited funding that constraints the project team. A consequence of limited funding for most dam removal projects is limited opportunity to train future dam removal practitioners.

Teams of experienced professional can make dam removal projects look easy - “cut along this line!”. Experienced gained by experienced teams does not, however, benefit the larger community in the absence of training new emerging professionals

The purpose of this presentation is to identify and present opportunities for training dam removal practitioners with foci on 1) design professionals and 2) development of dam removal teams. The basis for focusing on design professionals stems from the typical requirement for an engineer to develop design materials. The basis for focusing on development of dam removal teams is that many experienced dam removal practitioners are not design professionals.

Thursday
Horizon C
4:20:00 PM
Virtual Presentation

Building a national movement to advance fish passage through barrier removal

Amy Singler (asingler@americanrivers.org; American Rivers); Serena McClain (smcclain@americanrivers.org; American Rivers)

With over 1951 dams removed in the United States, scientists, engineers, and resource managers have demonstrated that removing dams and other instream barriers can be one of the most effective ways to permanently restore fish passage and improve the ecological function of rivers. The influx of federal funding in the US is an opportunity to re-envision much of our river infrastructure and build from our collective learning about how to restore fisheries and river health. During the presentation we review patterns of dam removal, identifying key lessons from the United States in order to increase the rate and quality of dam removal. Where we once worked on individual projects, we have an opportunity to focus on multiple dams within a watershed and plan for larger scale and more impactful projects. Changes to key laws and policies incentivize removal for dam owners and clarify the regulatory process for applicants and engineers. Bringing thoughtful monitoring and science we are addressing regulatory concerns about long-term environmental impacts, allowing for better project design and implementation. Through strategic planning for removals, better project design, thoughtful monitoring, and key policy changes we present a path to a national movement to advance barrier removal and fish passage. The influx of federal funding in the US is an opportunity to re-envision much of our river infrastructure and build from our collective learning about how to restore fisheries and river health. During the presentation we review patterns of dam removal, identifying key lessons from the United States in order to increase the rate and quality of dam removal. Where we once worked on individual projects, we have an opportunity to focus on multiple dams within a watershed and plan for larger scale and more impactful projects. Changes to key laws and policies incentivize removal for dam owners and clarify the regulatory process for applicants and engineers. Bringing thoughtful monitoring and science we are addressing regulatory concerns about long-term environmental impacts, allowing for better project design and implementation. Through strategic planning for removals, better project design, thoughtful monitoring, and key policy changes we present a path to a national movement to advance barrier removal and fish passage.

Thursday
Horizon C
4:40:00 PM
In Person: Oral Presentation

Identifying and Overcoming Issues with the Removal of Hydroelectric Dams

Bjorn Lake (bjorn.lake@noaa.gov; NOAA Fisheries);

In NOAA Fisheries' jurisdiction, 1,270 micro (<1 MW) and small (<10 MW) hydroelectric projects

produce only 5.2% of the authorized capacity in the Nation yet represent 73.5% of the Federal Energy Regulatory Commission (FERC) licensed and exempt hydroelectric projects. In many cases, these economically marginal projects do not have the resources to fund their decommissioning nor do they have the resources to install adequate fish passage and protection measures. NOAA Fisheries can mandate fishway measures using our authorities, but we cannot prescribe dam removal and FERC policy does not require dam removal during the surrender process. This situation has led to many projects continuing to operate without mitigation or remaining idle without a license or exemption. In this presentation, I will provide case studies across the country and discuss approaches to promote removal of non-viable hydroelectric dams including opportunities with the Infrastructure Investment and Jobs Act. Decommissioning and removing the derelict, underperforming hydroelectric developments will facilitate the restoration of diadromous species and provide opportunities to optimize the hydropower fleet by providing new sites for growth using modern technology that meet sustainability objectives.

Thursday
Horizon D
10:15:00 AM
In Person: Oral Presentation

Abstracts for Design, application, and performanec of nature-like fishways

Modifying a Nature-Like Fishway on the Cape Fear River, NC

Kevin Mack (kevin.mack@noaa.gov; ERT); Fritz Rohde (fritz.rohde@noaa.gov; NMFS);Twyla Cheatwood (twyla.cheatwood@noaa.gov; NMFS);

Between 1915 and 1935, the United States Army Corp of Engineers built three lock and dam structures in the lower Cape Fear River, impounding migrations of diadromous fishes. In 2013, the Army Corps completed construction of a nature-like fishway at Lock and Dam No. 1. The fishway was designed to mimic natural river habitats in the fall zone of southeast rivers and preserve the upstream pools created by the dam structure. In 2021, Cape Fear River Watch reconfigured the existing in-water fishway in order to improve its effectiveness for diadromous fish species, especially striped bass Morone saxatilis. The original nature-like fishway was improved by adding a series of three river-parallel fish pathways across the left, central, and right sections of the existing rock arch rapids. In addition, three small notches were cut into the concrete dam structure at the crest of the dam above the three fish pathways to create individual fishway channels for each new pathway. A combination of attraction flows from the notches, wider gaps in the fish pathways, and deeper resting pools, further mimic natural rapids and will help improve fish passage at the rock arch ramp.

Thursday
Horizon D
10:35:00 AM
Virtual Presentation

Hydrodynamics of a Nature-like Step-pool Fishway

Sruthi T K (tk.sruthi@gmail.com; Indian Institute of Technology Madras, India); Venu Chandra (vc@iitm.ac.in; Indian Institute of Technology Madras, India)

Nature-like fishways are structures that resemble the natural riverine ecosystem and facilitatethe passage and inhabitation of diverse aquatic organisms. The velocity range and turbulence levels of the flow arecrucial to the effectiveness of the fishway.The present study investigatesthe hydraulic characteristics of a nature-like step-pool fishway under varying flow conditionsthrough experimental and numerical modelling. The step-pool fishway isdesigned according to the body dimensions of the target species as per the guidelines developed bytheFederal Interagency. The Ichthyofauna of Indira Gandhi Wildlife Sanctuary, India,ischosenas the target species,and the details arecollected from the literature. A model scale of 1:4 is chosen for translating the fishway design into the experimental framework. The experimental study is extended using theComputational Fluid Dynamics software FLOW-3D to develop numerical results for a broaderrange of flow conditions. The outcomes of the study are presented in terms of rating curves and design charts relating dimensionless depth, dimensionless velocity, dimensionless discharge, turbulent kinetic energy,and energy dissipation factor of the pool.

Design, application, and performance of nature-like fishways.

Thursday
Horizon D
10:55:00 AM
In Person: Oral Presentation

Innovative Designs Require Innovative Approaches: CFD-based Design of the Saccarappa Falls Nature-Like Fishway

Benjmain Mater (bmater@aldenlab.com; Alden Research Laboratory, LLC); Gregory Allen (gallen@aldenlab.com; Alden Research Laboratory, LLC)

Three-dimensional (3D)Computational Fluid Dynamics (CFD) modeling is becoming widely utilized as a tool for designing fish passage measures. Traditional measures, such as fish ladders, lend themselves well to CFD analysis thanks to regular, relatively simple geometries. Nature-Like Fishways, however, are characterized by complex geometriesthat present a practical hurdletoCFD-based design efforts.This talk presents a case study in the novel use of CFD as a practicaltool in the design of a complex NLF on the Presumpscot River (Westbrook, ME). The final design was achieved by way of iteration between a 3D CAD terrain modeland a 2D/3D hybrid CFD model.Channel roughness elements wereexplicitly considered in the model. An evaluation of fish passage effectiveness was performed using results from the CFD simulations, wherein likelihood of passage by fish size was determined based on the swim speeds and endurance.Construction on the project was recentlycompleted, therefore, practical lessons-learned in implementing such a complex, non-traditional design will also be presented.The Saccarappa NLF stands as an example of how careful and creative modeling can push NLF design beyond relatively simple rock ramps and unlock the potential for more creative designs while reducing project uncertainty.

Design, application, and performance of nature-like fishways.

Thursday
Horizon D
11:15:00 AM
In Person: Oral Presentation

Hydraulic roughness parameterization in an NLF design - a post-project review

Michael Burke (mburke@interfluve.com; Inter-Fluve); Kristen Coveleski (kcoveleski@interfluve.com; Inter-Fluve)

The Howland fish bypass channel on the Piscataquis River in Maine is one of the largest nature-like fishways in North America, and is an important component of the Penobscot River restoration. The bypass channel was completed in 2016. During the design phase, the hydraulic characteristics of the bypass channel were simulated with a one-dimensional split-flow hydraulic model, to enable comparison of estimated performance to the design criteria established for the project. Parameterization of hydraulic roughness was highly influential on the predicted hydraulic conditions, yet because it applied to a proposed condition that did not physically exist, could not be calibrated for the eventual constructed condition. A range of approaches were employed in the modeling to limit the uncertainty regarding the actual hydraulic roughness, and its influence on the project design. Selected water surface profile and velocity measurements collected at varying flows over a three-year period following project completion provide the opportunity to compare the hydraulic characteristics of the constructed project to the model simulation results, with particular reference to hydraulic roughness parameterization.

Design, application, and performance of nature-like fishways.

Thursday
Horizon D
11:35:00 AM
In Person: Oral Presentation

Biological effectiveness monitoring of nature-like fishways; a design perspective

Mackenzie Butler (mbutler@interfluve.com; Inter-Fluve); Tim Brush (tbrush@interfluve.com; Inter-Fluve)

Planning for a fishway at a given location must consider many factors such as site hydraulics and hydrology, constructability, cost, biology of the fish species of interest, likelihood that a particular design will be effective in passing fish, among others. Many of those factors must be evaluated a priori but the effectiveness of the fish passage facility is an important a posteriori assessment that should not be undervalued. Interest in nature-like fishways (NLF) has increased in recent decades. The data on NLF effectiveness are growing but more are needed to better characterize the features of a site and fishway design that increase the likelihood of success. Here we will present a brief overview of NLF monitoring data collected in approximately the last decade on projects across the USA and even from countries outside the USA (e.g., disparate passage efficiency for Rainbow Smelt and Brook Trout in Prince Edward Island; a project in Korea; and various projects at FERC licensed hydro projects in the USA). We will conclude with monitoring data collection recommendations from a design practitioner perspective, to support continued refinement of NLF as viable fish passage features.

Thursday
Horizon D
11:55:00 AM
In Person: Oral Presentation

The Atlantic Coast Nature-Like Fishway Guidelines – derivation, use, and plans for the future.

Bjorn Lake (bjorn.lake@noaa.gov; NOAA Fisheries); James Turek (James.g.turek@noaa.gov; NOAA Restoration Center);Brett Towler (btowler@usgs.gov; U.S. Geological Survey); Alexander Haro (aharo@usgs.gov; U.S. Geological Survey)

In 2016, the Federal Interagency Nature-like Fishway Passage Design Guidelines for Atlantic Coast Diadromous Fishes was released as a Technical Memorandum by NOAA Fisheries and co-authored by representatives from the U.S. Fish and Wildlife Service and the U.S. Geological Survey. Since publication, fish passage project proponents across the Atlantic Coast have relied on the information provided in the document to design and construct nature-like fishways (NLF) for diadromous species. During this presentation, we will highlight key components of the existing guidelines and recommend how to best use the guidelines to inform fishway design by presenting lessons learned from case studies. We will provide detail on the limitations of the current guidelines and how we plan to improve the document with new information, other potential NLF types, and clarifications on certain design components.

Design, application, and performance of nature-like fishways.

Thursday
Horizon D
1:30:00 PM
In Person: Oral Presentation

Abstracts for Nature-like fishways: Current philosophy and innovative design

Energy Dissipation in Nature-Like Fishways – a 2D Perspective

Stuart Beck (stuart.beck@kleinschmidtgroup.com; Kleinschmidt Associates); Chris Goodell (Chris.Goodell@KleinschmidtGroup.com; Kleinschmidt Associates);Tyler Kreider (tyler.kreider@kleinschmidtGroup.com; Kleinschmidt Associates); Jesse Waldrip (Jesse.Waldrip@KleinschmidtGroup.com; Kleinschmidt Associates)

Conventional methods for calculating Energy Dissipation Factor (EDF) are not directly applicable in steep natural streams with diverse hydraulic conditions. An alternate way to calculate EDF relies on the output from a 2D hydraulic model and can be used to provide a plan view of distribution of EDF (and associated level of turbulence). Zones with low EDF would represent potential resting areas and zones with high EDF might be avoided during upstream migration. An example of a zone of high EDF would be a hydraulic jump. A hydraulic method to calculate a 2D energy dissipation factor is presented and case studies will be used to illustrate the 2D patterns of EDF at different flow magnitudes. The method relies on standard output from a 2D model (velocity, depth, and water surface elevation). Some post-processing of results from a 2D model would be needed to derive the 2D EDF. In a nature-like fishway, multiple pathways for fish passage might exist depending on the channel geometry and the flow magnitude, similar to a natural stream. Results from a 2D hydraulic model (depth, velocity, and EDF) can be used to evaluate passage conditions along the different pathways and can help guide the design process.

Thursday
Horizon D
1:50:00 PM
In Person: Oral Presentation

A new approach to steep channel design

Tim Abbe (tim@naturaldes.com; Natural Systems Design); Eleanor Bartolomeo (eleanor@naturaldes.com; Natural Systems Design);Julie Heilman (heilmaj@wsdot.wa.gov; WSDOT); Casey Kramer (ckramer@naturalwaters.design; Natural Waters)

Design for steep channels (3-10%) typically involves step-pool or boulder cascade morphologies with a focus on bank-full and greater flows. It is also important to consider low flow conditions in channel design since they are particularly important for fish passage. We have developed new concepts for step-pool design that focus on the defining a low-flow channel and maximizing its length to reduce gradient and drop heights at these flows. The core of our design are oblique laterally-inclined alternating steps along with rock baffles that increase low flow channel length. The design utilizes energy losses associated with roughness elements, turbulence and colliding flow streams to reduce velocities, partition shear stress and create hydraulic refugia for fish. The concept was developed for highway crossings and is in the early phases of research and testing for constructability, hydraulics and stability. We present project challenge that led to the concept and its initial development.

Thursday
Horizon D
2:10:00 PM
In Person: Oral Presentation

Examples of Nature-Like Fishway Design Considerations in Steep/High Energy Channels

Paul DeVries (paul.devries@kleinschmidtgroup.com; Kleinschmidt);

Steep (>2% gradient), high energy fishways span a shifting range of design approaches that transition from stream simulation to stream emulation as slope, design flow, and energy dissipation requirements increase. Hydraulic and geomorphic design analyses, analogs, and criteria vary accordingly. This talk describes practical design considerations and criteria in selected case studies, from a range of slopes and stream sizes. Limitations of the energy dissipation factor as a design criterion are identified.

Thursday
Horizon D
2:30:00 PM
In Person: Oral Presentation

Overcoming Constraints to Design the Island Farm Weir NLF

Tyler Kreider (tyler.kreider@kleinschmidtGroup.com; Kleinschmidt Associates); Gabriel Martin (gabriel.martin@kleinschmidtgroup.com; Kleinschmidt Associates)

After poor passage of American Shad and River Herring was documented at a Vertical Slot Fishway After poor passage of American Shad and River Herring was documented at a Vertical Slot Fishway at the Island Farm Weir on the Raritan River (New Jersey), Kleinschmidt was asked to develop an alternatives analysis for a new fish passage structure and subsequently developed a NLF design to replace the existing fishway. While not an overly tall dam, the site had substantial physical and operational constraints that will be discussed, as well as the design solutions to overcome those constraints. Physical and Operational constraints to be discussed include: designing around existing water intakes and associated infrastructure, working with bedrock substrate, minimizing the rise in the flood condition, and use of a modified downstream weir to meet the project objectives.at the Island Farm Weir on the Raritan River (New Jersey), Kleinschmidt was asked to develop an alternatives analysis for a new fish passage structure and subsequently developed a NLF design to replace the existing fishway. While not an overly tall dam, the site had substantial physical and operational constraints that will be discussed, as well as the design solutions to overcome those constraints. Physical and Operational constraints to be discussed include: designing around existing water intakes and associated infrastructure, working with bedrock substrate, minimizing the rise in the flood condition, and use of a modified downstream weir to meet the project objectives.

Thursday
Horizon D
3:40:00 PM
Virtual Presentation

Restoring the Continuity of Two Rivers in Southern Poland - 2022 Distinguished Project Award

Roman Żurek (zurek@iop.krakow.pl; National Water Management Authority, State Water Holding "Polish Waters" (Wody Polskie));

In Poland, there are over forty-five thousand barriers on rivers and streams. They vary in height from 10 cm to several dozen meters. Like most such structures in Europe, they were built mainly in the second half of the 20th century. Only less than 4 percent are equipped with fish ladders, of which more than half are ineffective. Restoring the possibility for fish and other aquatic organisms to migrate freely up and down is one of the objectives of the Regional Water Management Board in Krakow (National Water Holding "Polish Waters"), which is responsible for water management in the Upper Vistula river basin. The first implemented projects concerned two rivers: Biała Tarnowska and Wisłoka. The dams on Biala Tarnowska and Wisloka rivers have blocked or impeded the migration of fish for decades. As a result, species such as salmon, sea trout, and sturgeon have disappeared from the list of ichthyofauna found in our rivers, while others have been placed in the highest risk category. Attempts made so far to restore these species were based primarily on stocking, which without simultaneous opening of migration routes and restoration of sections useful for spawning and fry growth, have no chance of success. Both projects do not undertake restocking activities but are aimed to restore access to spawning grounds and create conditions for spawning. In the case of the Biała Tarnowska, the modernization included 15 fish passage barriers. Their reconstruction, concerning fish migration requirements, resulted in unblocking the 80 km (50 miles) long river corridor, including 43 km (27 miles) of the Biała Tarnowska River and 37 km (23 miles) of its tributaries, which resulted in unblocking the Biała Tarnowska River channel from its sources to its mouth. In the case of Wisłoka and its tributaries, the elimination of 7 fish migration barriers resulted in unblocking of the river corridor length of 254 km (158 miles) including 124 km (77 miles) on the Wisłoka River, 76 km (47 miles) on the Jasiołka River, and 54 km (34 miles) on the Ropa River. Both projects were implemented under the Infrastructure and Environment Operational Program 2014–2020, which is part of the European Union financial perspective. These projects are also the first attempt in the south of Poland to test different types of fish passes for migrating fish. Particular emphasis in the design was placed on the use of natural materials which differentiates these new fishways from the existing technical, concrete, and steel fish passes. The design and construction process in both projects was the result of cooperation between engineers and biologists, and it assumed that testing the effectiveness of the constructed fish passage facilities is part of the investment process, not just an add-on. A variety of commercially available survey techniques were used to document fish migration through the fish ladders and hydraulic monitoring was carried out at all sites. The assessments of the fish migration capacity of the structures confirmed that all new fishways have fulfilled their purpose: fish can again migrate in both directions. More information can be found in the detailed reports for the projects on these websites (English translation can be chosen in top right menu): https://biala-tarnowska.org/ https://wislokabezbarier.com/

Thursday
Horizon D
4:00:00 PM
In Person: Oral Presentation

Nelson Dam Removal – Use of physical and numerical modeling to design of a nature-like roughened channel fishway

Vaughn Collins (vcollins@nhcweb.com; Northwest Hydraulic Consultants); Peter Brooks (pbrooks@nhcweb.com; Northwest Hydraulic Consultants)

Nelson Dam is an aging irrigation diversion structure spanning the Naches River near Yakima, WA. The existing structure is currently being removed and will be replaced by a nature-like roughened channel fishway to provide robust fish passage, improve geomorphic continuity, and reduce flood risk, all while maintaining a reliable irrigation diversion on a large, dynamic, gravel-bedded river. Given the complex project setting and broad stakeholder group, a two-phase design process was implemented. The first phase involved construction of a 1:24 scale physical model to assess hydraulic and sediment transport patterns, sediment flushing capabilities, and fish passage conditions over a range of flows. The physical model study concluded with a preliminary design that demonstrated compliance with fish passage regulations, as well as met stakeholder expectations. The second phase involved development of a high-resolution SRH2D numerical hydraulic model of the roughened channel fishway and adjacent diversion facility to refine and finalize the design. The SRH2D model was calibrated to physical model observations and used to simulate the full range of design discharges to evaluate fish passage, flood conveyance, and channel stability. This presentation will discuss the methods, limitations, and benefits of integrating physical and numerical model findings to evaluate nature-like roughened channel fishways.

Thursday
Horizon D
4:20:00 PM
In Person: Oral Presentation

Nelson Dam Replacement Project: Final Design, Material Sourcing, and Construction Methods

Mike Garello (mike.garello@hdrinc.com; HDR Engineering, Inc.); Anna Mallonee (anna.mallonee@hdrinc.com; HDR Engineering, Inc.)

Nelson Dam is an 8-foot tall by 180-foot wide channel-spanning concrete structure originally constructed in the 1940's across the Naches River near Yakima, Washington. The current structure facilitates the diversion of irrigation water over 8,000 residents and commercial farmers connected to the City of Yakima's distribution system and along the Naches-Cowiche Canal. Nelson Dam is a known barrier to upstream migrating fish and has altered the profile of the river for miles, causing decreased sediment continuity and increased flooding potential upstream. Throughout over two-decades of planning, stakeholder engagement, and design, the City of Yakima is now replacing Nelson Dam with a new roughened channel. This multi-phased project will result in improved water supply reliability, restored fish passage, and enhancement of natural river processes meeting numerous regional and local objectives for the Naches River and Yakima Basin. This presentation will focus on the unique methods used for final design and construction of the roughened channel elements including the rock foundation, sheet pile seepage wall, rock bands, rock clusters, and pilot channels. Construction risk mitigation tactics such as the pre-construction material sourcing strategy as well as the phased dewatering approach will also be presented and discussed.

Thursday
Horizon D
4:40:00 PM
In Person: Oral Presentation

Middle Fork Nooksack Dam Removal, River Modification to Restore Fish Passage, and Water Supply Improvement

Brad Johnson (brad.johnson@kleinschmidtgroup.com; Kleinschmidt Associates); Matthew Prociv (Matthew.Prociv@hdrinc.com; HDR)

The City of Bellingham, American Rivers, and supporting partners have implemented several elements of a multi-benefit project on the Middle Fork Nooksack River. The project provides fish passage to 16 – 26 miles of critical habitat for three ESA-listed Puget Sound threatened anadromous fish species by removing the diversion dam while improving the reliability of the City's water supply. In-water work was completed in early fall 2020, restoring volitional fish passage to upstream habitat through dam removal and channel restoration. Upland work related to City water supply elements was completed in the summer of 2021. Final work to close out construction of the project is being conducted now with completion anticipated before the end of 2022. By moving the intake 680 feet upstream from the existing diversion dam, the project design was able to utilize the river gradient to maintain the required head to supply the river diversion after the existing diversion dam was removed. The project addressed several challenges including providing a river channel design to accommodate fish passage in a steep gradient, a high energy river system that mobilizes large boulders and transports large volumes of sediment; transmission pipeline that cut off access to the site during installation; a deep fish screen structure constructed between a protected riparian buffer on one side and a wetland on the other; a remote project site with no communications during construction; and the requirement to monitor and operate the project remotely . This talk will cover how these complex problems were addressed to create a project with many benefits that accommodated the interests of multiple stakeholders.

Thursday
Vista
10:15:00 AM
In Person: Oral Presentation

Abstracts for Cross-continental fish passage and conservation research network

Introduction to the Cross-Continental Fish Passage and Conservation Research Network

Daniel Zielinski (dzielinski@glfc.org; Great Lakes Fishery Commission); Ana T. Silva (Ana.Silva@nina.no; Norwegian Institute for Nature Research)

The Cross-Continental Fish Passage and Conservation Research Network (CONCERN) aims at strengthening an international collaboration of researchers from Norway, USA and Canada that work closely with both environmental conservation and hydropower industry and management. Commonalities in research facilities and untapped fish movement data across all three countries create opportunities for future collaborative work on fish migration and conservation. Complementary facilities and technology creates unique opportunity to develop cooperative research, facilitates exchange, and training of students developing similar research on fish conservation and river restoration. Work towards generalized analyses for fish movement data could provide insights on fish behavior and ecology, crucial scientific knowledge for the improvement of river management. CONCERN also identified the need for a merger between basic scientists, applied scientists, and engineers to translate laboratory understandings of cognition into engineered solutions for fish conservation and invasive species management. This symposium brings together scientists and engineers from all the three countries with extensive experience in fish passage and fish conservation research to share site-specific research goals, facility designs and capabilities, pitfalls/lessons learned, and avenues to add value to other (international) research questions. We also look to expand the network to include interested researchers from around the world.

Thursday
Vista
10:35:00 AM
In Person: Oral Presentation

The influence of flow characteristics on the upstream movement of Sea Lamprey at different spatiotemporal scales.

James Kerr (jkerr21@uoguelph.ca; University of Guelph, Canada);

Water flow remains one of the most effective and promising avenues for manipulating the movement and distribution of fishes in rivers, yet the mechanisms by which hydraulic patterns influence movement remain uncertain. We hypothesize sea lamprey movement is influenced by water flow patterns, but the nature of such relationships differs across the spatiotemporal scales that specific water flow characteristics and sea lamprey movements occur. We predict that fast-changing hydraulic features will influence small-scale sea lamprey movements, while slower-changing water flow patterns will influence large-scale sea lamprey movements. We test these predictions using a cognitive-based model of animal behavior, the Eulerian-Lagrangian Agent Method (ELAM). Model outputs are compared against two acoustic telemetry datasets of sea lamprey movement: 1) in the region downstream of the St. Marys River lock and dam complex in Sault Ste. Marie, Canada (large-scale model) and 2) as they approached a single hydropower dam (small-scale model). To date, eleven separate large-scale movement models have been generated and tested using the ELAM model. Work is ongoing but considerable progress has been made in systematically identifying the hydraulic patterns and movement behaviors that are governing lamprey route choice and destination as they migrate upstream.

Thursday
Vista
10:55:00 AM
In Person: Oral Presentation

Hydraulic impact on fish migration in Sariakandhi fish pass of Bangladesh

Bijoy Kumar Ghosh (bkghoshbuet@yahoo.com; DSHE, Ministry of Education. Bangladesh);

The importance of open water fish in our socio-economic regime has recently drawn the attention of the policy makers of the country. FCD/FCDI projects mainly serve the agricultural interests, but it interfere fish migration. This inevitably affects the open water fisheries sector as migratory routes. Nursing grounds of many species of fish are hampered and disturbed for these projects also. In order to permit fish migration in rivers, it is necessary to maintain conditions that help migrants reach their spawning grounds. To overcome obstacles, such as hydraulic structures, placed in the path of migrating fish, structures must be designed to assist the fish to pass them. The periodic and directed travel of fish mainly for feeding, breeding and over coming adverse climatic conditions is called migration. Fish passes are constructed to allow normal breeding migration and to ensure natural route of fish movement. The concept of a fish passes is relatively new in Bangladesh. At present, two Fish passes and two fish friendly structures are constructed. These are Fish Pass in Jamuna to Bangali River at Sariakandi in Bogra, fish Pass in Kawadighi Haor of Monu river in Moulovibazar, fish friendly structure in Lohajong river of Tangail and fish friendly structure at Morichardanra in Chapainawabganj. Fish fry, spawning and hatchling movement from Jamuna to Bangali River was the main objective of Sariakandi Fish Pass Project. The Fish Pass Project of Sariakandi is necessary for the development of the dominant fishes like catfish and small fishes. The structures will also aid in efficient development of the carp fishes. Spawning migration, mainly in carp fish, in the study area was found to begin at the 2nd week of May and continue up to the 3rd week of July. Catfish migrations began at the last week of March and continue up to the 2nd week of June. Fish fry and hatching movement from Jamuna to Bangali river was the main objective of Sariakandi fish pass project. The study also found that there were seven major category migratory species in the project area and the fish pass is contributing positively for growth of fishery resources in then study area. During the monsoon carp fish is the dominating migratory species. Carpfish migrates in a higher velocity, whereas, catfish migrates in a lower velocity. Some problems were found in the operation and management of fish pass.

Thursday
Vista
11:15:00 AM
Virtual Presentation

The fishpath project: A new idea for fish downstream guidance

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The continuing increase in global energy demand, the need to mitigate anthropogenic climate change by increasing renewable energy shares, and the unprecedent declining of biodiversity are drivers for major changes and growth in the hydropower (HP) sector as sustainability can only be achieved through transformative changes. The FishPath project aims at developing cost-effective measures for safe downstream migration of Atlantic salmon (Salmo salmo) and European eel (Anguilla anguilla) passing hydropower structures to help address the challenge of providing environmentally friendly energy. The project is based on the idea that knowledge on fish behavioural responses to eddies can be used to develop guidance systems. Thus, alternative migration pathways for fish around Hydropower Power Plants (HPP) and other water intakes can be created. Currently, design solutions used by industry are often suboptimal in terms of cost, technology, operation and fish protection efficiency. FishPath is expected to result in innovative solutions for the challenge of downstream fish passage at medium/large-scale hydropower plants worldwide.

Thursday
Vista
1:30:00 PM
In Person: Oral Presentation

Abstracts for Fundamental Science

Modeling upstream orientation of trout in a wide laboratory flume

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To improve our understanding of upstream orientation of fish on fishway scale, we developed a three-dimensional individual-based model based on brown trout (Salmo trutta fario) movement observed in a wide laboratory flume. We tested it against two hydraulically different flume set-ups.

We used the model to examine which of five behavioral rule versions would best explain up-stream trout orientation. The versions differed in the stimulus for swim angle selection. The baseline stimulus was positive rheotaxis with a random component. It was supplemented by attraction towards either lower velocity magnitude, constant turbulence kinetic energy (TKE), increased flow acceleration, or shorter wall distance.

We found that the baseline stimulus version (rheotaxis and random component) already ex-plained large parts of the observed behavior. Mixed results for velocity, TKE, and acceleration indicated that the brown trout tested did not orient primarily by means of these flow features. The wall distance version produced significantly improved results, suggesting that wall distance was the dominant orientation stimulus here. Our best explanation for these results is dominance of the visual sense favored by absence of challenging hydraulic stimuli. We conclude that under similar conditions (moderate flow and visible walls), wall distance could be a relevant stimulus in confined space, particularly for fishway studies and design.

Thursday
Vista
1:50:00 PM
In Person: Oral Presentation

A matter of scales: addressing allometry when predicting passage performance through velocity barriers

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Although it is well-known that swimming ability scales with body size, the nature of the scaling relationship remains poorly quantified. The most common approach to controlling for body size is to simply divide swim speed (cm s-1) by the length of the fish's body (cm BL-1), to produce normalized swim speeds (BL s-1). This approach assumes an isometric relationship between swim speed and body =length, however, which may not be accurate. While normalized swim speeds are sufficient when contending with small-scale differences in body size, the associated error can become large when extrapolating to animals that are either much larger or much smaller than those tested. We present some findings of recent work that illustrate this problem in the context of developing fishway designs for adult Atlantic sturgeon and other species. Various common methods for addressing length effects produced dramatically different performance predictions, highlighting the need for improved understanding of the factors driving allometry in swimming performance, and for identifying optimal ways of controlling for these effects.

Fundamental Science

Thursday
Vista
2:10:00 PM
Virtual Presentation

Passage through a fishway entrance at various velocities - results from flume experiments with small non-salmonids

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Challenges in the design of fishways, especially at large rivers, are contradictory requirements of a far-reaching attraction flow and an entrance that is passable for small fish. High flow velocities in the entrance might enhance attraction flow propagation and tend to have better attraction efficiency. However, these velocities may act as hydraulic barrier and prevent small bodied species or juvenile fish from entering the fishway. In the current study, passage efficiency of a fishway entrance was assessed in flume experiments. An entrance slot with 0.4 m width and water depth of 0.9 m was installed, resembling a standard fish way entrance in German waterways. Four slot velocities with 0.8 ms-1, 1.2 ms-1, 1.5 ms-1 and 1.8 ms-1 were investigated. In total 326 juvenile roach (Rutilus rutilus), gudgeon (Gobio gobio) and spirlin (Alburnoides bipunctatus) were tested. Fish behavior and passage success was recorded and hydraulic parameters were measured with an ADV-probe. All species were motivated and most fish tried to migrate upstream and pass the slot. Juvenile roach, gudgeons and spirlin differed in passage success and for all three species passage success decreased at higher slot velocities. The results of the experiments provide valuable contributions to the design of efficient fishways.

Thursday
Vista
2:30:00 PM
Virtual Presentation

Factors affecting Northern Pike (Esox lucius) leaping ability: implications for barrier design in invaded systems

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Invasive predatory fishes such as Northern Pike (Esox lucius) pose a serious threat to freshwater ecosystems and the communities that rely on aquatic resources. In Southcentral Alaska, selective fragmentation via vertical drop barriers may be a viable option to prevent invasive pike from spreading into salmonid habitat due to potential differences in leaping ability between native salmonids and invasive pike. To determine the efficacy of pike-selective barriers, we assessed pike leaping ability as a function of barrier height, pool depth, and flow rate, with individual pike size, growth rate, condition, and a proxy for standard metabolic rate analyzed as covariates. Adult pike (N = 60) were collected from Fort Peck Reservoir, Montana, USA and used in leaping trials in an open channel flume system at the U.S. Fish and Wildlife Service Fish Technology Center in Bozeman, Montana during the summer of 2021. Barrier height, pool depth, and pike size affected pike leaping ability, while flow rates did not influence leap success, and impacts of pike condition, metabolism, and growth are yet to be determined. These results can inform pike-selective barrier development and testing in Alaska and elsewhere pike are invasive to reduce predatory impacts of pike on native fish communities.

Fundamental Science

Thursday
Vista
3:40:00 PM
Virtual Presentation

Abstracts for Global policies on fish passage: Barriers and opportunities for successful management

Actions to restore fish passage in New Zealand: From science to policy and back again

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New Zealand's freshwater fish communities are characterised by a prevalence of diadromy, with a dominance of amphidromous species that undertake their primary upstream migrations as small-bodied (20-60 mm TL) juveniles. These species are highly susceptible to small impediments to upstream movement (e.g., vertical drops <100 mm), presenting a challenge for managing the impacts of riverine infrastructure on river connectivity. Effective action to restore fish passage requires awareness of the problem, evidence-based solutions, and an appropriate policy context. We describe how delivering credible, relevant and legitimate fish passage science and tools has enabled a new approach to fish passage management. This includes new national policies designed to prevent the creation of new instream barriers at culverts and weirs, and that require documentation and remediation of existing fish passage barriers across the national river network. We expect the new policies to drive a step-change in actions to restore fish passage in New Zealand. However, they present significant challenges for the practitioners responsible for implementing the policies – particularly a limited toolbox of fish passage remediation options specifically designed and tested for small-bodied species. Scientists are now being urgently called on to deliver cost-effective solutions for remediating a diverse array of instream barriers.

Thursday
Vista
4:00:00 PM
In Person: Oral Presentation

Laws, regulations and policies may contribute to weak decision-making processes for fish passages

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Most policies and regulations globally currently require fish passages to be installed at barriers as the main tool to restore migratory pathways. However, existence of legislation does not imply achievement of its expected outcomes and it is a multifaceted problem that may contribute to weak decision-making processes in fish passage. In this presentation I aim at promoting an open discussion about how laws, regulations or policies can, counterintuitively, promote weak decisions about the need for fish passages at barriers. I will bring examples from the Neotropics, particularly Brazil, where the legal framework may have led to misguided decisions. The results of this process can be threefold: i) installation of inefficient fish passages; ii) the absence of fish passages at barriers where such tool would be needed; iii) the use of fish passages as a simple justification to approve new dams under the consideration that the legal requirements were met. These results are of great concern and raise questions about the benefits and disadvantages of having a legal framework to decide on fish passage needs. And, yet this topic has been poorly assessed or discussed and poor decisions are likely to continue to be made.

Thursday
Vista
4:20:00 PM
In Person: Oral Presentation

Using Structured Decision Making to Assess the Consequences of Connectivity: A Case Study in Northwest Michigan

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Dams have dramatically altereded riverine systems throughout North America and are a major contributor to native fish population declines. Increasing awareness about negative impacts of dams has resulted in the call for many to be removed; However, in the Great Lakes region, some dams prevent the upstream movement of invasive species such as Sea Lamprey (Petromyzon marinus) and serve important socioeconomic benefits, such as flood control and providing recreational opportunities. Therefore, dam removal is often contentious among stakeholders and historically, socioeconomic factors were not fully incorporated into the decision making process for fisheries problems. This research uses Structured Decision Making to evaluate the ecological, social, and economic consequences and tradeoffs of enhancing connectivity for migratory fishes in the Great Lakes basin, using the Boardman River FishPass project as a case study. We describe our efforts to engage a diverse group of stakeholders to elicit their objectives under various connectivity alternatives. We found that although most stakeholders hold similar values regarding native fish passage, stakeholder values differed markedly regarding the passage of introduced Pacific salmonids. We developed predictive models to help stakeholders weigh the costs and benefits of enhancing connectivity for several fish species with varying life history traits and initial distributions. The results of this research will help inform decision-makers on alternatives of fish passage that are ecologically and socially acceptable to stakeholders and that are likely to achieve their objectives.

Thursday
Vista
4:40:00 PM
In Person: Oral Presentation

Cross-Disciplinary Research Perspectives on Fish Passage Policy and Community Engagement.

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Policies are a primary mechanism through which governments manage ecosystems and make decisions regarding fish and wildlife. Fish passage policies provide regulations and incentives for restoration of migratory pathways for aquaticspecies. Stakeholder support for policies is a crucial element of their success,howeverlittle research has been conducted to evaluatesupport for fish passage policies.Wildlife conservation in the United States also reliesonpolicy instruments to achieve management goals, and arecent study in Michigan, USA, evaluated determinants of support for wildlife conservation funding policies. We implemented a survey of recreationists(n=3500)to evaluate relative support for various tax systemsfor funding conservation efforts. Regression models and cluster analysis suggested thatstakeholder characteristics, such as values and socio-demographics, are significant determinants of support for certain policies. Fishpassageresearch and practicecould benefit from a similar focus on stakeholder values to leverage support for innovative approaches to funding fish passage projects.This prospective talk will highlight how social science approachesand cross-disciplinary insights can be applied in a fish passage context to inform research and community-engaged processes, specifically focusing on parallels between fish and wildlife conservation, community support and engagement, and stakeholder input into decision-making processes.