Abstracts for Oral Presentations

CRISPR/Cas9-Mediated fat1 Inheritance in Channel Catfish (Ictalurus punctatus) and Response to *Flavobacterium columnare* Challenge

Student

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Genetic improvement of disease resistance in channel catfish (*Ictalurus punctatus*) is crucial for sustainable aquaculture. The fat1 gene, also referred to as desaturase-12 (D12), originally derived from Caenorhabditis elegans, is involved in omega-3 fatty acid biosynthesis and has been proposed to influence not only lipid metabolism but also immune function. In this study, we evaluated the inheritance stability and disease resistance in F1 progeny produced from CRISPR/Cas9-edited channel catfish broodstock. Progeny generated during the 2024 spawning season were screened at seven months post-hatch using polymerase chain reaction (PCR) to assess fat1 inheritance. Mosaicism was evaluated in ten internal and external tissues, and consistent detection of the targeted fat1 sequence across all tissues indicated stable germline transmission and absence of detectable mosaicism. Furthermore, those progeny were subjected to a controlled *Flavobacterium columnare* challenge alongside non-transgenic control fish at a concentration of 1.16×10^6 colony-forming units per milliliter (CFU mL^{-1}) in tanks with a volume of 1.20 m × 0.34 m × 0.10 m. Mean survival time was higher in transgenic fish (165.8 hours) compared to controls (140.0 hours). Size-associated mortality patterns differed between groups, with transgenic fish exhibiting improved survival among smaller individuals and earlier mortality among larger fish relative to controls. Mean mortality weight was 3.25 g for transgenic fish and 4.0 g for controls, while mean survival weight was 2.30 g and 2.86 g, respectively. Fatty acid profiling is currently underway, and additional experiments are planned to evaluate the expression of fatty acid metabolism and immune-related genes during disease challenge. Together, these results demonstrate stable inheritance of the CRISPR/Cas9-targeted fat1 (D12) sequence in F1 progeny and suggest a potential role for fat1 in enhancing disease resistance in channel catfish.

Survival analysis of adult Brown Trout in flow-regulated Blue River using a mark-recapture method

Student

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The Blue River in Colorado was historically recognized for high trout production and designated a Gold Medal fishery by Colorado Parks and Wildlife. However, in 2016, a portion of the river was delisted following declines in trout populations attributed to habitat degradation and human development. This delisting suggests a potential trend of increasing ecological degradation, linked to altered flow regimes from high-elevation dams. This study examined seasonal variation in apparent survival of adult Brown Trout (*Salmo trutta*) and tested whether individual traits influenced survival in a regulated mountain stream. Using mark-recapture data within an open-population Cormack-Jolly-Seber framework, we analyzed seasonal survival patterns of adult Brown Trout from 2021-2025 in the lower Blue River below the Green Mountain reservoir. Trout (200-600 mm) were sampled each May and November annually using a tote-barge electrofishing unit and were uniquely marked with 12-mm passive integrated transponder (PIT) tags. Apparent survival of Brown Trout varied between summer and winter. Individual traits additionally showed season-dependent effects on survival. Body condition and length were strongly positively associated with overwinter survival, while body condition showed a negative association with summer survival. As alterations of the flow regime in mountain streams

intensify, incorporating season-specific survival dynamics into future flow management decisions may improve conservation outcomes and help sustain recreational fisheries.

An Evaluation of the Mechanisms Driving Dissolved Oxygen Downstream of the Klamath Dam Removal

Student

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As the world's largest dam removal began in the Klamath River in January 2024, fisheries managers were concerned that dissolved oxygen would fall below lethal levels during and after the drawdown of the associated reservoirs. The initiation of drawdown at the two farthest dams downstream, Copco II and Iron Gate Dams, resulted in a substantial amount of suspended sediment, rich with organic carbon from a century of cyanobacteria blooms, released downstream into the mainstem Klamath River. Multiple sediment pulses were accompanied by sags in dissolved oxygen to levels considered fatal to at-risk fish, such as Pacific salmon (*Oncorhynchus spp.*) and Green sturgeon (*Acipenser medirostris*), that are native to the Klamath River. The primary objectives of this study were to measure the magnitude and duration of dissolved oxygen sags during the dam removal, identify the mechanisms that contributed most to these sags, and assess whether these dynamics changed with distance downstream. Dissolved oxygen, streamflow, turbidity, water temperature, organic matter concentration, and biochemical oxygen demand were monitored for four months after initiation of drawdown at three sites downstream of the lowest dam. The study documented four dissolved oxygen sags during the drawdown process - two of which were to lethal levels. The temporal duration of dissolved oxygen impacts varied locally with reach scale geomorphology. Additionally, data from closed incubations suggest at least two distinct processes consuming dissolved oxygen at different time scales during the sediment pulses. These data provide important insights into mechanisms driving dissolved oxygen dynamics that can inform future river restoration efforts.

A combined genomics and modeling approach to understand the dynamics of Yellowstone Cutthroat trout hybridization within the Teton River Basin

Professional

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Hybridization with non-native species is a major threat to freshwater fishes where numerous species of conservation concern may spawn with invasive species. A better understanding of the factors influencing hybridization within rivers is therefore critical to evaluating the efficacy of conservation efforts. For example, connectivity restoration may have the unintended negative consequence of increasing hybridization rates between native and invasive species. Here we used SNP genotyping data to estimate existing hybridization proportions between Yellowstone Cutthroat trout (*Oncorhynchus virginalis bouvieri*) and non-native, Rainbow trout (*Oncorhynchus mykiss*) from the Teton River Basin. These empirically derived hybridization estimates then informed demographic-genetic individual-based models to evaluate how stream connectivity, mate preference, and selection interact to shape hybridization dynamics. Our empirical results identified 56 hybrids out of the total 444 fish in our dataset (12.6%); most of these appear to be backcrosses to Yellowstone Cutthroat trout or Rainbow trout and few were first or second generation hybrids (11 and 1, respectively). Proportions of hybrids also varied spatially across collection locations. Results of our individual based models indicate that both selection against hybrids and assortative mating are important for maintaining non-hybridized Yellowstone Cutthroat trout. Combined, selection and assortative mating had non-additive effects, and interacted strongly with connectivity of the stream network. The integrative approach of genetics

and modeling used here adds to our understanding the complexity of hybridization dynamics; this knowledge can contribute to improved conservation and management decisions.

Using An Interdisciplinary Approach to Understand Lamprey-People Relationships and Inform Lamprey Restoration in the Willamette River Basin, Oregon

Professional

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Pacific lamprey (*Entosphenus tridentatus*) fishing and consumption are essential community practices connecting Indigenous communities across time and space. Lamprey are also a key component of healthy river ecosystems in the Pacific Northwest. These people-lamprey relationships are affected by the disruption of Indigenous fisheries management, habitat degradation, and regional declines in lamprey populations since the 18th century. In the Willamette River Basin, Oregon, multiple river management and restoration efforts are directed at documenting, conserving, and restoring lamprey habitat and numbers. Though management and restoration draw upon a growing body of research and incorporate findings from cross-disciplinary work, these collaborative efforts lack long-term baseline data describing the interrelationships of people and lamprey that are essential to understand the deep historical context for contemporary practices and fisheries issues. This study informs lamprey restoration efforts in the Willamette River Basin by bringing hydrogeomorphic, archaeological, ethnographic, and historical data together with Indigenous knowledge. We are synthesizing records on lamprey harvest, distribution, and habitats with characterization of past hydrogeomorphic conditions across the landscape. The initial phase of this study will translate text-based lamprey-related oral histories and ethnographies into geospatial data. These data will be used alongside other hydrogeomorphic and ecological datasets to identify patterns of historical and precolonial lamprey use in the Willamette River Basin. The data and findings from this work will be used to identify knowledge gaps and outstanding questions, and will ultimately broaden understanding of lamprey habitats, distribution, and cultural-significance. This research will also inform short-term lamprey restoration efforts and longer-term conservation plans.

Delisting as a Management Transition, not an Endpoint

Professional

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Recovery under the Endangered Species Act is measured in decades. Of the 83 species delisted due to recovery, the average time from listing to delisting has been 33 years. When progress unfolds over decades, it is easy to view delisting as a final destination rather than a transition point in the long-term conservation and management of a species. This presentation examines delisting as a management transition through the lens of Oregon Coast Coho Salmon. We explore the distinctive biological and social attributes of Pacific salmon and highlight the novel public–private partnerships that have sustained a 28-year trajectory from listing toward recovery. Finally, we consider the management transitions, as well as the opportunities and challenges, that may emerge in a post-delisting context.

Machine Learning Reveals How Environment, Taxonomy, and Socioeconomics Predict Non-Imperilment in Global Freshwater Fishes

Professional

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Freshwater fishes are among the most threatened vertebrate groups, yet conservation assessments remain incomplete for many species. These fishes also support essential ecosystem services, including food security, recreation, and cultural values. Despite extensive human alteration of freshwater systems, the factors that determine species' vulnerability or resistance to imperilment remain poorly understood. We developed a machine learning framework to predict global imperilment status for 10,631 freshwater fish species using a comprehensive set of environmental, socioeconomic, and intrinsic biological predictors. Using updated IUCN Red List assessments, we trained and validated Random Forest classifiers to distinguish imperiled species (Vulnerable, Endangered, Critically Endangered) from non-imperiled species. We assessed the relative importance of 52 variables from 12 global data sources representing environmental conditions, human pressures, and species-specific traits. Model performance was higher for non-imperiled species (90.1% accuracy) than for imperiled species (81.8%), likely reflecting the greater heterogeneity of pathways leading to imperilment. Key predictors included habitat characteristics, taxonomic order, hydrological variables, and indicators of anthropogenic disturbance, underscoring the combined influence of ecological context, biogeography, and human activity. This integrative, reproducible approach demonstrates the utility of machine learning for proactive conservation planning and provides a scalable framework for global biodiversity risk assessment.

Complementary prey phenologies enhance invasional meltdown: shad and Siberian prawn fuel walleye in between pulses of salmon

Professional

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Recent research shows that predators benefit from phenological diversity in their prey resources, which prolongs foraging opportunity. Here we apply this concept to invasive species, by exploring whether introduced prey with unique resource phenologies benefit an introduced predator. In the Columbia River Basin, expanding populations of invasive walleye (Sander vitreus) pose a growing threat to imperiled native fishes, including ESA-listed salmonids (*Oncorhynchus* spp.) and Pacific lamprey (*Entosphenus tridentatus*). In addition to invasive piscivores such as walleye, invasive prey species such as American shad (*Alosa sapidissima*) and Siberian prawn (*Palaemon modestus*) have increased dramatically in recent decades. Indirect effects between invasive prey and native salmonids have not been robustly evaluated. Using year-round diet and stable isotope analysis, we quantified walleye trophic interactions with native and invasive prey in the lower Snake River, the largest tributary of the Columbia River. Walleye diets were dominated by Siberian prawn, American shad, salmonids, and lamprey with seasonal pulses in consumption driven by prey phenology. Stable isotopes revealed a cyclical shift in walleye tissue signatures, reflecting transitions among dominant prey over time. Both methods indicated that invasive prey species extended foraging opportunities and buffered seasonal gaps between native prey pulses, providing a novel example of the invasional meltdown hypothesis. These findings suggest that phenological complementarity among invasive and native prey may amplify predation pressure on native species and facilitate predator population growth. Our results underscore the importance of temporal dynamics and multi-species interactions in managing invasive predators and conserving native fish assemblages.

Hatchery-Driven Microbiome Structure as a Potential Contributor to Adult Salmon Enteritis and Pre-Spawn Mortality Risk

Professional

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Elucidating the mechanisms contributing to prespawn mortality (PSM) of adult Spring Chinook salmon is critical for mitigating the loss of genetic lineages and sustaining future recruitment. Although multiple biotic and abiotic drivers have been implicated in PSM, adult salmon enteritis (ASE)—a gut pathology repeatedly associated with elevated PSM in hatchery systems—has emerged as a consistent correlate of pre-spawn loss. The relationship of PSM with the gut microbiome has not been explored. Here, we asked: (1) Do hatcheries with a history of ASE exhibit distinct microbial community signatures? and (2) Within salmon suspected of having ASE, are particular microbial features associated with histopathological measures of gut integrity? To address these questions, we characterized the gut microbiome of spring Chinook salmon broodstock from six hatcheries, including facilities with and without reported ASE histories, using 16S rRNA gene sequencing. Preliminary analyses indicate substantial differences in microbiome composition among hatchery systems, with significant stratification based on ASE status. We show that markers of ASE severity are associated to overall microbial community structure and key microbial members. Interestingly, some taxa tend to be present in less severely or non-infected individuals which are lost during disease. Overall, these preliminary findings suggest that gut microbiome structure in adult Chinook salmon is strongly shaped by hatchery system and may be associated with pathological features of ASE. Future experimental manipulation will be necessary to understand if specific microbial taxa contribute directly to ASE pathological features. In addition, this analysis may identify candidate protective taxa associated with reduced disease severity. Such taxa could represent targets for microbial supplementation strategies in high-value broodstock populations, with the goal of mitigating disease progression and improving survival outcomes.

Transforming salmon population monitoring with computer-vision deep learning

Professional

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Monitoring the abundance of returning adult salmon and steelhead is foundational for the management of sustainable fisheries, and for guiding effective recovery actions. But traditional escapement monitoring approaches are labor intensive and costly, limiting their application across the diverse watersheds where salmon spawn, and creating risks to these vital ongoing programs when government budgets and priorities change. Computer-vision deep learning is transforming data analysis workflows across a diverse range of applications, and has potential to revolutionize how salmon populations are managed and monitored. Over the last 6 years the Salmon Vision collaborative, a US/Canada partnership between the Pacific Salmon Foundation, Wild Salmon Center, Simon Fraser University NetMedia Lab, and Lumax Ecological Analytics, has worked collaboratively with Indigenous Nations and resource management agencies to develop computer-vision tools for automated detection, tracking, and species classification across diverse monitoring technologies including RGB video recorded at weirs, sonar, and aerial drone surveys. In this talk we will share what we've learned, how these tools are currently being implemented, and identify opportunities for further integration of AI into salmon monitoring workflows around the North Pacific Rim.

Parr migrants use estuaries too: Chinook Salmon estuary growth and residence in an under-seeded system

Professional

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Tidal delta estuary habitats can provide benefits to juvenile salmon in terms of feeding opportunities, predation refuge, and osmoregulatory transition, but these benefits are distributed unevenly across species and life stages. Duration of estuary residence and growth rate in estuary habitats are two important metrics of estuary benefit conferred. It has been well established that some juvenile Chinook Salmon rear in estuaries for weeks to months. The life history observed expressing this temporal pattern has been fry migrants, typically entering the estuary <45 mm in fork length, in population proportions related to density dependent saturation of freshwater habitats. In large and well-seeded systems like the Skagit River in Puget Sound, it has been understood that parr migrants, which rear for more time in freshwater before undertaking seaward migration, do not spend appreciable time in tidal delta habitats. However, we observed parr migrant estuary rearing in an adjacent watershed estuary, the Stillaguamish River, which is far from fully seeded. We hypothesize that in the absence of early migrating fry, unused estuary habitats may be occupied by parr migrants, with the potential to confer additional growth and/or survival benefits related to estuary residence.

Integrating UAV and Ground Surveys to Monitor Redd Superimposition of Tule Fall Chinook in the White Salmon River, WA

Professional

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Interactions between hatchery-origin upriver bright (URB) fall Chinook and ESA-listed tule fall Chinook in the White Salmon River may reduce tule productivity through hybridization and redd superimposition. Tule salmon spawn earlier (Sept–Oct), making their redds vulnerable to URB superimposition later in fall. Initial surveys in 2022 found 71% of tule redds superimposed. To improve monitoring efficiency and accuracy, we integrated weekly ground surveys with UAV-based aerial imagery in 2023–2024. Weekly imagery was reviewed by multiple trained observers, while ground surveys mapped redd locations with high-accuracy GNSS tools to ensure spatial precision. Observer training and a review phase reduced misidentification of redds by 45% and improved precision, reducing variability among observers from 26% to 12%. Spatial agreement between methods was strong, with 66–77% of ground survey redd area overlapped by aerial delineations. Superimposition estimates varied by method (aerial: 31–88%; ground: 97%), but a combined approach yielded results similar to ground surveys (91%). By improving monitoring methods for assessing hatchery impacts on natural populations, this study advances effectiveness monitoring and offers new perspectives on how technology can enhance evaluations of biological outcomes critical to salmon recovery and hatchery management. Our approach provides transferable methods for other salmon populations and programs, supporting regional efforts to improve monitoring.

Distribution and Apparent Survival of Radio-tagged Juvenile Lost River and Shortnose Suckers in Upper Klamath Lake (2022–2025)

Professional

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A lack of juvenile recruitment of endangered Lost River Sucker *Deltistes luxatus* and Shortnose Sucker *Chasmistes brevirostris* into spawning populations in Upper Klamath Lake (UKL) is increasing the risk of extinction. To bolster recruitment, juvenile suckers have been reared at Klamath Falls National Fish Hatchery and released into UKL since 2018. The movement, distribution, and post-release survival of hatchery-reared juvenile suckers, however, was largely unknown. To address these uncertainties, radio telemetry and passive integrated transponder (PIT) tags were implanted in 910 juvenile hatchery suckers during 2022–2023 to monitor fish behavior and apparent survival following release. Tagged suckers were released at different locations, time periods (spring, fall), and sizes. Results indicated that suckers utilized multiple lake areas or partitions following release, with fish broadly distributed across different habitat types. Estimated, minimum apparent survival varied considerably within and across release groups, ranging from 15.3% to 54.5% at 30 days post release and from 0% to 16.4% at 360 days post release. There was some evidence that larger-sized suckers (> 300 mm, total length) had the highest apparent survival at 180 days post-release, had the broadest spatial distribution, and were the most likely to be observed at spawning sites. Due to a lack of sufficient replication, however, uncertainties remain regarding the degree to which release location and timing influenced fish behavior and apparent survival. Efforts to increase acclimation times of hatchery fish prior to release to reduce mortality during the first 30 days, to release suckers at larger sizes during the fall/winter, and to release suckers in central Upper Klamath Lake may increase survival and warrant additional research.

Rapid Gender Delineation of Salmonids using CRISPR/Cas12a & LAMP Techniques

Professional

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In recent years, there has been an emerging need for rapid genetic analysis in fisheries management in North America. One of the many bottlenecks that prolong conservation & management-based decisions is the timeline that it takes to receive results & answers from genetic samples collected the previous sampling season, largely due to the limited number of laboratories capable of processing DNA & the large number of groups who rely on them. To accurately identify specific genetic traits, traditional genetic analysis methods involve collecting a biological sample from the individual in question, and having it processed by a lab that specializes in DNA analysis. Often times, these labs are contracted by multiple agencies, and as a result, the time to receive processed results can vary, delaying critical management decisions. To address this challenge, we are developing CRISPR/Cas12a and LAMP-based rapid DNA detection technology to delineate gender of individual Salmonids by using gender-specific genetic markers. Genetic samples of *Oncorhynchus* and *Salvelinus* individuals were collected or donated by groups located in Washington, Oregon, & Idaho, and are being used to optimize reliable streamside genetic assays to enable real-time management decisions. By reducing processing time, our CRISPR & LAMP-based gender delineation approach could offer managers a powerful tool to directly address and rapidly manage evolving Salmonid populations, while also offering an alternative for groups who are interested in rapid genetic analyses of samples.

Streamlining Data Flow Across Programs with Differing Priorities: The Role of Communication and Collaboration in the Search for Solutions

Professional

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Monitoring and evaluation (M&E) programs perform a critical role in assessing hatchery operations and post-release fish performance to inform adaptive management and improve production outcomes. Given differing objectives and priorities between hatchery and M&E programs, data collection and workflows often evolve independently, resulting in siloed data systems, inconsistent formats, fragmented data flow, and duplicated effort. In northeast Oregon, we collaborated with hatchery partners to improve data integration from field collection through storage, access, and reporting while respecting differences in program goals, resources, and technical expertise. Working jointly with hatchery staff, our M&E team implemented electronic data collection using Survey123 and the Fish Inventory System (FINS) online application to streamline data entry and route information into a centralized location. To reduce barriers to data access and improve data sharing among partners, we developed an automated workflow using GitHub Actions to query the centralized database via API and deliver updated data to an R Shiny application. This online dashboard supports real-time hatchery management decisions and generates summaries required for submission to the state-mandated Hatchery Management System (HMS) database. Our approach demonstrates how intentional collaboration, shared infrastructure, and automated data pipelines can increase efficiency, improve data quality, and strengthen cross-program partnerships.

Tribal Led Ecological Stewardship in the Lower Klamath River

Professional

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The Yurok Tribe is the largest tribe in California. Ancestral Territory includes several north coast watersheds with the Lower Klamath River Sub-basin at its heart. The river is the life blood of the Yurok and they hold sacred their role as stewards and protectors of the land & water. The Klamath River is currently experiencing unprecedented revitalization following the recent removal of four mainstem hydroelectric dams. Simultaneously, the Yurok Tribe re-acquired nearly 50,000 acres of their homelands within the Lower Klamath River. This was one of the largest indigenous land back initiatives in California to date. Included in this re-acquisition is lower Blue Creek which the Yurok Tribe has designated as a Salmon Sanctuary. Blue Creek is the largest Lower Klamath tributary and is of significant cultural and biological importance. Blue Creek Sanctuary goals focus on 1) enhancing water quality and climate resiliency; 2) greatly improving conditions for native fish and wildlife; 3) promoting healthy late seral forests; 4) re-establishing vital prairies and oak woodlands; & 5) strengthening Yurok culture and sustainability by revitalizing traditional lifeways such as tending to the health of the land and water. In the Lower Klamath, Yurok Fisheries (YTFD) and our partner Fiori GeoSciences (FGS) are implementing innovative & effective, process-based restoration which includes complementary use of constructed log jams, creation of off-channel wetlands and other floodplain enhancements, bioengineering, and installation/stewardship of beaver dam analogues. With the return of lower Blue Creek to tribal ownership, the Yurok Natural Resources Departments are beginning to initiate ridge to valley floor scale restoration. In 2024, YTFD and FGS initiated comprehensive fisheries habitat enhancement within the lower two miles of Blue Creek. This work is being conducted in synergy & partnership with Yurok led prairie restoration occurring in the uplands of the Salmon Sanctuary.

Fishing for Answers: Investigating Smallmouth Bass Predation on Juvenile Chinook Salmon in the Okanagan Basin

Student

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Chinook Salmon (*Oncorhynchus tshawytscha*), a species of cultural and ecological importance, are critically endangered in the Okanagan River, where they represent the only remaining Canadian population within the Columbia River Basin. Escapement estimates since 2001 have consistently shown low returns, raising concerns about the factors driving their decline. In the Okanagan Basin, invasive Smallmouth Bass (*Micropterus dolomieu*) overlaps spatially and temporally with juvenile salmon during downstream migration, yet drivers of predation risk remain poorly quantified. During the 2024 field season, 197 Smallmouth Bass were collected from the Okanagan River, Vaseux Lake, and Osoyoos Lake. Diet composition was characterized using visual stomach content analysis and DNA metabarcoding. Of the180 non-empty stomachs, salmon were detected in 75 (42%). Salmon detections were more concentrated in riverine habitats (53 of 75 stomachs) and varied among habitat reaches, with the highest frequencies observed near hydraulic structures, such as low-head weirs and dams. The probability of salmon occurrence declined over the sampling period, indicating elevated predation risk during early migration. These findings demonstrate that predation risk to juvenile Chinook may be structured by both habitat and seasonal timing rather than occurring uniformly across the basin. Identifying predation hotspots and high-risk periods provides actionable insights for management aimed at improving juvenile salmon survival in the Okanagan Basin.

Evolution of a Long-term Collaborative Bull Trout Monitoring Study

Professional

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Bull Trout (*Salvelinus confluentus*) redd count surveys in the Metolius River basin began in 1986 as a collaborative effort among Portland General Electric (PGE), Oregon Department of Fish and Wildlife (ODFW), US Fish and Wildlife Service, US Forest Service, and The Confederated Tribes of the Warm Springs Reservation of Oregon. Redd count Surveys are conducted annually to evaluate spawning activity and population trends. since initiation, redd counts have increased substantially, from a low of 27 redds in 1986 to a five-year average of 981 redds in the most recent five-year period. to better understand spatial distribution patterns and interannual variation within survey reaches, partners implemented using ArcGIS Field Maps to collect data. PGE facilitated this transition by creating digital field forms, working with partners to determine field settings, conditional logic, and beta testing and by developing and maintaining the data infrastructure in a centralized geodatabase, ODFW serves as the lead agency and receives finalized datasets for distribution. During the transition to digital collection, inconsistencies were identified. Standardization was implemented to address the inconsistencies and improved consistency and interannual comparability. PGE developed an interactive Experience Builder application that allows users to view and request survey data. This collaborative modernization demonstrates how coordinated data management and digital data standardization can improve and modernize long-term aquatic monitoring programs.

Juvenile steelhead abundance and production increased when wood is added to headwater streams in the Blue Mountains, WA using process-based principles

Professional

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Natural wood regimes have been significantly altered across North America due to historic removal of beaver dams and development of riparian areas. The consequences of altered wood regimes have led to simplified, straightened, incised stream channels that are disconnected from their floodplains. The is a long history of using wood to restore streams to benefit fish; however, few studies have demonstrated increases in fish abundance and production beyond

reach-scales. Using process-based principles to implement restoration has been suggested to increase restoration effectiveness. We developed a low-tech process-based approach to adding wood to wadeable streams, and tested its effectiveness at increasing juvenile steelhead production using an Intensively Monitored Watershed experiment. Our study area was the lower 12 km of three headwater tributaries to Asotin Creek, WA. Each creek had three 4 km long sections with one treatment and two control sections. We added almost 700 wood structures over 14 km and conducted maintenance that resulted in almost twice as much wood being added to the initial treatment. We used two-day mark-recapture surveys to PIT tag juvenile steelhead and estimate abundance (fish/km), growth (g), survival, biomass (g/km), production (g/km/year), and emigrates (smolts/female) for 17 years (5 pre-treatment and 12 post-treatment years). We found significant increases ($p < 0.1$) in abundance, biomass, production, and productivity in treatment sections compared to controls. These responses were modest (~30-60% increases), varied between streams and seasons, and increased over the first 5-10 years, but then started to decrease after a watershed-scale fire and increased high intensity flooding. This study provides clear evidence that juvenile production can be increased with wood additons but cautions that significant maintenance and time is required to restore sustainable healthy streams and fish productivity.

Stepwise Stock Assessment for Lingcod in Prince William Sound, Alaska

Student

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Lingcod (*Ophiodon elongatus*) in Prince William Sound, Alaska, support commercial and recreational fisheries, yet a formal stock assessment has not been implemented to guide policy. Development of an assessment framework is constrained by the absence of reliable abundance indices, requiring evaluation of how catch, length, and age data inform population dynamics. In this talk, we describe a stepwise modeling workflow using the Stock Synthesis 3 (SS3) framework within the Stock Assessment Continuum (SAC) Tool to identify stable base model configurations, evaluate data informativity, and establish a foundation for sensitivity analyses. Model development followed a complexity gradient, progressing from length-only formulations to inclusion of catch data and conditional age-at-length (CAAL) data derived from paired samples. Particular attention is given to recruitment dynamics and confounding among growth, selectivity, and natural mortality in the absence of an independent biomass signal. Model performance is evaluated using convergence diagnostics, parameter uncertainty, and retrospective patterns. We examine sensitivity to key biological assumptions by evaluating alternative values of natural mortality (M), recruitment variability (σR), and steepness, and assess how these influence spawning biomass, depletion, and reference points across model configurations. These comparisons identify which data configurations dampen or amplify uncertainty under parameter perturbation. We hypothesize that incremental integration of catch and CAAL data will improve parameter estimability, reduce growth–selectivity confounding, and increase robustness to recruitment and mortality assumptions relative to length-only models. Establishing a transparent base model under restricted data conditions supports management by clarifying structural uncertainty and inference strength for guiding harvest strategies in nearshore groundfish systems lacking abundance indices.

Relative reproductive success in two species and two basins in NE Oregon—marching to their own drum beat

Professional

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Spring Chinook and steelhead populations in NE Oregon were listed as Threatened under the Endangered Species Act in 1992 after experiencing severe population declines. Supplementation programs were initiated in the Grande Ronde and Imnaha Basins, designed to increase the number of adults returning to spawn in nature. We generated 1-2 decades of relative reproductive success (RRS) results of hatchery-reared fish compared to their natural-origin counterparts in each of three systems, over the years spanning 2000-2022: Chinook in Catherine Creek and Lostine River, and steelhead in Little Sheep Creek. We noted similar patterns as well as substantial differences in RRS between species and streams. While hatchery-origin steelhead in Little Sheep Creek exhibited nearly universally significantly lower reproductive success (RS) compared to natural-origin, much larger variation in RS was evident in the Chinook systems. The lowered RS of hatchery steelhead was equally evident in juvenile offspring as in adult offspring, though in the Chinook systems RS varied year-to-year when measured using juvenile vs. adult offspring. In all three systems, RS was influenced positively with increase in fork length. Particularly in the Chinook systems, year-to-year variability was the single largest source of variation in RS, though was also evident in the steelhead stream. Origin, time of return, and competition correlated to RRS in varying ways. While multiple prior studies have provided examples of hatchery-origin Chinook and steelhead experiencing diminished RRS compared to their natural-origin counterparts, consistent with our findings in Little Sheep Creek, we estimated nearly equal RRS in some years in Catherine Creek and Lostine Rivers Chinook. Our data have shown that even systems that are geographically very close can exhibit significant differences in RRS. The key is to identify which factors play the greatest roles in each species and system.

Glacial Legacy and Fraser Basin Origins of Upper Skagit River Bull Trout

Professional

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The Skagit River watershed of Washington and British Columbia is a stronghold Bull Trout (*Salvelinus confluentus*) and reflects repeated Pleistocene drainage reorganizations. The upper Skagit drained north to the Fraser River and connected to the upper Columbia via the Similkameen, while the lower Skagit drained west to Puget Sound below Skagit Gorge. We analyzed 158 single nucleotide polymorphisms in 2,615 samples from 46 collections to estimate genetic diversity and population structure in upper and lower Skagit populations. Collections spanned the coastal and interior evolutionary lineages and included samples from the Fraser and lower and upper Columbia basins. Upper Skagit populations exhibited less than half the heterozygosity observed elsewhere and showed extensive hybridization with Dolly Varden (*S. malma*). A neighbor-joining tree based on Cavalli-Sforza chord distance grouped upper Skagit populations with Fraser populations rather than with lower Skagit or Columbia populations. These results support postglacial colonization from the Fraser basin and highlight the role of glacial history in shaping contemporary population structure, with implications for conservation in transboundary watersheds.

Quantifying Smallmouth Bass Predation on Juvenile Steelhead Using Reach-Scale Bioenergetics Modeling

Professional

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Expanding populations of nonnative predators pose growing risks to native salmonids in the Columbia River Basin. In parts of the John Day River Basin, seasonal environmental conditions

create spatial overlap between smallmouth bass (*Micropterus dolomieu*) and wild summer steelhead (*Oncorhynchus mykiss*) during critical rearing periods, yet predation risk in these tributaries remains poorly quantified. We used field data on water temperature, diet composition, growth, and seasonal entry and residency patterns of bass to develop bioenergetics-based estimates of bass predation on steelhead in Thirtymile Creek, a steelhead producing tributary of the lower mainstem John Day River. Smallmouth bass were sampled via electrofishing and hook-and-line from March through August in 2023 and 2024 across the full extent of surface flow where bass and juvenile steelhead co-occur. Stomach contents were identified to major prey groups, with macroinvertebrates classified to Order and converted to energetic content using order-specific length–mass and energy density relationships. Partially digested steelhead were reconstructed using contemporaneous length–weight relationships to estimate prey biomass prior to energetic conversion. Daily water temperature records were incorporated into bioenergetics simulations spanning the observed seasonal overlap period, and empirical recapture growth data were used to parameterize growth distributions for population-level simulations. Consumption estimates were generated by bass size class and scaled to estimated bass abundance within the hydrologically connected surface-flow reach using capture efficiency derived from block-net mark–recapture events. Model outputs quantify cumulative juvenile steelhead biomass consumed during seasonal overlap, offering a quantitative framework for assessing predation risk and guiding population modeling and management decisions.

There and Back Again: Managing Fisheries through Historic Floods and Droughts in south-central Montana

Professional

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Burbot *Lota lota* are experiencing population declines throughout their native distribution. In Montana, Burbot are native to the Columbia and Missouri river basins and despite being a popular game fish, little is known about their status. Since 2012, Montana Fish, Wildlife & Parks have been sampling for Burbot in the Yellowstone River annually using baited 13-mm bar mesh hoop nets to better understand their distribution, relative abundance, and population dynamics. Results from standardized long-term monitoring efforts coupled with age and growth analyses will help guide management decisions for Burbot in the Yellowstone River.

Salmon Recovery in a Hydroelectric System: The Baker Project's Emerging Successes

Professional

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Historically, the construction of two hydroelectric dams: 285-foot Lower Baker dam (1926), and 312-foot Upper Baker dam (1959) impounded deep draft reservoirs, changing the landscape of the Baker River basin in NW Washington State. Early mitigation efforts to raise and pass native salmon throughout the system were largely ineffective, resulting in a return of only 99 adult Sockeye in 1985. Collaborative development of a comprehensive settlement agreement during the 1999 – 2008 dam re-licensing process provided the impetus for Puget Sound Energy's investment of substantial capital and effort into developing a robust fisheries program, targeting recovery of this regionally significant Sockeye stock, and resulting in multiple recent record-setting years for Sockeye production, out-migration, and adult returns. Infrastructure now includes two modern floating surface collectors to safely pass juvenile fish downstream, a new hatchery dedicated to propagation of Sockeye and Coho, man-made gravel beaches that mimic

preferred natural spawning habitat for Sockeye, and a renovated fish trap to capture and transport returning adults. Population monitoring for juvenile recruitment and in-reservoir growth, connectivity between reservoirs for ESA-listed Bull Trout, gravel retention in the Skagit River downstream of the project, shoreline erosion monitoring, and funding for habitat enhancement are additional focal components of the program. In 2025, 11.69 million Sockeye were produced at the hatchery, nearly 1.5 million smolts emigrated from the reservoirs, and nearly 92,000 adults returned to the Skagit and Baker Rivers, renewing harvest opportunities for local tribes and recreational anglers, and revitalizing the aquatic ecosystem.

Building Foundations to Inform Management of Salmon and Steelhead Populations: ODFW's Data Flow and Tools

Professional

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The Oregon Department of Fish and Wildlife (ODFW) invests heavily in salmon and steelhead monitoring, collecting thousands of data points annually across Oregon to support ESA compliance, recovery planning, and statewide fisheries management and science needs. While data collection is robust, the challenge has been transforming disparate datasets into transparent, standardized information that decision-makers can easily use. Since 2010, ODFW has been an invested partner in the Coordinated Assessments Partnership (CAP)—a Columbia Basin-wide collaboration hosted by PSMFC, StreamNet, and PNAMP—to define indicators, document methods, and streamline data exchange for salmon and steelhead data. A key outcome of this effort is the Coordinated Assessments Data Exchange (CAX), which provides public access to high-level indicator data for salmon and steelhead, including 91 ODFW-managed populations spanning 75 years. These same datasets feed ODFW's Salmon and Steelhead Recovery Tracker, enabling a "one dataset, many displays" approach that supports NOAA status reviews, BPA reporting, regional recovery dashboards, and internal ODFW data reporting and displays. This presentation highlights ODFW's data flow of population level natural origin salmon and steelhead data from field collection to web-based tools, rigorous QA/QC processes, and emerging priorities such as hatchery data exchange, automated workflows, and modern visualization tools. Lessons learned underscore the importance of sustained coordination, clear documentation, and adaptive systems to ensure monitoring investments translate into informed management decisions.

Fish in a Working Prairie: Agricultural, Infrastructure, and Minnows in Big Coulee Creek, Montana

Professional

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Human population growth, drought conditions, road crossings, and agricultural land-use practices have altered the habitat complexity of many prairie streams across Montana. As such, prairie fishes are at high risk of homogenization and decline. Big Coulee Creek in central Montana, was once a stronghold for populations of Northern Redbelly Dace *Chrosomus eos*, a Montana Species of Special Concern. However, a lack of habitat connectivity and water availability has likely reduced their distribution and abundance. For example, in 2025, we encountered Northern Redbelly Dace just downstream of perched culvert but have not found these species at a site just 3.3 km upstream for the past three sampling seasons. Though we suspect the lack of connectivity due to road crossings is a primary threat for many small-bodied fish species in Big Coulee Creek, these relationships are complex and depend on many

physical and biological variables that are not easily generalized across spatial scales. Thus, we have implemented a monitoring program to assess both the prairie fish assemblages and the available habitat at both fine-scale and watershed-scale resolutions. Through these efforts, we will be better able to describe the relationships among habitat availability and quality, species diversity, and population dynamics in these highly stochastic, yet resilient, prairie ecosystems.

Integrating multi-method monitoring to characterize seasonal dynamics of green sturgeon (*Acipenser medirostris*) in Humboldt County, California

Student

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Green sturgeon (*Acipenser medirostris*) are a long-lived, anadromous species that spawn in large West Coast North American rivers but range widely in the coastal ocean. For coastal California Native American Tribes, green sturgeon are vital to cultural heritage and food security. Two genetically distinct population segments (DPS) are recognized: a southern DPS listed as threatened under the Endangered Species Act, and a northern DPS considered of "conservation concern." Although green sturgeon are known to use large estuaries and bays during summer months, little is known about their seasonal behavior and spatial distribution in Humboldt County, California—a region undergoing rapid ecological change due to aquaculture and planned on- and offshore wind development. Acoustic telemetry, drone and visual surveys, community outreach, and pop-up satellite archival tags were used to record seasonal presence, distribution, and movement patterns of adult green sturgeon from both populations within Humboldt Bay (Wigi), the Mad River (Baduwa't), and the Eel River (Wiya't). Monitoring occurred for a 4-month period (Aug - Dec) in 2024 and a 9-month period in 2025 (May - Dec), detecting 24 acoustically tagged green sturgeon. Although no acoustically tagged fish were detected in the Mad or Eel Rivers, visual observations indicate interannual variation in presence and spatial distribution. Green sturgeon frequently breach, providing a quantifiable index of presence. A total of 1,193 breaching events were documented exclusively in North Humboldt Bay, with breaching probability peaking in July and closely aligning with acoustic detections. This project is part of the Northern California Tribal Fisheries Collaborative, a partnership between Tribal, university, state, and federal personnel, and advances understanding of green sturgeon ecology and monitoring capabilities. It will also inform stewardship of Tribal and state natural resources amid habitat alteration and climate change.

Charting the Path: How the U.S. Fish and Wildlife Service Evaluates and Pursues Delistings Under the Endangered Species Act

Professional

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The Endangered Species Act (ESA) remains one of the nation's most powerful conservation tools, yet the process of removing species from its protections is often less widely understood than the process of listing them. This presentation provides a clear, practitioner-level overview of the ESA framework with a focus on delisting decisions. Drawing from my work on the U.S. Fish and Wildlife Service's Species Assessment Team, I outline how we evaluate species' biological status, apply statutory and regulatory standards, incorporate the best available science, and coordinate across programs and partners to determine whether a species has recovered sufficiently to warrant delisting. The talk will walk through each step of the delisting pathway, from status assessment and peer review to proposed rulemaking. By demystifying how delistings occur, this presentation aims to support practitioners, partners, and the broader

conservation community in understanding the delisting process and how science informs decisions at every stage.

Shared Visions, Shared Resources, Distinct Authorities: Tribal, State, and Federal Approaches to Native Fish Restoration

Professional

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Recognizing that native fish resources do not distinguish between the geopolitical boundaries they cross, the challenges of restoring native fishes to healthy and abundant levels is and should always be a coordinated and collaborative effort. As tribes, states, and federal agencies pursue shared restoration objectives for native fish in the Columbia River Basin, several collaborative initiatives exemplify this approach. These include the Columbia Basin Partnership Task Force which established basin wide vision and goals for thriving salmon and steelhead populations; the Walla Walla 2050 Strategy which focused on integrated water solutions for fish, farms, and families in the Walla Walla Basin; the Columbia Basin Collaborative which continues building on prior task force work to advance data-driven, integrated efforts; and the Six Sovereigns initiative, a partnership among the states of Washington and Oregon and four Columbia Basin Treaty Tribes—the Yakama Nation, Confederated Tribes of the Umatilla Indian Reservation, Confederated Tribes of the Warm Springs Reservation, and Nez Perce Tribe—driving the Columbia Basin Restoration Initiative to recover healthy and abundant salmon, steelhead, and other native fish while honoring tribal treaty rights and supporting regional resilience. These efforts balance benefits for the diverse constituents of each sovereign entity—such as cultural, economic, ecological, and harvest opportunities—with the overarching need to enhance fish population resiliency through habitat protection, policy alignment, adaptive management, and coordinated actions across jurisdictional boundaries.

A Salmon Ecosystem Conceptual Foundation for Estuary Restoration

Professional

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A cohesive recovery strategy for Pacific salmon populations requires a shared conceptual foundation to coordinate management actions across jurisdictions and interests. We evaluated an estuary restoration program as a case study of a “life history ecosystem” conceptual foundation proposed for Columbia River salmon conservation in 1999. Project selection criteria for the Columbia Estuary Ecosystem Restoration Program have evolved to evaluate the potential salmon benefits at site, landscape, and estuary scales. However, the program lacks an explicit conceptual foundation to account for cross-scale connections to other salmon life stages, life histories, and environments. We propose the following conceptual foundation, composed of three guiding principles, to place estuary restoration in a life history ecosystem framework: (1) the estuary is a subsystem of a complex natural-cultural system connected by salmon life cycles; (2) a dynamic mosaic of estuarine habitats supports the growth, ontogenetic development, and life history variations of salmon throughout the basin; (3) ecological processes and management actions beyond the estuary limit habitat opportunities and salmon life history expression within it. To validate the proposed conceptual foundation, we recommend additional performance measures to coordinate upriver water management actions with estuary restoration objectives, reduce hatchery risks to naturally produced juveniles, track estuary

contributions to adult salmon populations, and adapt estuary restoration actions in a changing climate.

Getting in the game with non-game: Idaho's Native non-game fish program

Professional

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There are twenty-eight documented native non-game fish species found in Idaho. While these species are well represented numerically, they are often underrepresented from the standpoints of staff and financial investment within the program portfolios of state, federal, and tribal fisheries agencies. Emphasis of many fisheries programs is rightfully focused on gamefish species which are significant cultural and economic drivers behind program prioritization. However, neglect of native non-game fish species can have unintended negative impacts on ecosystems, gamefish populations and associated fisheries, as well as risk of additional regulatory burden on agency programs. Historically, the Idaho Department of Fish and Game placed little emphasis on native non-game fish within its overall portfolio, mostly due to the lack of dedicated funding streams. However, a specialty license plate can fix a lot of ills. The department has increased the funding base and personnel support of its Native Non-Game Fish Program over the past few years. This presentation will highlight the mechanisms which facilitated expansion of the program, emphasize the ecological importance of these species, highlight initial accomplishments of the program, and present a path for the future. We are excited to continue to build the program and engage with other agency partners to increase understanding and conservation of native nongame fishes in Idaho.

I Like the Way You Move: Using Fine-Scale Telemetry Data to Determine Utilization Area of Spawning Habitat by Adult White Sturgeon in the John Day Reservoir, Columbia River

Professional

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White Sturgeon (*Acipenser transmontanus*) inhabit major river systems in Western North America, moving through the Pacific Ocean to occupy various systems. They are slow growing, long-lived, and late maturing fish. White Sturgeon historically spawn downstream of waterfalls, in fast, cool water over complex substrates. The implementation of hydropower dams in the Columbia River have disrupted that natural spawning habitat and activities of White Sturgeon in this system, limiting individuals to spawning habitat downstream of the dams and powerhouses. Detection data from a dense array of sixteen Innovasea VR2AR receivers in the McNary tailrace in 2023 and 2024, was used to generate location estimates based on correlated random walk (CRW) in a state space model. Movements were extrapolated with a joint movement persistence model and paired with Kernel Utilization Density (KUD) analysis to quantify individual space use. Home and core range areas were calculated, and sex-specific and spatio-temporal interactions were analyzed with overlap matrices. These results highlighted a difference in habitat use by sex between the spawning and non-spawning periods. It also showed that males and females had different core utilization areas but overlapped for 0.16 km2 during the spawning period. The results provide areas of potential interest to further address habitat complexity, fine-scale space use, and recruitment to further study spawning, foraging, and refuge-seeking behaviors in order to continue the conservation of White Sturgeon.

Advancing adaptive decision-making through an Environmental Water Manager (EWM) role to enhance the ecological resilience of Western U.S. river systems

Professional

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Despite years of focused conservation efforts, Western U.S. river systems have faced precipitous declines in freshwater species. To reverse this trend, recent research and real-world practice have advocated for ecological flow management approaches that operate at the watershed scale and treat ecological health on equal footing with other system objectives. The complex adaptive decision-making and knowledge requirements needed for these system-level approaches to succeed motivates the need for careful implementation by a manager with the institutional authority and agency that are responsive to evolving conditions. More formally, the concept of an Environmental Water Manager (EWM) has been proposed as a mechanism to ensure that water budgets allocated to the environment are employed to enhance ecological resilience while navigating other competing water use objectives. Effective allocation decisions require the EWM to utilize information across multiple timescales (past, present, short-to-long term future) and integrate it into environmental release decisions that best meet ecological water quantity, quality, and timing targets that are balanced with other system requirements. In this work, we explore this EWM challenge through a modeling framework that captures the state-aware, multi-timescale, and multi-objective aspects of the problem. We develop a coupled systems and temperature modeling framework that allows us to support adaptive EWM decision-making using realistic information sources, including long-range (365-day) hydrologic ensemble forecasts and stream temperature state information. Our results clarify the important tradeoffs that emerge in environmental flow decision-making across timescales, show the value of different information sources and the impacts of their uncertainty, and illustrate the potential for EWM adaptive decision making to promote ecological resilience.

Benefits of a Versatile Tribal In-House Data Capture, Management, Reporting System

Professional

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Implementing hundreds of projects across 14 Columbia River Subbasins and 13 million acres of Treaty territory, Yakama Nation Fisheries (YNF) is comprehensively restoring species and the habitats upon which they rely. In order to adaptively manage project implementation, monitor recovery successes and meet reporting obligations, enormous amounts of data are collected. To be most effective and efficient in supporting these requirements, YNF has developed an affordable component-based system to modernize data collection, processing, and sharing throughout the program. Iteratively developed, expanding as resources allow, we have been able to demonstrate our flexible information management system to be effective at meeting our priority goals to migrate legacy process, make real-time data remotely available, enabling efficient regional sharing and reporting, while retaining in-house ownership, management and control. Benefits include immediate data review and validation, tools for QA/QC and standardization across projects, improved efficiency of staff time, elimination of versioning, and enabling real-time decision making through automated summary report outputs. Our system has been implemented for a variety of projects based on priority and ability to adopt, including numerous production, habitat restoration, and M&E projects. Components of the system include, but are not limited to, the use of ESRI's Survey123 field forms, SQL Server Reports,

API connections, credentialed-access web-based dashboards, and real-time visualization tools. The system is flexible to incorporate other tools and processes to accommodate variations in specific projects as needed. During our talk, we will give an overview of our component-based, flexible system, and provide some updates and real-world examples of implementation successes, outcomes and lessons-learned as we continue to adapt our system to meet emerging needs.

Supporting downstream migration of smolts with a flow velocity enhancement system

Professional

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Juvenile salmon and steelhead rely on the natural turbidity of rivers during periods of outmigration. This behavior, a key piece of evolutionary history across anadromous salmonid species (*Oncorhynchus* spp.), is challenged by regulatory practices throughout the Pacific Northwest and beyond. Physical barriers and diversion infrastructure (e.g., hydropower, irrigation) create hazardous conditions by dampening migratory cues and incidentally attracting migrants. In the Cowlitz River (Washington), we installed a venturi hydraulic system to enhance velocity and turbulence within the current and mimic natural flow regimes. Chinook salmon (Oncorhynchus tshawytscha) smolts were tagged with acoustic tracking devices and subsequently monitored in a two-dimensional hydrophone grid. Statistical analyses were performed on the individual locations of fish relative to the artificial plume. Findings from both natural and radio-tagged smolts suggested that the Flow Velocity Enhancement System (FVES) can successfully provide guidance to anadromous fish. Paired with previously conducted physical studies, these results indicate that innovative methods like the FVES are valuable for future management of migrating smolts. Additionally, the system provided ulterior benefits such as clearance of floating debris.

From Smolts to Adults: Progress and Adaptation in the Deschutes Basin Reintroduction Program

Professional

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More than fifteen years have passed since the first spring Chinook smolt was captured at the Selective Water Withdrawal facility on Lake Billy Chinook and transported around the Pelton Round Butte Hydroelectric Project to begin its journey toward the Pacific. Since then, the reintroduction effort above the Project has been a story of persistence, adaptation and hard-earned progress. Through an adaptive management approach, the co-licensees, Portland General Electric and the Confederated Tribes of Warm Springs Reservation of Oregon, along with other basin partners, have steadily refined strategies to move closer to the long-term goal: establishing sustainable, harvestable runs of salmon and steelhead in the upper Deschutes Basin. Over the past six years in particular, several key program changes-including transitioning to smolt acclimation, releasing excess hatchery adults above the dam, and installing a lead net-have contributed to increased adult Chinook and steelhead returns. This presentation will highlight these recent actions, the lessons learned along the way, and how these strategies may inform similar reintroduction and passage programs across the region.

Environmental and Fish-Specific Drivers of Juvenile Chinook Salmon Migration Rates and Ocean Arrival Timing in the Klamath River

Professional

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Juvenile salmon migration reflects an evolved life-history strategy that balances the energetic costs and mortality risks of movement against the benefits of reaching marine habitats, where growth potential is often greater. Faster migration rates are associated with higher in-river survival; however, rapid downstream movement may limit growth opportunities, and smaller body size at ocean entry is linked to reduced early marine survival. Ocean arrival timing also matters. Smolts that arrive before the onset of spring transition, when upwelling increases productivity and prey availability, are less likely to survive than those arriving afterward. Together, these interacting processes shape populations. To evaluate how environmental and fish-specific factors influence migration rates and population dynamics, USGS along with the Hoopa, Yurok, and Karuk Tribes conducted an acoustic telemetry study from 2022–2024 in the Klamath River. Generalized linear models with AIC-based selection identified water temperature, pool habitat proportion, fish length, and cold-water tributary density as key predictors of movement. Using estimated parameters and rotary screw trap data, we simulated migration rates and ocean arrival timing for four tributary populations. We found strong effects of water temperature and fish size and weaker effects of the proportion of pool habitat and the density of cold-water tributaries on migration rate. Migration initiation timing and tributary distance from the ocean most strongly influenced ocean arrival timing. Increases in temperature and fish size over each migration season compressed ocean arrival distributions relative to the distribution of migration initiation. The proportion of fish to arrive prior to spring transition varied among populations and years.

Building a Long-Term Record of Oregon's Freshwater Fishes

Professional

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The Oregon State University Ichthyology Collection (OSIC) is coordinating a statewide effort to document Oregon's freshwater fish biodiversity and rebuild a specimen backed baseline for long term monitoring. In many Oregon rivers and streams, we either lack modern baseline surveys or the most comparable sampling occurred >50 years ago, limiting our ability to evaluate current distributions, community turnover, and changes in biodiversity as land use and river conditions continue to shift. We are implementing a standardized, specimen-based workflow that pairs voucher collections with high-quality photographs, tissue samples for genetic analyses, and consistent habitat measurements at each site. These materials create a permanent record of species occurrences, genetics, and environmental context that can be revisited and reanalyzed as new questions and analytical tools emerge. To prioritize effort, we compiled and georeferenced historical and recent occurrence records and summarized survey coverage across Oregon's major basins and tributary networks. We then overlaid coverage with landscape and water related pressure indicators to identify "areas of concern" where limited baseline data coincide with high current pressures and likely rapid change. In this presentation, we (1) present statewide maps of sampling coverage and data gaps, (2) highlight priority areas where new vouchered surveys will have the highest payoff for detecting change, and (3) share early case examples illustrating how museum vouchers paired with field data support repeatable, defensible assessments of biodiversity change through time. Our goal is to strengthen the foundation for freshwater fish research and management in Oregon and to ensure we don't lose the record of what's here as conditions continue to shift.

Effects of water storage and delivery on shoreline spawning activity of endangered Lost River Sucker in Upper Klamath Lake, Oregon

Professional

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Lake-spawning Lost River suckers *Deltistes luxatus* in Upper Klamath Lake spawn in shallow shoreline locations where springs discharge into the lake. Because of the shallow depths of the spawning habitats, water management that changes lake surface elevation during the spawning season could cause behavioral changes in spawning fish due to reduced available habitat and decreasing depths. We examined the association between lake surface elevation, including rapid declines in lake surface elevation, and interannual use of specific spawning sites, fidelity to these sites, daily spawning activity, and spawning duration using a long-term dataset of PIT tag detections at the spawning sites. Our results indicate that low Upper Klamath Lake surface elevations were associated with Lost River Suckers visiting a reduced number of spawning sites, which spawning sites were primarily visited, and shorter durations between first and last detection at the spawning sites. Rapid declines in lake surface elevation did not have an effect in any of our models, however, this result is limited to the magnitude of rapid declines in lake surface elevation documented in our data, which was small.

Partial migration and its functional genomic basis in fishes: New results from the Australian barramundi and comparison to salmonid fishes

Professional

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Migration is a fundamental biological process. Some organisms exhibit partial migration, where a portion of an interbreeding population migrates and another portion does not. With partial migration, migrants and residents can be subject to vastly divergent pressures favoring different genetic backgrounds, yet come together to freely interbreed. We tested for a heritable basis to partial migration in Australian barramundi Lates calcarifer, a fish of substantial cultural and economic importance across its range. A combination of otolith microchemistry and a genome-wide association study of a population of barramundi from North Queensland, Australia identified genetic variants that were significantly associated with partial migration. Nearly all implicated variants were located in a small region on a single chromosome (Lca24). This pattern was also evident in a nearby, genetically more similar partially-migratory population (650 km away along the coastal margin). However, it is not evident in more genetically and physically distant partially-migratory populations (2,500-3,800 km away along the coastal margin). These findings indicate that alternative genomic mechanisms may be associated with partial migration across the diverse populations of Australian barramundi. These findings are contrasted with examples in salmonid fishes where loci associated with life history variation may have wide distributions and exhibit homology between species. In particular, suppression of recombination in salmonids and increased recombination in Australian barramundi may contribute to the observed patterns. We further speculate on the genomic redundancy of salmonids in contributing to differences in the functional genomic basis of traits between these two lineages. While genetic backgrounds are an important component contributing to partial migration, the presence and accessibility of suitable habitat is required for life history variation to be fully realized in migratory fishes.

Redband trout growth potential informs habitat quality in drought-prone Great Basin ecosystem

Student

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Great Basin redband trout (*Oncorhynchus mykiss* ssp.) are indicator species of high-desert arid environments capable of withstanding wide fluctuations in abiotic conditions. Despite this adaptability, redband trout are considered at-risk with range reductions attributed to habitat alterations and climate change. Management is complicated by limited knowledge on the factors impeding their physiological tolerance and distribution, specifically how environmental conditions influence performance and growth potential. Redband trout of the Goose Lake Basin— an endorheic valley in the Great Basin characterized by dynamic hydrology and land use change— typify the problems faced by interior populations and can serve as a model for understanding how fish may respond to climate-mediated constrictions in habitat quality and connectivity. In this study, growth potential serves as a proxy for habitat quality. We collected redband trout diet (n = 88) and otolith samples (n = 29), and stream temperature data at 21 sites across seven hydrologic/ elevational strata in summer 2024. Otoliths were used to quantify an annual proportion of maximum consumption (pCmax) using the Wisconsin bioenergetics model fitted with adult rainbow trout parameters and basin-specific data on stream temperature and prey energy density (from diets). Model outputs were used to calculate an average summer pCmax using degree-day accumulation to delineate the season; this value was combined with prior inputs to project summer growth potential for all 88 fish. Variations in growth were mapped across strata to differentiate between low- and high-quality habitat. Preliminary results indicate that prey energy density (3539-6517 J*g-1 wet mass) varied spatially, with the highest values observed in Thomas-High. Annual and summer pCmax was 0.30 (0.25-0.42). Findings will support conservation of priority habitats for this endemic species and provide a template through which other Great Basin populations may be managed.

Linking phylogenetics to native lamprey conservation across spatial scales- from the Northern Hemisphere to the Willamette River basin

Professional

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Native non-game fish are understudied, creating limitations for their conservation and management. Often, simply understanding population and species diversity is a primary challenge. Species identification is particularly difficult for fishes where taxonomic classification based on genetic information differs from that based on morphological assessments. These inconsistencies are apparent among lampreys, an ancient lineage of jawless fish that lack many of the morphological characters often used for taxonomic classification in fishes. We addressed these information gaps in the genus *Lampetra*, from genus level classification at a global scale to species and population diversity in Willamette River basin, Oregon. Phylogenetic analyses of all publicly available sequence data at two mitochondrial genes support designation of new genus to describe western North American brook and river lampreys formerly classified as *Lampetra*. To more accurately represent diversity of North American lampreys, we assign them to a new genus, *Occidentis*. To explore species diversity within *Occidentis*, we performed a species delimitation analysis using all publicly available cytochrome b

sequences. Results revealed the existence of several candidate (undescribed) species present in subbasins of Oregon and California. Despite different adult morphology and feeding behavior, results demonstrated that western brook lamprey (*O. richardsoni*) are best categorized as life history variants of the larger *O. ayresii* species complex. At a local scale, we observed varying phylogeographic patterns within *Occidentis*, with some lineages and species endemic to a single subbasin of the Willamette River. In other cases, the distribution of other more common lineages was shaped by headwater stream capture. Information from this research has informed both conservation policy and management in several western states and highlighted the need for more research on candidate species across the west coast.

Broadscale eDNA sampling to define historical, current, and future Pacific lamprey distributions

Professional

Carim, Kellie; *Rocky Mountain Research Station, kellie.carim@usda.gov*

Pacific lamprey (*Entosphenus tridentatus*) were once abundant in Pacific Northwest streams, where they play important roles in subsistence and cultural identity of many Indigenous peoples. Like many anadromous species, they have declined over the last century due to habitat loss and fragmentation throughout their historic range. In response, numerous Tribal, federal, and state and natural resource agencies have initiated conservation projects focused on improving habitat quality and connectivity, as well as reintroductions in historically occupied habitat. Given the breadth of these activities, information on the current species' distribution and suitability of current and future habitat is needed to prioritize conservation efforts and increase long-term conservation success. To address this need, we led a broadscale eDNA sampling effort to assess current distributions and develop habitat suitability models for Pacific lamprey throughout the Columbia River basin and coastal subbasins of Oregon and Washington. Over 2,600 unique locations were surveyed with support from over three dozen Tribes, natural resource agencies, local governments, and NGOs. Subsequent presence/absence data was analyzed in a spatial stream network modeling framework to identify predictors of Pacific lamprey occurrence. Results indicate that Pacific lamprey occurrence is positive correlated with stream flows and temperature, and negative correlated with elevation, stream slope, road densities and prevalence of agriculture in a subbasin. This model was then used to estimate historical distributions of Pacific lamprey in the absence of human activities, as well as scenario planning maps for targeted conservation efforts.

Using Habitat Models as Decision-Support Tools for Salmonid Conservation, Restoration, and ESA Analysis

Professional

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Conservation decisions increasingly hinge on our ability to translate habitat change into biologically meaningful outcomes, yet few tools do this in a way that is transparent, spatially explicit, and decision-relevant—particularly for ESA impact assessments and conservation and restoration planning for anadromous salmonids. This presentation illustrates how ICF's application of the Ecosystem Diagnosis and Treatment (EDT) model can support restoration and conservation planning and ESA impact assessment by linking spatially explicit habitat attributes to life-stage–specific productivity and capacity responses. EDT is applied as a scenario-based decision-support framework to evaluate baseline, impact, and restoration alternatives,

emphasizing relative change and dominant habitat pathways. Specifically, EDT can be used to identify priority reaches and restoration actions, assess tradeoffs among conservation strategies, and quantify relative biological benefit or risk (take) in a transparent and reproducible manner. From an ESA Habitat Conservation Plan (HCP) perspective, the approach also provides a structured pathway for translating habitat-based impacts and restoration actions into relative estimates of incidental take and mitigation effectiveness, supporting conservation planning that is both biologically grounded and regulatory-relevant. The framework highlights how EDT can accommodate uncertainty through structured hypotheses, spatial scaling, and comparative analysis, informing conservation prioritization and adaptive management in complex river systems. The presentation draws on specific applied project examples to demonstrate how these analyses are developed, interpreted, and used to inform real-world conservation and restoration decisions and ESA analyses.

Stream Evolution Thresholds and Restoration Decision Making

Professional

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River management and restoration project managers, funders, and designers face challenging decisions regarding the scale, type and intensity of intervention needed to achieve desired outcomes. At one end of the restoration spectrum are light-touch, low-tech approaches that seek to restore damaged river forms and functions by prompting and promoting natural processes. While widely referred to as process-based restoration, they may be better described as ‘process-led’. More intensive and impactful approaches that seek to remove anthropogenic constraints to allow natural processes to recover are described as ‘process-reset’. The Stream Evolution Triangle (SET) provides the framework to objectively evaluate these restoration options and their appropriateness for adoption in different fluvial process domains. Looking through the lens of the SET, we can more fully understand river history and the lasting impacts of river management, but also the restoration potential. With an understanding of where a stream currently resides within the SET, restoration decisions are scientifically founded and provide a starting point for management decisions. The SET provides a framework to evaluate river management actions from concept through implementation, and into monitoring and evaluation. In river restoration, we are frequently faced with the decision of when to act and how to act. Do we take a ‘wait and see’ approach, do we prompt recovery with vegetation management and small wood structures, or do we start up the big equipment? This talk will explore thresholds for action in river restoration and how we can more effectively use tools for risk-based decision making.

Linking concepts of adaptive capacity to ESA-listed salmon and steelhead populations in tributaries of the Upper Willamette River with high-head dams

Professional

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Adaptive capacity is an emerging concept and considers the abilities of coupled biological and human systems to persist in the face of altered environments. On-going recovery efforts for Upper Willamette Valley Chinook salmon translocate adult fish above high-head dams without fish passage to spawn. Trap-and-transport translocation of adults above dams increases access to spawning and rearing habitat but reduces the number spawning downstream and translocation has been associated with high rates of pre-spawn mortality in several locations, particularly in years with warmer temperature. Offspring of translocated adults must pass reservoirs and dams during downstream migration, inducing a diversity of juvenile life history

pathways including 'novel' reservoir life history pathways. Thus, translocation and juvenile life history diversity may or may not increase adaptive capacity depending on the relative performance of offspring from adults spawning above vs. below dams. We developed an agent-based model of cohort replacement rate to estimate relative performance and total adult returns for alternative translocation protocols and restoration scenarios. Lastly, water operations in the Willamette Valley affect thermal and flow regimes and we simulated the thermal history of adults during upstream migration using biotelemetry data and agent-based models to identify the potential for exposure to acute and chronic thermal stress. The results demonstrate risk of chronic thermal stress in early-run salmon and higher acute thermal risk in late-run salmon. Taken together, while dams and reservoirs have strongly negatively impacted native salmonids, several past and on-going efforts have enhanced the adaptive capacity of both ESA-listed species on the current landscape. More broadly, we contend that consideration of adaptive capacity elements can enhance mechanistic understanding and identify conservation opportunities under current and future conditions.

Addition of dietary fluoride or iodide does not protect juvenile chinook salmon from bacterial kidney disease, but protection of rainbow trout by dietary fluoride is confirmed

Professional

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Bacterial kidney disease (BKD) is a major cause of prespawning mortality of returning adult spring chinook salmon, captive-reared chinook salmon and causes juvenile morbidity and mortality in hatchery-reared chinook and coho salmon. The disease is caused by the bacterium *Renibacterium salmoninarum*. Dietary fluoride protects rainbow trout from an injected *R. salmoninarum* challenge (Bowser et al. 1988). A dietary fluoride- iodide combination was found to reduce *R. salmoninarum* prevalence in Atlantic salmon (Lall et al. 1985). Fluoride (as NaF) and Iodide (as KI) did not affect growth of *R. salmoninarum* in test tube cultures, suggesting the protective effect would only be demonstrated in live fish. We fed fluoride supplemented or unmodified diets to Oregon stocks of spring chinook and coho salmon and rainbow trout for 28 days, followed by an injected challenge of 3.2 million live *R. salmoninarum* cells. Dietary supplementation continued for 3 months postinjection, during which survival and weight gain were monitored. No protective effect of fluoride was found in spring chinook and coho salmon, however the 10 mg F/kg fish/day fluoride diet provided statistically significant protection for rainbow trout, confirming previous results. Coho salmon and rainbow trout accepted the fluoride diet readily but chinook salmon showed some feed rejection and slower growth. In a separate trial, 10 mg I/kg fish/day did not protect spring chinook from *R. salmoninarum* challenge. No evidence was found of organ or cellular damage from the fluoride or iodine modified diets.

Historical and current status of Snake River Chinook Salmon

Professional

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Monitoring of Snake River Chinook Salmon and Steelhead in Idaho has been occurring by Idaho Fish and Game since the 1940's. In the earliest years, surveys and evaluations informed harvest management as well as basic ecological knowledge. Subsequent data collection was instrumental in species' ESA listings. Monitoring in recent decades has contributed to status assessments, population trend monitoring, and has supported a variety of management and

informational needs. Here we present a timeline of our long-term datasets that inform VSP parameters, changes to our methods, notable research, and lessons learned.

Explore more: Using the Monitoring Resources Explorer Map to encourage collaboration through the discovery of data collection events

Professional

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The Pacific Northwest Aquatic Monitoring Partnership (PNAMP) facilitates collaboration and coordination of a mosaic of ecological monitoring programs to work across boundaries and promote scientific understanding necessary for the management of the Nation's natural resources. We believe an integral piece to the ecological monitoring puzzle is the preservation of where, when, how, and why data are collected and analyzed. Thus, PNAMP's MonitoringResources.org, a metadata documentation tool, allows managers the opportunity to chronicle their monitoring projects, and in doing so, create foundational practices that can be sustained or adapted to fit environmental and sociological changes. And yet, Monitoring Resources is more than just a documentation tool; it is also a discovery and collaboration tool. The Monitoring Resources Explorer Map is an online map viewer that supports data discoverability and accessibility. This visualization tool displays thousands of data collection events with links to associated metadata such as protocols and methods throughout the western United States. Additionally, the Explorer Map is equipped with a variety of informational layers and filters that provide a comprehensive understanding of environmental conditions and anthropogenic impacts over large spatial and temporal scales that often cross typical jurisdictional boundaries. Our aim is that the Explorer Map can be used to inform better management decisions and encourage collaboration to preserve long-term monitoring efforts and help identify gaps for future investigation.

Spring Chinook Reintroduction in the Hood River Basin

Professional

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The presentation will share perspectives on programs to augment populations of steelhead and spring chinook affected by poor in-basin habitat conditions resulting from natural and anthropogenic sources. Monitoring, habitat enhancement, and hatchery augmentation programs have occured for both steelhead and spring chinook for over 30 years, however, goals for both species have not been attained. The spring chinook program lacks clearly defined objectives for determining success.

Whole Nuclear Genomes Identify Novel Relationships of Cutthroat Trout in the Southern Rocky Mountains

Student

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Colorado hosts a diversity of Cutthroat Trout (*Oncorhynchus clarkii*); however, despite three decades of molecular studies, clarity on their phylogenetic history and native range remains elusive, with implications for management and conservation. For example, whether Colorado River Cutthroat Trout (CRCT) found east of the Continental Divide in the South Platte and Arkansas River basins became established during recent times (within 150 years) with anthropogenic influence or on their own long ago, changes their management prioritization. To

address this information gap, we used high-coverage (18x) whole genome resequencing to analyze DNA samples from the extant lineages of Cutthroat Trout native to the Southern Rocky Mountains (SRM), as well as five other Cutthroat Trout taxa from the remainder of their range. We identified ~40 million single nucleotide polymorphisms (SNPs) from 48 individuals and additionally filtered to remove paralogous and copy number variant loci which may confound signatures of population structure in ancestrally tetraploid organisms. We identified novel genetic relationships in three populations of former CRCT found east of the Continental Divide, with one population – South Hayden Creek – possessing a unique nuclear genome from the rest of the populations in its a priori lineage. South Hayden Creek is a wild population that may harbor ancestral diversity despite widespread historic stocking across the state. Additionally, we confirmed the presence of three distinct evolutionary lineages across the range of the former CRCT. Two of these forms – the former "blue" and "green" lineages – are as distinct from one another as other groups with unique subspecies designations in the SRM. Our results directly inform management prioritization for conservation populations of Cutthroat Trout across the Southern Rocky Mountains and bolster our understanding of the mosaic of Cutthroat Trout diversity across North America.

Suspended sediment and turbidity response following a megafire and post-fire salvage logging

Professional

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Megafires that encompass entire watersheds may enhance risk of erosion and sediment delivery to streams that can negatively affect water quality, fish habitat, and downstream drinking water. High-intensity precipitation events that occur within the first post-fire year may have the greatest effect on stream sediment flux and water quality by flushing recently deposited ash and organic material into streams. We monitored suspended sediment, turbidity, and discharge in 7 nested sub-basin locations within North and South Fork Gate Creek for the first two years after the Holiday Farm Fire, which began within 41 days after fire containment. All watersheds were completely within the fire boundary, exposed to high severity fire, and experienced extensive post-fire salvage logging during our study. Mean suspended sediment concentrations (SSC) ranged from 12 to 87 mg L-1 with maxima reaching as high as 5082.2 mg L-1 in one upstream location during a December 2020 storm event. SSC concentrations were within the range of concentrations previously reported in unburned reference streams in western Oregon and in other post-fire studies. Hysteresis of SSC primarily followed clockwise patterns indicating proximal sediment sources that were rapidly mobilized in nearly all events across locations. Turbidity estimated SSC from three locations revealed the magnitude of SSC in the December 20, 2020 event was greater than the maximum SSC identified in the second year post-fire (January 6, 2022) despite salvage logging continuing throughout this period. Our study reveals the importance of immediate monitoring to understand the magnitude of sediment concentrations after wildfire with concurrent salvage logging. Our findings agree with other recent work from the western Pacific Northwest that has found limited hydrological, sediment, and geomorphological responses in the first few years after the 2020 Labor Day wildfires.

Long-Term Assisted Migration and Fluvial Expression of Cutthroat Trout in a Fragmented Working Watershed

Professional

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Migratory life-history strategies enable salmonids to access seasonal habitats and contribute genetic diversity across river networks. In working watersheds of the Intermountain West, irrigation infrastructure has fragmented streams and constrained this expression in many coldwater systems. On the Cub River in southeastern Idaho, a diversion dam constructed in 1925 eliminated upstream migration for fluvial Cutthroat Trout from the mainstem Bear River. In 2006, a fish ladder with a manual trap was installed to facilitate upstream passage of native Cutthroat Trout while preventing nonnative species encroachment. We summarized fish ladder trap data collected from 2006–2025 to evaluate long-term patterns in migratory passage, species composition, and size structure. Over 1,200 Cutthroat Trout have been passed upstream of the diversion, supporting continued fluvial expression and upstream genetic contribution. Annual captures declined from an early average of 232 fish per year during 2007–2009 to 51 fish per year from 2010–2016, likely a result of high-flow events in 2010 and channel stabilization in 2011 downstream of the ladder entrance. The ladder was not operated from 2017–2019; operations resumed in 2020, with captures averaging 29 fish per year during 2020–2025. To provide watershed context, we compiled existing fish distribution, electrofishing, eDNA, and stocking datasets from IDFG and the USFS, along with conducting tributary stream crossing assessments. Across the three major tributaries, 21 road crossings and one diversion structure were identified, nearly half classified as moderate to severe barriers. Together, these results underscore the importance of long-term fish ladder operation while emphasizing that sustained fluvial expression depends not only on passage infrastructure, but also on improved ladder access conditions and targeted watershed-scale habitat restoration to support fluvial Cutthroat Trout persistence in the Cub River watershed.

Meta-analysis of Steelhead and Salmon Catch-and-Release Survival

Professional

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Efforts to recover depressed stocks of steelhead and salmon in North America include implementation of mark-selective recreational fisheries, whereby anglers are allowed to harvest hatchery-origin fish but must release natural-origin fish. Catch-and-release (C&R) is generally thought to be an effective tool for conservation due to high survival of released adult salmon and steelhead in freshwater. However, estimates of C&R survival are necessary to approximate the number fish that perish after being released. Studies designed to estimate C&R mortality have produced highly variable results among species and fish size classes, gear types, and environmental conditions. Disparate studies with complex, nuanced findings and advocacy for principled restrictions on angling practices has led to diverse regulations, some of which do not provide a clear conservation benefit. Mount Hood Environmental collaborated with Pacific States Marine Fisheries Commission, Idaho Department of Fish and Game, and Washington Department of Fish and Wildlife to develop a metadatabase representing data collected in rivers throughout Washington, Oregon, and Idaho. This database is a near-comprehensive collection of currently available data for salmon and steelhead C&R in freshwater. The metadatabase was analyzed to estimate effects of C&R and use of different terminal tackle types on survival for steelhead trout, Chinook Salmon, and Coho Salmon within 48-hours of C&R. We found that survival of angled steelhead and Coho was very similar to survival of control fish, indicating no detectable effect of angling. However, survival of angled Chinook Salmon was approximately 9.4% lower than non-angled Chinook. The difference between C&R survival of Chinook Salmon and the other two species warrants further investigation but may be attributed to greater effects

of hooking location on Chinook survival. Terminal tackle type, including barbed hooks, did not influence survival, but hooking location did.

Integrating Growth, Mark-Recapture, and Harvest Information for White Sturgeon Stock Assessment in the Lower Columbia River

Professional

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White Sturgeon *Acipenser transmontanus* abundance in the Lower Columbia River has traditionally been estimated using independent Lincoln-Petersen estimates and a fixed size-selectivity curve. However, analyzing years independently does not fully utilize the information present in multi-year recapture patterns. An integrated Bayesian framework was developed to jointly analyze growth and capture-recapture data from approximately 70,000 individuals captured over 16 years in the stock assessment. Flexible splines were used to estimate individual growth trajectories from observed growth increments and size-at-capture data. A multiple imputation workflow propagates growth uncertainty into a Robust Design mark-recapture model, enabling estimates of gear selectivity, size-specific survival and abundance from multi-year capture histories with explicit quantification of uncertainty throughout. Future work will focus on integrating harvested tag recoveries to further refine survival estimates and incorporating acoustic telemetry data to better inform temporary emigration parameters.

Cryptic Genetic Structure and Evolutionary Divergence in Idaho's *Prosopium* species

Professional

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Biodiversity is underestimated when cryptic diversity (i.e. genetically distinct lineages lacking obvious phenotypic differences) is overlooked. Mountain whitefish (*Prosopium williamsoni*), one of 38 native fish species in Idaho, is widely distributed across the western U.S. and considered a single, phenotypically homogeneous species. In contrast, cutthroat trout exhibit extensive genetic structuring and are divided into multiple species and subspecies. We aimed to determine whether mountain whitefish contain cryptic genetic lineages or represent a single evolutionary unit. We also compared genetic diversity and divergence within mountain whitefish to three closely related *Prosopium* species endemic to Bear Lake: Bear Lake whitefish (*P. abyssicola*), Bonneville cisco (*P. gemmifer*), and Bonneville whitefish (*P. spilonotus*). We analyzed genome-wide nuclear single nucleotide polymorphisms using Restriction-Site-Associated DNA sequencing and sequenced the mitochondrial cytochrome oxidase b gene from fish collected at 46 sites across the western U.S. Our results revealed three divergent *Prosopium* lineages: western mountain whitefish populations downstream of Shoshone Falls in the Snake River, mountain whitefish from Missouri River tributaries, and eastern mountain whitefish populations upstream of Shoshone Falls with the three Bear Lake endemic species. Genetic diversity and divergence were highest in the western lineage. Despite close geographic proximity, populations from the Big Lost and Big Wood rivers belonged to different lineages and exhibited the lowest genetic diversity. The Bear Lake species were distinct in the nuclear dataset but not in mitochondrial DNA, suggesting recent speciation. These findings reveal unrecognized genetic structure in mountain whitefish and provide insights for conservation and management of Idaho's native *Prosopium*.

Centering local and indigenous perspective and knowledge in management co-design: a case study from the west Pacific outer islands

Professional

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Prioritizing ecological, cultural and societal health in the stewardship of coral reefs is a dynamic endeavor that requires resources, intentional planning, and a process to put community values, needs, and leadership at the center of the effort. Management plans that focus disproportionately on increasing fish biomass and/or coral cover often fall short of serving the people that rely on their reefs for both food security and cultural integrity. This in turn compromises the long-term success of the management efforts. We present our approach to co-designing (led by local managers) a large Marine Respected Area in Yap state, and how contemporary science was used to support local knowledge and traditional practices to design a plan that will meet regional conservation targets and local social, cultural, ecological and economic needs. Under the guidance and direction of local leaders and managers/reef owners, our western science teams developed metrics including connectivity (genomics), stress testing (metabolomics), reef and fish surveys, isotope analysis of fish for trophic position, and above and below water orthomosaics, to assess habitat and fish 'health'. Local leaders discussed traditional practices and knowledge of declines for both management and fish, and outlined management strategies that are (or were historically) effective. We will present the science and knowledge integration and how they were used to co-design the Marine Respected (Managed) area. This talk will focus on how local leaders and managers directed the science, and how the science was used to support the process.

From Smolts to Returns: Modeling Latent Ecosystem Drivers of Growth and Survival in the Northern California Current

Professional

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Marine survival for Snake River spring/summer Chinook salmon has long remained well below recovery targets. While climate is the dominant predictor of survival, and a warming ocean is chronically detrimental, a more mechanistic understanding of limiting factors may identify management levers to mitigate population declines. To improve this understanding, we developed a Structural Equation Modeling (SEM) framework that incorporates a wide range of ecosystem data while accounting for complex correlation structures. We utilized a streamlined model selection approach incorporating size, growth, and catch-per-unit-effort (CPUE) data from NOAA's Juvenile Salmon and Ocean Ecosystem Surveys (JSOES), nested within a smolt-to-adult-return model. The measurement model defines latent variables representing prey, competitors, and predators within both the Northern California Current (NCC) and multiple Alaskan ecosystems, differentiating impacts prior to and subsequent to the JSOES survey. Our structural model identified robust ecosystem predictors of growth rates and early ocean survival; we further explored the pathways connecting growth and early survival to adult recruitment. These results facilitate more targeted modeling of age-at-return and help pinpoint the specific management interventions with the greatest potential to improve adult returns in a changing climate.

Ac**oustics in Action: A Novel Approach to Mitigation of Pinniped Predation**

Professional

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While population increases in many pinniped species in recent years is a positive development, it brings challenges when pinnipeds heavily predate vulnerable fish populations. This can be particularly damaging at anthropogenic migration “bottlenecks” in riverine environments – bringing established conservation policies into conflict. Efforts to limit predation often include lethal (culling) and non-lethal (hazing) mitigation; however, in many cases non-lethal methods fail to provide a long-term solution due to habituation and induced hearing loss, and lethal removal must be used extensively to yield meaningful results. Targeted Acoustic Startle Technology (TAST), developed at the University of St. Andrews, is a novel taxon-specific alternative that has been found to deter pinnipeds from confined areas without causing harm or affecting non-target species. TAST elicits the autonomous auditory startle reflex, consistently triggering avoidance responses. It has proven highly effective in reducing pinniped interactions with fisheries and aquaculture, showing a 91-97% reduction in seal predation in a test trial on a salmon farm over one year. TAST also has the potential to non-lethally mitigate pinniped predation on ESA listed fish stocks when carefully applied to riverine environments. Collaborative trials in the Pacific Northwest have shown a clear deterrence effect and/or modelled a reduction in predation events. Over several years of research, and through significant review and improvement, lessons have been learned about fostering effective collaboration, adjusting to dynamic situations, and achieving positive conservation outcomes in various habitats. Continued exploration of TAST integration into comprehensive management strategies in the Pacific Northwest could yield significant results for all.

Managing Proliferative Kidney Disease in an Oregon Hatchery

Student

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Proliferative Kidney Disease (PKD) is caused by the myxozoan parasite *Tetracapsuloides bryosalmonae* (T. bryo). Although the parasite is endemic in Oregon, there were previously only 4 documented instances of infections, all in state hatcheries between 1994 and 2001. However, outbreaks of PKD caused epizootic mortality in juvenile Chinook salmon (*Oncorhynchus tshawytscha*) at Leaburg Hatchery (McKenzie R.) from 2020-2024, Dexter Hatchery (Willamette R.) in 2021 and 2025, and Cole Rivers Hatchery (Rogue R.) in 2025. In response to the initial outbreaks, our laboratory collaborated with the Oregon Department of Fish and Wildlife to launch a multi-year monitoring program at Leaburg Hatchery to address concerns regarding the parasite’s origin, its distribution in water sources and fish stocks, and species-specific impacts. From 2021- 2024, we sequentially sampled water from the hatchery to quantify waterborne parasites via qPCR and collected kidney tissue from both Chinook salmon and steelhead trout (*Oncorhynchus mykiss*) for histology and PCR to detect malacosporeans. Genetic analysis confirmed the parasite as T. bryo belonging to the endemic North American strain. Our surveillance revealed that fish exposure to waterborne spores begins in early June, with the first kidney infections detectable in mid-July. Though infection prevalence reached 80% or higher in both species, disease signs were observed only in Chinook, as evidenced by severe granulomatous inflammation of the kidney. Degree day analyses indicate that only the Chinook salmon met the established time and temperature thresholds to develop clinical PKD (~30 days ≥15˚C), which may explain these disparate infection outcomes. These findings have directly informed hatchery management, such as timing and duration of fish transport and holding. PKD still threatens salmonids in Oregon hatcheries, but this work has demonstrated actionable mitigation strategies that arose through comprehensive fish-health monitoring.

The role of a monitoring plan in the delisting of the Apache Trout

Professional

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Fish populations are routinely monitored to assess their status and inform management. For ESA-listed species, monitoring plays an important role in assessing the status of populations and, thus, the species as required by the ESA every five years (5-Year Status Review). In 2017, the Apache Trout Implementation Team finalized a monitoring plan for Apache Trout with a goal of estimating abundance of populations with a certain level of precision that required sampling 100-m reaches every 0.5 km, equal to sampling 20 percent of the habitat, every 5 years. Implemented since 2016, the plan has yielded estimates of abundance, along with other information, used to conduct a species status assessment (SSA) for the Apache Trout. The SSA was developed in conjunction with a Cooperative Management Plan signed by action agencies with a commitment to monitoring as specified in the plan regardless of listing status. The SSA then informed the 5-Year Status Review that recommended the species be removed from the federal list of threatened and endangered wildlife. The Apache Trout was delisted in October 2024, and post-delisting monitoring will be done according to the monitoring plan. The effectiveness and feasibility of the Apache Trout Monitoring plan, and subsequent delisting, has led to development of a similar monitoring approach and level of effort for the Lahontan Cutthroat Trout that is currently ESA-listed as threatened.

Proof of Concept: Stocking YY-males to Eradicate Brook Trout in a Closed Population

Professional

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Introducing YY-male brook trout (fish with two Y chromosomes) is a biological control strategy designed to eradicate a population by skewing the sex ratio over time to all male (Schill et al. 2016). In 2018, the Columbia River Fish and Wildlife Conservation Office (FWCO) and partners, initiated a proof of concept study to assess the feasibility of using the YY-male approach to eradicate nonnative Brook Trout from Tyee Springs. Tyee Springs is a spring fed stream in SW Washington that flows less than one kilometer before being screened and treated as the water source for fish reared at Carson National Fish Hatchery. In 2019 we developed a stochastic population model to estimate the number of years it would take to eradicate the Tyee Springs Brook Trout population. Based on annual stocking and removal rates, the model predicted eradication in about 11 years. Demographic data used to populate model parameters were estimated from three mark/recapture events. We began annual suppression and stocking efforts in 2020, and the project is now in its sixth year. This presentation will provide an overview of the project, monitoring results, model updates, genetic results, and highlight lessons learned.

Advancing Regional Biosecurity: Addressing the Commercial Boat Hauling Vector in the Pacific Northwest

Professional

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Aquatic Invasive Species (AIS) prevention in the Columbia River Basin (CRB) has historically prioritized the recreational boating pathway. However, commercially hauled watercraft represent a high-risk vector that frequently circumvents established inspection protocols due to logistical complexities and non-standard transit schedules. This presentation analyzes the operational dynamics of the commercial hauling industry and the administrative challenges associated with

regulating interstate maritime commerce. Using the Call Before You Haul (CBYH) program as a case study, we examine the transition from a traditional regulatory framework to a service- and incentive-based mitigation model. We will review the technical and jurisdictional integration of 24/7 notification systems, digital reporting tools, and multi-agency coordination involving state AIS coordinators, state Departments of Transportation, and the U.S. Department of Transportation Federal Motor Carrier Safety Administration (FMCSA). The discussion focuses on how this collaborative approach establishes a comprehensive biosecurity protocol to facilitate the interception of high-risk vessels prior to their introduction into CRB waters.

Airborne thermal infrared imagery for river mapping: now you can see

Professional

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Airborne thermal infrared (TIR) remote sensing has been an essential tool for evaluating river conditions before, during, and after restoration projects. High-resolution TIR mapping reveals spatial gradients in surface water temperature, identifies groundwater upwelling zones, and tracks changes in thermal heterogeneity as impoundments are drained and channels are reconnected. These thermal dynamics shape habitat suitability for cold-water salmonids, which depend on cool refugia, thermally stable reaches, and access to cold tributaries during migration and rearing. Collecting RGB imagery alongside TIR greatly improves the interpretability and ecological value of these datasets by providing detailed context on channel morphology, riparian condition, sediment exposure, and geomorphic change. When integrated, TIR and RGB imagery allow practitioners to pinpoint cold-water habitats, evaluate expected changes to physical and thermal processes, and anticipate how salmonids may respond to newly restored or reconnected environments. This presentation will highlight real-world examples from multiple rivers, demonstrating how combined remote-sensing approaches support more informed restoration planning, adaptive management, and long-term conservation in restored systems such as increased meanders, introducing log jams, and dam removal systems.

Pacific Salmon Data Discovery Tool

Professional

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The Northwest Fisheries Science Center and Pacific States Marine Fisheries Commission are leading a collaborative effort to develop a Pacific Salmon Data Discovery Tool. The goals of this web-based database are to (1) provide annually updated summaries and visualizations of Pacific salmon data (e.g., population abundance estimates, productivity trends, age data) and the associations between salmon populations and environmental drivers (e.g., marine heat waves, abundance and survival rates of predator and prey species, freshwater habitat quality and quantity), and (2) serve as a data repository to publicly house salmon relevant data currently held by organizations (e.g., Pacific Fisheries Management Council), co-managers, and research scientists . The data discovery tool provides a single location to hold data across ecosystems (freshwater, estuary, marine) and data types (documents, data files, derived data products, spatial data, GitHub links) relevant to Pacific Salmon. Many of these datasets exist in agency reports or databases maintained by external agencies or groups (e.g., states, tribes, Pacific Salmon Commission, Pacific Fisheries Management Council), but are not centralized, or generally accessible to the public. Our focus will be to serve as an information clearinghouse for a broad user community - from casual data exploration through standardized data visuals, to comprehensive data downloading supporting regional harvest and conservation management analysis.

Effects of hatchery-rearing practices on olfactory imprinting and homing in Pacific salmon

Professional

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Homing in salmon is governed by the olfactory discrimination of home-stream water. Exposure to home stream water during appropriate juvenile stages is critical for olfactory imprinting and successful completion of the adult homing migration. Hatchery rearing does not necessarily affect homing fidelity but many hatchery rearing and release practices can increase the rate of straying by adult salmon returning from the ocean to spawn. In this presentation, we briefly review stray rates of wild and hatchery salmon and identify hatchery practices that may contribute to straying. We then describe several experiments examining how hatchery-rearing practices may affect the olfactory system of juvenile salmon during olfactory imprinting. Specifically, we examined the effects of water source and rearing environment on the smolting physiology and gene expression patterns in the olfactory rosettes of Chinook salmon and steelhead. Well water is often used in hatcheries to control temperature and limit exposure to pathogens. In the first experiment, we examined the expression of odorant-receptor mRNA in the olfactory rosettes of steelhead reared in stream water vs. well water during the parr-smolt transformation, a sensitive period for olfactory imprinting. Specific odorant-receptor mRNA expression increased dramatically during the parr-smolt transformation in steelhead reared in natural stream water relative to fish reared in well water. In a second experiment, we examined the effects on similar physiological and molecular markers as well as adult return rates and homing fidelity of Elk River hatchery fall Chinook salmon maintained in well water vs. river water during embryonic rearing. Physiological differences between well water- and river water-reared Chinook salmon were less pronounced than in the steelhead study. Differences in odorant receptor mRNA expression were also observed in hatchery and wild steelhead during their juvenile outmigration through the Columbia River.

Apparent Tag Effect on Threatened Spring-Run Adult Chinook Salmon in the Grande Ronde Basin

Professional

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Passive integrated transponder (PIT) tags and radio tags are widely used to study movement, passage, habitat use, survival, and behavior of salmon populations. We evaluated the effects of handling and tagging adult spring-run Chinook salmon (*Oncorhynchus tshawytscha*) in two Grande Ronde Basin stream in northeast Oregon: the upper Grande Ronde River and Catherine Creek. Fish were marked with 12-mm PIT tags in the pelvic girdle or dorsal sinus, and a subset received gastrically implanted radio tags. Groups were categorized by capture and handling at an Adult Collection Facility (ACF), also referred to as a weir. Fish were either tagged with a PIT tag, a radio tag, or a combination of the three. Movements were monitored using stationary PIT arrays near spawning reach boundaries upstream of each ACF. Detection probability and apparent survival were estimated using a Cormack-Jolley-Seber model implemented in a Bayesian framework. Tagging at the ACF with either a PIT tag or a radio tag reduced the likelihood of fish reaching primary spawning areas by 66.6–80.0%. Also, radio-tagged fish migrated upstream more slowly than non-radio tagged fish. These findings suggest that handling and tagging late in the adult spawning migration can negatively affect movement and spawning success. Fisheries managers and scientists should carefully consider

the potential negative effects of handling and tagging adult Chinook salmon late in their spawning migration, especially in populations with depressed abundance levels.

Abundance, Movement, and Ladder Ascension Success of Walleye at Lower Granite Dam

Professional

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Many factors attribute to suppressed salmon and steelhead populations including non-native fishes that are apex predators. Walleye were illegally introduced in the upper Columbia River basin in the late 1940s. Walleye have since become widespread throughout the Columbia and lower Snake rivers and limited data indicates continued expansion and increased prevalence. Counts of walleye trapped at Lower Granite Dam (LGD) show an exponential rate of increase since the first was trapped in 2016. Although these counts track some measure of relative abundance, it was unknown what they represented and how successful they were at ascending the ladder and further colonizing upstream. We PIT-tagged 154 walleye in 2023, 189 in 2024, and 156 in 2025 to examine re-entrance into the fish ladder, success rate of exiting the ladder, and trapping efficiency of the fish trap at LGD. Of the PIT-tagged fish that entered the ladder the trap captured 4.1% in 2023, 5.7% in 2024, and 2.7% in 2025. Of the PIT-tagged fish that were detected in the bypass channel, the trap captured 30.0% in 2023, 20.9% in 2024 and 13.5% in 2025. These trapping and success rates expand counts to 3,799 walleye that entered the ladder in 2023 and 3,339 in 2024 and 5,710 in 2025. Expanded numbers of walleye currently upstream of Lower Granite Dam were 463 in 2023, 735 in 2024, and 2,185 in 2025.

Demographic insight of native Desert and Sonora suckers in the Lower Verde River

Student

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In central Arizona, Sonora and Desert suckers are increasingly recognized as part of a developing, yet unquantified, native fishery. However, evaluating their sustainability requires reliable stock status information, including population estimates, age and growth trends, fecundity, and survival/mortality. Unfortunately, this data is not available for many important Southwestern species and populations. Here, we describe the development of stock status information for populations of Sonora Sucker and Desert Sucker in the lower Verde River and Salt River. We conducted a mark-recapture study on a 5.6-kilometer reach of the lower Verde River, a reach heavily used for recreational angling, from June to December 2025. Surveys were conducted across monthly two-pass sampling periods to determine abundance, survival, recruitment, and population structure. A total of 496 Sonora Suckers and 433 Desert Suckers were tagged, and 39 and 28 Sonora Sucker and Desert Sucker were subsequently recaptured. To determine the influence of limited recapture rates on population inference, estimated using POPAN, an open-population framework. Habitat type, month, sampling effort, and individual fish length were incorporated as covariates. Age-at-length relationships were derived from pectoral fin ray examination. This study provides baseline demographic information for native suckers in the lower Verde River and demonstrates a repeatable monitoring approach that can be applied to future management and conservation.

Historic and contemporary selection define conservation units for a short-range endemic within an anthropogenically-altered riverscape

Professional

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Numerous selective forces act upon allelic frequencies of broad-ranging biodiversity, yielding well-represented conservation units (CUs). Yet these are much less apparent in range-restricted forms where anthropogenic impacts, topography, and population structure are minimized. Here, short-range-endemics (SREs) are noteworthy for having historic habitats abridged, temporal recolonizations curtailed, and anthropogenic extinctions accelerated. Their CUs/intermediate stages contrast with conventional perceptions regarding evolution/natural history are thus often overlooked. Herein we evaluate both for an SRE (Madtom catfish). We do so by deriving/ evaluating 2,725 genomic DNA loci/SNPs (one/read) from N=178 non-lethally sampled individuals (plus N=57 outgroups) from the Neosho River Basin (KS/OK/MO; USA). Six significantly different populations were sequentially identified, with dispersal significantly constrained by downstream impoundments (N=14 low-head dams; N=2 reservoirs; timespan >100 years). Flow regulation/fragmentation were identified as the most strongly associated of eight environmental variables. Genotype-environment analyses (GEA) revealed localized adaptive differences among populations, with N=61 loci significantly associated with the environment. Redundancy analyses (RDA) identified strong correlations between genetic and environmental variances across two axes: Hydrologic-physiographic (N=20); Landcover (N=18). Stream reach and location juxtaposed with local adaptation along the longitudinal and directional gradients of important environmental variables. The 61 loci associated with N=30 genes: Anatomical-developmental (head, eyes, brain); Response to stimuli (stress, chemical, hypoxia); and Metabolism. Our results demonstrate CUs/intermediates can be not only identified within SREs, but also characterize for NMT an apparent response to long-term, anthropogenically-induced habitat perturbation.

Does rescue risk adaptation? A genomics perspective on isolation, translocations, and recovery of the threatened Little Colorado River Spinedace

Student

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The Little Colorado River Spinedace now persists in three isolated watersheds within the Little Colorado River Basin. This federally threatened minnow faces ongoing pressure from habitat alteration, climatic shifts, and invasion by non-native predators. Over the past two decades, managers have conducted translocations within watersheds to increase abundance and expand habitat occupancy; however, these efforts have not been monitored for potential impacts on genetic diversity of Spinedace. To inform future conservation actions we sequenced the Spinedace genome and analyzed single nucleotide polymorphisms (SNPs) from 475 individuals spanning relict samples from the 1990s and contemporary samples from 2024 and 2025. Our results show that overall genetic diversity has remained relatively stable within watersheds through time. However, levels of genomic divergence among the three watersheds indicates long-term isolation and potential local adaptation to their distinct habitats. Analysis to identify local adaptation are currently ongoing. This study helps address a key management challenge where genetic rescue can benefit declining populations, but mixing could disrupt locally adapted gene pools and lower fitness if local adaptation is confirmed. Our findings provide a genomic framework and baseline to aid in decision making for future translocations as managers maintain and ultimately recover the endemic Little Colorado Spinedace.

Coordinating Delta Smelt Supplementation Through an Interagency Governance Framework

Professional

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Recovering endangered species often requires moving beyond isolated research projects toward coordinated, multi-agency implementation. For Delta Smelt (*Hypomesus transpacificus*) in the San Francisco Estuary, this shift has been formalized through the Culture and Supplementation of Smelt (CASS) framework, an interagency governance structure aligning science, policy, and implementation. We highlight how CASS functions as the coordinating backbone for Delta Smelt supplementation, focusing on the U.S. Bureau of Reclamation's role in funding, integrating, and sequencing interdependent projects. Delta Smelt supplementation originated from a conservation hatchery program established to maintain a genetically managed refuge population. As wild abundance declined toward extinction risk, managers explored whether captive-propagated fish could support the wild population. This progressed through an experimental phase testing feasibility, genetic safeguards, logistics, and monitoring. The program has since evolved into a coordinated supplementation effort responding to regulatory and recovery needs. In 2025–2026, supplementation transitioned from experimental release to full implementation, requiring biological and institutional readiness. CASS enabled this transition by clarifying agency roles and ensuring projects function as components of a unified program rather than standalone efforts. After five years of multi-agency releases, evidence of wild recovery remains limited; however, supplementation has prevented extinction and resolved major operational challenges. This case study demonstrates how collaboration frameworks and portfolio-based funding can support adaptive management and scalable conservation for endangered species recovery.

Linking Alternative Prey Biomass to Atlantic Salmon Smolt Survival in the Penobscot River

Professional

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Contemporary Atlantic salmon (*Salmo salar*) recovery efforts have adopted a multi-species, ecosystem-based management approach that recognizes the ecological services provided by other diadromous fishes. Among these species, river herring (Alosa spp.) have increased dramatically over the last decade and potentially reduce predation pressure on out-migrating Atlantic salmon smolt through a process known as prey buffering–an ecological phenomenon that reduces predation risk to one prey species when in the presence of another alternative prey species. To test this hypothesis, we used a state-space model informed by acoustic telemetry data describing the timing and success of Atlantic salmon smolt (n = 2120) movements through the Penobscot River estuary (rkm < 45) and estimates of relative abundance of potential alternative prey (mean = 51882 kg; SD = 36851 kg) derived from hydroacoustic sampling. From 2012–2023, we found that smolt survival was positively related to alternative prey biomass. Overall survival of smolts within the estuary was high, ranging from 0.93–0.97 (0.90–0.98; 95% CL) across the observed biomass of alternative prey. Model estimates indicate that the odds of smolt survival increases by 21% for every doubling of prey biomass within the estuary. While the increases in survival associated with increased biomass were relatively small, these results demonstrate that prey buffering is a measurable ecological process that contributes incrementally to Atlantic salmon smolt survival and may reinforce broader multi-species recovery strategies.

Incorporating angler perspectives and ecological evidence to inform management of non-native fish interactions with native Yellowstone Cutthroat Trout in the Teton River Basin, Idaho

Student

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Management actions, such as removals of nonnative species can create tension between fisheries managers and anglers. These are circumstances within which both ecological and social science may be needed to address these challenges, provoking collaboration where angler's attitudes and anecdotal experiences are considered in decision-making. One such context occurs in the Teton River drainage (Idaho, USA), where Yellowstone Cutthroat Trout (YCT) (*Oncorhynchus clarkii bouvieri*) are a native species imperiled due to habitat degradation and negative interactions with nonnative trout. In particular, Rainbow Trout (RBT) (*Oncorhynchus mykiss*) are considered a major threat due to their hybridization with YCT, but competitive interactions with nonnative Brook Trout (Salvelinus fontinalis) are also a concern. In this context, we are integrating social research with ecological studies and long-term data. I conducted semi-structured interviews with Teton River anglers and fisheries managers to explore their perceptions of YCT conservation and management approaches to mitigate invasive species impacts, as well as the "tension" that I have observed in initial interviews. My interviews were coded into network mental models of both group's varying perspectives. I have conducted ecological research focused on Badger Creek, a Teton River tributary that received rotenone treatment in fall 2025 to remove its high RBT numbers. I am evaluating ecological assumptions underpinning this removal that may help in predicting its ecological outcomes. I also will draw on long-term, drainage-wide species distribution modeling based on electrofishing and eDNA to determine if there is evidence for additional locations that might be priorities for future removal efforts. Considering angler opinion along with ecological research may contribute to creating a comprehensive management approach to preserving YCT populations within the Teton River drainage.

A Typology of Fishing Community Perspectives on Salmonid Hatcheries in Oregon

Professional

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Pacific salmon and steelhead hatcheries are central to fisheries management along the West Coast of North America, yet they remain a source of persistent controversy. While often framed in binary terms of pro- or anti-hatchery, public perspectives are more nuanced. We conducted 18 in-depth interviews with members of Oregon's non-tribal fishing communities, including recreational anglers, professional fishers, non-governmental organizations, hatchery workers, scientists, and policymakers, to explore perceptions of salmonid hatcheries. We developed a typology of perceptions of salmonid hatcheries in Oregon, identifying five distinct belief-based types, which we label Advocates, Reformers, Balancers, Skeptics, and Restorers. These types differed in how they evaluated hatcheries' social and ecological impacts, governance legitimacy, and management acceptability. While Advocates and Reformers emphasized hatcheries' social, economic, cultural, and ecological benefits, Skeptics and Restorers prioritized minimizing ecological harm and questioned hatchery effectiveness. Balancers acknowledged both social benefits and ecological risks, supporting context-specific management. All groups articulated different meanings of the term "wild," suggesting that different perspectives across typologies may exacerbate fundamental miscommunications. Our findings highlight the complexity of stakeholder views and the limitations of binary framings. We suggest that tailored

communication and engagement strategies, informed by typologies, may foster more inclusive and productive dialogue in hatchery policy and management. To support scientists and managers, we introduce a hatchery communication toolkit.

Avian predation on salmon and steelhead smolts in the Columbia River basin: A review of research, monitoring, and evaluation studies

Professional

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To understand the degree to which piscivorous colonial waterbirds limit the survival of salmon and steelhead smolts in the Columbia River basin (CRB), researchers from Real Time Research, Oregon State University, and the U.S. Geological Survey have investigated predator-prey interactions since the late 1990's. As part of this work, over 70 technical reports and 50 peer-reviewed scientific publications that cover a wide range of topics regarding avian predation have been produced (see www.birdresearchnw.org). Studies involving piscivorous waterbirds have largely focused on identifying breeding sites, colony sizes, inter-colony movement and dispersal patterns, and foraging ecology. Studies of the impacts of avian predation on smolts have focused on the diet composition of birds, the number and percentage of fish consumed by birds, and identifying biotic and abiotic factors that influence fish susceptibility to avian predation. This long-term research, monitoring, and evaluation (RM&E) program has identified predation by some breeding colonies as a factor that limits the survival of some ESA-listed salmonid populations, particularly steelhead populations from the Upper Columbia River and Snake River. Consequently, addressing concerns over avian predation has become a component of management plans, such as lowering predation by reducing the size of the largest or most impactful avian colonies. This presentation will summarize several key findings from this long-term RM&E project, with a focus on predation of ESA-listed salmon and steelhead smolts during outmigration, the efficacy of management actions aimed at reducing predation, emerging issues and concerns, and remaining critical uncertainties.

Transcriptomes and Genomes Inform the Taxonomic Status of Cutthroat Trout (Oncorhynchus clarkii)

Professional

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Continuing discussions on the taxonomic classification of Cutthroat Trout are precipitated in part by the rapidly burgeoning array of molecular data integrated with existing evolutionary and ecological history. In the 1950s, Robert Behnke conducted a comprehensive reevaluation of the group and delineated 14 subspecies based on morphological characteristics, Pleistocene biogeographic events, and contemporary distribution patterns. His designations provided a foundational framework for recognizing and conserving the remaining diversity within the species. Subsequent molecular approaches—including karyotyping, allozyme analyses, mitochondrial DNA sequencing, SNPs, microsatellites, RAD sequencing, and whole genome sequencing—have largely supported Behnke's phylogenetic hypotheses, while also revealing areas of persistently weak resolution among certain lineages. To address these remaining uncertainties, we generated de novo transcriptomes for nine Cutthroat Trout subspecies, the Bear River Bonneville form, and two Colorado River lineages (Uncomphagre and Green River). Additionally, using a Greenback Cutthroat Trout specimen, we assembled and annotated a chromosome level, subgenome resolved complete genome. From these transcriptomes, we identified 1,983 orthologous genes to construct phylogenies that refine current understanding of

subspecies relationships. The tetraploid origin of the Cutthroat Trout genome was a complicating but resolvable factor in gene identification. Notable results identify Bear River Cutthroat Trout as a Yellowstone lineage. Our results suggest that recent taxonomic elevations under the Unified Species Concept are premature. Although taxonomic discussions should continue, the traditional subspecies level framework for Cutthroat Trout will continue to support the fundamental priorities of conservation: preserving populations and sustaining the natural processes that have enabled Cutthroat Trout to persist over evolutionary time.

Genetic evidence of hybridization between desert and Sonora suckers

Student

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Phenotypic responses to hybridization between closely related species in replicate environments can provide insights into the process of hybridization in nature, the repeatability of hybridization outcomes, and local adaptation through selection. In Arizona, desert sucker (Catostomus clarkii) and Sonora sucker (Catostomus insignis) distributions overlap across most of their range. The two species are assumed to hybridize based on field observations in streams where they co-occur, however, little population genetic work exists for these fish and no prior studies have identified genetic hybrids. We collected desert and Sonora sucker individuals from 31 streams across Arizona in 2024 and successfully sequenced reduced-representation genomic libraries for 681 individuals from 31 sampling sites. Preliminary analyses of these genetic data have identified 20 hybrid individuals of the 462 individuals sampled from streams where they co-occur, suggesting that hybridization is occurring at low rates (mean 4.3%) in the majority of sampled streams that these species coinhabit (68.8%). Further research will work to understand the population genomic structure of both parental species and to expand sampling to better quantify variation in hybridization rates in streams where the two species co-occur. In addition, further research will investigate what the ecological drivers are that may be contributing to these patterns and what ecological implications the existence of hybrids may have for these stream systems.

Refining indices of risk from salmonid hatcheries

Professional

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The risk to wild populations from domestication selection in hatcheries is commonly indexed with estimates of the proportion of hatchery-origin spawners (pHOS) on natural spawning grounds. Widely used calculations of pHOS are not commensurate with the genetic theory that motivates the use of pHOS as an index of risk from domestication selection. I derive an alternative metric of pHOS that is commensurate with the spatiotemporal variability of natural- and hatchery-origin fish and the genetic theory used to index risk. I describe nuance associated with indices of hatchery risk, including how to calculate variances. The widely used calculation of pHOS will overestimate the risk when the densities of breeding natural- and hatchery-origin fish differ in space or time. The analytics provided here will improve empirical estimation of an index of risk from hatchery-origin fish and the associated uncertainty.

Triggers of early migration of juvenile wild spring/summer Chinook salmon

Professional

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Chinook salmon (*Oncorhynchus tshawytscha*) express a wide range of strategies for the timing and duration of their juvenile migrations both within and among different life history types. Migration is initiated when individuals leave their natal streams and begin a process of moving downstream. Wild spring/summer Chinook salmon from the Salmon River basin can initiate migration out of their natal streams and into downstream tributaries over a period of several months. This process can begin as parr and continue through to the following spring and early summer as yearling smolts. The timing of exit from the natal streams is different for each individual in a population and can depend on multiple intrinsic and extrinsic factors. We investigated factors associated with the timing of exit from natal streams for several populations of wild spring/summer Chinook salmon from various locations in the Salmon River basin of Idaho over a span of several years. Fish were PIT-tagged as parr in the late summer and were continuously monitored for detections on in-stream arrays as they exited their natal streams and at detection locations downstream. We used discrete hazard functions with mark-recapture methods to jointly model the processes of survival, detection, and exit timing. We present results for factors related to the daily conditional probability of exiting the natal stream.

Shifting Perspectives in Effectiveness Monitoring: Lessons from the Middle Fork John Day IMW

Professional

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Intensively Monitored Watersheds (IMWs) were designed as long-term programs to link restoration actions to habitat change and fish population responses. However, inconsistent results across regions have contributed to ongoing uncertainty about restoration effectiveness and the monitoring frameworks used to evaluate it. Using the Middle Fork John Day IMW (MFIMW), a basin-scale, multi-agency effort operating since 2008, as a case study, we synthesize lessons learned from long-term monitoring and reflect on persistent challenges that have limited inference. These challenges, including mismatches between monitoring and restoration scales, delays between habitat change and detectable biological response, inadequate identification of limiting factors prior to restoration, and the absence of clearly defined restoration objectives, have limited our ability to draw definitive conclusions. Consequently, it remains unclear whether observed outcomes reflect insufficient implementation, unrealized habitat change, delayed biological response, or failure to address the priority limiting factor. Although the future role of IMWs in effectiveness monitoring remains uncertain, large-scale restoration projects and rapidly evolving post-implementation habitats in the MFIMW area highlight the need for targeted monitoring to feed the John Day Basin Partnership's adaptive management framework. This creates an opportunity to adapt monitoring frameworks while restoration actions are ongoing rather than retrospectively evaluating outcomes. We propose a shift toward reduced basin scale monitoring and focusing on specific reach scale habitat response variables that can be directly linked to restoration mechanisms, with results intended to inform future projects and be transferable to other basins. These lessons emphasize the value of flexible, process-informed monitoring frameworks that evolve alongside restoration efforts and deliver actionable insights for future restoration strategies.

Assessing spatial synchrony in Pecos pupfish (*Cyprindon pecosensis*) populations

Student

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Understanding how temporal variation in population dynamics influences persistence is especially important for species inhabiting variable environments. When populations fluctuate synchronously, shared environmental disturbances can drive simultaneous declines, increasing extinction risk. In contrast, asynchronous dynamics can buffer species against environmental stochasticity through portfolio effects. Pecos pupfish (*Cyprinodon pecosensis*) occupy dynamic aquatic habitats subject to extreme disturbances, yet temporal asynchrony in their population dynamics has not been explicitly evaluated. We analyzed long-term monitoring data from core Pecos pupfish populations in southeastern New Mexico to estimate abundance, identify environmental drivers, and assess evidence for temporal asynchrony. Using hierarchical N-mixture models within a Bayesian framework, we estimated annual abundances while accounting for imperfect detection across 13 monitoring sites sampled between 2012 and 2025. Models incorporated site-level environmental covariates influencing abundance and survey-level covariates affecting detection probability. These analyses provide insight into how environmental heterogeneity and local conditions shape population trajectories over time. Preliminary results indicate that sinkhole populations of Pecos pupfish generally respond synchronously to one another, while wetland populations show a mix of synchronous and asynchronous dynamics. By identifying populations that exhibit stability, resilience, or asynchronous dynamics, this study directly informs conservation planning for Pecos pupfish, highlighting how habitat-specific synchrony may influence vulnerability to region-wide disturbances and shape long-term persistence of this species.

Investigating the association of Ichthyophonus with signs of Yukon River Chinook salmon pre-spawning mortality

Professional

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Yukon River Chinook salmon abundance has declined and affected subsistence fisheries since the 2000's where record low returns occurred in 2020-2023. Studies in the early 2000's showed that heavy infections by the protisian parasite, *Ichthyophonus*, may impact adult salmon survival during their long upriver migration. High infection prevalence and severity of this parasite also coincided with the low returns in recent years with signs of additional high riverine en route mortality. We are investigating if severe infections with *Ichthyophonus* are associated with en route mortality and population declines. We pursued several approaches, including both field and laboratory studies. *Ichthyophonus* infections in the population declined as fish migrated upriver in some study years, indicating parasite-associated mortality. We developed a new model to estimate this mortality that indicated about 8-16% of the Canadian substock may have died en route due to this parasite, which accounted for nearly 40% of the natural mortality. We are also using this model to estimate the lethal threshold for assessing the percentage of fish at-risk for this associated mortality as part of a rapid in-season annual monitoring program. Controlled laboratory experiments showed that Yukon Chinook salmon are highly susceptible to disease and mortality and the estimated lethal threshold in lab trials has mirrored those from field data. Lastly, we screened fish for infections that were collected from the Northern Bering Sea survey and found that salmon become infected after their first summer at sea and the prevalence of *Ichthyophonus* increases with age. Additionally, the reservoir source for infections has not yet been identified. Overall, there were various lines of evidence that supported the conclusion that *Ichthyophonus* negatively impacts the survival of Yukon River Chinook salmon at multiple life-history stages.

Using multiple PIT interrogation systems and sampling methods for large-scale fish movement studies

Professional

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Several passive integrated transponder (PIT) interrogation systems and sampling methods are available for tracking the movements of PIT-tagged fish in rivers over a large scale or long periods of time. Each system or sampling method has advantages and drawbacks to use. Here, we use a fish movement study in the Colorado River headwaters near Granby, Colorado to highlight how each of these methods are being used and the data that can be collected from them. Nearly 7,000 PIT-tagged Brown Trout, Rainbow Trout, and sculpin have been released in the Colorado and Fraser rivers above and below Windy Gap Reservoir since the study began in 2020. These fish are being used to understand how fish movement has changed since construction of a bypass channel around the reservoir was completed in 2024. Of the PIT-tagged fish released, a total of 3,894 have been recaptured during the study, with 2,731 unique tags being detected by only one of the four methods used. Three Oregon RFID river-spanning, stationary antenna stations were constructed in 2020, with an additional three stations added within the connectivity channel in 2023. These spatially discrete antenna stations have been collecting temporally continuous fish movement data since their deployment. Biomark submersible antennas have been intermittently deployed in several locations to collect additional data during the Brown Trout and Rainbow Trout spawning seasons. Mobile raft antennas equipped with GPS were deployed three temporally discrete times annually (spring, summer, fall) to determine spatially continuous fish locations throughout the entirety of the Colorado and Fraser rivers study section. Additionally, discrete electrofishing events are used to collect previously PIT-tagged fish and release newly tagged fish annually. Although combining discrete and continuous sampling methods provides a plethora of data, it creates challenges for data management and analysis, which we will also discuss during this presentation.

Tag-recapture data informs seasonal survival and movement of Flathead Chub

Professional

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Effective conservation is often hindered by a lack of quantified life history metrics and population drivers for many species, including survival rates and movement. Survival rate is a major determinant of population size and abundance dynamics, and understanding variation in survival may provide insights into the timing and magnitude of discharge required for plains stream fishes to persist. Movement drives metapopulation dynamics, including gene flow and reestablishment of extirpated populations. Understanding movement rates between habitats, the extent and directionality of fish movement, potential effects of barriers, and the timing and frequency of movements related to flow events may pinpoint important annual and seasonal dynamics. The native fishes of the North American Great Plains ecoregion are an assemblage of conservation concern with gaps in knowledge of many species' life history traits. We estimated seasonal apparent survival, transition (movement), detection, and temporary emigration probabilities for a Great Plains cyprinid, the Flathead Chub *Platygobio gracilis*, in Fountain Creek, Colorado. A multistate mark-recapture approach using 13,108 PIT tagged fish showed mean monthly apparent survival was 0.75 (range = 0.68–0.80) but varied seasonally, with the highest estimates in winter, intermediate in summer, and lowest in autumn and spring. Apparent survival also varied among stream reaches, likely due to differences in the amount of pool and large wood habitat. Flathead Chub moved most in summer and little in winter, with higher upstream movements in summer balanced by higher downstream rates in spring and

autumn. Analyses also revealed high temporary emigration from stream reaches, indicating high small-spatial-scale movement rates. These results indicate that fragment lengths required for Flathead Chub conservation may be shorter than previously described, if flow, habitat, and connectivity requirements are met.

Whole-Team Data Strategy: How a Participatory and Iterative Approach Increases Data Integrity and Efficiency

Professional

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Fisheries monitoring often depends on complex data workflows involving field collections, data entry and QA/QC, analysis, and reporting, where small mismatches between field realities can compound into delays, rework, and avoidable error. Participatory research is a collaborative approach in which stakeholders, community members, and researchers co-design and co-produce knowledge that is more relevant, usable, and grounded in real world experience. We can apply the same principles to the entire research team, from field staff to principal scientists, ensuring we leverage the diverse perspectives and experiences of team members at each level. Our collaborative and adaptive data strategy includes input and feedback from field staff, permitting biologists, senior scientific and engineering staff, and data managers. This talk will highlight a novel sampling methodology that utilizes a modified pontoon boat collecting up to 1TB of data per day in California's Central Valley, and how the data management strategy evolved over time with input from team members at all levels. Taking an iterative and collective approach to data management strategies has allowed us to improve data collection efficiency, post-processing time, and increased overall data quality and integrity. For example, integrating on-board data collection to a central hub has allowed us to start and stop five different pieces of equipment at the same time, allowing for ease in post-processing time and effort. Although incorporating diverse viewpoints and implementing an adaptive approach to data management strategies can require more upfront costs and time, it has the potential to save hours in workflow steps, increase data quality, and improve the daily lives of field staff and analysts. We conclude with some practical lessons learned for designing adaptive data systems in fisheries science.

A survey of social science research conducted by NOAA Fisheries to support recovery of salmon and steelhead in the Pacific Northwest

Professional

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Runs of salmon and steelhead once returned to rivers in the Pacific Northwest of the United States in prolific numbers, providing livelihoods and cultural identity for native peoples, and later for non-native residents. These salmon and steelhead populations have declined precipitously over the past 150 years due to a variety of anthropogenic factors, and 28 populations are listed as threatened and endangered under the Endangered Species Act on the US West Coast. Since the first listings, sizable resources have been devoted to developing science to understand how anthropogenic stressors affect salmon, and recovery plans promote their recovery. While salmon recovery science is largely focused on understanding the biophysical determinants of salmon survival, scientists and recovery managers increasingly recognize the importance of economic and social factors in mediating the effectiveness of salmon recovery efforts. In this presentation, I will motivate the importance of social systems in determining the success of salmon recovery efforts, and provide an overview of research being conducted by NOAA's Northwest Fisheries Science Center to understand the social and economic dimensions of salmon recovery. Specifically, I will review completed and ongoing research related to several

research themes. These themes include: developing models to identify which recovery alternatives produce the greatest recovery impact with available resources, quantifying the co-benefits of salmon recovery activities, promoting voluntary partnerships with private landowners and other parties affected by salmon recovery activities, and understanding how institutions and governance structures impede salmon recovery. To close, I will discuss opportunities for future social science research to address emerging salmon recovery challenges.

The utility of reference genomes for fisheries management: a tool for understanding hybridization in Coastal Cutthroat Trout

Professional

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Understanding the genetic consequences of hybridization is crucial for the management and persistence of the culturally and economically significant salmonid species in the west. One major challenge to species and fisheries management is the identification of hybridized taxa that have been sympatric for a long time, such as Coastal Cutthroat Trout (*Oncorhynchus clarkii*) and Steelhead/Rainbow Trout (*Oncorhynchus mykiss*). While numerous studies have documented candidate genetic markers for hybridization between *O. mykiss* and *O. clarkii* and other cutthroat species (i.e. *O. lewisi*), their efficacy in delineating hybrids seems to vary across the range. This could be due to variances across species in the organization of their genomes or challenges identifying diagnostic markers without high quality reference genomic resources. To resolve this, we generated a high-quality, reference genome assembly and linkage map for Coastal Cutthroat Trout to identify shared and variable chromosomal structure between the two species. This will aid in identification of loci diagnostic of species and hybrids.

Field-Based Identification of Cold-Water Habitats to Support Restoration and Protection Prioritization in Oregon

Professional

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Identifying cold-water habitats that can act as potential thermal refugia is a critical first step in supporting climate resiliency for salmonids and other sensitive aquatic species in Oregon's watersheds. This presentation describes the Oregon Department of Fish and Wildlife's Cold-Water Project, a field-based approach to locating and characterizing cold-water habitats across river networks, with emphasis on site selection and thermistor deployment techniques used to confirm thermal contrast under peak summer conditions. Since 2022, the project has completed over 1,700 thermistor deployments across 11 Oregon basins (197 in 2022, 353 in 2023, 565 in 2024, and 606 in 2025), the majority installed by ODFW's Water Program and supplemented by select partner monitoring sites, contributing to a growing statewide dataset that supports cold-water screening and prioritization efforts. Field efforts are guided by spatial temperature prediction models (NorWeST and Hydroregion 17) and basin-scale screening to target tributaries and mainstem reaches likely to provide meaningful cold-water refuge (i.e., >2°C difference). Paired thermistor deployments at tributary–mainstem confluences are used to quantify the magnitude and persistence of thermal differences most relevant to salmonids and refugia potential. We describe practical field considerations that influence site placement, including channel mixing, seasonal flow constraints, access, and deployment security. While data processing and quality assurance are briefly noted, the focus of this talk is on field-stage decisions that allow cold-water features to be consistently identified and compared across

basins. These methods are intended to supplement thermal refugia analyses and help guide prioritization efforts for future monitoring, restoration planning, and adaptive management.

The role of PIT tags in the recovery of Columbia River Sockeye Salmon

Professional

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Columbia River Sockeye Salmon returns to Bonneville Dam in recent years have hit highs not recorded since counting started Bonneville Dam in 1938. The information provided by PIT tags has contributed to this success story for Okanagan and Wenatchee Sockeye Salmon but may also be providing warning signs for the future. This presentation will trace the development of the use of PIT tags for Sockeye Salmon, from juvenile tagging at Rock Island Dam in the 1990s and adults at Bonneville Dam in 2006 to today with juveniles being tagged in the Okanagan and Wenatchee rivers and adult tagging at Bonneville, Wells, and Tumwater dams. The PIT tag antenna network, non-existent outside of antennas at some mainstem Columbia River dams in the 1990s and 2000s, has expanded to include additional mainstem dams plus 5 sites on the migratory route in the Wenatchee Basin and 8 sites in in the Okanagan Basin. This data is used not only to estimate abundance in the Wenatchee and Okanagan basins, but also for Okanagan River flow management which has had a major role in this stock's recent abundance.

Overview of research on salmon and steelhead, with an emphasis on the diversity of ecological, physiological and evolutionary processes addressed across life stages

Professional

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The vast migratory reach and intricate life histories of Pacific salmon and steelhead create a unique nexus where biological complexity meets an equally formidable landscape of human effort. The presentations in this symposium reflect a massive, multi-faceted research endeavor; however, the scientific "readiness" of this work for management is as varied as the life stages themselves. To provide a framework for these talks, we will categorize the current state of salmonid research by life stage, highlighting how our analytical approaches—and our ability to translate findings into immediate management actions—vary significantly across the species' life cycle. We offer a high-level overview from a comprehensive literature review focused on the utility of science for managing Pacific salmon and steelhead in the Columbia River basin under a changing climate. This synthesis highlights the representation of diverse biological processes, drivers, and responses analyzed across life stages. We propose a perspective on the inherent strengths and weaknesses of the current research landscape and present the ways salmonids are most likely to respond to climatic shifts, alongside the management options available to mitigate negative impacts. Finally, through audience participation, we will aim to identify the most critical and "management-ready" questions to tackle next.

Implementation of a mobile DNA sequencing laboratory for real-time assessment of Columbia River basin fisheries

Professional

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Estimating the migration timing, stock-specific abundance, and ancestry proportions of native salmonids is essential for effective conservation and management in the Columbia River basin. Here, we present results from the inaugural year of an innovative monitoring program intended to provide real-time genetic stock assessment of salmonids from priority fisheries during critical migration, spawning, and harvest periods. Throughout 2025, we developed the mobile genetics laboratory in the form of a custom 44' trailer where receipt of tissues, completed genotypes, and final PBT and GSI analyses were intended to be completed within a 24-hour period, providing the most up-to-date genetic assignments for monitoring trends across stocks in the Columbia River and its tributaries. We extensively designed, tested, and demonstrated protocols that support our selected DNA sequencing technology platform, achieving >99% concordance between the permanent laboratory in Hagerman, ID, and the mobile laboratory. After further equipping the trailer with all necessary DNA extraction and sequencing library preparation equipment, we successfully deployed the mobile laboratory on a total of four occasions to address priority needs including in-season stock identification, broodstock screening, and verification of source stocks for reintroduction programs. Across all deployments, genotyping results were generated within 16-24 hours of sample receipt, achieving >97% genotyping success, including genotyping of degraded samples. Overall, we highly successfully demonstrated the utility of the mobile genetics laboratory, providing critical information to managers in real time. With the unprecedented success of the laboratory in its inaugural year, we aim to increase deployments to additional sites of spawning, migration, and harvest significance while increasing our capacity for processing greater numbers of samples.

Adaptive Evolution and Phenotypic Plasticity Contribute to Thermal Capacity of Steelhead in a Warming World

Student

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Rapid adaptation to accelerating environmental changes may be critical for the persistence of salmonids, whose physiologies and life histories are shaped by environmental temperature. Steelhead (*Oncorhynchus mykiss*) occupy thermally heterogeneous landscapes, but face high risk of extirpation, partially because of warming waters. Population persistence under warming conditions depends on both short-term resistance mediated by phenotypic plasticity and long-term resilience driven by contemporary evolution, yet our understanding of the relative contributions of these mechanisms to heat tolerance is poorly understood. Here, we seek to narrow this gap by quantifying the plastic and evolutionary drivers of thermal tolerance in five *O. mykiss* populations in coastal California with thermally distinct habitats, using physiological experiments and stream temperature records spanning weeks to decades. We measured upper thermal limits in juveniles using a streamside critical thermal maximum (CT_{max}) protocol following 20-hour exposures to one of four temperature treatments, and compared thermal performance curves among populations with generalized additive models. CT_{max} trials revealed that both short-term plastic responses and longer-term evolutionary processes contribute to inter- and intra-population variation in thermal tolerance. Phenotypic plasticity conveyed short-term resilience to warming events in all populations, shown by a strong positive correlation between CT_{max} and acclimation temperature. In addition, populations from warmer streams exhibited higher mean CT_{max} values and distinct thermal performance curves, providing evidence for local adaptation to thermal regimes. Ongoing research aims to extend these findings by exploring the genomic basis of thermal tolerance. Importantly, we show that both short-term plasticity and long-term adaptation provide crucial pathways for persistence, which informs effective management of steelhead populations in a warmer future.

Fish Communities in Agricultural Drainage Ditches: Scoping Review

Professional

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Modern intensive agricultural practices and land conversion have been linked to significant losses of freshwater biodiversity. Despite these landscape changes, endemic fish communities continue to persist in channels draining agricultural lands. Here I investigate and synthesize the available primary literature on fish use of agricultural drainage ditches, with particular emphasis on the disturbances and habitat variables influencing fish communities. Scoping review methods were used to investigate the breadth of this growing body of literature by systematically quantifying both the type and extent of available data. A literature selection process was conducted following a keyword search across three fisheries related databases that yielded 656 scholarly articles. The subsequent evaluation of the 31 selected scholarly articles revealed that agricultural drainage ditches can support varied fish communities across different habitats. Channels experiencing disturbances such as dredging or fill removal exhibited contextual impacts on fish communities based on landscape and local habitat variables. Physical habitat features and watershed level variables such as connectivity were often greater predictors of fish presence and abundance than local variables. These results indicate that disturbances to agricultural drainage ditches require individual and contextual evaluations when considering management actions. Further, land use, connectivity, and physical habitat alterations show the greatest potential when considering conservation and habitat improvements of agricultural drainage ditches. Greater valuation of both fish communities and the agricultural drainage ditches they inhabit is needed to understand their total contribution to biodiversity in altered landscapes and the role agricultural ditches can play as refuges from disturbance.

Long-term patterns of hypoxia and biogeochemical variability in the Columbia River estuary and plume

Professional

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The Columbia River estuary and its buoyant plume form a dynamic river-ocean transition in the Northeast Pacific that is crucial to the development and migration of many Pacific salmon species. River flows and tidal exchange influence stratification and biogeochemistry of the estuary and plume. During summer months, wind-driven upwelling transports high-salinity, low-oxygen deep ocean water to the coast and into the estuary. This can result in oxygen levels low enough to cause physiological stress to salmon across the estuary-plume system. Long-term observations of physical and biogeochemical attributes of this dynamic system are crucial for understanding changes and drivers. These observations also provide a benchmark for validation of hydrodynamic models that are increasingly used to inform policy and management decisions. The Columbia River Inter-Tribal Fish Commission's Coastal Margin Observation and Prediction (CMOP) program maintains a long-running network of buoys and fixed stations to monitor conditions in the estuary and coastal waters as well as models of the river-estuary-ocean continuum. Here, we use CMOP observations across 15 years to construct climatologies of physical and biogeochemical properties of the lower estuary and plume. We use this framework to investigate how interannual variability in coastal and estuarine hypoxia is influenced by factors including wind stress, river outflow, shelf biogeochemistry, and marine heat waves. Bottom water oxygen levels in summer months frequently drop below concentration thresholds for physiological stress and acute mortality of Pacific salmon species. However,

timing and magnitude of hypoxia vary interannually with coastal upwelling events and river discharge. Increasing understanding of shifts in hypoxic events driven by long-term environmental change will enhance conservation and management of Pacific salmon and other fisheries that are commercially and culturally integral to the region.

Ghosts of predation past: Using decay in PIT tag detection probability at avian colonies to estimate past mortality rates for juvenile salmonids

Professional

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Predation on juvenile salmonids by colonial waterbirds in the mainstem Columbia River has been well-documented using PIT tag recoveries at avian colony sites, but avian predation on salmonid populations at the tributary level has received less attention. We investigated predation on natural- and hatchery-origin juvenile salmonids at an inland mixed-species avian colony in the Grande Ronde Basin (NE Oregon), dominated in recent decades by double-crested cormorants. Although this colony is small (~70 cormorant breeding pairs) relative to avian colonies in the mainstem Columbia, the level of impact on local salmonid populations, potentially exceeding 20% mortality for some groups, may be significantly hindering recovery efforts for two populations of Snake River spring Chinook salmon. Most studies using PIT tag recoveries at avian colonies rely on current-year tag recoveries and measurements of tag detection probability to estimate predation rates on fish migrating during that year. However, smaller tributary colonies often lack consistent annual PIT tag scans, limiting the ability to examine predation rates over time at these colonies. We applied a novel methodology using decay in PIT tag detection probability over time to estimate annual predation rates at the Grande Ronde avian colony during past years when no scans of the colony were conducted. Estimates of specific annual predation rates will allow investigation of factors affecting predation among years and among cohorts of fish, such as fish size, flow during emigration, migration timing, and abundance of migrants. This type of information may help inform how modifications to habitat, hydrology, and hatchery release practices could reduce predation mortality for both natural- and hatchery-origin smolt during spring outmigration.

Intraseasonal Water Allocation Strategies for ESA-Listed Salmon and Steelhead Conservation in an Agricultural Basin: A Hydroeconomic Abundance-Capacity Approach

Student

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In the Columbia River Basin, low abundances of ESA-listed salmon and steelhead are a visible indicator of broader socioecological stress. Over the past four decades, federal and state agencies have spent over $10 billion on recovery efforts, yet sustained increases in wild adult returns remain limited. In watersheds of the upper Columbia, seasonal streamflows support a multibillion-dollar agricultural sector, and late-season diversions by senior water rights often take priority over later-established instream flow protections. As snowmelt runoff declines into late summer, streamflow can become a limiting factor during critical spawning and juvenile rearing periods, when augmented flow can produce large habitat gains. These conditions motivate a central question: What are the ecological benefits and opportunity costs of reallocating agricultural water to instream flows during the irrigation season? We develop a weekly-resolved hydroeconomic model for Washington State's Lower Wenatchee Basin that links abundance

capacity and agricultural production decisions on a common monetary scale. Expected abundance capacity is derived from weighted usable area using a reach- and life-stage-specific mapping that incorporates fish density, seasonal occupancy, and smolt-to-adult survival probabilities. Ecological gains are valued using willingness-to-pay (WTP) estimates for adult abundance, and agricultural opportunity costs are measured as revenue losses from temporary irrigation curtailment. We compare benefits and costs across habitat-maximizing, net-benefit-maximizing, and agricultural profit-maximizing allocation rules under varying inflow and WTP conditions. Our results show that net-benefit-maximizing augmentation is concentrated in late-season periods when streamflows are most limiting, and crop water sensitivity is lower. When WTP is high or drought conditions intensify scarcity, net-benefit-maximizing allocations can closely approximate habitat-maximizing allocations.

Seasonal Movement Patterns of Radio-Tagged Walleye Below Lower Granite Dam, Snake River

Professional

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Expanding populations of walleye (*Sander vitreus*) in the Snake River Basin have raised management concerns regarding potential predation on migrating juvenile Pacific salmonids. These concerns have motivating efforts to better understand spatial overlap and movement patterns near hydropower facilities where they may be particularly vulnerable. To characterize seasonal movement patterns relevant to this potential overlap, we used radio telemetry to monitor walleye movements below Lower Granite Dam before, during, and after the spring juvenile salmon outmigration period. Thirty-two walleye were surgically implanted with radio transmitters at the Lower Granite adult fish facility and tracked using fixed receiver arrays distributed throughout the tailrace and downstream migration corridor. During the study period, 88% of tagged walleye were successfully redetected within the primary tailrace area. Movement patterns exhibited strong seasonal structure, with changes in spatial occupancy occurring over the course of the spring migration period. These results indicate that radio telemetry can provide reliable movement data for walleye in the hydropower tailrace and reveal pronounced seasonal shifts in activity and distribution. This work provides baseline information on walleye presence and movement dynamics below Lower Granite Dam and establishes a framework for future analyses evaluating predator-prey overlap with migrating juvenile salmonids.

A highly modified lineage in a highly modified riverscape: genetic and phenotypic patterns in steelhead and rainbow trout (Oncorhynchus mykiss) populations in the California Central Valley

Professional

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Genetic tools offer fisheries scientists and management an additional lens to understand patterns in populations and make informed decisions. However, a complex genetic background or location in highly modified habitats complicates both interpretation of molecular analyses and application of results for management implications. This talk explores the neutral and adaptive genetic relationships of steelhead and rainbow trout (Oncorhynchus mykiss) populations dispersed in the California Central Valley (CCV). The CCV and its river systems were heavily transformed in the last 200 years through widespread damming of rivers and diversion of water, and the structure of its O. mykiss populations was homogenized from transplanting individuals between watersheds. Utilization of SNPs and microhaplotype panels enabled determining important traits like population structure, age at spawning, timing of spawning, and strength of

association between adaptive genotype and phenotype. We found that CCV-lineage O. mykiss population dynamics represented a mixture of native and stocked populations that reflect historic and modern riverscape uses, and are genetically and phenotypically distinct from other neighboring lineages. Additionally, the strength of association between genetic variation and adaptive phenotypes depended on population ancestry, with CCV-lineage individuals exhibiting little to no association between genotype and phenotype. These results confirm significant differences in frequency and strength of association between genotype and phenotype maintained between different O. mykiss lineages, as well as the potential for the strength of genetic and phenotypic association to vary by lineage of a species. Our results also add to the discussion of adaptive genetic variation in conservation contexts by demonstrating limitations to genetic variation and phenotype associations across lineages.

From Barrier Removal to Biological Response: Monitoring Chinook Recolonization after Klamath Dam Removal

Professional

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Restoring longitudinal connectivity is a central strategy in salmon recovery across the Pacific Northwest, yet quantitative benchmarks of adult population response to large-scale barrier removal remain rare. In 2024, removal of four dams on the Klamath River reconnected over 640 km of historically inaccessible anadromous habitat—the largest dam removal project completed to date. This unprecedented action created an opportunity to evaluate effectiveness monitoring at basin scale in real time. We deployed high-resolution multi-beam imaging SONAR to enumerate adult Chinook salmon (*Oncorhynchus tshawytscha*) migrating into newly reopened habitats during the first two post-removal migratory seasons. An estimated 7,742 (95% CI: 7,702–7,778) adults passed upstream in 2024 and 13,310 (95% CI: 12,876–13,733) in 2025, representing 18–19% of total basin returns. Within two years, Chinook reoccupied 85% of their documented historical distribution, expanding over 300 river kilometers and reaching elevations of 1,250 m. This case study demonstrates how emerging monitoring technologies can generate precise, near real-time estimates of adult response at scales relevant to management decisions. By pairing high-resolution passage data with spatial distribution surveys, the Klamath program provides one of the first quantitative basin-scale benchmarks of salmon recolonization following dam removal. The findings highlight both the rapid biological response to restored connectivity and the importance of standardized, scalable monitoring frameworks capable of linking restoration actions to population-level outcomes. As restoration investments accelerate across the Pacific Northwest, and beyond, the Klamath experience illustrates how integrating innovative technologies with coordinated regional monitoring can strengthen inference, improve cost-effectiveness, and inform adaptive management of large-scale connectivity projects.

Biological, freshwater, and marine drivers of age at maturity in wild Chinook Salmon

Professional

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Understanding variation in age at maturity is important for endangered species recovery because older, larger adults contribute disproportionately to the next generation. Conditions in early life stages may have underappreciated impacts on age at maturity. Our study objective was to associate adult age of individually tagged wild, spring/summer Chinook Salmon (*Oncorhynchus tshawytscha*) outmigrating from the Snake River (Idaho and Washington, USA) in 1998–2020 with covariates measured during juvenile and subadult stages. We used a

hierarchical Bayesian ordinal probit regression model to estimate statistical effects of juvenile body length, seasonal migration timing or river temperature, transported or in-river hydrosystem passage, river flow, and a large-scale ocean index. Results indicated notable carryover effects consistent with underlying biological mechanisms related to growth and development, in which shorter juvenile length and later seasonal migration timing were associated with older adults. These biological and behavioural factors were more important than riverine or marine environmental conditions examined. Our study suggests that managers and decision makers should consider carryover effects from the juvenile life stage on age structure in conjunction with survival.

Federal/tribal collaboration to update aging infrastructure and promote fish migration and survival in estuaries: restoration design at the McGlinn Island jetty

Professional

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Pacific Coast estuaries abound in aging infrastructure, a reflection of over 150 years of efforts to reduce tidal inundation and control hydrodynamics. Much of this infrastructure was built without regard to habitat use in estuaries by anadromous salmonids. The McGlinn Island Jetty in the Skagit River delta provides a case study of the challenges presented by aging infrastructure. This 1-mile rock jetty was built in the 1920s by the US Army Corps of Engineers (ACOE) to reduce sediment infill and dredging of the Swinomish Channel, a natural distributary modified for navigation. The jetty was built on piles of brush that have rotted away, resulting in a structure that looks functional but is actually quite porous. Resultant hydrodynamics can kill juvenile salmon entrained within the jetty, and can temporarily block upstream passage for some adult salmon, thereby increasing their predation risk. These problems came to light because of a federal/tribal collaboration to develop alternative designs to redesign the jetty for improved connectivity, as well as fish kills observed during and after initiation of the collaboration. Collaborators developed 12 alternative designs and evaluated them with three goals in mind: 1) increase connectivity to tidal wetlands north of Swinomish Channel, 2) improve safe fish passage, and 3) maintain or reduce current dredging costs for maintaining navigability of Swinomish Channel. Multiple criteria associated with these goals pointed to several alternatives in which fish passage could be improved without impacting dredging costs, resulting in both ACOE and tribal support for some alternatives. While this project is by no means completed, the collaboration has fast-tracked implementation for improvements that had been shelved over a decade before. Elsewhere along the Pacific Coast, efforts that feature planned collaboration over multiple design alternatives may help jumpstart improvements to aging infrastructure.

Estimating Catch and Release of Wild Steelhead Using Electronic Harvest Records of Hatchery Origin Steelhead and On-Site Interviews

Professional

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The Oregon Department of Fish and Wildlife (ODFW) introduced an electronic licensing system (ELS) in 2018, enabling a shift from traditional roving creel surveys to a hybrid e-creel design using capture-recapture methods to estimate harvest. One limitation of ELS is its inability to record released fish, which is critical for ESA-listed summer steelhead (Oncorhynchus mykiss) fisheries in Northeast Oregon, where wild fish harvest is prohibited. Accurate wild-origin catch-and-release estimates are needed to account for incidental release mortality. We compared hatchery steelhead harvest and wild steelhead catch-and-release estimates derived

from e-creel and traditional creel methods across three fisheries and four run years. Steelhead seasons are open for eight months annually and include large areas of inaccessible land due to private ownership or wilderness designation. ELS records revealed that traditional surveys missed 20–41% of hatchery harvest and an unknown number of wild encounters. E-creel harvest estimates were larger but more precise than traditional estimates. Variability was influenced by total harvest, the number of ELS app users vs. paper harvest tag users and observed catch of adipose-marked and unmarked fish. ELS app use varied among fisheries and increased over time. E-creel estimates of wild catch-and-release were larger than traditional creel estimates, yet precision was similar to traditional creel in the Grande Ronde and Wallowa fisheries. The precision of e-creel wild catch-and-release estimates in the Imnaha fishery was better than the traditional creel. Unlike traditional creel methods, e-creel accounted for all temporal and spatial angling effort. The flexibility of hybrid e-creel sampling improves efficiency but requires careful restructuring of ground-based surveys to maximize harvested fish encounters for precise estimates.

Rising tides and warming waters: Dual impacts of oncoming climate change on estuary nursery function

Student

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Climate change threatens to restructure coastal ecosystems over the coming century through diverse mechanisms including sea-level rise-driven habitat losses and warming temperature mosaics beyond current or historical norms. These shifts will carry key consequences for important coastal ecosystems, such as estuaries, and the species that rely on them. For example, young Pacific salmon use estuaries as nursery grounds during seaward migration. This study investigated how sea-level rise and warming water temperatures will together impact estuary nursery suitability for juvenile coho salmon across two contrasting systems on Vancouver Island, British Columbia. We connected water temperature and sea-level rise predictions to salmon using physiologically guided abundance models fit to four years of field data to forecast shifts in estuary suitability across mid- and end-of-century climate change scenarios. We also examined shifts under both mean and maximum temperature regimes and explored the role of upland estuary migration in mitigating habitat losses. Together, we found that climate change drove highly system-specific responses—estuary suitability declined by up to 61.2% with higher temperatures across the warmer, less complex system, but expanded by as much as 159.5% across the larger, more complex system through most scenarios. However, across both estuaries, restricting upland migration always constrained future suitability, worsening with more severe climate change. Collectively, these results reveal how habitat losses, physiological tolerance, and constrained estuary migration could together increasingly limit future estuary suitability for juvenile salmon as climate change worsens, but how systems may respond at differing paces. These results also highlight the importance of key restoration and management actions to build estuary resilience—maintaining habitat complexity and thermal refugia across systems, and enabling upland estuary migration potential.

Oregon's Bull Trout Recovery Strategy: Is it getting us where we need to go?

Professional

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Following the finalization of the Bull Trout Recovery Plan in 2015, ODFW and USFWS, along with USGS and USFS, developed a statewide strategy to guide its implementation in Oregon.

This strategy aims to integrate management actions with research, monitoring, data organization, and analysis to achieve recovery efficiently and transparently. Key components include annual threat assessments, core-area monitoring plans, habitat suitability projections, and decision-support tools for prioritizing recovery actions. To promote transparency and collaboration, the strategy features a dedicated website for information sharing. Implementation of the strategy relies heavily on Oregon's 12 Bull Trout working groups for local level data collection, assessment and decision making. With most components now complete, we can evaluate the strategy's effectiveness as a roadmap toward delisting, make necessary adjustments, and identify next steps for recovery.

Linking Stakeholder Values to Risk Tolerance in Fisheries Management: Evidence from the Lower Columbia River

Professional

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Understanding how public values shape risk tolerance is essential for designing fisheries management strategies that are biologically effective and socially durable. We evaluated how stakeholder preferences inform harvest control rule (HCR) selection for Lower Columbia River tributary fisheries using a structured decision-making framework integrating public input with policy and legal constraints. A global survey of 4,000 respondents measured attitudes toward fishing opportunity, conservation priorities, regulatory trade-offs, and management principles using Likert-scale items and HCR scenarios. Exploratory factor analysis of polychoric correlations identified three latent value dimensions: (1) access-oriented catch-and-release preferences, (2) hatchery and harvest-focused opportunity values, and (3) conservation and long-term stewardship priorities. Latent class analysis revealed three distinct stakeholder groups with high classification quality (entropy = 0.88) and strong stability across bootstrap refits, indicating reproducible value-based segmentation. Ordinal regression demonstrated a quantitative relationship between value orientation and preferred HCR risk levels, linking priorities directly to tolerance for conservation risk versus fishing opportunity. The value statements most responsible for class differentiation emphasized science-based decision-making and willingness to accept short-term reductions in fishing for long-term sustainability. These results show fisheries preferences are structured, predictable, and measurable, providing actionable insight for managers. Integrating empirically derived public value profiles into management strategy evaluation can improve transparency, anticipate stakeholder responses to regulatory alternatives, and support targeted communication. Our findings demonstrate fisheries management is fundamentally a social-ecological process and that robust quantitative social data can meaningfully inform policy design.

Evaluating spatial and temporal patterns in environmental DNA concentrations during historically low salmon runs in a Yukon River tributary, Alaska

Student

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Monitoring the abundance of migrating salmon is critical for fisheries management in the Yukon River Basin, where recent Chinook (*Oncorhynchus tshawytscha*) and Chum Salmon (*O. keta*) abundances have reached historical lows. Environmental DNA (eDNA) has emerged as a potential monitoring tool for salmon, but interpreting eDNA concentrations depends on assumptions about how DNA is distributed across space and time in subarctic rivers. These assumptions remain largely untested during extremely low salmon abundance. Here, we

quantified variation in salmon eDNA temporally across sampling dates, longitudinally among sites, and laterally across river cross-sections. We collected eDNA samples at seven sites along the Chena River, a key Yukon River tributary, before, during, and after migration in 2022. Sites were selected based on proximity to spawning grounds to capture eDNA concentrations above, within, and below the core spawning regions. At two of these sites, we also sampled laterally across a river cross-section. Using species-specific quantitative polymerase chain reaction (qPCR) assays, we quantified Chinook and Chum Salmon DNA and evaluated spatiotemporal variation in eDNA concentrations. Building on prior work linking eDNA concentrations to salmon abundance at escapement assessment sites in the Yukon River Basin, this study examined whether spatiotemporal heterogeneity affects how well single-point, daily sampling represents salmon presence and relative abundance. While previous studies have documented eDNA-abundance relationships in smaller streams with higher salmon densities, this study provides the first evaluation of eDNA distribution in a larger river during historically low salmon runs. Our results inform when and where eDNA sampling is most effective and guide the design of eDNA monitoring efforts in data-limited, climate-impacted river systems.

Evaluation of spill operation effects on the passage behavior and survival of spring migrant smolts at Little Goose Dam, 2025

Professional

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Court-ordered Spring spill at federally operated hydroelectric dams of the lower Snake and Columbia rivers has been implemented since 2018 to improve survival and reduce powerhouse passage and hydrosystem travel time of salmonid smolts at the expense of power generation. An acoustic telemetry study was conducted during the spring of 2025 to evaluate the effect of spill operations at Little Goose Dam (LGS) on the forebay residence time, dam passage routing, dam passage survival, and tailrace egress time of yearling Chinook salmon and juvenile steelhead relative to past studies conducted during lower spill operations. A total of 1735 yearling chinook salmon and 2212 juvenile steelhead were implanted with a Juvenile Salmon Acoustic Telemetry System (JSATS) transmitter and released upstream of Lower Granite Dam, which is the next dam upstream of LGS on the lower Snake River. Autonomous and cabled acoustic telemetry receivers were deployed at and downstream of LGS to evaluate passage behavior and survival. Preliminary results indicate that dam passage survival was slightly higher for Chinook salmon that passed during maximum spill operations (S = 0.992; SE = 0.004) compared to those that passed during lower (30%) spill operations (S = 0.971; SE = 0.009). Dam passage survival was similar for steelhead that passed during maximum spill operations (S = 0.988; SE = 0.004) and 30% spill operations (S = 0.992; SE = 0.005). Higher spill levels resulted in a greater percentage of smolts passing LGS via the spillway (92–95%) compared to past studies (56–70%). Survival probability from LGS to Lower Monumental Dam, which is the next dam downstream of LGS, was about 2 to 4 percentage points lower in 2025 compared to past studies.

Temporal comparison reveals weakened association between genotype and phenotype at a major-effect locus in Dworshak hatchery steelhead

Professional

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Life history diversity in salmonids contributes to population resilience, yet the mechanisms driving contemporary life history change remain difficult to disentangle from demographic and

environmental effects. We evaluated long-term changes in genetic variation, adaptive haplotypes, and life history traits in the Dworshak National Fish Hatchery steelhead (*Oncorhynchus mykiss*) broodstock by comparing archived scale samples from founding broodstock (1969–1976) with contemporary samples (2014–2016; 2019–2022). Neutral genetic diversity and population structure remained stable through time, indicating no evidence of genetic drift, bottlenecks, or erosion of diversity. In contrast, we detected significant temporal shifts in adaptive variation at chromosome 25 near the six6 locus, including a decline in the long haplotype historically associated with extended ocean residence and larger body size. Ocean age composition also shifted over time, with an increased proportion of 2-ocean fish and altered age distributions within six6 genotype classes. Although six6 genotype remained significantly associated with length-at-age, the magnitude of phenotypic differences among genotypes was substantially reduced in contemporary samples, indicating a weakening of genotype-phenotype relationships. These results suggest that environmentally driven plasticity increasingly constrains the expression of genetically based life history variation. Our findings demonstrate that life history change can occur without loss of neutral genetic diversity and highlight the importance of integrating genetic and demographic data to understand eco-evolutionary responses of salmonids under changing ocean conditions.

Warner Sucker: On the Road to De-Listing

Professional

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The Warner Sucker *Catostomus warnerensis* is a long-lived endemic that occupies the low-gradient reaches of three major streams and a chain of ephemeral lakes in the Warner Basin in southeastern Oregon, northwestern Nevada, and northeastern California. The species was federally listed as threatened in 1985 due to threats including reduced range, habitat fragmentation, and the proliferation of nonnative game fishes in the lakes cited. A 1991 Recovery Plan listed three recovery criteria: 1) A self-sustaining metapopulation is distributed throughout the creeks and lakes; 2) Passage is restored within and between streams; and 3) No threats exist that would threaten the species' survival. Recovery efforts to date have largely focused on restoring fish passage and screening around diversion dams. Early efforts in the 1990s (e.g., Denil weir, portable fish ladders) proved unsuccessful, but the formation of the Warner Basin Aquatic Habitat Partnership (WBAHP) in 2017 accelerated the restoration of fish passage in the basin with designs customized for Warner Sucker. This collaboration of local, state, and federal agencies is working closely with landowners in the valley to rebuild irrigation infrastructure with fish passage, via a Focused Investment Partnership (FIP) grant with the Oregon Watershed Enhancement Board (OWEB). By the end of 2026, the major diversion structures will have upstream fish passage, a noteworthy success from the collaborative work of the WBAHP and the OWEB FIP. Several challenges remain on the road to de-listing. These include screening major diversions, developing a monitoring framework to confirm populations remain self-sustaining, ensuring that the operation of irrigation infrastructure continues to support fish passage, and assessing and mitigating the potential future impacts of climate change. Additionally, questions remain about the impact of non-native fish and whether parts of the irrigation network could be considered functional habitat.

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

Professional

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From previous work we determined that the Deschutes stock of spring Chinook salmon reared at the Round Butte/Pelton Ladder complex on the Deschutes River, Oregon were relatively large throughout the rearing process, had relatively high rates of precocious male maturation (age-2 minijacks), and had high rates of fish returning as age-3 jacks. Along with hatchery managers, we designed an experiment to assess if rearing fish at smaller size but a higher abundance would affect smolt quality, adult return rates, and age structure of returning adults. Two treatment groups ("big" vs. "small") were produced over five consecutive release years. The "big" treatment was raised to a smolt release size of ~8 fish/lb with a density of 80K fish/raceway (low abundance) while the "small" treatment was raised to a smolt release size of ~15 fish/lb with a density of 150K fish/raceway (high abundance). Smolt quality (i.e. gill ATPase, lipid levels, condition factor) was similar for big and small treatments. However, rearing more fish to a smaller body size reduced the rate of early male maturation by >50%. Additionally, rearing fish to a smaller release size reduced the number of age-3 returns and resulted in similar, but slightly more age-4 returns. These results show an overall shift of mean age at return: 2.91 years and 3.15 years for the big and small treatments, respectively. The biggest takeaway from this study is that rearing smaller fish, but more of them, can increase the total number of age-4 fish returning while reducing the number of both minijacks and jacks. This research provides insights into how changing rearing protocols could help optimize production and improve adult returns.

Beyond Bottlenecks: Impoundment-Driven Shifts in Lower Trophic Levels of the Columbia River Food Web

Professional

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Mainstem Columbia River Dams have modified food webs in many ways, some of which are readily apparent. For example, dams create migration bottlenecks, where migratory fish congregate and create artifical feeding grounds where they can be easily and noticeably exploited. But dams have also facilitated changes to lower trophic levels that are less apparent but potentially more consequential for food webs that once supported large salmon runs. Historically estuarine, two malacostracan crustaceans, *Neomysis mercedis* (Oppossum Shrimp) and *Palaemon modestus* (Siberian Prawn) have extended their range at least 700 km upstream through impounded reaches of the Columbia and Snake rivers. While their abundance in Columbia Basin Reservoirs can rival that in native habitats, both taxa favor lower water velocities and greater depths associated with forebay reaches. The magnitude of food web repercussions of Siberian Prawns, *Neomysis*, and other lower trophic level shifts mediated by impoundment is largely unexplored.

Modeling potential Chinook salmon and steelhead habitat in Snake River's blocked area upstream of Hells Canyon, Idaho

Professional

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The upper Snake River Basin has been blocked to anadromous salmonids by construction of hydroelectric projects since the late 1890s, culminating with Hells Canyon Dam in 1967, the most downstream (rkm 398) project without fish passage. The feasibility of reintroducing anadromous salmonids into the blocked area requires information about the suitability of stream reaches for rearing and spawning. The project area under consideration for reintroduction efforts is comprised of seven large watersheds containing over thirteen thousand perennial stream

reaches indexed to the National Hydrography Dataset. Our primary objective was the characterization and identification of potential rearing and spawning habitats for Chinook salmon and steelhead in the blocked area upstream of Hells Canyon, Idaho. We created and tested spatial models of rearing and spawning habitat with channel morphology, hydrology, and stream temperature variables obtained from regional peer-reviewed datasets. Models were challenged with set-aside data comprised of randomly selected reaches and independent eDNA data. In addition, we created a habitat index model for each species by converting rearing and spawning model probabilities into binary format and overlaying and summing by reach, resulting in a habitat index from zero to three. The best models contained predictors of August stream temperature, summer flow, and channel slope, but model covariates differed by species and life stage. Model accuracies ranged from 72% to 92% depending on the species and model covariates. In total, there were > 2,000 km of predicted rearing and spawning habitat for both Chinook salmon and steelhead. We identified abundant amounts of potentially suitable Chinook salmon and steelhead habitat throughout much of the blocked area. Additional screening of reaches will occur using local knowledge, but the habitat index model provided a foundation for planning and screening purposes.

(HT)-qPCR Is The Reel Deal: A High-Throughput Approach To Native Fish Conservation Efforts In The Umpqua River Basin

Professional

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Freshwater ecosystems are a complex web of biotic and abiotic interactions with various elements influencing the species distributions. It is important to consider how co-occuring species and abiotic factors might influence seasonal distributions of native species. eDNA has become a valuable tool owing to its sensitivity and non-invasive nature, however when used in single species applications it fails to capture the co-occurance of other species. The use of a high throughput (HT)-qPCR platform bridges the gap between the sensitivity and cost efficiency of single taxon (ST)-PCR and the broader taxonomic coverage of eDNA metabarcoding, thus offering a middle ground for eDNA workflows by allowing investigators to simultaneously probe thousands of samples on a nanoliter scale with multiple (ST)-qPCR assays to capture community data across a wide temporal and geographical range. Using a SmartChip we cataloged the seasonal basin-wide distribution of seven fishes and three mussels in the Umpqua River basin, Oregon, United States: Umpqua chub, coho salmon, coastal cutthroat trout, Pacific lamprey, Umpqua pikeminnow, redside shiner, smallmouth bass, western pearlshell mussel, western ridged mussel, and Oregon floater mussel. We then demonstrate the value of this detection dataset in a spatial occupancy modeling application for the endemic Umpqua chub, a species of conservation concern and a candidate for listing under the Endangered Species Act, and the nonnative smallmouth bass. The model estimated the effects of environmental covariates and residual species interactions, and generated spatially continuous predictions across the basin. Results were consistent with a narrow and fragmented distribution of Umpqua chub populations and suggested avoidance of bass-dominated habitats (e.g., large, warm streams) underscoring the synergistic threat posed by invasive species and warming patterns and demonstrate the utility of HT-qPCR to capture spatially intensive community data.

Evolving Fisheries Management in Idaho; Respecting the past and preparing for the future

Professional

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Fisheries management operates at the intersection of dynamic ecological, social, and political conditions. Conserving native fish species while sustaining fishing opportunities increasingly depends on cooperative approaches that maximize limited resources. As challenges grow more complex, fisheries managers must collaborate and innovate—developing advanced tools, adaptive policies, and robust information systems—to ensure native fish persist and recreational opportunities remain available for future generations.

Eradicating brook trout in northern New Mexico: What has been learned in eight years of pairing the Myy approach with mechanical removals

Professional

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Non-native species are one of the primary threats facing freshwater ecosystems and considerable research has focused on developing methods to eradicate or reduce their abundance. One such method includes the development of non-native male fish with two Y chromosomes (Myy) that are stocked into wild populations. When these fish mate with wild females, 100% of their progeny are males. Over time, this approach can skew the sex ratio to all male and lead to the decline and potential eradication of the population. Since 2018, biologists from New Mexico State University and the New Mexico Department of Game and Fish have used the Myy method paired with mechanical removal to manage non-native brook trout (Salvelinus fontinalis) in three isolated, northern New Mexico streams. Research and monitoring on these systems have been ongoing to assess the feasibility of eradicating non-native brook trout with a combination of these removal strategies. Broadly we have observed an 80.1 - 92.2% decline in wild brook trout abundance and a consistent, albeit variable, increase in the proportion of males among our three study streams. In this retrospective, we reflect on lessons learned over the last eight years of pairing the Myy approach with mechanical removals. We review previous research comparing the survival and reproductive output of Myy fish with wild counterparts and assessing how variation in vital rates (i.e., survival and reproduction) affect predicted time to extirpation. Finally, we consider what questions remain unanswered as this work is expanded to other species and regions.

White Sturgeon Passage in the Columbia River Basin: What We Know and What Needs to Change

Professional

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Construction of the Federal Columbia River Power System fragmented a once-continuous white sturgeon *Acipenser transmontanus* population into functionally isolated subpopulations. Fish passage facilities built for salmon have largely failed to reconnect them. This presentation synthesizes current research on upstream and downstream migration, passage facility performance, and emerging design standards to identify priorities for management action. Dam-by-dam passage count data reveal a stark geographic gradient: The Dalles Dam passes 45–382 sturgeon annually, Bonneville 11–129, and counts approach zero above McNary Dam. Mid-Columbia PUD projects have recorded essentially no confirmed upstream ladder passage across years of monitoring. PIT tag analysis at Bonneville Dam (Cox, 2025) indicates that most ladder detections reflect feeding behavior rather than spawning migrations, with subadult-sized

fish (70–140 cm) predominating. Effective sturgeon passage requires design features incompatible with standard salmonid ladders: full-depth bottom guidance, minimum orifice dimensions of 0.75 m wide by 1.0 m high, water depths exceeding 1.0 m, alternating high-velocity (0.84–2.52 m/s) and rest zones (0.51–0.68 m/s), and entrance locations positioned where sturgeon naturally congregate. The 2024 USFWS Passage Guidelines for the Pacific Northwest formalize these criteria and establish a 95% passage performance target, which is a standard no existing Columbia River structure currently meets for this species. The 2013 Columbia Basin White Sturgeon Planning Framework concludes that biological knowledge now exceeds management action. Moving forward requires barrier removal where feasible, sturgeon-specific retrofits at existing structures, and adaptive monitoring at both the individual dam and metapopulation scale.

Early effects of multi-phased adaptive management and restoration on an estuarine habitat mosaic

Professional

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Estuaries within Puget Sound once comprised a rich habitat mosaic that connected the rivers flowing from the mountains with the saltwater of the Salish Sea. With European settlement, much of the estuaries of Puget Sound were converted to farmland. To reverse habitat loss and jump start estuary ecological function will require the work of stakeholders, restoration practitioners and scientists from a variety of disciplines and organizations. Here, we describe one such effort, the ongoing restoration and adaptive management projects within the Stillaguamish Tidal Delta. Using best available science, the Stillaguamish Tribe of Indians and the Nature Conservancy have collaboratively restored and adaptively managed two adjacent projects near the mouth of the Stillaguamish River. The central action of these projects was the multi-phased construction of new distributary channels that connect through both areas. This novel restoration technique is different from dike set back restoration in that it not only creates additional rearing habitat for juvenile Chinook Salmon from the Skagit, Stillaguamish, and Snohomish Rivers, but will also redistribute freshwater across the estuarine habitat mosaic. These actions are hypothesized to not only influence the physical habitat,(i.e. water temperature and salinity) but also change how the Stillaguamish River Summer/Fall-run Chinook Salmon are distributed across the landscape. Phase One of adaptive management was completed in fall of 2023 and Phase Two of adaptive management was completed in the fall of 2026. Here, we present five years, (2021-2025) of water temperature, salinity, and genetic stock identification data. These years cover three years pre-adaptive management and two years of Phase One adaptive management, allowing us to demonstrate early physical habitat and ecological responses to these projects. We will also discuss the future of monitoring within the Stillaguamish Tidal Delta now that Phase Two has been completed.

Examining the vertical distribution of Pacific halibut as they encounter a groundfish bottom trawl

Student

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The U.S. West Coast groundfish bottom trawl fishery is a major economic driver for Oregon, Washington, and California coastal communities, bringing in an estimated $46 million in ex-vessel value in 2023. In the U.S. West Coast groundfish bottom trawl fishery, fishers target a variety of species such as sablefish (*Anoplopoma fimbria*), rockfishes (*Sebastes* spp.), lingcod (*Ophiodon elongatus*), and flatfishes, but are prohibited from retaining Pacific halibut

(*Hippoglossus stenolepis*, hereafter halibut). Recent regulation changes in the bottom trawl fishery now allow high-rise trawls (i.e., trawls with a headrope height >1.5 m above the seafloor) in areas where previously only low-rise trawls (i.e., trawls with a headrope height <1.5 m above the seafloor) were permitted. To determine if this regulation change could have an impact on halibut catches, I constructed a separator trawl to vertically separate halibut into two groups; halibut that would be caught in a low-rise trawl versus halibut that would only be caught in a high-rise trawl. I also attached LED light clusters to the wing tips and upper bridles of the trawl for approximately half the tows conducted to determine if artificial illumination could have an impact on halibut catch. My study found that for both illuminated and non-illuminated tows, using a low-rise trawl will reduce halibut bycatch by 21% and 16%, respectively. I also found that the addition artificial illumination reduced halibut bycatch by 52% in the low-rise trawl and 49% in the high-rise trawl. Finally, in a comparison between an illuminated low-rise trawl and non-illuminated high-rise trawl, I found that the illuminated low-rise trawl will reduce halibut bycatch by 58%. These results indicate that trawl design can affect halibut bycatch and that artificial illumination may also help to reduce their bycatch.

The Effect of Intermittent Cyclic Fasting in Juvenile Chinook Salmon Growth and Disease Resistance

Student

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Exact timing of feed acquisition in rivers is unknown for Chinook Salmon (*Oncorhynchus tshawytscha*). In a hatchery setting, feed likely arrives in a predictably large influx. The Wild Fishes Surrogate Project rears Chinook Salmon in a hatchery setting so that their resulting phenotype is similar to a naturally produced phenotype. We investigated intermittent cyclic fasting over the previous three years, examining interaction effects of intermittent fasting with diet on body composition, disease resistance, gut microbiome, and the stress response. Fasting cycles consisted of feeding periods for 96h and fasting periods of 72h. During the feeding period, fasted fish were given the same amount of feed in total as their unfasted counterparts. We found that fish fed a conventional hatchery diet in conjunction with intermittent cyclic fasting had the same growth and body composition as fish that did not experience fasting. After a month of consistent daily feedings, fish with fasting experience were better able to tolerate a week of fasting compared to their unfasted counterparts. In a separate experiment, we found that fish fed a low-lipid diet in conjunction with intermittent cyclic fasting exhibited higher disease resistance when challenged with *Aeromonas salmonicida*. Taken together, we provide evidence that intermittent fasting during juvenile Chinook Salmon's primary growth phase is not detrimental to growth and may reduce susceptibility to disease.

From Ivory Tower to River Corridor: OSU-Cascades and a Deschutes RiverLab for Applied Fisheries, Hydrology, and Restoration Ecology Learning

Professional

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There is a persistent missed opportunity for academic researchers and students to partner with resource managers in ways that advance applied science and management while offering students perspectives and skills by working with practitioners on real-world problems. Natural resource managers often lack time and funding to monitor restoration and fisheries recovery to the degree they would like. Academic researchers can drift toward "ivory tower" questions that are not aligned with management priorities or complex field conditions. Meanwhile, undergraduates can complete their degrees with limited field experience, missing out on the

knowledge, skills, and confidence that hands-on work provides. In this session on a proposed Deschutes "RiverLab," we highlight transdisciplinary collaborations in the Deschutes Basin between OSU-Cascades and local partners that simultaneously strengthen undergraduate education, support real-world management, and generate scientific advances. Example efforts include monitoring hydrologic conditions, fire effects, and process-based restoration. At OSU-Cascades, place-based learning and field components are central to Natural Resources and Environmental Science courses. Likewise, a defining feature of a RiverLab is tight coupling of research with workforce development through field-based education. Stream restoration research and monitoring can therefore serve dual purposes: (i) producing evidence of restoration effectiveness and (ii) creating opportunities for undergraduates to work as research technicians and participate in field-intensive coursework. Students visit active restoration sites, learn restoration methods and design considerations, interact directly with practitioners, and contribute data that inform local management while advancing broader restoration science. We conclude with transferable opportunities and challenges for transdisciplinary partnerships.

Reintroduction of Pacific lamprey to upper Willamette tributaries following decades of habitat inaccessibility

Professional

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Pacific Lamprey (*Entosphenus tridentatus*) numbered in the millions at Willamette Falls, but spawners declined due to habitat fragmentation, blocked passage, and development. Non-tribal commercial harvest once killed hundreds of thousands, but abundance is so low that even tribal harvest of a few hundred fish is difficult. Because larvae filter water and adults deliver marine-derived nutrients to freshwater ecosystems, lamprey declines have had cascading ecological consequences. In 2025, Pacific Lamprey were reintroduced to five Willamette River tributaries blocked by major dams: Detroit (North Santiam), Green Peter (South Santiam), Cougar (McKenzie), Hills Creek (Middle Fork Willamette), and Fern Ridge (Upper Willamette). These sites were selected through inter-agency technical review and confirmed extirpated using eDNA. CRITFC, along with Yakama Nation, Confederated Tribes of the Umatilla Indian Reservation, Confederated Tribes and Bands of Warm Springs, and Nez Perce Tribe—translocated 50 adults to each location. The goal is to reestablish larval production in areas where lamprey were extirpated 70+ years, with the potential to generate up to 2.5 million offspring per site. Monitoring will include eDNA sampling to evaluate whether predicted spawning habitats were used, followed by assessments of larval and juvenile downstream passage and, ultimately, adult returns to Willamette Falls. Additional infrastructure will be required for long-term evaluation. This tribal-led restoration effort was supported by numerous partners, including the Confederated Tribes of Grand Ronde, Confederated Tribes of Siletz Indians, USDA, USFWS, ODFW, Oregon Zoo, PGE, ACOE, McKenzie River Trust, Pacific Crest Council, and local watershed councils. A captive cohort at the Oregon Zoo will further inform strategies through survival comparisons of overwintered versus directly released adults. Together, these efforts provide a model for restoring lamprey to dam-fragmented river systems.

Effects of River Restoration and Hydropower in the Columbia River Basin on Anadromous Fish: State of Knowledge and Vision for Future Research

Professional

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Recovery of Pacific salmon in large river systems such as the Columbia River Basin (CRB) has been challenged by complex life cycles, which integrate conditions experienced across

freshwater, estuarine, and marine habitats. In this context, hydropower development has fundamentally altered flow, temperature, sediment, and connectivity, affecting survival at multiple life stages. This presentation takes a large-scale view of river restoration as a mitigation tool for hydropower impacts on anadromous salmonids, using the CRB as a model system. We view restoration strategies in terms of their capacity to alleviate constraints on population growth at critical points in the life cycle, from natal habitats and juvenile downstream migration through hydropower systems to adult upstream return. We review the current state of knowledge on interactions between hydropower, river restoration, and salmonid populations in the CRB, and identify key uncertainties that limit understanding across spatial and temporal scales. A central challenge is measuring and modeling environmental and biological processes at both fine and basin-wide scales in ways that capture cumulative life-stage effects and long-term population consequences. We highlight emerging conceptual, monitoring, and modeling approaches with promise to support the integrated multi-scale understanding that is critical for improving salmon resilience in the CRB. This inherent complexity emphasizes the importance of coordinated efforts among researchers, regulators, managers, and practitioners.

Out of Sight: Freshwater carryover effects drive shifting marine migration timing and declining visibility to NOAA ocean survey

Professional

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Interior Columbia River spring/summer Chinook salmon (*Oncorhynchus tshawytscha*) are incredibly important culturally and economically but remain at critically low abundances. While annual marine trawl surveys provide early indicators of year-class strength, they offer only "snapshots" of a population in rapid migration. Current interpretations often overlook interannual variation in migration timing, which can bias estimates of the proportion of the population intercepted by sampling. We developed a mechanistic Integral Projection Model (IPM) to simulate the outmigration of the Snake River Evolutionarily Significant Unit (ESU) from Bonneville Dam through the Northern California Current. Integrating 25 years of NOAA and DFO trawl data, acoustic telemetry, and dam passage records, we evaluated how freshwater conditions and marine movement speeds influence population distributions (summarized as centers of gravity) as well as survey "visibility." Results: Interannual variation in ocean distributions stems from dam passage timing, conditions in the Columbia River plume, and ocean survival and migration rates. Model selection favored marine migration speeds of 15-18 km/d, consistent with several previous estimates. Notably, a long-term shift in outmigration timing has increased population visibility in May (38% to 57%) while causing June visibility to plummet (20% to 6%) over the study period. This computationally efficient framework standardizes marine survey data by accounting for the spatiotemporal progression of the run. By quantifying how hydrosystem management (e.g., dam spill, transportation) influences marine distribution, this model provides fisheries managers with a real-time tool to improve adult return forecasts and optimize ocean research in a changing climate.

Econometric Models for Estimating Costs for Salmon Habitat Restoration in the Northwest USA

Professional

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In the United States, hundreds of millions of dollars are spent each year restoring habitat to promote recovery of salmon populations that have been “listed” under the U.S. Endangered

Species Act (ESA), but none of these populations have yet recovered sufficiently to warrant delisting. To achieve the greatest recovery possible given limited resources, managers need to be able to determine which actions contribute the most to recovery per dollar spent. This requires methods to evaluate how alternative restoration actions will impact growth and stability of salmon populations, but also tools to estimate the costs of those actions. In this paper we present statistically estimated models of cost of a variety of salmon habitat restoration actions using data from projects completed over the last two decades in Oregon and Washington. Our models provide a means to estimate costs for some of the most common salmon habitat restoration actions that are expected to impact future salmon population abundance and productivity including barrier removals to reopen habitat, increasing instream wood abundance, riparian shading, increasing channel complexity, and floodplain restoration and connection. These models can contribute to strategic planning by providing a means to easily estimate costs of alternative habitat restoration scenarios that may contain hundreds of individual restoration actions spread over large areas. Pairing these cost models with biophysical models that link conservation actions to salmon survival can enable analysts to evaluate and compare the return on investment (ROI) or relative cost-effectiveness of alternative portfolios of restoration actions and understand how the type, scale and location of restoration actions impact cost-effectiveness.

The role of the Council's Fish and Wildlife Program to mitigate hydrosystem effects in relation to other efforts in the Columbia Basin

Professional

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Guided by the Northwest Power Act of 1980, the Northwest Power and Conservation Council's Fish and Wildlife Program represents a 45-year effort to protect, mitigate, and enhance fish, wildlife, and habitats affected by the hydropower system in the Columbia Basin. The construction and operation of the hydropower system has long been recognized as one of the major limiting factors for anadromous and resident fish in the basin. The F&W Program specifically addresses this factor by including numerous actions to modify the structure and operation of the hydrosystem (e.g., flow or passage). The Program also includes actions such as habitat restoration and protection, artificial production, or management of invasive or predatory species that are meant to improve survival in other habitats or life stages, to offset mortality that cannot be addressed at the dams. In this talk, we present the most recent iteration of the F&W Program, how it is developed, implemented, and evaluated in an adaptive management framework, and how it is responsive to changing conditions in the basin over time. In addition, we discuss how implementation of the F&W Program occurs in tandem with efforts implemented under complementary authorities- such as habitat restoration associated with ESA recovery efforts, or hatchery production associated with other mitigation programs. The results of these multiple efforts influence the success of the F&W Program, and vice versa. While the scope and investment in the Council's Program make it one of the largest fish and wildlife mitigation efforts in the world, its long-term success will rely on continued collaboration and coordination with other restoration, recovery, and mitigation efforts in the basin to address ongoing and emerging challenges.

Juvenile Salmonid Response to Reconnected Tidal Floodplains in a Working Lands Estuary

Professional

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The Coquille basin, located on the Southern Oregon Coast, has seen significant estuary habitat loss since the beginning of European settlement. Yet it remains as critical rearing habitat for juvenile salmonids and a focus of local restoration actions. This presentation summarizes multi-year findings from the Lower Coquille Tide Gate and Fish Passage Monitoring Program that evaluates how modern tide-gate technology and adaptive water-management strategies influence juvenile coho salmon growth, movement, and residence patterns within restored off-channel habitats embedded in privately and publicly owned “working lands” developed through multi-partner collaboration. Results indicate strong interannual variability in habitat use linked to the annual flow regime of the Coquille River, with increased occupancy of non-tidal sites during high-water years and frequent cross-site movement—approximately one quarter of tagged juveniles visited two or more restoration areas. Residence time scaled with project size, and recapture growth rates at restoration sites consistently exceeded inferred growth at the sites, underscoring the ecological lift potential of even partially reconnected floodplains. Long-term monitoring proved essential for capturing variability in fish behavior and environmental drivers, revealing that short-duration datasets would underestimate both habitat value and system complexity.

Salmon Age Structure and Abundance Through Time: Zooarchaeological Evidence from the Skagit River Delta, WA

Student

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Archaeological fish remains from several sites in Washington State's Skagit River system provide a rare opportunity to examine both salmon age structure and abundance patterns since approximately 700 years BP. In this study, we utilized a vertebrae-based aging analysis of salmon remains. Our initial results show fish age-at-harvest in deep time was similar to age-at-maturity in postcolonial populations. These preliminary data indicate there is stability in salmon age structure since 700 years BP in the Skagit River system. We pair vertebrae-based ageing with abundance estimates calculated using simple ratios (number of individual salmon specimens/total fish). Temporal analysis indicates that salmon relative abundance decreases through time, contradicting regional patterns observed in Pacific Northwest riverine sites. These findings offer greater contextualization and data on precolonial salmon abundance in river and slough systems and demonstrate how legacy collections, when paired with rigorous aging methodologies, can reveal deep-time patterns relevant to contemporary fisheries management and habitat restoration priorities.

Tamamta (All of Us): Transforming Western and Indigenous Fisheries and Marine Sciences Together

Professional

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The Tamamta program seeks to transform fisheries education, research, and governance systems in Alaska and beyond. We are motivated by deep systemic inequities, Indigenous erasure, racism, and continued violence against Alaska Native peoples, and we strive to uplift Tribal sovereignty, Indigenous values, governance practices, and knowledge systems. We envision a future where Indigenous Peoples and our/their knowledge and governance systems steward land, fish, and animal relations. Our program supports three cohorts of Indigenous and allied students to pursue their graduate degrees in western and Indigenous fisheries and marine sciences. We are working to decolonize and Indigenize our curriculum, programs, and

institutions. We are hosting difficult dialogues, providing short courses, and cultural exchanges for state and federal partner agencies to join this collective transformation. In this work, we center deep relational work based on reciprocity, respect, and redistribution. We will share our origin story, our work over these first five years, and some opportunities and challenges along the way.

How can we improve tool co-production in Columbia River DART and Central Valley SacPAS?

Professional

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Fish and river management occurs adaptively across years with pre-/post-season information, and dynamically through seasons with real-time information. The relevant information often requires data integration from multiple sources, and value-added summarizations into appropriate and usable metrics. Missing steps between data observation and actionable outcomes exist as knowledge-action gaps. Some gaps stem from: a lack of awareness and access to data; data displays that miss value-added meaning and relevance to actions; and predictions that fail to incorporate the latest data and biological mechanism. For over three decades, Columbia Basin Research has sought to fill these gaps by providing public access to historical, real-time, and forecasted data and analysis tools, through a centralized repository of integrated data from federal, state, tribal and local agencies. We highlight select online tools developed in collaboration with data owners and users of Columbia River Data Access in Real Time (DART, www.cbr.washington.edu/dart) and Central Valley Prediction & Assessment of Salmon (SacPAS, www.cbr.washington.edu/sacramento/). Some of the most relevant and well-used tools were developed through co-production and are maintained through a cyclic process of refinement, adaptation, and deepened connections. We discuss the importance of continued collaboration and feedback from diverse users in building relevant metrics and functionalities into our tools with the aim of reducing knowledge-action gaps. In this context, we would like to learn what gaps we may have overlooked, and we seek collaboration with the wider resource management community in improving our services for and with practitioners and managers.

Columbia Basin Restoration Initiative Developed by the Yakama, Umatilla, Warm Springs and Nez Perce Tribes and the States of Washington and Oregon

Professional

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The Columbia Basin Restoration Initiative (CBRI) represents the collaborative effort of four Columbia Basin tribes and two states, collectively recognized as the Six Sovereigns, to develop a comprehensive solution to their shared and complex challenges in addressing salmon extinction and energy demand on the Columbia River. The CBRI is intended to be used as the basis for discussions on priorities for CRB salmon recovery and rebuilding to advance "… a durable long-term strategy to restore salmon and other native fish populations to healthy and abundant levels, honoring Federal commitments to Tribal Nations, delivering affordable and reliable clean power, and meeting the many resilience needs of stakeholders across the region." The CBRI strives for a true win-win outcome for all beneficiaries of a healthy and resilient Columbia River Basin. Some parts of the proposed Initiative can and should be advanced by the Federal government under existing authorities and appropriations. Other elements will require Congressional support through additional appropriations or legislation, or both. Time is of the essence in both cases to meet the urgent needs of Columbia Basin fisheries

and communities, and the inevitable changes facing the Region. The CBRI identifies key elements and actions to accomplish the goals set forth by the Columbia Basin Partnership for thriving populations of salmon and steelhead. The Six Sovereigns are using a multi-pronged strategy to address pressing energy challenges and rebuild healthy and abundant fish runs in the Columbia River.

Canary in the Creekbed: Real-Time Evidence of 6PPDQ-Induced Mortality and Developmental Impairment in Coho Salmon

Student

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Storm events should renew salmon streams, yet in roaded watersheds they can deliver contaminant pulses that trigger acute coho mortality. Urban Runoff Mortality Syndrome (URMS) is a recurrent pattern of rapid mortality after stormwater exposure and is strongly linked to 6PPD-quinone (6PPDQ), a tire-wear transformation product. Juvenile coho reside in these watersheds for months to a year, but their risk has yet to be evaluated under field conditions that capture both ambient creek water exposure and storm-event 6PPDQ peaks.
We built a flow-through exposure facility on Miller Creek (Burien and Normandy Park, Washington), a stream that receives untreated roadway runoff and has recurrent coho mortality. In two phases, fish were reared in parallel in well water (control) or unfiltered creek water (treatment). Creek water reflected baseline conditions between storms and captured 6PPDQ spikes during runoff events. Phase 1 exposed juvenile coho across three spring storms. Creek water juveniles showed symptoms consistent with URMS and averaged 80% mortality. LC-MS/MS confirmed 6PPDQ peaks of 72 to 110 ng/L in 2 to 3 h composite samples during mortality windows. Phase 2 fertilized embryos on-site and reared fish to fry under the same exposure design. Creek water fry showed delayed yolk absorption, reduced cranial growth, and 29.9% lower caudal fin area, with reduced swim performance. In a 24-hour 6PPDQ challenge, control fry showed dose-dependent mortality, whereas creek water fry showed mortality only at 160 ng/L, four times higher than concentrations reported to kill half of naive fry in 24-hour laboratory tests. These results extend roadway runoff risk from a returning-adult crisis to a life-stage continuum shaped by episodic storms. In short, traffic generates the chemical, storms mobilize it, and drainage networks deliver it. Where high-traffic runoff is rapidly conveyed to salmon habitat, storm-event peaks are likely to set URMS risk and early-life performance outcomes.

Decadal Population Trends and Restoration Efficacy in the West Fork Smith River, Oregon

Professional

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Assessing the efficacy of instream restoration requires long-term trend data sets that account for regional environmental variability. This study utilizes a 28-year monitoring period (1998–Present) to quantify adult and juvenile salmonid responses to restoration and management in the West Fork Smith River, a bedrock-dominated basin in Southwestern Oregon. Control comparisons with control life-cycle monitoring study basins, regional ESU and sub-strata population trends. Furthermore, a unique 67-year spawning index (1958–Present) demonstrates that peak spawner abundance has effectively rebounded from pre-1980 lows following the implementation of passage improvements and $1.6M in habitat enhancements. These results underscore the importance of basin-scale modeling and overwinter survival data in guiding successful salmonid recovery.

Evaluating the contributions of natural and reconditioned repeat spawning female steelhead to spawning above Lower Granite Dam, WA: an interagency collaboration

Professional

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Natural-origin steelhead stocks above Lower Granite Dam (LGR) in the Columbia River Basin have declined sharply, increasing extirpation risk. Steelhead kelts are abundant but repeat spawners (RS) are rare (~1.2% above LGR). To supplement spawning above LGR, CRITFC and the NPT established a research-scale Snake River kelt reconditioning program (KRP). Natural-origin female steelhead kelts are captured, held, fed, and released to spawn again as Reconditioned RS. Natural RS repeat spawn without captive reconditioning. The goal of this study was to leverage long-term datasets and expertise from co-managers and collaborators (CRITFC, NPT, IDFG, and UI) to evaluate Reconditioned and Natural RS rates in the Snake River above LGR. We addressed 3 objectives: (1) quantify kelting rates to LGR, (2) quantify overall RS, and consecutive and skip spawning rates, and (3) evaluate the contribution of the KRP to RS above LGR. Efficiency rates for kelt detection during downstream migration through LGR were developed, revealing that an average of 79% of natural-origin female steelhead that migrated upstream through LGR were estimated to return downstream through LGR after spawning. This indicates that large numbers of female kelts are potentially available for reconditioning. Overall RS rates were comparable between Natural and Reconditioned RS but skip spawning rates were much higher in Reconditioned RS (77%) compared to Natural RS (29%), suggesting that the KRP is maintaining the skip spawning life history in Snake River steelhead. Finally, Reconditioned and Natural RS contributed approximately equally to the spawning population, indicating that the KRP is substantially increasing numbers of natural-origin repeat spawning females. As the kelt project transitions from the research to the production stage, this contribution should increase. Combining unique perspectives, datasets, and expertise from diverse agencies promises to maximize impact on steelhead recovery.

Science's role in hatchery management to support the U.S. Endangered Species Act

Professional

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Pacific salmon and steelhead hatcheries deliver benefits to commercial, recreational, and tribal fisheries, and play an increasingly important role in conservation and recovery efforts. Yet, despite these benefits, hatchery-origin fish pose risks to natural-origin populations. In accordance with the Endangered Species Act (ESA), NOAA Fisheries is required to conduct consultations that evaluate how hatchery programs affect ESA-listed Pacific salmon and steelhead, and to ensure that hatchery operations are not likely to jeopardize the continued existence of ESA-listed species. In many cases, hatchery programs directly take natural-origin fish for broodstock, and in nearly all cases hatchery programs indirectly affect ESA-listed species through ecological and genetic interactions. To evaluate the magnitude, direction, and scope of potential impacts from hatchery programs, NOAA Fisheries relies upon the best available science for both hatchery- and natural-origin populations. Contributing data are typically collected by federal, state and tribal hatchery co-managers, whose particular interests and concerns can differ and thereby influence the nature of available information. From the perspective of NOAA Fisheries' ESA consultation process and our obligation to use the best scientific information available, I will discuss the value of hatchery research, monitoring and

evaluation projects, highlight some common information gaps, and speak to the importance of open communication and timely coordination among hatchery co-managers.

Stewarding trust to restore habitat for fish

Professional

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In the Pacific Northwest, fisheries managers and fish conservation advocates rely on habitat restoration as a tool for protecting native fish such as salmonids, particularly as drought and wildfires intensify from climate change. One habitat conservation tool that has garnered considerable attention is partnering with North American beavers (*Castor canadensis*). In the current talk, we synthesize lessons learned from semi-structured interviews with 23 restoration practitioners in Oregon, USA to explore how professionals from government agencies, non-governmental organizations (NGOs), service organizations, and private businesses communicate with private landowners about nonlethal beaver management and habitat creation. Using abductive analysis, we identify trust-building as an essential element of habitat restoration practice. This includes 60 tactics restoration practitioners use to build trust, which we present using a combination of the Shared Foundations model of trust and the adaptive management cycle. Our findings also show that practitioners navigate tensions between tactics and adapting their approaches to individual landowners and restoration contexts. We discuss the implications of these trust stewardship practices for fisheries management and conservation, particularly in light of ongoing scientific debates about the benefits of beavers for fish.

Returning spatial structure and diversity to salmonid freshwater habitat and populations

Professional

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Salmonids evolved to exploit the spatio-temporal dynamics of healthy riverscapes. For more than two decades, ESA recovery plans, status assessments, and management actions have been guided by the Viable Salmonid Population (VSP) framework. The VSP framework consists of four components, Abundance, Productivity, Spatial Structure, and Diversity, and is based on the ecological and evolutionary principles of population resilience arising directly from diversity. The population health importance of Abundance and Productivity are readily apparent, and map directly to common population assessment methods based on stage-specific enumeration. However, Spatial Structure and Diversity based indicators of population health are less common, and no standardized analytical structure to address them was developed across all of the Pacific salmon ESU/DPSs at the time of ESA listing. Nonetheless, diversity is a key biological principle to apply in management and evaluation of salmon and steelhead population health because alternative ontogenetic pathways provide the capacity for within and between generation responses to the spatial and temporal variation in freshwater, estuarine, and marine rearing conditions. In freshwater environments alone, human modification has predominantly been in the direction of simplification and stabilization. The loss of floodplain connectivity, wood supply, and beaver wetland building, has reduced micro- to meso-scale habitat diversity through a reduction in longitudinal, lateral, and vertical structural complexity. Overall, riverscape simplification and stabilization results in niche space reduction and simplification, which has implications for all aspects of VSP. However, lowered abundance and productivity due to habitat

simplification is indirect; the population impacts of habitat simplification result from a loss of diversity and spatial structure. Management goals of population health through freshwater habitat process restoration will be more successful when targeting capacity for more types of fish, not just more fish capacity. Three decades post-ESA listings, it is time to revisit how we apply the VSP framework, in particular the Spatial Structure and Diversity elements, to find direction and inspiration for salmon and steelhead recovery and rebuilding.

Synthesis and integration of data and models for informed decision making across salmonid life cycles

Professional

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Across the Pacific Northwest, information has been collected for decades on salmonid demographic parameters, habitats, and environmental conditions. These data come from a wide variety of sources from field and laboratory studies to remote sensing. Through analysis of time series of population data and estimates of historical habitat conditions, we can estimate the magnitude of changes in fish abundance and habitat quality and quantity from pre-alteration to the present. Together, these data allow us to construct models of how salmon populations are likely to respond to changing conditions at each life stage from emergence in freshwater through maturity in ocean environments. These life cycle models provide a method to estimate effects from a variety and suite of management levers and changing climate and ocean conditions. We present some past and recent modeling applied examples that have helped to inform management decisions, and we highlight a life cycle modeling approach of recent work, HARP (Habitat Assessment and Restoration Planning model), that advances our efforts to understand potential population responses from freshwater habitat restoration efforts in the context of the whole salmon life cycle.

Evaluating the Trojan Y chromosome strategy for the removal of invasive Sacramento Pikeminnow from the Eel River, California

Student

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The introduction and spread of Sacramento Pikeminnow (*Ptychocheilus grandis*) in northern California's Eel River basin represents a significant threat and impediment to the recovery of several threatened native fish species. This study was undertaken to evaluate the Trojan Y chromosome (TYC) strategy for the extirpation of pikeminnow from the basin. The TYC strategy is a biocontrol method that relies on the production and stocking of fish with YY sex chromosomes, which may be phenotypically male (YY male or Myy) or female (YY female or Fyy). These YY fish produce all-male offspring when mating with their wild conspecifics, potentially leading to the extirpation of wild-type females over time. To evaluate the strategy, we constructed a mechanistic, individual-based population model to simulate a TYC Sacramento Pikeminnow stocking program. The specific study objectives were to (1) estimate the amount and time scale of YY Sacramento Pikeminnow stocking needed to achieve elimination; (2) evaluate how a TYC program would be affected by the rate of manual pikeminnow suppression, the relative survival of YY pikeminnow, and the phenotype of stocked YY fish (i.e., Fyy or Myy); (3) evaluate the mathematical feasibility of a TYC program for population reduction in an open system where elimination would not be possible due to influx from outside sources (e.g., a river tributary); and (4) identify key biological uncertainties for future investigation.

Fishing activity and the ichthyofauna of two rivers of Congo Basin (Boumba and Kadei) in Eastern Cameroon

Student

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Several studies have investigated the relationships between the forest, emblematic terrestrial animals and humans in the Congo Basin, the "second lung of the planet" after the Amazon rainforest; but very few studies have questioned the relationship between this forest, the aquatic biodiversity it shelters and its exploitation through fishing. In this context, this study carried out from December 2018 to May 2019 aimed to evaluate the fishing activity and the ichthyofauna of the Boumba and the Kadéi, two rivers in the Congo Basin. Fishermen, fishing gear, species and quantities caught were inventoried using pre-established survey sheets and monitoring of fishermen's landings. A total of 16 and 99 fishermen were recorded respectively on the Boumba and the Kadei. The latter, from one river to another, use as fishing gear, the gillnet (75%), the cast net (3%), the hooks (17%) and the Nasse (5%) and present CPUE values of 2.12kg/day on the Boumba against 3.12kg/day on the Kadei. Of the 845 fish specimens examined for this study, 56 species, 34 genera, 13 families and eight orders come from the Boumba and 70 species, 36 genera, 15 families and eight orders from the Kadei. According to the IUCN classification, almost all of these species are native to the Congo Basin and of least concern (LC). However, two species (*Bryconaethiops quinquesquamae* and *Synodontis pardalis*) are in danger of extinction and thus constitute a major conservation issue that should be taken into account in the conservation programs of riparian protected areas such as the Boumba bek National Park; one species (*Mormyrus iriodes*) is endemic to the Congo Basin; and another (*Mormyrus caballus*) remains to this day not evaluated by the IUCN.

Hatchery assisted re-introduction of salmonids post dam removal, utility or futility?

Professional

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The dam building era in the United States has generally concluded and the dam decommissioning era is in its nascent stages. The decommissioning of dams and the ability of anadromous fishes to return to their historic habitat presents questions regarding how best to restore salmonid and other native fish runs in these upper basins. Recent dam removals on the Elwha, Klamath and other rivers provide us with examples of how anadromous fishes recolonize their ancestral waters. The two dams on the Eel River are going through the decommissioning process and various options are being proposed to aid in recolonization. We examined the results of hatchery assisted and natural recolonization of salmonids in newly un-dammed basins, and the impacts of hatcheries on wild fish populations. We assessed the viability of the Chinook salmon population in the Eel River. We also investigated the current state of run-timing, life-history and overall genetic diversity in resident *O. mykiss* above Scott Dam on the upper Eel. Our results suggest the resident trout population above Scott Dam would be primed for reestablishment of steelhead post dam removal. In the vast majority of cases, hatcheries and/or trap and haul programs have been pre-emptively implemented. However, our research indicates active recolonization should be reserved for very particular situations and the Eel River dam removal is not one of these situations.

Contracting and expanding juvenile spring Chinook salmon rearing distributions across the Middle Fork John Day River

Professional

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During summer baseflow conditions, the availability and arrangement of thermally-suitable rearing habitat is a dominant control on the distribution of juvenile salmonids across watersheds, thereby influencing density-dependent processes, survival, and productivity. For spring Chinook Salmon, which hold through the summer and spawn in late summer, thermal conditions also exert control on the distribution of spawning locations, with potential carry-over effects on offspring rearing distributions the following year. In this study, we assess how inter-annual variability in environmental conditions, spawner abundance, and the spatial patterns of spawning locations interact to shape the mid-summer rearing distribution of juvenile Chinook Salmon across the thermally-heterogeneous Middle Fork John Day River (MFJDR) in NE Oregon. We conducted reach-level snorkel surveys in four years (2021, 2023, 2024, and 2025), with the spatial extent including nearly 70 kilometers of the mainstem and 9-20 tributaries each year. While we aim to build a long-term dataset that encompasses broad variability in environmental conditions and spawner abundances, initial findings indicate that spatial patterns of juvenile rearing distributions generally reflect the prior year redd distribution in cool years, but are contracted in warmer years and better explained by thermal conditions. We discuss implications of expanding and contracting spawning and rearing distributions on population-level density dependence and as further warming progresses with climate change.

Upstream migration in the Columbia-Snake River Basin: Lessons learned from two decades of adult salmon and steelhead biotelemetry projects

Professional

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Adult fish passage studies have a century-long history in Columbia Basin and has produced foundational behavioral studies and engineering design. The confluence of new technologies and ESA-listing of salmon and steelhead populations in the 1990s ushered a second wave of studies conducted in an adaptive management framework, frequently with evaluation of modified fishway structures or operations as primary study goals. At local scales, telemetry studies quantified individual movement rate, route selection, pinniped predation risk, and relationships with river environment and dam operations. Monitoring multi-dam reaches and movement into tributaries revealed patterns of survival, circuitous migration pathways, detection of natal plumes well below confluences, lower migration success by individuals passing fishways more slowly, and population-specific phenology. The delayed effects of transportation on migration behavior, success and straying were revealed by the combined use of PIT- and radio-tagging. The ability to intercept known-source fish in early migration allowed direct estimation of the energetic cost of migration. Early application of thermal biotelemetry revealed diverse thermal exposures and responses across species and populations, identified delay associated with thermal gradients in fishways, and potential interactions between behavioral thermal regulation and vulnerability to fisheries. Overall, the program has demonstrated generally high rates of passage success by adult salmonids resulting from a combination of biological traits and careful engineering and operational improvements. Continued areas of concern include the cumulative and delayed effects of thermal exposure, potential disease and prespawn mortality risk. Spring- and summer-run populations are more vulnerable to these risks than fall-run populations as conditions in the Columbia Basin continue to warm.

Molecular riverscapes show aquatic biodiversity shift following dam-removal on the Klamath River

Professional

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Global restoration and conservation of freshwater biodiversity are represented in practice by works such as the Klamath River Renewal Project (KRRP), the largest dam removal and river restoration in the United States, which has reconnected 640 river kilometers. With dam removals, many biological outcomes remain understudied due to a lack of pre-impact data and complex ecosystem recovery timeframes. To avoid this, we created the KRRP molecular library, an environmental specimen bank consisting of over 1,100 environmental samples collected along 114 river kilometers, for long-term curation of environmental nucleic acids collected from the restoration project. As an initial application of the KRRP molecular library, we used a Before-After Reference-Impact (BARI) study design and environmental DNA (eDNA) metabarcoding to evaluate changes in fish and herptile biodiversity in the Klamath River and tributaries between 2023 (pre-dam removal), 2024 (mid-dam removal), and 2025 (post-dam removal). We present the observed community composition changes following dam-removal and ecosystem restoration and the BARI molecular library as an effective and durable approach for archiving biological change in response to landscape-scale restoration.

A Kokanee Life Cycle Model: an adaptive management tool for the Lake Sammamish kokanee recovery program

Professional

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The Lake Sammamish kokanee population is in steady decline despite current efforts to recover the population including spawning, stream restoration, and hatchery supplementation. Program managers sought a quantitative framework to evaluate which life stage(s) are limiting recovery and which management strategies may help meet recovery goals. Our team created a kokanee life-cycle-informed population model. We used 10 years of observational data of Lk Sammamish natural origin and hatchery kokanee to estimate survival parameters for a model that contained three life stages 1) egg to fry, 2) fry to adult, and 3) reproduction. We then made management relevant adjustments to survival for either natural origin or hatchery kokanee at various life stages to explore the extent management actions might stabilize or restore the population. Our study suggests that low fry to adult survival in the lake is likely a limiting factor for the kokanee population that will be difficult or impossible to overcome with stream restoration or enhanced hatchery program efforts alone. This project demonstrates how collaboration and partnership amongst individuals and agencies can lead to the creation of a useful management tool that provides practical guidance. The project was made possible by leveraging partnerships created by the Lake Sammamish Kokanee Working Group. Members include: local and tribal governments, nonprofit organizations, local/state/federal agencies and residents of the Sammamish watershed. Specifically, these efforts were led by a King County Water and Land Resources team and would not have been possible without consultation and feedback from scientists with WA Dept of Fish and Wildlife and University of Washington's School of Aquatic and Fishery Sciences. Results from this model will be used to inform updates to priority management actions taken over the next 5 years.

Evolutionary diversification of Cutthroat Trout from western North America as defined by NextRAD sequencing data

Professional

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Cutthroat Trout are one of the most widely distributed fish in western North America that also exhibit significant intraspecific variation. Historically, this variation has been described using different subspecies names. Early taxonomic studies defined the range of different subspecies of Cutthroat Trout by major watershed boundaries and more recent genetic studies using mtDNA sequence data have confirmed that some subspecies can be organized by geographic boundaries. However, natural stream capture events connecting watersheds may have obscured major evolutionary branches of Cutthroat Trout as defined by mtDNA sequence data. Genome-wide sampling of Cutthroat Trout DNA promises to provide an unambiguous picture of the evolutionary history of Cutthroat Trout because it can avoid the problems associated with phylogenetic comparisons using maternally-inherited genes. In this study, we use NextRAD genotype-by-sequencing to obtain single nucleotide polymorphisms from throughout the genome of Cutthroat Trout. We compare samples from all major subspecies, and from throughout the geographic range of Cutthroat Trout to determine the major evolutionary branches of Cutthroat Trout and an indication of the geographic distribution of those divisions across watersheds. It is our hope that this work will provide some clarity in defining the distribution and extent of taxonomic and conservation boundaries for native Cutthroat Trout populations.

Influence of fall fork length on smolt migration survival in relation to Columbia River migration conditions for spring Chinook Salmon reared at Leavenworth National Fish Hatchery from 2010-2019

Professional

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As part of a larger study on the feasibility of using partial recirculating aquaculture systems (PRAS), this presentation will focus on the use of fall fork length as a surrogate metric to understand how conventional raceway management has influenced overall program performance. Fall fork length was chosen because it is the most common individual characteristic measured at most hatcheries concurrent with tagging of fish with Passive Integrated Transponder (PIT) tags. This dataset consisted of ~72,000 spring Chinook Salmon that were PIT tagged and measured for fork length in October of each year from 2010 to 2019. These fish were released from Leavenworth NFH each spring as 1-year-olds and we estimated survival to McNary Dam approximately 325 river km downstream. Yearly Columbia River migration conditions including flow and water temperature were used as covariates to account for year-to-year variation. These data were analyzed using the Cormack-Jolly-Seber model in Program MARK. We found a positive quadratic relationship between length and survival with survival increasing with length until about a length of 115 mm after which survival did not increase with length. Additionally, we found positive relationships between migration season water temperature and flow with survival. In future years these results will be used to guide comparisons between PRAS and conventional raceway rearing. For example, does a 115 mm fish have similar or different survival if reared in PRAS vs a raceway.

Mechanistic links between juvenile and adult Chinook salmon behaviors and survival in an Idaho Wilderness basin

Professional

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Recent decades have provided unprecedented advances in quantifying fish movements and how they underlie life history diversity and population structure. Large river stretches within Idaho Wilderness provides the basis for a better understanding of how salmon life cycle stages and habitats are connected within riverscapes of minimal anthropogenic disturbance. For 20 years, our work in this region has focused on understanding drivers of life history diversity in a large undisturbed watershed and how variation in this freshwater experience impacts adult survival and behaviors. In this work, we have combined collaborative tagging efforts in an intensively studied basin with an extensive understanding of within basin otolith microchemical variation to link juvenile and adult life cycle stages. Our results support other studies that demonstrate significant differences in juvenile growth rates, smolt size, time of ocean entry and survival to adulthood between juveniles that begin movements downstream early and those that rear for a full year in natal reaches. Individuals that overwintered in more downstream habitats grew more over winter, produced larger smolts, entered the ocean earlier and survived to adulthood at higher rates. Including spatially explicit chemical data from the otoliths of returning adults underscores how highly variable migratory behaviors are within this population and the diversity of habitats that are utilized throughout freshwater residency. Discrete recapture sites of tagged individuals provide critical information on juvenile migration timing and survival but greatly underestimates the suite of behaviors expressed in a wild population. Lastly, linking adults to specific juvenile behaviors demonstrates a potentially mechanistic link between the diversity of juvenile strategies and population resilience.

Adult Salmon Enteritis in spring Chinook Salmon; potential causes, distribution and links to prespawn mortality

Professional

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Adult salmon enteritis (ASE) is a severe intestinal disease in adult spring Chinook Salmon in Oregon and Washington, with associations to prespawn mortality (PSM). The disease is diagnosed by histology, with severe ulcerative enteritis and inflammation of the of the mid-intestine and pyloric caeca. We have been studying PSM in spring Chinook Salmon in the Willemette Basin since 2009, with examined fish approaching 1,000, representing healthy and PSM fish from the summer, fish spawned at hatcheries, and post-spawned fish from rivers. The severity of the lesions increase in fish through spawning, but is accelerated in PSM fish. *Ceratonova shasta* and *Enterocytozoon schreckii* are common in the intestines of fish with ASE, but many are not infected and thus neither are likely the primary cause. A controlled transmission study at OSU entailed exposing fish by oral gavage to affected tissues, where some recipient fish developed ASE-like lesions and were infected with both *E. schreckii* and a novel virus, but not C. shasta. In 2022-2025 we expanded our geographic survey for ASE, examining PSM fish and spawners from hatcheries including populations connected to the Columbia River (Willamette, S. Santiam, Sandy, Round Butte and Carson hatcheries). We also examined fish from the Puget Sound region (White River and Minter Creek). All populations connected to the Columbia River exhibited ASE, *E. schreckii* and *C. shasta*, whereas those connected to Puget Sound were completely normal and showed no parasites. Regarding temperature, field and lab studies showed that cooler water does not prevent or treat ASE, but does reduce associated mortality. Together, our research indicates that ASE is caused by a novel pathogen, rather than acceleration of intestinal degradation associated with natural senescence in this semelparous salmon. Its actual distribution in Chinook Salmon and links to PSM is an ongoing question with our team.

Translocation of Adult Pacific Lamprey to the Warm Springs River and Monitoring of Larval Distribution and Density on the Warm Springs Reservation by the Confederated Tribes of Warm Springs

Professional

Keo, Aldwin; *The Confederated Tribes of Warm Springs Natural Resources, aldwin.keo@ctwsbnr.org*

Pacific Lamprey is a culturally important species to the Warm Springs tribal members. Consequently, the Confederated Tribes of Warm Springs (CTWS) Natural Resources Fisheries Department have been implementing a translocation program and have been monitoring the distribution and density of Pacific Lamprey larvae. A key objective of the translocation program is to increase spawning opportunities for adult lamprey that have migrated into the Deschutes Basin by collecting lamprey at Sherars Falls (rkm 44) and Bonneville Dam (rkm 234). Translocated lampreys are tagged with a Passive Integrated Transponder (PIT) tag, and their movement is monitored within the Warm Springs River basin and Shitike Creek with instream PIT-tag arrays. Along with a PIT tag, lamprey's length, girth, and dorsal gap are measured. CTWS Fisheries Department staff are also monitoring Pacific Lamprey larval distribution and substrate preference in the Warm Springs River watershed and Shitike Creek using electrofishing surveys. The goal of our program is to monitor each Pacific Lamprey life stage including ensuring adult lamprey make it back to the spawning grounds, that larvae are present in our waters, , Tribal members continue to harvest lamprey, and that lamprey will be present on the table as one of our “First Foods” tribal members honor.

Tackling Funding Gaps and Climate Challenges in Oregon’s Hatchery System: That Elephant Won’t Eat Itself

Professional

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Pacific Northwest hatchery programs face dwindling resources and increasing demands, jeopardizing their core missions. Climate change compounds financial pressures, introducing increased risks of water temperature extremes, drought, and disease outbreaks. To address resource shortfalls, programs defer maintenance, leave positions vacant, or cut less-essential expenses. Over time, deferring maintenance investment goes from savings in the short run to significant incurred costs when problems become critical—or worse, the system fails entirely. Breaking this cycle requires strategic planning and data-driven decision-making. In 2020, the Oregon Department of Fish and Wildlife (ODFW) initiated a climate vulnerability assessment of its hatchery system, evaluating six facilities of varying geographies and risk profiles. ODFW leveraged these findings to secure legislative funding for a comprehensive third-party review of the state hatchery system. This assessment addressed five critical domains: climate impacts on hatcheries, climate impacts on hatchery fish, economic costs and benefits, current and future infrastructure needs, and future program roles and needs under climate change. These findings provided a strong foundation for ODFW’s successful request for infrastructure investments. For the 2025–27 biennium, the Oregon legislature allocated $20 million in bond funds to begin addressing infrastructure needs—part of an estimated need exceeding $180 million. Looking ahead, climate change will intensify hatchery operational challenges while simultaneously increasing the role of hatchery production in sustaining fisheries and protecting wild populations. This presentation provides an example of how strategic planning and data-driven decisions can help create a roadmap for resilient hatchery systems.

Concurrent irrigation pauses can create stream flow pulses for fish during critical low-flow periods

Student

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Streamflow augmentation can support endangered fish during low-flow periods. Irrigated agriculture being the largest out-of-stream consumptive use, there is potential to augment streamflow by temporarily leasing from agriculture. This potential has not been fully realized, perhaps due to a focus on leasing at the extensive margin where land is either irrigated or not. Leasing at the intensive-margin—applying less water on the full land extent—has received limited attention but could be promising, especially related to short-term pulse flows for fish. We address this with two questions: Can a concurrent short-term pause of irrigation withdrawals meaningfully increase streamflow for fish during critical periods? What is the associated foregone crop production and revenue loss? We used the CropSyst model to simulate irrigation demands, yield impacts from a 15-day pause, and resulting revenue reductions for three focal watersheds in eastern Washington State of the United States, and generated water supply curves that provide the marginal cost of augmentation. We evaluated the strategy's ability to bring flows to levels beneficial for fish for at least two consecutive days. Results indicate that a short-term irrigation pause can provide meaningful levels of pulse-flows if conducive conditions related to upstream crop mix, acreage, and augmentation needs are met. The mean cost from lost revenue across years from reduced yields ranged from $1 to $125/acre in scenarios where the targeted streamflow was achieved. This water leasing strategy has potential in some locations to represent a win-win situation for agricultural and environmental stakeholders and warrants further exploration.

Indus Waters Treaty Suspension threatening Pakistan's Aquatic Biodiversity and Ecosystems

Professional

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The Indus River system constitutes the ecological and socio-economic foundation of Pakistan, sustaining the world's largest contiguous irrigation network and supporting national food security, rural livelihoods, and freshwater biodiversity. For more than six decades, the 1960 "Indus Waters Treaty" (IWT) provided a stable trans-boundary framework regulating water allocation between India and Pakistan. However, India's unilateral suspension of the treaty in April 2025 poses unprecedented risks to downstream hydrological stability, ecosystem integrity, and environmental security in the lower-riparian state, especially in the Chenab River. The Chenab River sustains extensive floodplains, wetlands, and riparian forests that support diverse aquatic and terrestrial biodiversity, including native fish species, migratory waterfowl, and freshwater-dependent livelihoods. The Chenab River supports native biodiversity, including Golden Tor Mahseer (Putitor), Wallago catfish, Indian soft-shell turtles and migratory waterfowl, all dependent on natural flow regimes. Any significant reduction or alteration in Chenab flows threatens essential ecological processes, including nutrient transport, seasonal flooding, groundwater recharge, and fish spawning cycles. These disruptions would directly undermine agricultural productivity and inland fisheries in Pakistan's Punjab plains, widely regarded as the country's "breadbasket". The suspension of the IWT by India further exacerbates existing climate-related vulnerabilities in the Sub-continent Indus basin, including accelerated Himalayan glacier retreat, increased frequency of extreme floods and droughts, and erratic monsoon patterns. In the absence of a structured water-sharing framework, reduced freshwater and

sediment flows risk intensifying desertification, soil salinity, and ecological degradation, extending downstream to the Arabian Sea Indus Delta, where mangrove ecosystems and coastal fisheries are already in decline. Beyond geopolitics, the 2025 IWT suspension by India represents a profound ecological challenge. Long-term sustainability of the Indus basin, particularly biodiversity-rich Rivers such as the Indus and Chenab Rivers, depends on predictable environmental flows, cooperative trans-boundary governance, and recognition of ecological water requirements essential for regional stability and resilience.

What we learned implementing an end-to-end habitat status and trends monitoring framework

Professional

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The Okanogan/Methow Basin Monitoring and Evaluation Program (OBMEP) is a multi-decadal program that monitors steelhead habitat in the Upper Columbia River Distinct Population Segment. Nearly all components of our data flow schema are founded upon a hierarchical spatial structure that functions as a common currency to collect and disseminate data. This structure is readily assembled from broadly available and regionally accepted resources which link uplands to stream corridors at coarse (HUC4 subbasin, 100+ km), intermediate (HUC6 subwatershed, 10-100 km) and fine (reach, 1-4km) resolutions. Focusing on the underlying reach network spatial structure and eventual data synthesis methods a priori when selecting habitat data collection designs/methods provided a strong underpinning to our habitat monitoring framework. Having clear beginning and end-points for the data pipeline are vital to organizing monitoring efforts and data, reporting results, and informing stream restoration implementation. In recognition of the variety of uses that interested parties may have for monitoring data, the OBMEP provides data and model results in two ways: 1) QAQC-approved habitat data are presented in a data portal supported by a relational database structure with several data visualization options and 2) habitat model results are hosted in a cloud-based “report card-style” status and trends reporting tool. We present the process that has been implemented to build out this monitoring and reporting structure in the Okanogan and Methow River subbasins as an approach that others can leverage in their region.

Advancing AI-Assisted Fish Counting at Hydroelectric Facilities using BlueFish

Professional

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Hydropower facilities in the Columbia River Basin rely on fish counting programs mandated under the U.S. Endangered Species Act to monitor adult salmonid passage and inform conservation and management decisions. Traditional counting methods (i.e., manual video review or “live” on-site observers) are labor-intensive and vulnerable to errors in detection and identification from observer fatigue and fast passage. This presentation describes a computer vision camera system jointly developed by Spheros Environmental and MarineSitu to automate fish detection, classification, and counting. The system has been trained, calibrated, and deployed at multiple sites in the Columbia River Basin, where it has reduced observer workload while improving consistency and maintaining accuracy of count data. An edge-based computing platform performs real-time species-level classification and securely uploads imagery and metadata to the cloud. Observers then review and refine these automated classifications through the BlueFish software to efficiently generate validated count summaries for regulatory reporting. A continuous maintenance and retraining model enables the system to adapt to

dynamic river conditions, including turbidity changes, lighting variation, and changes in seasonal species distribution. Case studies from recent deployments show species-level classification accuracies approaching 90% for Pacific salmonids in certain assemblages. Ongoing development, which is supported by the U.S. Department of Energy, includes counting with an underwater camera, stereo-based length estimation, and expanded juvenile monitoring. Collectively, this technology provides a scalable, standardized approach to improving fish count reliability and supporting long-term conservation decisions across Columbia River Basin hydropower facilities.

Early Successes of a Tribal Reintroduction Project

Professional

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The Confederated Tribes of the Umatilla Indian Reservation (CTUIR) Fisheries program develops, operates, and co-manages artificial fish production facilities that release fish throughout the traditional use areas (specifically the Umatilla River, Grande Ronde River, and Walla Walla River Basins) to replace extirpated populations and supplement depressed populations. Spring Chinook in the Walla Walla River were extirpated in the early 1900s. Work to replace this population started in the 1990s, but existing habitat, flow, and passage barriers needed resolution before implementing hatchery supplementation. The effort to return adult spring Chinook salmon to the basin began with outplanting adults and has progressed to full term rearing of yearling smolts that are released in two rivers in the basin, with the first adult returns from the fully reared smolts occurring in 2025. Reintroducing salmon to the Walla Walla Basin faces many challenges. The tribe has taken a logical approach to meeting these challenges, starting with outplants of adults, moving into smolt releases of out of basin stocks, all while working on improving habitat, securing water in the river for fish, and building their first tribally operated hatchery. Progressing through the process, the tribe now consistently rears and releases 500,000 smolts into the basin each year. Adult returns will allow the hatchery program to continue to progress through a phased master plan to return fish to the basin. Challenges will continue into the future, but the outlook is bright with 2025 producing enough adult returning fish to meet both spawning escapement goals and broodstock collection goals for the first time. Protection of water, and habitat projects will continue as the tribe prepares for increasing adult returns which will allow for harvest in the basin, while still meeting the escapement and broodstock goals.

Unveiling a Legacy of Fish Introductions to Mountain Lakes Using Historical Records and eDNA Surveys in a National Park

Professional

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Across the western US, introductions of non-native fish into historically fishless mountain lakes have impacted native biota. In Olympic National Park (OLYM), we reconstructed historical fish plantings using records dating to 1930 coupled with contemporary fish and native amphibian distributions. We used Environmental DNA (eDNA) to estimate the current distribution of fish and amphibians in 117 remote mountain lakes throughout 13 watersheds. Bayesian occupancy models determined how lake physical attributes and fish planting history relate to fish and amphibian occupancy. The most frequently detected species were Brook Trout (*Salvelinus fontinalis*), Rainbow Trout (*Oncorhynchus mykiss*), Cascades Frog (*Rana cascadae*) and Northwestern Salamander (*Ambystoma gracile*). eDNA sampling detected 52 lakes with

amphibians only, 45 with fish and amphibians, 14 with fish only, and 6 with no fish or amphibians. The number of times a lake was stocked was the best predictor of occupancy for Brook and Rainbow Trout. Higher occupancy of Brook Trout was associated with lower elevations, lower solar radiation, and larger lake area. Cascades Frog occupancy showed no relationship to fish presence or lake physical traits. Our results document the contemporary distribution of introduced fish and native amphibians in OLYM, suggesting mechanisms of fish persistence over time and areas where native amphibians are impacted by introduced fish. These results can guide management options like targeted fish removals that could benefit native fauna while still providing recreational fishing opportunities.

Mapping the potential for fish to compensate for total dissolved gas in a large river

Professional

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Total dissolved gas (TDG) supersaturation is an issue affecting dammed rivers worldwide. It is of concern because elevated TDG can cause gas bubble trauma (GBT) in fish and other aquatic life resulting in sub-lethal effects and mortality. Fish can compensate for the effects of GBT by moving to sufficient depth to collapse gas bubbles or keep them in solution in the blood. The extent to which compensation occurs is affected by species- and size-specific tolerance and behavior. To better understand the nexus between available habitat, fish behavior, and TDG saturation, a 2-dimensional hydraulic river model was used to evaluate how depth and velocity interact to create suitable fish habitat in the lower Clark Fork River, Idaho. The model indicated that suitable habitat is most widespread at low discharge and declines in both area and volume with increasing discharge. Most habitat where velocity and depth are suitable for fish to compensate for the effects of elevated TDG is located near the river margins and is adjacent to shallower habitat where TDG exposure is more severe. Despite the limitations associated with calculating mean water column velocity, 2-dimensional models like the one used in this analysis can be useful for identifying where fish are likely to be located under various discharge conditions and where they are most likely to experience the effects of elevated TDG and associated GBT.

Insight from three decades of research on wild juvenile Chinook salmon

Professional

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Long-term research is vital for understanding complex relationships within fish ecology. Beginning in the late 1980s with the early development of passive integrated transponder (PIT) tags NOAA fisheries sought to better understand the life histories of juvenile salmonids in their natal habitats. From 1992 – present, we used PIT tags to mark ~334,000 wild Snake River spring/summer Chinook (*Oncorhynchus tshawytscha*) salmon juveniles across 15 populations in the Salmon River basin of central Idaho. Fish were tagged as parr and monitored as they migrated out of the basin over the subsequent fall, winter, and spring. Lower Granite Dam is the first dam encountered by tagged fish migrating towards the Pacific Ocean and represents the first opportunity for detection of PIT tags on the mainstem Snake River. Estimated parr-to-smolt survival averaged approximately 15%, but has varied considerably (7.2 – 27.4%) among years and populations. Long-term monitoring of outmigration patterns suggests up to three different pulses of juveniles, hinting at even more complex early life history strategies than previously known for these populations.

Population Responses of Coho Salmon and Steelhead to Watershed-Scale Restoration: A 24-Year BACI Study

Professional

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After more than two decades of coordinated monitoring, uncertainty persists across the Pacific Northwest regarding the biological effectiveness of watershed-scale restoration and its role in salmon recovery. Using a 24-year intensive life-cycle monitoring dataset (2001–2024) within a Before-After-Control-Impact (BACI) framework, the Lower Columbia Intensively Monitored Watersheds (IMW) program evaluated population-scale responses of coho salmon (*Oncorhynchus kisutch*) and steelhead (*Oncorhynchus mykiss*) to large-scale habitat restoration in three relatively small, comparable, and naturally varying watersheds in the lower Columbia River Basin. Two watersheds received comprehensive restoration focused on juvenile overwinter survival and floodplain function—including large woody debris (LWD) installation, side-channel reconnection, high-flow refuge creation, and migration barrier removal—while a third watershed served as an unrestored reference system. Restored watersheds exhibited a >30% increase in coho biomass relative to expected production in the absence of restoration, along with higher parr-to-smolt growth rates and larger smolt size at outmigration—metrics closely linked to marine survival and adult returns. Steelhead exhibited weaker population responses, likely because restoration actions were primarily designed to enhance coho rearing habitat. These population-level responses demonstrate that coordinated, watershed-scale restoration can yield measurable biological outcomes when supported by long-term, intensive monitoring. Our results underscore the importance of implementing restoration efforts at ecologically relevant scales that address key factors limiting population productivity.

Catch trends, size structure, and age composition of a population of non-native Lake Trout (*Salvelinus namaycush*) in Wallowa Lake, Oregon

Professional

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Lake Trout (*Salvelinus namaycush*) are highly predatory, long-lived, spawn multiple times throughout their lives, and have contributed to the decline of important native fish populations and recreational fisheries. Lake Trout were introduced to Wallowa Lake in Northeast, Oregon USA by state fishery managers between 1956 and 1961 with the release of about 200,000 hatchery-origin fingerlings. Wallowa Lake fisheries have long been culturally important to local indigenous communities, and important recreational angling opportunities exist including a Kokanee fishery that currently holds the world record for an angler caught fish. To understand the status of this non-native species in Wallowa Lake, we summarized trends in Lake Trout catch over the past 65 years, described current size structure, and evaluated age composition to understand trends in recruitment. Mature Lake Trout were caught by anglers by the 1980s, and Lake Trout had become well established at apparently low abundance levels by the early 2000s. Since 2008 when regular surveys began, Lake Trout have regularly been encountered. Large individuals (700 – 900 mm FL) are common and often show evidence of prior year spawning. Based on age distribution, natural recruitment of Lake Trout occurs regularly. Ages of Lake Trout in Wallowa Lake are consistent with age distributions in other waterbodies along the southern edge of Lake Trout distribution. Most fish caught are less than 10 years old. Fish 10 – 20 years old were regularly sampled, but fish older than 20 years old were rare. The maximum age observed was 28 years. Fish grew quickly reaching 600 mm (FL) or greater between 4 and

6 years of age. Fish have been observed in the diets of Lake Trout as small as 302 mm suggesting piscivory is a key component of growth. Our data suggests it will be important to continue monitoring Lake Trout in Wallowa Lake to ensure the population of Lake Trout does not expand to a size detrimental to the Wallowa Lake ecosystem.

Representation Matters, Demographics Demand It – Perspectives from Parkrose High School

Professional

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If we want to conserve healthy aquatic ecosystems for the next generation(s), we must improve the ethnic and racial diversity of our profession. Plain and simple, we are all in the fisheries/aquatic conservation profession because it's relevant to us; we care about fish and their habitats. Also plain and simple, the demographic picture of the U.S. population will be dramatically different in the coming decades than when we began our schooling and careers. So – we must stay relevant; we must work now to ensure an engaged, informed, diverse cast of future members in our profession. ORAFS, its DEI Committee, its E/O Committee, and ExCom are all doing important work but we, all of us, each of us, can act locally to move forward in this direction. This talk reviews an example of recent investments in time and funding to involve BIPOC students in learning about fish, conservation and job opportunities. It also highlights the difference in demographics between AFS and the public we serve, and how a focus on schools like Parkrose HS can help us meet our mission well into the future.

Looking Under the Hood: Using Sensitivity Analysis to Strengthen Salmonid Restoration Prioritization

Professional

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Restoration prioritization frameworks are widely used in salmonid recovery to guide investment decisions across watersheds with limited funding and high biological uncertainty. These tools typically integrate multiple species, life stages, geomorphic classifications, and habitat condition metrics into a single cumulative score used to rank stream reaches. While such models provide valuable structure and transparency, their internal behavior is rarely evaluated beyond face-value rankings. We conducted sensitivity analyses of a watershed-scale restoration prioritization model (Atlas). The model incorporates 18 life-stage presence (P) and 18 life-stage importance (U) inputs, alongside single categorical geomorphic potential and habitat condition scores. Using one-at-a-time perturbations and Monte Carlo simulations, we evaluated how variation in each input influenced cumulative scores and reach rankings. Results revealed strong structural redundancy: U and P scores were highly correlated by design, effectively double-counting life-stage information. Despite the biological complexity embedded in life-stage scoring, final rankings were often more sensitive to fewer, less-correlated inputs such as geomorphic potential and habitat condition. Sensitivity patterns were consistent across model variants, suggesting that model architecture, rather than species- or life-stage-specific nuances, was driving prioritization outcomes. This case study highlights lessons for fisheries professionals: complex biological inputs do not necessarily translate to proportional decision influence; correlated metrics can embed implicit weighting and trade-offs; and stable rankings may reflect structural constraints rather than ecological certainty. Sensitivity analysis strengthened the tool by increasing transparency and identifying opportunities for refinement.

Routine incorporation of sensitivity analysis can improve defensibility, stakeholder confidence, and adaptive management outcomes.

Shared Rivers, Shared Risks, Shared Rewards: Combining Supplementation AND Restoration in the Grande Ronde Basin

Professional

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Recovery of Snake River Basin spring/summer Chinook salmon and steelhead relies on two sets of actions that are typically discussed side-by-side in recovery plans: improving habitat conditions and using hatchery supplementation to support natural-origin populations. In practice, however, the people implementing these actions often operate through different planning cycles, technical frameworks, and decision processes. This presentation argues that measurable progress will come faster, and be easier to defend, when restoration practitioners and supplementation programs treat their work as a coupled strategy rather than two coordinated-but-separate efforts. The core idea is that outcomes in each arena are strongly conditioned by the other. Habitat investments shape the survival, capacity, and spatial opportunity available for fish to express gains. Supplementation decisions shape whether and where restored areas are actually seeded with spawners, how quickly natural production can respond, and what signals monitoring programs can detect. Because both groups are accountable to the same population metrics (e.g., abundance, productivity, spatial structure, and diversity), success should be framed as a shared product of integrated choices, not as parallel contributions that can be evaluated independently. Drawing on findings from a novel genetics-based approach in Grande Ronde Basin, this talk provides concrete, high-level illustrations of how tighter collaboration can improve both implementation and inference. We conclude with a practical set of collaboration touchpoints: joint problem statements and theories of change tied to recovery metrics; shared spatial targeting that links restoration actions with broodstock and release strategies; and monitoring designs built to support collective learning and adaptive management. The intent is constructive and forward-looking: to offer a path toward routine co-implementation that helps habitat and supplementation investments amplify one another for Chinook and steelhead recovery.

Synthesizing coastal restoration effects on Whidbey basin Chinook Salmon, an example using cumulative effects evaluation for salmon habitat restoration from Washington, USA

Professional

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In the Salish Sea, extensive human development has reduced the extent and quality of salmon habitats and disrupted the ecological processes that create and sustain them. These losses are particularly acute in estuaries, where as much as 90% of historical habitat has been eliminated or substantially altered, which has direct impacts on Chinook Salmon. Habitat restoration has become a primary strategy for rebuilding ecosystem structure and function in degraded coastal and estuarine systems. Significant investments over the past several decades have restored tidal exchange and increased rearing habitat for juvenile Chinook Salmon. However, restoration implementation has largely occurred at the project (site) scale, with limited capacity to evaluate how multiple actions interact across landscapes to recover multiple populations. As a result, there remains no comprehensive framework for assessing cumulative biological benefits to

salmon. To address this gap, we applied a structured framework to evaluate the cumulative effects of estuarine restoration for Chinook Salmon in the Whidbey Basin that is inclusive of the Snohomish River, Stillaguamish River and Skagit River. Drawing on years of existing but disparate monitoring data, we apply causal inference across nested hypotheses linking restoration actions to ecological responses and, ultimately, to salmon performance. Our efforts integrate a hierarchy of hypotheses into a multi-level causal analysis to evaluate restoration outcomes across spatial and organizational scales. This approach is designed to leverage existing monitoring information to draw inference at broader ecological scales that matter for populations. Preliminary findings suggest that we find strong support that restoration is increasing habitat availability and structure and support that restoration in improving juvenile Chinook distributions and movement. With future work planned, we present a novel approach to synthesizing information at broad scales.

Pacific Salmon Data Discovery Tool: Enhancing Marine Ecosystem Data Integration and Collaborative Science

Professional

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The Northwest Fisheries Science Center and Pacific States Marine Fisheries Commission are developing an emerging tool that enhances access to data relevant to salmon in marine ecosystems. The Pacific Salmon Data Discovery Tool demonstrates new approaches for data connectivity and cross-ecosystem synthesis by providing annually updated summaries and visualizations of Pacific salmon data (e.g., population abundance estimates, productivity trends, age data) alongside environmental drivers in marine ecosystems (e.g., marine heat waves, abundance and survival rates of predator and prey species). This web-based platform reduces barriers to information discovery across agencies, regions, and knowledge systems by centralizing datasets that currently exist in disparate agency reports, databases, and research repositories maintained by various agencies and tribes. By serving as a data repository that publicly houses salmon-relevant data across ecosystems (freshwater, estuary, marine) and data types (documents, data files, derived data products, spatial data, GitHub links), this shared digital infrastructure accelerates collaborative science and improves understanding of ocean drivers of salmon survival. Our focus will be to serve as an information clearinghouse for a broad user community - from casual data exploration through standardized data visuals, to comprehensive data downloading supporting regional harvest and conservation management analysis.

Considering Lamprey Passage: Analysis of Fishway Improvements at Bonneville Dam

Professional

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In the Columbia River Basin, the native Pacific lamprey (*Entosphenus tridentatus*) has declined in abundance and range over the last several decades. While fishways within the river's major dams have been used to aid the upstream passage of adult migrants and connect critical habitat, they have typically favored the biology of salmonids over other native species. However, lamprey abundance has shown a recent upward trend due to increased awareness and conservation efforts, such as fishway improvement and translocation, to protect this culturally important species. The objective of this study was to determine passage times, passage efficiency, and behavior beyond the dam in response to a new fishway configuration. We conducted an acoustic telemetry study to assess the efficacy of recent changes made to the

Washington shore fishway at Bonneville Dam (BON) to better accommodate lampreys' unique morphology and swimming behaviors. Adult lamprey captured in BON fishways were implanted with a passive-integrated transponder (PIT) tag and a high-powered acoustic tag with a pulse interval of either 5 or 15 seconds – with an estimated lifespan of 4 months or 1 year, respectively. Acoustic autonomous receiver arrays were deployed throughout the reach between BON and The Dalles Dam to determine tributary selection and upstream behavior. A total of 710 fish were released downstream of the dam tailrace and tracked as they passed through the fishways. Passage efficiency (the proportion of fish that passed the dam), fishway passage time, and passage bottlenecks were evaluated to address study goals and identify zones for improvement within the current fishway configurations. Initial results suggest that the changes made to the Washington shore fishway improved passage efficiency while decreasing travel time. Analysis of passage bottlenecks and upstream behavior is ongoing and subject to completion in the fall of 2026.

Eulachon smelt fecundity: Egg counting 101

Professional

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Eulachon *Thaleichthys pacificus* are a forage fish endemic to the Eastern Pacific. They are an anadromous fish important to fresh water and saltwater food webs. In the early 1990's Eulachon experienced a precipitous decline in populations, and in 2010 the Southern distinct population segment of Eulachon (sDPS) was listed as a threatened species under the Endangered Species Act (ESA). An emphasis was placed on the research of environmental conditions, outgoing juvenile migration, and fecundity. Fecundity, typically expressed as the number of gametes produced by an individual female, is a life history characteristic readily measured across many fishes, and in 2012 NOAA awarded a grant to the Washington Department of Fish and Wildlife (WDFW) specifically to study Eulachon fecundity. A small study was done, to research the proportion of ovarian weight needed to accurately estimate the fecundity of an individual female. This resulted in the adoption of a 5% proportion of ovary weight that is subsampled for fecundity estimates. Analysis of ovary thickness, egg adhesiveness, and skein tightness informed the development of a Maturation Index used to differentiate between green fish, ripe fish, and those slightly spawned out. We established a correlative ratio between the two ovaries within each fish to serve as a diagnostic tool to screen each female and provide the most representative sample. The primary objectives of this study were 1) To identify criteria that select representative females for fecundity analysis. 2) To develop sampling protocols that reduce error and improve precision in estimates of fecundity, thereby refining estimates of Eulachon abundance in the Columbia Basin. These important tools aid in the determination of which fish are the most fecund, giving us more accurate average fecundity numbers.

Beyond the 'Roundtable': Continuing to Advance the Dialogue on Hatcheries and Stocking Programs

Professional

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Hatcheries and stocking programs have long been subject to vigorous controversy, with some arguing against these techno-fallacies based on a large body of research demonstrating a lack of efficacy and even harm to wild fish genetics and ecosystems, and others finding new promise in how they might address rapidly changing ecologies and social needs for fisheries or conservation. Scientific advances and guiding principles such as the Responsible Approach

provide a means for addressing such issues in a systematic and science-based manner but have not been widely and effectively implemented. A Roundtable session at the 2024 World Fisheries Congress aimed to break the deadlock and advance the dialogue through innovative engagement and community-building. Common themes included a sense that although hatcheries and stocking are human endeavors, human dimensions have been neglected in science and policy; an underscoring of the diversity of approaches and contexts (one size does not fit all); and a strong sentiment among participants that open and constructive dialogue is overdue. In this presentation, we will review key insights from the Roundtable, discuss ongoing and emerging activities aimed at building an increasingly broad-based, trans-disciplinary community of practice around the use of aquaculture-aided approaches.

Believers, Pragmatic Heretics, and Constructive Agnostics: Reflections on Stakeholder Perspectives Relative to Marine Stock Enhancement Programs

Professional

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Hatcheries and stocking programs for salmonids have long been operated at a large scale and are subject to vigorous controversy. By contrast, marine stock enhancement (MSE) programs for other fish or invertebrate species are of more recent origin, operate at smaller scales, and generally have escaped major public controversy. Here we reflect on stakeholder perspectives relative to such programs, informed by in-depth interview studies conducted in California and Florida. We found that many stakeholders can be characterized as belonging to one of three categories. “Believers” feel that MSE is a promising and pro-active approach to fisheries conservation and management that either already contributes to positive outcomes or will do so once we know how to “get it right”. Many aquaculture scientists associated with hatchery operations and many recreational anglers fall under this category. “Pragmatic heretics” view MSE as a distraction of limited relevance to conservation and management but accept that such programs are here to stay because of their public appeal and the influence of believers. Many fisheries scientists and managers fall under this category. “Constructive agnostics” view MSE as an approach both worthy and in need of evaluation. This is the preserve of a relatively small group of scientists and professionals. Vocal and committed opponents to MSE are rare. We discuss how this situation traps MSE in a stalemate and outline potential approaches for integrating MSE more constructively into fisheries management and conservation efforts.

Using a habitat-based model to inform river restoration planning decisions for Puget Sound salmon

Professional

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The Habitat Assessment and Restoration Planning (HARP) model is a process-based model that links changes in riverine habitat quantity and quality to salmon and steelhead life-cycle models to compare the potential effectiveness of habitat restoration actions and strategies. This approach combines mathematical representations of watershed processes with species and life-stage specific fish-habitat relationships to estimate carrying capacity and survival under various restoration, climate, and hatchery management scenarios. These estimated parameter values are used to drive a spatially explicit life-cycle model that accounts for all life stages throughout a river network. The application of this model across various watersheds in western Washington illustrates that effective habitat restoration cannot take a “one size fits all” approach. Spatially heterogeneous legacies of habitat alteration combined with variation in life-history

strategies can lead to different restoration approaches that are most beneficial to certain species and populations. Moreover, our results indicate that restoring freshwater habitats alone may fall short of recovery goals for some populations, but relatively small improvements in marine survival could dramatically increase estimated returns in spawners. The HARP model provides a framework for restoration practitioners to leverage the relationships between watershed-specific landscape changes and salmon life-cycles to promote more informed restoration planning decisions.

Yakama Nation's efforts to keep the importance of Pacific Lamprey alive within Tribal Communities and beyond

Professional

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Lampreys are an ancient group of jawless fishes that originated more than 450 million years ago. Pacific Lamprey (*Entosphenus tridentatus*) is one of the largest anadromous lamprey species in the world and has historically ascended ~1,000 miles upriver within the Columbia River Basin similar to anadromous salmonids prior to the hydro dam construction era (1933-1975). Harvest have traditionally occurred throughout the Columbia River Basin (and beyond) and they were highly valued by the local and regional indigenous people similar to salmon species. Pacific Lamprey population numbers as well as distribution have declined sharply since the hydro dam construction era and unfortunately tribal communities that had in-depth relationships with the species have borne the brunt of this loss. To help bridge the gap between lamprey and tribal communities, we highlight the importance of not only preserving and incorporating Traditional Ecological Knowledge but also restoring the human and cultural dimensions of lamprey to fully achieve true species recovery. We engage the tribal youth through our Youth Workers Program where they learn hands-on restoration through our project as well as lamprey harvests. To engage even beyond the tribal communities, we have created a Lamprey in the Classroom program that allows students of all ages and background to interact with lamprey on a daily basis.

Oregon Coast Coho Habitat: A look back at the Oregon Plan and 27 years of monitoring

Professional

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We summarized results of 27 years (1998-2024) of habitat surveys across the Oregon Coast Evolutionary Significant Unit (ESU) within wadeable streams (1st-3rd order). We surveyed 1,222 unique locations during summer conditions (June through September) within the distribution of coho salmon (*Oncorhynchus kisutch*) spawning and rearing habitat to describe habitat conditions and estimate the rearing capacity for juvenile coho salmon using a Habitat Limiting Factors Model (HLFM). Sample sites were randomly selected and spatially balanced within a rotating panel, where surveys occur annually, every three years, nine years or once only. Across the sampling period, we conducted 3,013 surveys. Analysis of variance (ANOVA) tests were conducted on selected attributes to evaluate whether differences existed between monitoring strata and individual sampling years. In addition, we used a linear mixed model to evaluate sites surveyed two or more times during the sampling period for trend detection. ANOVA results described differences among most attributes across sampling years, and all attributes across monitoring strata. We also found commonality among strata, an increasing trend in riparian canopy shade and a decreasing trend in active channel width. When modeled estimates of

rearing capacity were stratified by year and monitoring area, significant differences were observed between strata. In addition, median parr capacity and lower quartile bounds across strata all fell below the low-quality habitat threshold (<900 parr/km) while upper quartile bounds all fell below the high-quality habitat threshold (>1,850 parr/km). The linear mixed model detected a decreasing trend in parr capacity at the ESU level and trends in parr capacity across all strata. The model detected decreasing trends for the North Coast, Mid Coast, and Mid-South Coast strata, and an increasing trend in the Umpqua stratum. The results of these analyses will be used to inform the OC Coho status assessment.

Examining the Effects of Nocturnal Hatchery Releases on the Survival and Migratory Behavior of Juvenile Spring Chinook Salmon

Student

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We used acoustic telemetry to describe the differences in movement patterns and survival of nocturnally and diurnally released juvenile hatchery spring Chinook salmon (*Oncorhynchus tshawytscha*) in the Hood River, Oregon. In total, 261 age-1 Chinook salmon were implanted with acoustic tags and released into the West Fork of the Hood River at the Moving Falls fish facility at river kilometer 24.5. The movements of these fish were monitored by autonomous hydrophones distributed across six locations within the Hood River, two in the Nichols Boat Basin, and six in the Hood River delta at the confluence with the Columbia River during April-June 2024. Concerns related to entrainment and survival for Chinook salmon that may enter the Nichols Boat Basin upon exiting the Hood River mouth were also evaluated in this study. Approximately 94 percent (246/261) of the tagged Chinook salmon were detected at the Hood River mouth within 24 hours of release. Downstream migration of nocturnally released smolts was significantly faster than that of day-released smolts. Nocturnally released smolts median travel time to the Hood River mouth was 6.9 hours, while the diurnally released smolts median arrival time was 16.2 hours. Of the juvenile Chinook salmon in our study that reached the mouth of the Hood River, 94.5% exited the delta within 24 hours. There was no evidence of fish using the Nichols Boat Basin during our study, probably due to low water limiting access during the outmigration window. Cumulative apparent survival was estimated to be high for both study groups, with approximately 94% (C.I. 0.778 – 0.975) and 97% (C.I. 0.821 – 1) survival rates for the day and night release groups, respectively. Overall, these results may be useful in other basins where concerns about entrainment and the effects of nocturnal hatchery releases on in-river outmigration survival are unknown.

Overwinter survival of coastal coho salmon following large wood restoration

Student

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In the Oregon Coast Range, loss of stream habitat complexity is a key limiting factor for many coho salmon populations. Stream habitat complexity is particularly important during the winter rearing period, when juvenile coho salmon seek out refuges from high flow and can experience mortality. In response to widespread declines in stream complexity, large wood (LW) restoration has been widely implemented to enhance coho salmon winter rearing habitat. However, basin-scale assessments of LW effectiveness are uncommon and have typically focused on shorter-term responses, leaving uncertainty about whether benefits persist over longer timescales. We evaluate how a basin-scale LW restoration effort has influenced the overwinter survival of coho salmon in the Coast Range of Oregon over a 15-year study period. Using a Before-After-Control-Impact (BACI) study design, we analyzed overwinter survival for 5 years

pre-treatment and 9 years post-treatment in a restored basin (Mill Creek) and a reference basin (Upper Mainstem Lobster Creek). We also examined changes in the relationships between size structure of the population and successful overwintering juvenile coho in the restored basin. The LW restoration was associated with a positive (+4.2%) but non-significant effect on the juvenile overwinter survival. However, when considering the hierarchical structure of fish interactions in streams, we see a more demonstrable response to restoration. The greatest increase in overwinter survival following restoration occurred in the medium fish-size class, which likely gained access to newly created LW refuge due to its competitive position immediately below the largest juveniles. Findings from this study suggest that restoration-driven increases in habitat are not evenly distributed across the population, and that assessments incorporating intrapopulation dynamics may be necessary to fully capture the long-term benefits of LW restoration.

Lessons learned from 30 years of implementing Intensively Monitored Watersheds (IMW): aligning the science with partners, policy, and funding

Professional

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Intensively Monitored Watershed (IMW) studies are one of the largest and most audacious programs in our effectiveness monitoring toolbox. Over the past 30 years, we have learned not only about the science of large-scale restoration but also about the social aspects of these programs. Although the focus of previous IMW reviews has been largely on scientific methods and results, we argue that an equally important emphasis should be placed on the relationships and processes needed to successfully implement restoration and monitoring programs at a watershed scale. This talk presents several lessons learned from IMW studies based on interviews with policy staff, restoration practitioners, and scientists working in IMWs across the Pacific Northwest, USA. These interviews highlight the coupled social- ecological nature of IMWs and provide a common framework that links scientific inquiry, restoration implementation, and policy decision-making. Sharing best practices and lessons learned from IMWs will help others successfully plan, implement, and manage effectiveness monitoring programs at any scale, helping ensure the information generated leads to new insights, applying adaptations, and ultimately more successful restoration over the long-term.

Thermal heterogeneity structures diverse Chinook Salmon spawning portfolios across a stream network

Professional

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Pacific salmon exhibit diverse life histories and local adaptation shaped by spatiotemporal variation in biotic and abiotic conditions. This biocomplexity buffers populations against environmental variability and reduces risks of demographic failure. One key aspect of biocomplexity is spawning phenology, a reproductive attribute that generates population resilience in Pacific salmon. However, the environmental mechanisms structuring spawn timing remain poorly understood. We analyzed 3,016 wild Chinook salmon (*Oncorhynchus tshawytscha*) redds georeferenced from 2002-2005 across eight tributaries to Idaho's Middle Fork Salmon River and evaluated how stream- and reach-scale thermal conditions and spatial habitat variation influenced spawn timing. Linear mixed-effects models with stream-reach random intercepts and slopes explained most of the variation in observed salmon spawning dates (marginal $R^2 = 0.698$; conditional $R^2 = 0.985$). Spawn timing advanced nonlinearly with

antecedent 90-day mean water temperature and plateaued at warmer sites. Stream and year effects were also significant, with spawning occurring progressively later through time. Importantly, reach-specific random slopes revealed pronounced heterogeneity in thermal sensitivity, suggesting that unmeasured local hydrologic and geomorphic processes mediate phenological responses to temperature. Together, these results demonstrate that fine-scale habitat heterogeneity, particularly thermal heterogeneity, structures diverse salmon spawning portfolios. Notably, we documented the persistence of highly diverse spawning portfolios within this interior Chinook salmon population despite extremely low contemporary abundances and its "Threatened" status under the U.S. Endangered Species Act. Conserving diversity in spawn timing across heterogeneous habitats in dynamic environments may be critical for maintaining the adaptive capacity of Chinook salmon to a warming climate.

Using radio telemetry to characterize the return of Chinook Salmon to the Upper Klamath Basin

Professional

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The removal of four hydroelectric dams on the Klamath River in 2024 was one of largest river restoration projects in North America, restoring access to hundreds of miles of habitat to anadromous fishes that had been blocked for over a century. Understanding how adult fall-run Chinook Salmon (*Oncorhynchus tshawytscha*) respond to renewed connectivity is critical for guiding restoration outcomes and adaptive monitoring in the Upper Klamath Basin. Although the four mainstem hydroelectric dams were removed, Keno and Link River Dams remain on the landscape near the outlet of Upper Klamath Lake and, may influence anadromous fish migration. Monitoring salmon migrations across hundreds of miles of river is inherently challenging, and the upper portion of the mainstem Klamath River presents additional logistical constraints due to its high-gradient reaches and geologic features that limit access to certain areas. This study used radio telemetry to evaluate adult salmon migration throughout the Upper Klamath Basin. The objectives of this project were to; 1) characterize migration timing, 2) assess passage success through former dam sites, 3) document use of newly accessible spawning habitats, and 4) identify potential barriers to migration. Radio-tagged adult fall-run Chinook salmon were detected during their upstream migration using a basin-wide network of fixed receiver stations, supplemented by mobile tracking and aerial surveys. Detection data were used to identify passage success, describe migration timing, and locate spawning activity in newly accessible and difficult-to-survey habitat. This presentation will summarize migrations observed during the fall 2025 season. Fall-run Chinook salmon were documented migrating through former dam sites, utilizing newly restored spawning habitats, and moving both upstream and downstream past the remaining dams.

Classification and Prioritization of Cold-Water Tributary Refugia Habitats in Oregon

Professional

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Cold-water tributaries help maintain favorable water-quality conditions, including temperature and dissolved oxygen, at mainstem confluences and downstream, supporting coldwater-dependent aquatic species. They provide important thermal refugia that allow

salmonids to reduce energetic costs and find relief during periods of stressful summer temperatures. Given that climate change is projected to further increase stream temperatures and reduce streamflows during baseflow periods, identifying and ultimately protecting cold-water refugia is a critical conservation strategy for Oregon's native fishes and a priority for the Oregon Department of Fish and Wildlife's Water Program. This work builds on an extensive field-based paired-temperature sensor deployment effort, led by ODFW's Water Program, designed to identify cold-water habitats during critical summer months. Here, we describe our methods for analyzing, classifying, and prioritizing Oregon's cold-water habitats based on the magnitude and duration of temperature differences between paired tributary and mainstem sites. To date, ODFW has analyzed over 300 paired deployments and assigned classifications according to the magnitude and duration of cold water provided by tributaries (e.g., from temporarily cool to perennially very cold). To further evaluate the quality of the identified cold-water refugia, we are developing a prioritization framework that also considers streamflow conditions, fish presence, and temperature thresholds for coldwater species. This classification and prioritization effort is intended to identify areas with cold-water habitats that may be resilient to future climate change, and that would benefit from further protection, or streamflow and riparian restoration.

Juvenile Pacific Lamprey Passage Behavior and Survival at Bonneville Dam, 2025 Preliminary Results

Professional

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In recent decades, habitat degradation and migration barriers have led to significant population declines of Pacific Lamprey (*Entosphenus tridentatus*) within their native ranges. These fish are indicators of the overall health of the aquatic ecosystem and are a culturally significant resource to the Native American tribes of the Pacific Northwest. Under the framework of a voluntary Conservation Agreement adopted in 2022, tribal entities, government agencies, and other partners are engaging in collaborative science to better understand the challenges that this species faces during the freshwater downstream migration period and identify steps forward in their conservation. In 2025, Pacific Northwest National Laboratory (PNNL) conducted an acoustic telemetry study to assess the passage, behavior, and survival of juvenile Pacific lamprey at Bonneville Dam (BON). Juvenile lamprey were collected from juvenile fish facilities at lower Snake River dams and McNary Dam on the lower Columbia River. Prior to the operation of fish collection facilities, fish were provided to PNNL by the Yakama Nation Fisheries. Once collected, juvenile lamprey were transported to McNary Dam (if not collected there) and tagged with PNNL's Eel/Lamprey Acoustic Transmitter (ELAT). A total of 526 juvenile lamprey were tagged and released upstream of BON with the goal of evaluating survival, migration rates, and dam passage routes. ELAT-tagged fish were tracked via fixed and autonomous receivers at the dam and in the BON pool. Overall survival at BON dam was estimated to be 0.705 (SE=0.040). Data analysis is ongoing, but preliminary results suggest that most juvenile lamprey passed BON through the spillway (53%) and that dam passage survival was higher for fish that passed through the B2 powerhouse than other routes (B1 and Spillway). Most fish that passed BON did so at night, though preliminary data analysis revealed that survival probabilities were similar for both daytime and night-time passage.

Implementing a Parentage-Based Tagging Program for Bear Lake Cutthroat Trout

Professional

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This study evaluates the implementation of Parentage-Based Tagging (PBT) as a method to distinguish hatchery and wild-origin Bear Lake Cutthroat Trout (BCT). PBT allows for efficient, large-scale identification of individual fish based on genetic markers, eliminating the need for physical or mechanical tags. We genotyped 225 broodstock from Mantua Fish Hatchery, 53 fish released above the Swan Creek weir, and 200 juvenile offspring from the SY2024 broodstock, achieving a 100% genotyping success rate. Of the assigned offspring, 189 were successfully matched to two parents, while 11 were assigned to a single male, likely due to an un-sampled female. Results indicate that PBT effectively genetically tagged all offspring produced. Additionally, genetic screening identified six hybrids in the broodstock, allowing their offspring to be diverted to offsite releases. These findings support PBT as a cost-effective and reliable alternative to traditional tagging approaches, with the added advantage of hybrid detection in broodstock populations.

Utilizing environmental DNA (eDNA) to determine the presence of four species of concern within the Upper Clackamas basin

Professional

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The Upper Clackamas basin, located primarily on the Mount Hood National Forest, historically supported native salmonids as well as several non-game species of cultural significance. Despite extensive partner efforts to restore habitats and improve passage, knowledge on species distributions (particularly for non-game species) throughout the upper basin is limited. From August to October of 2024, we collected and filtered water from twenty-five sites within the mainstem Clackamas River and tributaries within the upper basin. Visual snorkel surveys were paired with eight of the water collection sites. Filtered water samples were processed for environmental DNA (eDNA) for four species of concern: Pacific lamprey (*Entosphenus tridentatus*) – a state sensitive species supported by trap and haul, Western pearlshell mussel (*Margaritifera falcata*) – expected extant in the basin with no known observations, Western ridge mussel (*Gonidea angulata*) – expected extinct in the basin and under review for federal listing, and a reintroduced experimental population of Bull trout (*Salvelinus confluentus*). Pacific lamprey were positively detected at four sites, including upstream of the current known distribution, but no adults or juveniles were visually observed. Bull trout were positively detected at five known sites, and visually observed at the reintroduction site. No freshwater mussels were detected or visually observed within the basin. Results from this study inform monitoring and recovery plans for these species as well as federally listed salmonids, are being utilized to leverage finer-scale and temporal studies, and highlight the utilization of eDNA as a non-invasive tool for monitoring sensitive or elusive non-game aquatic species in forested watersheds.

Pathways for integrating historical information into fisheries decision-making

Professional

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Historical information has provided key insights into long-term ecological change to marine species and ecosystems, with value to fisheries. Yet, pathways to integrate these diverse data sources into fisheries decision-making have not been clear. Here, we identify an array of biological, ecological, and social information suitable for contemporary science- based decision-making, derived from local ecological knowledge, historical archives, archaeological middens and palaeoecological material. We outline two broad pathways to integrate these historical data into fisheries decision- making, demonstrating that data- driven use of historical information is

relevant across a range of management contexts. First, historical information can inform fisheries assessments that range from simple to complex, affecting indicators of stock status. Second, it can inform estimates of biological potential and social preference, affecting the choice of fisheries reference points. Using the Caribbean Sea as an example, we illustrate these ideas with case studies representing diverse species and historical data types. Integrating historical data can improve indicators of the current state of fish populations and result in management decisions based on a more complete understanding of a potential range of variation, avoiding shifted baselines. The urgency of this work is underscored by accelerating environmental changes and the rapid loss of invaluable historical information sources. By illuminating pathways, our goal is to increase the accessibility of these types of information and to underscore that scientists, managers, and resource users have roles to play in identifying and integrating relevant long- term data at various spatial and temporal scales to sustainably manage marine fisheries.

Predicting Outmigratory Behavior of Winter-Run Chinook Salmon in the Sacramento River, California

Professional

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Predicting the outmigratory behavior of juvenile salmonids from environmental and biological covariates may help inform fish management in large, regulated river systems. The capability to predict arrival time would be particularly important for the endangered Sacramento River winter-run Chinook Salmon when they encounter downstream hazards of water diversion. We developed a Bayesian generalized linear multilevel model with an inverse Gaussian response distribution that predicts outmigratory behavior between Red Bluff and Sacramento with two parameters: the migration rate (km/day), and the rate of population spreading (km2/day). Using passage times of more than 10,000 acoustically-tagged juvenile Chinook Salmon originating from late-fall, winter, and fall hatchery production, we quantified the effects of five environmental covariates (water velocity, flow, temperature, turbidity, and pulse-flow) and two biological covariates (day and body length) on both the migration and spreading rates. Our results indicate all five environmental covariates are good predictors of one or both parameters of the response distribution during periods when wild winter-run populations are outmigrating. The effects of water temperature and velocity are the strongest. In contrast, neither of the biological covariates appear to be good predictors of outmigratory behavior.

Understanding inherent precision and bias in Pacific salmon abundance survey methods

Student

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The effectiveness of fisheries management and conservation policies depends on surveys designed to estimate the abundance of target species over time. A variety of survey methods are employed for these purposes, each characterized by some level of precision and the potential for directional bias. While low levels of precision in survey methods lead to low confidence in point estimates of population abundance or forecasts, directional bias presents a more pernicious problem as it may lead to the mismanagement of imperiled species, invasive species, and commercially valuable populations, due to over- or under-estimation of their numbers. This study estimates levels of precision and bias associated with 28 survey methods commonly used by the Oregon Department of Fish and Wildlife to estimate the abundance of 68 populations of Chinook (*Oncorhynchus tshawytscha*) and coho salmon (*O. kisutch*), and

steelhead trout (*O. mykiss*), from 1980 to 2022. Using multivariate autoregressive state-space models (MARSS), we distinguish observation (sampling) error from process (environmental) error and estimate directional bias at the level of individual methods. We find that, while some survey methods are generally more precise than others (dam counts, weir counts, and redd counts are highly precise), the same survey methods can have very different levels of precision and biases when applied to different species. Additionally, we investigate the extent to which individual populations are subject to inherent imprecision and bias as a result of the survey methods historically employed in monitoring efforts.

Informing Integrated Hatchery Management Using Parentage-Based Tagging

Student

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Snake River fall Chinook (SRFCH) are produced and managed under the Lower Snake River Compensation Plan and through cooperation of several federal, state, and tribal entities. SRFCH are an integrated, composite stock managed with a target broodstock composition of 30% natural-origin fish. The total program produces 6.8 million subyearlings between three hatcheries and has 11 release locations throughout the Snake River basin. Currently, hatchery spawning is conducted using a random selection of natural- and hatchery-origin fish. Due to historical conservation concerns and current funding logistics, hatchery reared SRFCH are marked at around a 50% rate. Uncertainty in fish origin prompted the implementation of parentage-based tagging (PBT) to determine the origin of returning adults. Adoption of PBT has allowed the program to replace functions historically supported by coded-wire tag (CWT) recoveries, including broodstock composition and run reconstruction. Beyond replacing these CWT functions, PBT transforms the program's ability to evaluate broodstock performance, enabling data-driven management decisions that support recovery of ESA-listed SRFCH. By analyzing the past 10 years of historical PBT data collected at spawning, reproductive success of specific origin crosses can be quantified and applied to future spawning strategies with the goal of increasing adult returns and maximizing the effectiveness of natural-origin brood. Collaboration between biologists and hatchery staff is imperative to implementing changes while navigating the logistical challenges that come with such a large-scale program.

The Power of Perspective in Ecosystem Diagnosis & Treatment Modeling: Informing Salmon Recovery and Flood Management in the Chehalis Basin

Professional

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Habitat-based models play a critical role in translating ecological data into management decisions, yet their effectiveness depends strongly on the perspectives used to frame questions and trade-offs. In the Chehalis Basin in Washington, Ecosystem Diagnosis & Treatment (EDT) modeling has been applied for more than a decade to inform the basin's Long-Term Strategy for aquatic species restoration and flood damage reduction through a highly collaborative process. This presentation explores EDT from an ecosystem-based, decision-support perspective, highlighting how iterative discussions and shared learning among agencies, Tribes, local governments, and stakeholders have influenced model assumptions, interpretation, and application. EDT integrates spatially explicit habitat conditions and species- and run-specific life history requirements to diagnose constraints on salmonid performance and evaluate alternative management scenarios. In the Chehalis Basin, EDT has been used to assess current conditions, explore future conditions with climate and land-use change, and compare the ecological consequences of restoration and flood damage reduction strategies. Rather than

focusing on individual actions or sites, the EDT perspective emphasizes basin-wide context, cumulative effects, and transparent evaluation of trade-offs. Ongoing collaboration has been central to ensuring model assumptions, uncertainties, and results are clearly communicated and appropriately interpreted, supporting restoration prioritization, evaluation of infrastructure alternatives, and adaptive decision-making. The model has evolved alongside decision needs, demonstrating how perspective in habitat modeling is both collaborative and adaptive. Lessons from the Chehalis Basin illustrate how ecosystem-based habitat modeling, grounded in inclusive dialogue and clear decision contexts, can bridge science and management to support resilient strategies under changing environmental conditions.

Navigating a 6PPDQ world

Professional

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6PPD-quinone (6PPDQ) is a tire derivative in stormwater runoff that has recently been found to be acutely toxic to some aquatic organisms. The chemical is toxic to certain sensitive fish species at exceedingly low concentrations. Tools to reduce the impact of this chemical on fish are the subject of intense study and development. Much of that studying occurring in the Northwest, as agencies scramble to create new programs and discharge limits. This presentation presents on 6PPDQ from the perspective of a consulting civil engineer and covers: 1.) What is 6PPDQ, and where does it come from, how does it harm fish, which fish are most susceptible to harm. 2) What can be done about it and where are improvements happening? What BMPS are believed to be successful at treating or managing 6PPDQ. 3.) How has this effective capital improvement projects for cities and municipalities, and what strategies can be used to adjust or position their projects.

Ecological responses to small barrier removals and high flows in a coastal California stream

Professional

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Small fish passage barriers are commonly removed to restore connectivity and ecosystem function. However, few studies focus on small dams and seldom investigate responses at multiple ecological scales. Tracking responses to restoration actions can also be confounded by extreme weather events that occur during sampling. Given the rise in small barrier removals and climate-driven disturbances, there is an urgent need to understand how streams respond to these events. In this study, we characterized physical and biological responses to the removal of two small barriers and an extreme (98th percentile) flow event in the Jalama Creek Watershed (Santa Barbara County, CA) located within The Nature Conservancy's Jack and Laura Dangermond Preserve. To support steelhead (i.e., the anadromous form of *Oncorhynchus mykiss*) recovery, two fish passage barriers were removed from the first 3 km of anadromous habitat in 2023 and 2024. We used a Before-After Control-Impact framework to measure stream habitat and benthic macroinvertebrate (BMI) responses to restoration actions, while opportunistically investigating the influence of a high-flow event that occurred during our study. Two years after dam removal, macroalgae levels decreased to baseline conditions and fine sediment was transported downstream to sediment-starved areas. Across 25 BMI samples, we documented 121 unique taxa (mean Shannon's diversity = 2.10) which were dominated by mayflies of the genera *Caenis* and *Tricorythodes*. Barrier removals did not influence the BMI community which was instead driven by water depth and the abundance of coarse particulate organic matter. However, the winter flood temporarily decreased BMI densities and increased

the relative abundance of early colonizer genera *Baetis* and *Simulium*. Collectively, we observed rapid physical and biological changes in response to disturbances and provide baseline information to inform steelhead research and recovery efforts in Jalama Creek.

Three Decades of Independent Science for the Columbia River Fish and Wildlife Program: Informing Policy, Projects, and Progress in the Face of Growing Challenges

Professional

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Independent scientific review is a critical part of fish and wildlife program and project implementation, research, and development in the Columbia River Basin. Independent scientific review is intended to help decision-makers separate scientific variables from other considerations (political, economic, cultural, etc.) and ensure environmental decision-making reflects the best scientific knowledge. For the past three decades, independent scientific review for the Northwest Power and Conservation Council's Columbia River Fish and Wildlife Program has been conducted by two groups: the Independent Scientific Review Panel ([ISRP](https://www.nwcouncil.org/fish-and-wildlife/fw-independent-advisory-committees/independent-scientific-review-panel/)) and the Independent Scientific Advisory Board ([ISAB](https://www.nwcouncil.org/fish-and-wildlife/fw-independent-advisory-committees/independent-scientific-advisory-board/)). The ISRP reviews projects funded through the F&W Program, and the ISAB synthesizes the state of the science on key issues central to the protection, mitigation, and enhancement of Columbia Basin fish and wildlife and their habitats. The groups' work has built on foundational river restoration reports from the mid-1990s: the Independent Scientific Group's [Return to the River](https://www.nwcouncil.org/reports/independent-scientific-group-return-to-the-river/) and the National Research Council's [Upstream: Salmon and Society in the Pacific Northwest](https://www.nationalacademies.org/publications/4976). In addition to an overview of the ISAB's and ISRP's approach to the science and policy interface, this talk will highlight findings from several key reports released in the past decade that describe significant progress despite growing stressors, provide guidance on a path forward, and exemplify the goals of scientific review. The reports cover [predation management](https://www.nwcouncil.org/reports/isab2019-1/), [American shad](https://www.nwcouncil.org/reports/american-shad-columbia-river-past-present-future/), [salmon reintroduction to blocked areas of the basin](https://www.nwcouncil.org/reports/isab2022-2), [salmon survival metrics](https://www.nwcouncil.org/reports/isab-sar-and-sas-metrics-report/), [habitat restoration strategies](https://www.nwcouncil.org/reports/isrp-habitat-retrospective-report/), and [climate resilient approaches to mitigation](https://www.nwcouncil.org/reports/isab2025-2).

Multitrophic responses to tidal marsh restoration: early wetland design effects on water quality, food web, and fish communities

Professional

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Tidal wetland restoration is a key strategy for recovering estuarine ecosystem function under accelerating sea-level rise and climate variability. Dutch Slough in the San Francisco Estuary offers a rare opportunity to examine how restoration design shapes early ecological trajectories

across contrasting basin types. Over the first three years after construction, including one year pre-levee breach, we used a Before–After–Reference–Impact framework to monitor two engineered tidal channel networks and a large open-water basin that provide soil for the tidal channels. Integrated, low impact measurements, including high-resolution water-quality sensors, video-based fish surveys, eDNA community profiling, and machine-learning-assisted zooplankton imaging, captured physical and biological transitions following tidal reconnection. Early responses included shifts in dissolved oxygen, turbidity, chlorophyll-a, habitat heterogeneity, and emerging food-web structure, with patterns differing across channel complexity and basin configuration. This talk will delve into how specific design features influenced these early trajectories, highlight insights gained from multiple monitoring approaches, and discuss what these results suggest for planning resilient, functional tidal wetlands under changing climate and landscape conditions.

Reactive to Proactive – Using Fish Passage Technology to Increase Habitat Restoration

Professional

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When using old ways of thinking about fish passage (ladders, lifts, etc.), the effort to aid fish on their migratory journey quickly becomes a complicated and expensive endeavor. Existing projects continually chase regulatory requirements to accommodate multiple and varying species - consultants win, and fish lose. Using newly available technology, however, these issues are much more easily and effectively resolved. The only real restraint seems to be our own ability to adjust our ways of thinking and take advantage of all that technology has to offer. Advanced, modular fish passage systems that provide selective, autonomous, volitional and economical passage of fish over dams are now available. In particular, a new technology from the EU, the “FishLock”, will be presented, demonstrating its function and case study results from various rivers in Austria, Germany and Switzerland, as well as the simple origins that led to this ingenious invention. Creative thinking can have a ripple effect, as well. In addition to discussing the direct benefits for fish and fish passage, there will also be discussion on the indirect benefits for fisheries restoration - how making use of such technology can simplify operations so that dam operators can more easily accept providing fish passage, rather than continually resisting it. Moving beyond traditional thinking about fish passage and embracing innovation can lead to real dividends: – operators can shift from the expense of being reactive, to proactively solving fish passage issues and moving on with producing clean hydropower. Fish, tribes, anglers’ groups and NGOs can realize more river miles opened more quickly because site installations can be more easily deployed. Shifting from reactive operations to the proactive embrace of technology is good for fish and good for the environment, and this invention is one way to help.

Adaptive management of habitat rehabilitation and monitoring in the Lemhi River watershed

Professional

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The Lemhi River Intensively Monitored Watershed (IMW) Program has explored many avenues of monitoring and evaluating fish response to habitat rehabilitation actions. The major limiting factor for Chinook Salmon in the Lemhi River basin is rearing habitat. Providing an increase in habitat capacity to meet life stage specific requirements is challenging to assess when adult returns remain low. Numerous environmental and out of basin factors influence adult

escapement to the Lemhi River, making it difficult to relate habitat to changes in salmonid population level response. The temporal and spatial scale of structured evaluations has changed over the years due to challenges associated with quantifying salmonid response to rehabilitation actions. Monitoring and evaluation efforts have helped guide habitat implementation. The habitat program has transitioned from reconnecting tributary habitats to increasing habitat complexity in the mainstem Lemhi River by reconnecting the floodplain and off channel habitats. Over the years, the Lemhi River IMW program has assisted in guiding rehabilitation efforts and has learned to evolve and adapt monitoring and evaluation efforts to better assess fish response to habitat rehabilitation actions. Monitoring life stage specific salmonid response to habitat has proven to be challenging but understanding the limitations of monitoring, adapting to challenges, and learning from past studies are beneficial to assessing population level responses of salmonids to changes in their habitats.

Introduction to Structured Decision-making to Approach Values-based, Multi-stakeholder Natural Resource Decisions

Professional

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Structured decision-making (SDM) is a methodology for collaborative decision making that was developed to address complex natural resource decisions. It is a values-based approach that is well suited to making decisions when there are multiple stakeholders with different and sometimes conflicting objectives and values, particularly in contexts when there is high levels of uncertainty. SDM uses structured facilitation processes combined with quantitative scientific methods to provide decision makers with both the space and the information needed to make transparent, collaborative decisions. Many government agencies are expanding their use of this methodology due to its flexibility and suitability for adding learning into the decision making process (such as in adaptive management), including the US Fish & Wildlife Service and USGS as well as state agencies such as the California Department of Water Resources and Washington Department of Fish & Wildlife. The purpose of this talk is to briefly introduce the types of decisions that SDM is best suited to be used for (with case studies from fisheries contexts), the steps involved in the process, the different roles that participants in an SDM can take (facilitator, subject matter expert, quantitative modeler, decision maker, etc.), and to provide resources for learning more about SDM in the future.

Risks and Cumulative Impacts of Floating Offshore Wind and Intermodal Container Port Development in Estuarine and Coastal Habitats

Professional

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Estuary restoration and related wetland connectivity efforts have been a goal of public and private partnerships established across many coastal ecosystems. These efforts to restore function and resiliency in the face of climate change are now challenged by major development projects proposed or underway in some of the same geographic locations of ongoing restorations. Although the current US Federal programs have slowed the development of floating offshore wind on the Pacific Coast, projects in California's Humboldt Bay are moving forward with plans for major port infrastructure and shoreline development to support this emerging industry. In Oregon, the just released Draft Oregon Offshore Wind Energy Roadmap identifies the magnitude of considerations and challenges associated with development and installation of offshore wind power in remote multiple coastal locations. In Coos Bay Oregon, a large multimodal container port project has been proposed that would require removing more

than 30 million cubic yards of substrate from the estuary bottom to allow for large container ship traffic to enter and berth. Massive projects such as these target estuaries and shorelines in sparsely populated and undeveloped coastlines. These developments and the associated coastal communities affected face developmental challenges that involve powerful large scale economic players. This presentation will highlight some of the complex challenges and risks associated with modification and disturbances in important marine and estuarine habitats, and human communities within the lens of cumulative impacts.

The Borax Lake Chub: Can They Handle the Heat of a Warming World?

Professional

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Borax Lake Chub are endemic to a shallow 4.1-ha geothermally heated lake in the Alvord Basin. The species exist near its upper thermal tolerances during summer, as demonstrated by major decreases in abundance associated with severe heatwaves in some years. During elevated summer temperatures, fish find thermal refuge along the margins of the lake farthest from the vent. The quantity, quality, and location of thermal refuge can vary daily, depending on the maximum air temperature, wind speed, and wind direction. Borax Lake Chub were removed from the endangered species list in 2020, but the delisting publication noted that although the immediate anthropomorphic threats that led to the original listing have been removed or ameliorated, a remaining residual threat is the reduction of habitat suitability during periods of warm air and water temperatures possibly exacerbated by climate change. To better understand this threat, we assessed the critical thermal maximum (CT_{max}) of the species by subjecting fish to thermal ramping rate trials (0.33°C/min) until loss of equilibrium. Daily maximum lake temperatures were evaluated with temperature loggers positioned along the lake margins from 2006-2025. The average CT_{max} of Borax Lake Chub was 40.1°C (range: 39.5-40.5°C). Fish size had no relationship to CT_{max}. Daily maximum lake temperatures in summer averaged 34°C across all logger locations and years. Daily maximums >39.5°C recorded at any location were rare (0.7% of observations) and never occurring at all logger locations simultaneously in a day. However, based on the relationship between maximum air temperature and lake temperature, climate change could potentially increase the lake temperatures by >1°C by the end of the century. This is expected to result in the number of occurrences of lake daily maximum >39.5°C increasing by an order of magnitude and occurring throughout the lake on some occasions, increasing the likelihood of heat-induced mortality events.

Management Tools And Approaches To Non-native Fish Control In Colorado Rivers And Reservoirs In The Upper Colorado River Basin

Professional

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Non-native fishes such as Smallmouth Bass *Micropterus dolomieu*, Northern Pike *Esox lucius*, Walleye *Sander vitreus*, and a variety of other species pose a substantial threat to native fish populations in the Upper Colorado River Basin. Reservoirs can be sources of non-native fish, and if left unmanaged, pose a threat to native fishes in the basin. Balancing recreational angling opportunities and non-native fish control efforts require complex management strategies. State, tribal, federal, and NGO partners in the Colorado River Basin form the Upper Colorado River Endangered Fish Recovery Program and have developed tools and new approaches to manage compatible species for recreational angling while jointly managing against undesired species in critical habitat. Colorado Parks and Wildlife implements management tools that include

compatible fish stocking (including sterile sportfish and cool/warmwater species that are unlikely to thrive in riverine habitats), angler incentive programs, unlimited bag and possession limits for problematic nonnative fish species, reservoir screening and netting requirements to reduce escapement, and education and outreach to contribute to the recovery and conservation of native fish species within the basin while also managing for compatible sportfishing opportunities.

Long-term dynamics of Oregon's kelp forests with an emphasis on nearshore marine fishes

Student

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Among the most productive ecosystems on Earth, kelp forests are prime examples of imperiled foundation habitats that are critical to numerous marine species. In the California Current (CC), kelp forests harbor nearshore fishes, including key fishery species such as rockfish, salmonids, lingcod, and cabezon. Multiple stressors, including marine heatwaves, intense storms, and loss of keystone species, have caused major recent declines of bull kelp (*Nereocystis leutkeana*) forests. Despite robust monitoring efforts in other regions of the CC, subtidal surveys in Oregon primarily target invertebrates and algae, while monitoring of fish communities remains limited. This data gap is concerning considering Oregon has lost more than two-thirds of its annual peak kelp canopy since 2010. To address this lack of information on kelp-dependent fish communities,, we are comparing temporal changes in fish assemblages using novel community composition data collected through three in-situ diver survey methods (visual, environmental DNA, and stereo-video) at three nearshore sites. Multivariate tests reveal fish diversity and abundance of dominant rockfish species is dependent on kelp canopy cover, as well a suite of environmental factors including substrate type, relief, and upwelling. Fish assemblages and abundance also differ seasonally, reflecting fish movement in response to the natural decline of kelp in the winter. Additionally, we are using ARC GIS to analyze trends in Oregon's kelp forest canopy over the past century. Preliminary results show major fluxes in dominant kelp canopy regions of the Oregon coast over time. Pairing canopy kelp aerial data with in-situ fish survey data will enable a better understanding of how kelp forests sustain Oregon's nearshore fish communities in regions of the coast that have experienced the greatest declines in kelp forest habitat over time.

Modeling aquatic food web responses to wildfire in Oregon watersheds

Professional

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Increasing wildfire severity is reshaping forested watersheds of the Pacific Northwest, yet ecosystem responses depend not only on species presence but on the network of interactions that sustain aquatic communities. We apply aquatic food-web modeling to evaluate post-fire responses across headwater streams burned in the Riverside, Beachie Creek, and Holiday Farm fires, and in the South Fork McKenzie River, Oregon, where floodplain restoration preceded wildfire. Together, these systems provide a gradient of fire severity, reference (unburned) conditions, and restored versus unrestored reaches. Using empirical species-occurrence data and literature-based consumer–resource interactions, we assemble multi-trophic food webs spanning primary producers to fish. We quantify changes in connectance, linkage density, average path length, and omnivory to assess shifts in trophic complexity and potential resilience. In the South Fork McKenzie River, we compare one year pre-restoration, two years post-restoration, and one year that is both post-restoration and

post-fire, alongside unrestored sites. Across burned headwater streams, we model three years following wildfire and integrate abiotic covariates including temperature, nutrients, and sediment. Preliminary analyses indicate that network metrics may reveal structural and functional changes not detected by traditional community indices alone. By linking food-web structure to disturbance gradients and management context, this framework provides mechanistic insight into how fish and their supporting food webs respond to wildfire. Food-web modeling may offer managers an early indicator of ecosystem vulnerability and recovery potential in fire-prone watersheds.

Can FIRO (Forecast Informed Reservoir Operations) aid Willamette River salmon passage?

Professional

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The Upper Willamette River has two ESA listed evolutionary significant units for steelhead and Chinook salmon populations that benefit from US Army Corps of Engineers (USACE) Willamette Valley System (WVS) reservoir operations in recent years. The UWR winter steelhead return timing is prior to potentially high temperatures below the WVS dams and reservoirs. They benefit from reservoir releases of downstream flows in the North and South Santiam Rivers during spawning and rearing life history stages. In contrast, the UWR spring run Chinook salmon return timing over Willamette Falls is from March to August, which can expose them to lower flows and higher temperatures in spring or summer months. Reservoir operations that provide benefits for passage are generally enhanced by reservoir refill. Releases are used to provide both downstream habitat and operational passage. In dry years, lower refill can be in tension with reservoir releases to meet minimum flow objectives. Forecast Informed Reservoir Operations uniquely rely on improved precipitation forecasting skills and provide alternative refill actions while maintaining flood risk management. The modified operations may change the timing of refill to benefit flows and temperatures. Reservoir and dam passage options include spillways, regulating outlets, and turbines—all of which link upstream to downstream habitats, and rely on different elevations. When spillway options are available, Chinook juvenile passage timing responses are dramatic. Spill operations are normally at night, with daytime hydropower operations, since past studies have shown that most juveniles move downstream at night. Data from recent years shows the spike in passage once the spillway is operable, and a decline over time in most years as juveniles move out or are unable to find outlets as the reservoir refills fully. I will show examples from multiple subbasins refill, and resulting operations, that change juvenile downstream passage options.

Extending Genetic Baselines: Improving GTseq for Degraded and Historical Samples

Student

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Baselines provide essential reference points for understanding contemporary populations and the genetics of fisheries. Most genetic baselines were created only after large-scale anthropogenic changes associated with industrialization, urbanization, and commercial harvest, limiting our ability to detect long-term shifts in genetic diversity and population structure. Efforts to extend these baselines using historical samples require methods capable of generating reliable genotype data from degraded DNA while remaining directly comparable to modern datasets. Yet widely used genotyping approaches rely on high-quality nuclear DNA and often fail on degraded specimens, whereas the mitochondrial DNA-based approaches commonly used

for degraded samples offer limited interoperability with contemporary datasets. This study evaluates whether a widely used modern genotyping method (genotyping-in-thousands by sequencing; GTseq) can be effectively applied to poor-quality and low-quantity DNA. We tested several protocol modifications to assess their ability to improve GTseq genotyping success and accuracy across a range of DNA inputs and degradation levels. These optimizations enhance genotyping performance, supporting the inclusion of archival material and offering the potential to recover data from highly degraded archaeological specimens. This expanded capability could extend baseline datasets by decades to centuries, giving managers clearer insight into whether current patterns of genetic diversity and population structure reflect recent pressures or long-term trajectories.

Conservation Genetics of Endangered Speckled Dace Subspecies in Northeastern Nevada

Professional

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Northeastern Nevada is home to two endangered and narrowly-endemic Speckled Dace subspecies that inhabit Independence Valley (*Rhinichthys osculus lethoporus*) and Clover Valley (*R. o. oligoporus*). The former is endemic to a single spring complex, while the latter occupies three separate springs. Their populations have experienced large fluctuations in census size over the past two decades, which has raised concerns about their genetic variability. Furthermore, little is known about gene flow within and among these populations, or the phylogenetic relationships between these two subspecies and Speckled Dace found in neighboring basins. We addressed these knowledge gaps using restriction-site associated DNA sequencing (RADseq) to evaluate 585 Speckled Dace individuals at 2,730 genetic loci. Results showed that effective population size (Ne) estimates tended to correspond with results of past population monitoring efforts. While Independence Valley was found to contain a single population with a large contemporary Ne, estimates for Clover Valley populations were variable, and temporal sampling indicated potential declines in Ne that coincided with changes in census size. Phylogenetic analysis indicated that one Clover Valley population (Clover Valley Warm Springs) was more closely related to Independence Valley Speckled Dace than to the other Clover Valley populations. This relationship could potentially be explained by fluvial and/or pluvial connections to Pleistocene Lake Clover, which linked the two basins during the early Holocene. These results have improved our understanding of the history and population structure of these endangered Speckled Dace populations.

Gut Check: Evaluating differences in Kootenai River Mountain Whitefish diets

Student

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Nutrient addition is increasingly used as a management tool to enhance productivity in nutrient-limited rivers, yet its effects on fish diets are often evaluated indirectly. In the Kootenai River, nutrient additions began in 2006 to support food-web productivity and fish populations. We analyzed long-term stomach content data from Mountain Whitefish (*Prosopium williamsoni*) collected annually from 2002–2024 to evaluate spatial and temporal shifts in diet composition associated with nutrient enrichment. Results indicate significant, sustained changes in overall diet composition following nutrient addition, with effect sizes varying among river zones and through time. These shifts were accompanied by changes in dietary diversity, suggesting long-term restructuring of prey use. Our findings demonstrate that nutrient enrichment can alter

consumer diets at the population level and highlight the value of long-term diet monitoring for evaluating the ecological effectiveness of river nutrient-addition programs.

The River Within Our Veins: The Mission to Save the Salish Sea Salmon

Professional

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The recovery of Salish Sea salmon is a challenge too vast for any single entity to solve. This 15 minute documentary explores the vital role of the Puget Sound Ecosystem Monitoring Program (PSEMP) and the diverse network of collaborators working to restore the region's ecological health. Moving beyond traditional silos, the film highlights how agencies, academia, nonprofits, and Tribal nations have unified to transform fragmented data into a cohesive, bottom-up approach to habitat restoration. The narrative centers on the critical importance of estuaries, nurseries where salmon build resilience necessary for ocean survival. Focusing on the need and benefits of long-term research monitoring, the documentary showcases various methodologies, from beach seine sampling to soil sensor technology. It delves into landmark efforts like the Elwha River dam removals, illustrating how the restoration of natural sediment flows and the installation of engineered logjams create immediate benefits for fish and local communities. The film emphasizes that collaboration is rooted in Tribal co-management and the integration of ancestral knowledge and honors the Salmon People and their deep historical context and Tribally led recovery efforts. The documentary also highlights the avenues for the development of a diverse workforce—incorporating Tribal youth and military veterans—noting pathways for people to become involved with this work. The film offers a powerful and beautiful testament to the necessity of long-term commitment, showing that when we restore the rivers, we help to promise a sustainable legacy for future generations.

Monitoring Chinook egg-to-fry survival in a dynamic, western Washington River: preliminary results from the Nooksack Basin

Professional

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Egg-to-fry survival is a critical and often limiting life stage for Chinook salmon, yet empirical estimates are scarce in coastal rivers. For the Nooksack River in Washington, Chinook (*Oncorhynchus tshwaytscha*) egg-to-fry survival has been identified as a key data gap and limiting factor for recovery. In 2025, we initiated a basin-wide study to estimate spring Chinook egg-to-fry survival across the North, Middle, and South Forks of the Nooksack River—which differ in glacial influence, hydrology, and channel conditions. We constructed artificial redds and installed scour chains at 24 sites (72 total redds) to examine effects of habitat (river reach, fine sediment intrusion, scour) and parentage on Chinook egg-to-fry survival and development across the basin. Each redd was stocked with fertilized hatchery gametes and placed in a modified Whitlock-Vibrate egg box. Water temperature was continuously monitored to estimate development rates and time retrieval at ~50% emergence. Historic flooding during incubation resulted in many artificial redds being scoured, dewatered, or buried, which we assumed represent zero survival. Egg boxes were recovered at 8 sites and average egg-to-fry survival—including those scoured out—averaged 0%, 4%, and 11% for the North, Middle, and South Forks. Initial first-year results suggest survival varies among sites, forks, and habitat settings. Most sites showed complete egg-to-fry mortality due to scour or fill, while others showed moderate-to-high survival, with few intermediate outcomes. These results indicate that local geomorphic and hydraulic conditions strongly influence early life-stage success and that some habitat settings may be more resilient to scour, deposition, and high-flow disturbance.

Despite extreme flood conditions, results remain encouraging and demonstrate the value of this approach.

Streamlined Habitat Restoration: Evaluating Model Response to Automated vs. Fine-scale Data for Regional Planning

Professional

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The Habitat Assessment and Restoration Planning (HARP) model is a framework that links landscape processes to habitat conditions, and subsequently to salmonid life-stage productivities and capacities. By evaluating how habitat-forming processes have deviated from historical conditions, and how they may shift under future scenarios, HARP identifies the potential effectiveness of spatially explicit restoration actions. To date, this modeling approach has been completed in the Chehalis River basin, the Stilllaguamish/Snohomish basins, and currently being implemented in the Upper Columbia River basin, covering a large swath of area and ecosystem types. A core component of this analysis involves transforming raw geospatial data into key habitat metrics that act as our restoration drivers: riparian shade, floodplain connectivity, wood abundance, beaver ponds, bank armor, fine sediment, and fish passage barriers. In past iterations, these metrics have been hand-digitized or modeled by NOAA from aerial imagery or LiDAR – a granular and often time-consuming approach that can be difficult to scale to management-level units like Evolutionary Significant Units (ESUs) or data-limited regions. To address this, we are investigating whether 'off the shelf' datasets and models can serve as viable alternatives. However, it remains unclear if spatially explicit habitat capacities and restoration effects derived from the HARP model are significantly altered by the use of fine-scale inputs versus coarser, more efficient data. Using the Stillaguamish River basin as an initial case study, we will compare the 2023 high-resolution HARP outputs as a benchmark against a streamlined version of the same habitat, now parameterized with relevant existing literature, regional datasets, and scalable models. By analyzing habitat metrics across subbasin units, we can evaluate whether a more approachable process maintains the necessary detail to provide actionable results for regional land managers.

Empowering Community Science with AI-Enabled Identification of Individual Trout via Angler-Generated Photographs

Professional

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Artificial intelligence (AI) is revolutionizing ecological research and conservation through analysis of wildlife imagery. AI-driven pattern recognition presents new opportunities for identifying not only species but individuals in nature, through unique natural markings such as fur coloration, scars or, in our case, spotting characteristics. This opens new opportunities for crowdsourcing data in fish population dynamics through efficiently acquired mark-recapture data. We present a new individual recognition tool "[TroutSpotter](https://troutspotter.wildme.org/)", which blends data management software and AI models that have been trained on tens of thousands of trout photographs. TroutSpotter can ultimately provide ranked lists of filtered matches in support of individual trout ID and population assessment, using a deep-learning foundation model that draws from photo banks of all species on the hosting [WildMe-Wildbook] (https://www.wildme.org/platforms.html) research platform – from trout to sea dragons to giraffes – for improved accuracy and match visualization. TroutSpotter enables batch uploads of photos, a task now embedded in the

[OnWater](https://www.onwaterapp.com/) angling mobile app which allows direct photo submission and pulls complementary data from flow and temperature gages and a proprietary fish size estimation model. We overview the status of our current model training efforts and discuss opportunities for assisting with targeted datasets to improve model accuracy, and for applying this tool more deeply to various scientific and community engagement endeavors in the future.

Contaminants in the Columbia River Basin and Effects on Fish Health

Professional

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Much progress has been made in the past few decades in understanding the sources, transport, fate, and biological effects of contaminants in aquatic ecosystems. Despite these advancements, significant obstacles still prevent comprehensive assessments of the ecological risks associated with contaminant mixtures and interactions with other environmental stressors. Many of these challenges arise from the extrapolation of results from single chemical, high concentration laboratory exposure trials to actual conditions experienced by wild fish populations. We will explore the state of knowledge on the presence and effects of various contaminant classes found in the Columbia River Basin, and their known impact on aquatic food webs and fish health. We will explore case studies to illustrate key challenges, including the complexity of evaluating mixtures of emerging and legacy contaminants in the aquatic environment, issues related to bioavailability, and understanding sublethal effects on a range of anadromous and resident fish species. Two major unknowns remain: the extent to which individual fish encounter and assimilate contaminants, and the ultimate effects of these contaminants on their populations.

The Resolution of Archaeological Fisheries Data: Insights and Challenges from the Oregon Coast

Professional

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Archaeological fishbone assemblages are essential sources of historical benchmark data for understanding species abundance, distribution, life-history, and resilience. However, archaeological assemblages admittedly provide only a rather coarse record of ecosystem dynamics and composition in the past as they are produced by human choices of prey selection, processing, consumption, and discard, and then further altered by decomposition and archaeological methods themselves. This presentation will review the rich potential, and the limitations, of archaeological data for use in conservation planning to help support cross-disciplinary conversations, drawing on available information for Native American marine fisheries on the Oregon coast as an example.

Perspectives from the classroom: ORAFS Funds in Action

Professional

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In order to build a diverse workforce in fisheries science, first high school students need to know the significance of where they live. Teachers from Parkrose High School in Portland Oregon, are using Education Materials and Participation Grant funds to: Develop a rigorous place-based and social justice centered curriculum surrounding the Columbia River basin, with hands-on data collection for students Connect local hatcheries and career-training programs with one of the

most diverse school districts in the United States This presentation is based on data from student surveys reflecting on their experience learning about the responsibilities of fish biologists at Bonneville hatchery, and from viewing salmon spawning grounds at Eagle Creek. In this presentation, teachers share experience and plans to build lasting connections between Parkrose School District and local hatcheries, using the egg-to-fry classroom program to build student-lead data collection experiences and place-based learning.

Past, Present, and Propagated: A Population Genetic Perspective on Hatchery Impacts

Professional

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Spring Chinook in the Grande Ronde and Imnaha basins in northeastern Oregon have been subject to various supplementation strategies from the 1980s to present. Early supplementation actions (1980s to late-1990s) were primarily focused on fish abundance, as opposed to preserving endemism, resulting in the use of out-of-basin stocks to supplement native populations. These strategies did not achieve recovery goals and often lead to high straying rates. These observations, paired with the ESA listing of spring/summer Chinook in the early-1990s, prompted the implementation of a local brood policy in the late-1990s. This policy continues today and focuses on rebuilding populations using fish that naturally return to their natal streams. In addition to tracking fish abundance and productivity, the impacts of these management actions can be evaluated by examining genetic data through time. This allows co-managers to assess temporal patterns in population structure, as well as levels of introgression by the non-native stocks, the persistence of this introgression and metrics of genetic diversity. In this talk, we will review population genetic data from all major tributaries in the Grande Ronde basin, and the Imnaha basin, from the 1980s to present. We also include data from Lookingglass Creek samples collected in the 1960s, which represent the endemic, or pre-supplementation, stock. Lastly, given that tissue collections of such temporal longevity can be difficult to compile, the patterns observed in the Grande Ronde and Imnaha basins may provide broad insight to long-term impacts in systems where similar management actions have been implemented.

Nez Perce Fishery Management: A people with a place and purpose

Professional

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The Nez Perce Tribe is working to restore salmon runs to healthy and harvestable levels to support the needs of our people and the lands and rivers that support them. Tribal fisheries are managed so salmon contribute to the needs of people -- food supply, economy, and health and wellbeing. Our purpose is to use our management authorities -- on our own and in concert with other tribal, state and federal managers -- to manage salmon along their migration and life cycle. Our management authorities follow the salmon to all the places they go across their lifetime. As a management entity, we work in various ways to bring about a future where salmon and our people can live and thrive together once again.

Emerging Hatchery Technology: Impacts of Partial Recirculating Aquaculture Systems on Olfactory Imprinting in Fall Chinook

Student

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As climate change continues to impact water availability, quality, and temperature, hatcheries must be innovative in how fish are reared. Emerging technologies such as partial recirculating aquaculture systems (PRAS) are increasingly being implemented in salmon hatcheries to combat the challenges associated with climate change. These systems use far less water than typical flow-through tanks, increase body condition, and require less feed overall for the fish being reared. However, these systems are very large investments and the potential impacts of this rearing technique on return rates remain unknown. To further understand the impacts of PRAS rearing on salmon, we have initiated a study examining the effects of these systems on olfactory imprinting in Fall Chinook. Salmon imprint on specific odors in their rearing water at key points in their life cycle (e.g., the parr-smolt transformation, embryo development and hatching). PRAS systems are designed to use much less water than typical flow-through systems by treating the output water with mechanical and biofiltration, UV sterilization, and re-oxygenation. Though a small portion of “fresh” water is added to the system regularly, this is far less than fish experience in a flow-through system and less still than they experience in the wild. Because of this water cycling, it is likely that fish in a PRAS unit receive fewer environmental olfactory cues than fish in flow-through tanks, potentially leading to decreased imprinting or missed cues. In addition, fish may experience high concentrations of conspecific odors recirculating in the system with unknown consequences for imprinting. To assess imprinting, we will compare olfactory gene expression of fish reared in PRAS and flow-through systems via RNAseq to determine if there are significant differences between typical hatchery rearing and PRAS. This study will inform how new rearing technologies are implemented in hatcheries.

A new hatchery model of fitness and genetic diversity provides management insight while resolving a domestication paradox

Professional

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Hatcheries are widely used to recover threatened species, support reintroductions, and supplement harvested stocks. Yet domestication selection in hatcheries can reduce wild fitness and genetic diversity, posing risks for long-term population viability. Existing models assuming Gaussian fitness in both captive and wild environments fail to explain why captive-favored phenotypes persist and often overpredict demographic decline. We developed a genetically explicit, individual-based model incorporating Gaussian selection in captivity, multi-niche balancing selection in the wild, variable selection strength, and two management-relevant parameters: two-way gene flow and broodstock size. This framework reproduces empirical patterns of fitness, demography, and genetic variation that previous models could not explain. Our results show that (i) adaptive genetic variation can be maintained when habitat diversity supports multiple ecological niches, (ii) captive-favored genotypes can persist in the wild without causing demographic collapse, and (iii) neutral diversity is highly sensitive to broodstock size and the proportion of captive-born breeders. These findings offer a mechanistic resolution to discrepancies between theory and observation and provide actionable guidance for designing captive breeding programs that support recovery or harvest goals while more fully preserving evolutionary potential.

Drivers of Relative Reproductive Success in Wenatchee Spring Chinook

Professional

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Upper Columbia River salmon face increasing threats from climate change and ecosystem alterations. While prior studies have linked environmental variables to survival across life stages, a comprehensive synthesis of ecological and phenotypic effects on individual productivity is lacking. This study describes a research approach combining multiple datasets to identify spring Chinook limiting factors. By applying this methodology to the Wenatchee basin, reproductive success data are integrated with a novel spatiotemporal framework to assess relative reproductive success (RRS). This provides managers a research-based framework for prioritizing restoration and resource allocation in areas likely to sustain productivity. Generalized Additive Models (GAMs) initially analyze potential spawners, estimating effects of parental origin, phenotypes (lipid content, fork length), and long-term environmental drivers. Smolt-to-Adult Return rates serve as a proxy for ocean conditions, enabling models to account for varied marine experiences. This methodology identifies traits that buffer individuals against stressors during upstream migration and spawning site arrival. To move beyond traditional approaches, a novel spatiotemporal hurdle model analyzes known spawners' reproductive success. This methodology differs from standard RRS analyses by explicitly incorporating spatial and temporal dependencies. By integrating stream network data with localized drivers, including stream-scale spawner density, cumulative heat stress, and flow regimes, the model visualizes fitness landscapes across the basin. This spatially explicit framework, combined with ocean-stage proxy data, enables managers to identify reaches where environmental conditions influence reproductive productivity. Collectively, these models provide a toolset for bridging hatchery and natural production to support the performance of both groups within natural life-history trajectories.

Integration of statistical methods to improve understanding of the impacts of dam operations on mortality and injury of juvenile Chinook salmon at Cougar Dam

Student

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In 2021, court-ordered operational changes were implemented at Willamette Valley System dams to improve passage survival for at-risk juvenile Chinook salmon (*Oncorhynchus tshawytscha*). At Cougar Dam, a 452-foot rockfill dam on the South Fork McKenzie River, these changes included a deep fall drawdown and a delayed spring reservoir refill. Using data from rotary screw traps below the dam, we analyzed the effect of these operations on mortality and injury of juvenile Chinook salmon with a combination of statistical models and Bayesian networks. Our analysis revealed that survival was significantly higher during the post-injunction period, suggesting the new operational measures have been successful, and, while all tested operational variables had a significant impact on survival, fish length was the most important predictor of both mortality and injury. The statistical models identified interactions between variables, highlighting the complex relationships that drive survival. The Bayesian networks help untangle these interactions and evaluate tradeoffs between mortality and injury. Using these methods in tandem can help support adaptive management of dam operations with the goal of improving juvenile Chinook survival, and may help assess other, multi-stakeholder, objectives of dam operations. Our case study is focused on Cougar Dam, but can be used as a framework for other dams where fish passage is of concern.

Characterizing the distribution of Oncorhynchus mykiss genetic diversity in the Klamath River Basin before dam removal

Professional

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Genetic assessments serve as powerful tools to evaluate the effects of anthropogenic habitat fragmentation on natural populations. In the Klamath River Basin, construction of four dams from 1912 to 1962 had a profound impact on the distribution of anadromous fishes, blocking access to over 751 river kilometers of critical habitat. To characterize the genetic diversity and connectivity among *Oncorhynchus mykiss* in the basin prior to historic removal of the four dams in 2024, we genotyped 2,466 samples at 193 presumably neutral and 105 putatively adaptive markers. Using complementary population genetic analyses, we found a clear division between coastal and inland *O. mykiss* lineages located primarily downstream and upstream of the outlet of Upper Klamath Lake, and little genetic structure associated with dams. Further, we detected distinct inland and coastal genetic lineages upstream of the lake outlet supporting the hypothesis that ancestral inland *O. mykiss* were secondarily invaded by a coastal lineage. Based on the chromosome Omy5 markers associated with anadromous/resident phenotypes, we found that anadromous and heterozygous genotypes were more prevalent downstream of the lake outlet while resident genotypes were dominant upstream of the outlet. Based on the chromosome Omy28 markers associated with adult migration timing, we found that late-migration timing and heterozygous genotypes were numerous downstream of the lake outlet while early-migration timing genotypes were prevalent upstream of the outlet. The results of our population genetic analyses highlight the genetic diversity and structure of *O. mykiss* in the Klamath River Basin and will serve as an important baseline for future assessments post dam removal.

Beaver Dam Analogs: A Rorschach Test of Ecological Restoration

Professional

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The field of stream restoration has been criticized for inadequate monitoring of project outcomes and embracing paradigms based on insufficient evidence. Despite detailed manuals and widespread project publicity, low-tech, process-based restoration (LTPBR) has gaps in the evidence for its efficacy. For example, hundreds of LTPBR projects have been implemented to store water behind human-built structures known as beaver dam analogs, or BDAs. Nevertheless, there remains insufficient information to determine whether BDAs perform the basic function of a beaver dam: raising and retaining water levels. The elevation difference between water above and below a dam is called head height. One reason for a knowledge gap in head-height responses after LTPBR is that scientific monitoring of BDAs is sparse, which we quantify by comparing the number of known BDA projects across North America with the number of peer-reviewed reports assessing project success. In addition, the small number of studies assessing BDA head heights seldom report maintenance effort, beaver adoption, or restoration trajectories, making it difficult to understand the amount of adaptive management needed for such projects to succeed. Finally, LTPBR lacks specific, standardized success metrics, allowing head height to be conflated with other desired outcomes rather than assessed separately. We present three case studies from LTPBR projects in Central Oregon to illustrate these problems and clarify future goals for improved monitoring and project success. Until then, the efficacy of BDAs in raising water levels remains largely unknown, permitting a range of perspectives and making them a Rorschach test of ecological restoration.

First Documentation of Fall-Run Chinook Salmon Spawning in the Headwaters of the Klamath River Following Mainstem Dam Removal

Professional

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Removal of four mainstem hydroelectric dams on the Klamath River in 2024 restored volitional fish passage to headwater habitats for the first time in more than a century. This unprecedented, basin-scale reconnection provides a rare opportunity to document the initial repopulation of previously inaccessible habitats by Chinook Salmon (*Oncorhynchus tshawytscha*). In fall 2025, The Klamath Tribes Ambodat Department, in collaboration with the Oregon Department of Fish and Wildlife, implemented a strategic, basin-wide monitoring effort to document the return of fall-run Chinook Salmon upstream of Upper Klamath Lake. In this presentation, we will describe the coordinated monitoring approach used to assess the spatial distribution, abundance, and life-history characteristics of returning adult Chinook Salmon throughout Upper Klamath Lake and its major tributaries. We conducted spatially extensive foot-based, paddle-craft, and boat visual surveys to document spawning distribution and estimate escapement using redd counts and repeated live fish observations. Carcasses recovered across the basin were used to collect biological data, including fork length, sex, age structure from scale samples, and hatchery contribution inferred from coded-wire tags. This effort represents the first comprehensive documentation of Chinook Salmon spawning in the Klamath River headwaters following dam removal and establishes a critical foundation for evaluating future population expansion and recovery.

Movement dynamics in a fragmented population of redband trout (*Oncorhynchus mykiss gairdneri*)

Professional

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Historically, the Hangman Creek watershed supported productive stream habitats that provided a diversity of resources for the Coeur d'Alene Tribe. However, anthropogenic pressures have deteriorated the quality of these environments and diminished the abundance of resources. Despite changes, a remnant population of redband trout (*Oncorhynchus mykiss gairdneri*) has persisted, but suitable habitat is fragmented. Consequently, several distinct sub-populations are largely isolated to headwater streams in the upper portion of the watershed. Although varying levels of movement do provide some connectivity, this is limited and associated low levels of diversity may limit the population's resilience. Because of this, the population could be vulnerable to collapse if climate and land use pressures shift or intensify. With the goal of protecting and strengthening the population, the Coeur d'Alene Tribe has implemented a variety of stream restoration projects. Population monitoring has occurred in conjunction with restoration to evaluate success and better inform future projects. Due to the importance of promoting connectivity, monitoring has focused on tracking movement patterns. Accordingly, between 2013 and 2023 redband trout were tagged with passive integrated transponder (PIT) tags and movement was tracked using a network of PIT tag detection stations. This monitoring indicates a significant decline in both emigration from and return to select sub-watersheds over the 10-year period. This provides evidence for declining expression and success of movement in the Hangman Creek Watershed, a trend that is particularly troubling due to already low connectivity. Currently, more extensive monitoring approaches are being used with the goal of identifying factors limiting movement.

Barriers to Salmon Recovery in the Columbia River Basin: Institutional Dynamics and Governance Challenges

Professional

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Societies develop patterns of behavior that provide stability, predictability, and meaning. These patterns, known as institutions, are shaped by normative, cultural, and regulative elements that structure power dynamics in natural resource governance. In the Pacific Northwest, salmon populations have declined under the cumulative weight of institutional arrangements, particularly those established since contact between European and Indigenous peoples. Understanding how these institutions function and evolve is critical to addressing the current barriers to salmon recovery. The Columbia River Basin presents a particularly complex governance environment. Multiple stakeholders with competing interests, coupled with government organizations holding significant decision-making authority, have created institutional inertia that reinforces the status quo. This complexity is compounded by jurisdictional fragmentation across federal, state, tribal, and local authorities, each operating under different mandates and timelines. With landscape-scale stressors like climate change, habitat degradation, and altered hydrology intensifying, maintaining the status quo will not ensure healthy salmon runs. Meaningful change is therefore essential to improve salmon health and resilience. Perspectives diverge on the most effective approach to change, reflecting different values, priorities, and assessments of institutional capacity. However, alignment and collaboration among diverse stakeholders remain essential for producing substantive and lasting change. This presentation traces how the current governance structure evolved and examines how this historical development shapes contemporary function, particularly, the distribution of power among actors. This analysis provides a foundation for discussing recent successes and challenges in implementing institutional change, and offers considerations for future salmon recovery efforts.

Traditional Ecological Knowledge: Tribal Practices are Innovative and Progressive – The Yurok Tribe as a Case Study

Professional

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The Yurok Tribe of Northern California is the largest Tribe in California by population. The Tribe is at the forefront of the recent removal of four Klamath River dams, which was one step in undoing two centuries of harm to the environment and native people from colonization. All Tribes along the Klamath River continue to fight for the protection and restoration of the watershed. As a Tribal fisheries scientist and citizen, my work merges the paradigms of TEK and western science. Fish recovery is simultaneously a social justice issue and a scientific one for our people. The loss of fish species not only represents a loss of biodiversity but a loss of cultural heritage, food security, and food sovereignty. The Yurok Tribe fisheries program is using innovation and technology in fisheries stewardship which serve as a model to other agencies including high-throughput genetic analyses, salmon scale-aging, LIDAR surveys, aerial surveys with Tribally owned fixed-wing aircraft and drones, eDNA for fish species/absence, thiamine deficiency analyses, fish disease monitoring, habitat restoration, native plant revegetation and salmon repopulation post-dam removal, and many other tools.

Using genomics to understand the effect of anthropogenic barriers on Yellowstone Cutthroat Trout in the Teton River

Student

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Genomic data can be used to study how anthropogenic barriers affect functional connectivity of populations, which can help identify management units and conservation actions. When population connectivity is restricted by barriers, individual dispersal is reduced, leading to genetic differentiation between populations. Furthermore, disconnectivity results in isolated

populations of smaller size, which are more susceptible to the loss of genetic variation. The distribution of Yellowstone cutthroat trout (YCT) has declined largely due to human-driven fragmentation. An example of this is the Teton River, where a dam built a century ago fragmented the river. Preliminary genetic work showed that YCT populations upstream and downstream of the dam are genetically differentiated, and demographic declines are suggested by the disappearance of the once-common migratory individuals. Using a large genomic dataset and extensive geographic sampling, we are assessing spatial patterns of differentiation and diversity in the watershed. Results show that the major axis of differentiation between populations in the river is associated with the dam, with populations in each river section (above/below the dam) more similar than populations spanning the dam. Clustering analyses also indicate differentiation at a finer scale, with genetic subgroups present in each section. We then used genomic-based demographic modeling approaches to test whether the dam caused the differentiation by comparing the estimated divergence time between populations with the time of dam construction. Using this same modeling approach, we will assess whether there were changes in population size following the dam construction. Through this work, we are generating a better understanding of the consequences of human barriers to fish movement, and informing management actions for YCT populations in the river.

Modernizing Fisheries Data in the Klamath Basin: A Collaborative Leap Forward

Professional

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The Klamath Basin Fisheries Collaborative (KBFC) Passive Integrated Transponder (PIT) Tag Monitoring and Database Project brings together more than 30 partners to maintain and enhance a shared fish tracking system and support collaborative fisheries monitoring across the Klamath Basin. This system uses PIT tag technology to track native fish movements and provide critical data for fisheries management and ecosystem restoration. The project strengthens efforts to evaluate Klamath River restoration opportunities in response to ecological challenges and the needs of several species protected under the Endangered Species Act. Years of PIT tag research conducted by multiple entities laid the foundation for KBFC and shaped its goals for collaboration, data sharing, and database development. Supported by the Pacific States Marine Fisheries Commission, KBFC engages Tribes, federal and state agencies, and non-governmental organizations in collaborative efforts to improve fisheries and ecosystems. Data collected through the KBFC PIT tag database informs management decisions and guides restoration strategies aimed at sustaining native fish populations and improving river health throughout the Basin.

Genome of a giant: Insights from the Lahontan cutthroat trout genome assembly

Professional

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Lahontan cutthroat trout (*Oncorhynchus clarkii henshawii*) are a unique lineage that are currently listed as Threatened under the federal ESA. Despite their conservation status, few genomic resources have been developed for this lineage. We present the first high-quality reference genome for Lahontan cutthroat trout. We use this assembly to describe genomic synteny and structural rearrangements with rainbow trout (*O. mykiss*) and the diverged westslope cutthroat trout (*O. c. lewisi*) lineage. To demonstrate the utility of this reference genome, we compare mapping efficiency of low-coverage cutthroat trout genomes to this reference and rainbow trout references and assign local ancestry in rainbow-cutthroat hybrids.

Untangling the additive effects of predation by multiple piscivorous colonial waterbird species on salmonid survival in the Columbia River

Professional

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Quantifying the degree to which avian predation is an additive versus compensatory source of mortality is critical to evaluating the efficacy of predator management strategies aimed at reducing predation. In the Columbia River basin, salmonid smolts face numerous hazards (e.g. predation, dam passage and diversion, disease, etc.) that reduce survival during migration. Previous research has measured the additive effects of individual mortality sources, but biological systems do not function in isolation. Interspecific interactions, such as predation by multiple predator species and colonies, can confound species-specific predation estimates when predators are modeled in isolation. To address this, we expanded upon previously published research of avian predation on steelhead smolt survival by jointly modeling the additive effects of Caspian terns and California and ring-billed gulls across large spatial and temporal scales. By simultaneously estimating predation effects, we disentangled species-specific contributions to smolt mortality. Results confirmed previous findings that tern predation was a super-additives source of mortality, suggesting impacts far beyond simple consumption. In contrast, gull predation was primarily but perhaps not completely additive and was consistent over time despite recent increases in the magnitude of gull predation. Our results highlight ecological and methodological nuances of estimating predation in multi-predator systems with direct implications for predator management in the Columbia River basin. Joint modeling reveals dynamics, including nuances associated with varying levels of additive mortality and interspecific interference, that single-hazard frameworks may overlook.

Declining native fish abundance amidst rise of nonnative fishes in the Willamette River

Professional

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Major declines and losses in native biodiversity are occurring globally. Most examples come from marine or terrestrial ecosystems, a few key freshwater species, or from inland streams, and in many cases comparable methods are not used across time highlighting data gaps for communities in large rivers. We assessed a complete fish assemblage of 41 native and nonnative fishes along 240 km of the Willamette River using consistent methods between two decades. Our findings revealed a river-wide decadal decline in the abundance of native fishes that was outpaced by an increase in numbers and richness of nonnative fishes, especially downriver. We revealed a biogeographic pattern where the greatest decline for native backwater fishes occurred downriver whereas the greatest decline for native fishes of small cold streams was upriver. Sixty percent of individual native fishes showed evidence of a decline in abundance or apparent occupancy between decades. Cascadian sucker (*Catostomus bondi*, part of the Mountain sucker complex) was the most affected native fish between decades showing river-wide declines in apparent occupancy and abundance. Our results suggest the beginning of a transition in the river assemblage with biogeographic differences upriver versus downriver. We show a decade's time is sufficient to detect biodiversity shifts while potentially allowing for time to address urgent challenges for native communities and river management.

A River Divided: The past, present, and (reunited?) future of the Deschutes River

Professional

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The Deschutes River is a complex system; primarily spring-fed, with tributaries originating from high in the eastern slopes of the Cascades as well as the western Ochocos and the Columbia Plateau, the Deschutes has long been a cold-water oasis in the high desert. However, dams to feed irrigation and hydroelectricity have fragmented the watershed, blocked fish migration, and altered flow regimes and water quality. The construction of the Pelton Round Butte Dam complex in the 1950s and 60s resulted in a “Lower Deschutes” managed for anadromous fish and an “Upper Deschutes” managed for resident trout. More recently, a rapidly growing population in Central Oregon has increased urbanization and recreational demands in the basin. But there have also been some dramatic positive changes to the Deschutes in the past twenty years. Altered management at Pelton Round Butte has reintroduced anadromous fish to the upper basin, and the Confederated Tribes of Warm Springs, state and federal agencies, and nonprofit organizations are working to restore ecosystems throughout the Deschutes. Despite these more recent positive changes, the Deschutes remains a river divided: most groups work in either the Upper or Lower Basin, and management is still largely split along those same lines. We propose the creation of a Deschutes RiverLab, which will serve as a hub for research, training, and community building in the basin. This talk will provide a background to the Deschutes River Basin and outline how a Deschutes RiverLab could build on and support the positive work already underway in the Deschutes, while advancing more wholistic management across the watershed.

Using SONAR to monitor adult Chinook salmon, steelhead, and coho salmon populations in the Elwha River before, during and after dam removal

Professional

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A major goal of the removal of two large dams on the Elwha River in Washington State was to increase salmon populations. To assess this goal, we used multi-beam imaging SONAR to monitor adult Chinook salmon, steelhead and coho salmon populations since 2010, 2013 and 2019, respectively. SONAR has proven an effective tool to provide accurate estimates of both abundance and run timing before and during dam removal, as well as after dam removal. We quantified multiple sources of uncertainty into our estimates including species apportionment, observer error, subsampling expansion, and data gap filling. As part of the SONAR enumeration, we also conduct weekly net sampling in the vicinity of the SONAR sites to capture migrating salmon and apportion raw fish passage derived from the SONAR to species specific passage. The net sampling has also been used to identify changes to life history, particularly in steelhead. From 2009 to 2025, the Chinook population has ranged from 1,370 to 7,600 fish and is generally trending upwards. From 2013 to 2025, the number of steelhead has ranged from 385 to 2,300 with the number increasing each year for the last five years. Coho salmon have been estimated since 2020 and have ranged between 4,800 and 6,800 adult returns. SONAR combined with net sampling has been an effective tool to enumerate adult returns as well as develop demographic, genetic, and life history information for the Elwha River dam removal.

Connecting the Dots: Synthesizing Drivers of Prespawn Mortality in Pacific Salmon

Professional

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Prespawn mortality (PSM) is the death of adult salmon after freshwater entry but prior to successful spawning. It represents a pervasive and escalating threat to Pacific salmon populations throughout the Pacific Northwest. In some populations and years PSM can exceed 90%, undermining recovery investments in passage infrastructure, hatchery supplementation, and habitat restoration. The drivers of PSM are diverse, operating across spatial and organizational scales, and rarely act in isolation. Thermal stress, infectious disease, contaminants, altered flow regimes, trap-and-haul operations, and the intrinsic physiological demands of semelparity each challenge the resilience of returning adults. Yet research and management have historically addressed these stressors in isolation, limiting our ability to identify critical thresholds, interactions, and intervention leverage points. This introductory talk aims to provide a synthesizing overview of PSM and its many contributing factors, framing the ecological, physiological, and management context that motivates the symposium. Drawing on case studies from diverse systems across the Pacific Northwest, we trace the causal web linking landscape-scale processes to pathogen-level interactions, examining how cortisol-mediated immune suppression during sexual maturation creates a physiological foundation for disease susceptibility, how thermal regimes and anthropogenic disturbance amplify that vulnerability, and how management operations such as trap-and-haul may introduce additional stressors that interact with pre-existing conditions. By synthesizing current understanding across these interconnected domains, we aim to identify critical knowledge gaps and highlight the value of integrated, multi-disciplinary approaches for reducing PSM in threatened populations.

Flush or Fill? Using Adaptive Management to Navigate Critical Seasonal Trade-offs in the Willamette Valley

Professional

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High-head dams of the U.S. Army Corps of Engineers' Willamette Valley System (WVS) impede fish passage and alter hydrology for ESA-listed salmon and steelhead. Re-establishing sustainable populations above these dams is a primary recovery goal, but significant challenges with both upstream and downstream passage have made solutions elusive. Efforts to improve fish survival are complicated by major operational trade-offs between fish passage, water supply, and water quality, all of which are subject to the uncertainty of seasonal precipitation and runoff in this rain-driven basin. To address these challenges, a new adaptive management framework was developed as part of a 2024 ESA consultation. This presentation uses a 2026 proposed operational change at Cougar Dam as a case study to illustrate the framework in action. The case study centers on a critical conflict: delaying the spring reservoir refill to improve downstream passage for juvenile Chinook salmon versus ensuring the reservoir fills sufficiently to manage water temperatures downstream for adult salmon in the summer and early fall. Following a 2025 operation where low inflows prevented the reservoir from refilling after the passage window, a revised strategy was proposed. This new approach involves an earlier, more rapid drawdown with high-flow "flushing" events to encourage juvenile out-migration, allowing refill to begin sooner. This talk will review the WVS adaptive management program and demonstrate how it is used to refine operations, test hypotheses, and navigate trade-offs in real-time.

Physiological Studies Assist Steelhead Kelt Reconditioning Programs in the Columbia River Basin: A Synthesis

Professional

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Every spring, many ESA-listed post-spawning steelhead kelts migrate downstream throughout the Columbia River Basin (CRB), but few return. These kelts are capable of repeat spawning and represent a major opportunity for recovery of steelhead populations. Beginning in 2000, CRITFC led a collaborative project with CRB tribes (Yakama Nation, Nez Perce Tribe) to capture and recondition female kelts. The project also benefitted from collaboration with the University of Idaho and state and federal fisheries agencies. As part of this project, we investigated post-spawning physiology in kelts (https://doi.org/10.1093/fshmag/vuaf108). By the kelt stage, lipids stores were depleted leaving muscle protein as the main energy source. There was a ~10-week recovery period after spawning, during which heavy mortality occurred and growth rates were minimal or negative. The ability to maintain osmotic homeostasis and access remaining lipid stores predicted survival through this period. Plasma levels of estradiol and vitellogenin diverged between consecutive and skip spawning kelts beginning at 20 weeks post-spawning, enabling screening of fish for maturation status prior to release. Consecutive spawners consistently had higher growth rates than skip spawners during the 10 weeks after spawning, suggesting that a positive energy balance during this period stimulates ovarian recrudescence. Treatment for Saprolegnia and parasitic copepods was required to maximize survival and consecutive maturation rates. Spawn timing was similar between first time spawners and reconditioned kelts, and egg production increased at the second spawning. We found no support for a hypothesized tradeoff between reproductive investment in initial versus future reproduction in reconditioned kelts. As the CRB kelt project transitions from the research to the production phase, it stands as one of the few projects in the basin preserving and enhancing steelhead populations in the face of ongoing declines.

A population genomic assessment of coastal cutthroat trout hybridization in the Skagit River

Professional

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Coastal cutthroat trout are known to hybridize with naturally sympatric steelhead since secondary contact was established after divergence, estimated between 2 – 10 Ma. The consequences of hybridization can include the beneficial exchange of adaptive variation or cause the erosion of distinctiveness and the loss of biodiversity. Hybridization with native steelhead and further disruption of reproductive isolation by the introduction non-native rainbow trout can negatively impact coastal cutthroat trout populations which are also threatened by anthropogenic habitat disturbance and changes in abiotic conditions. Understanding if and how hybridization contributes to declining populations of coastal cutthroat trout is necessary to make informed decisions regarding human activities that affect their long-term viability. However, assessing the prevalence and effect of hybridization has been limited by the low precision of small numbers of genetic markers used to identify parent species and hybrid classes. We leverage population genetic data from thousands of samples of both species and their hybrids to catalog a large number of species-diagnostic markers and use these data to investigate the patterns of coastal cutthroat hybridization with steelhead/rainbow trout, primarily in the Skagit River. Additionally, using high quality reference genome assemblies, we are able to characterize the genomic distribution of gene flow between species and gain valuable insight into the biological factors that maintain or erode biodiversity.

Review of Major and Minor Pathogens of Adult Pacific Salmon (Oncorhynchus spp.) in Freshwater in the Pacific Northwest of North America

Professional

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Adult Pacific Salmon, after returning to freshwater, endure several environmental and physiologic stressors (e.g., immunosuppression) and exposure to or exacerbation of pre-existing pathogens. Hence a multitude of primary pathogens and opportunists occur in these fish as they complete their spawning journey, with some linked to prespawn mortality (PSM). We conducted a comprehensive review of pathogens affecting adult salmon from California through Alaska during this life stage, recently published: https://doi.org/10.3390/pathogens1501008. Pathogens were categorized based on significance to adult salmon health or role in epizootiology, categorizing them on their contribution to PSM, disease severity, and transmission risks to progeny. Our review integrated literature analysis with direct, often unpublished field observations. Bacteria like *Aeromonas salmonicida* (furunculosis) and *Renibacterium salmoninarum* (bacterial kidney disease) remain critical drivers of PSM, and Saprolegnia and Flavobacterium spp. are important opportunists. Except for Infectious Hematopoietic Necrosis Virus (IHNV), designated a major concern, most viral infections are incidental and do not cause measurable disease or mortality in spawning adults. Adult asymptomatic IHNV carriers have the potential for parental transmission to progeny, where it can cause catastrophic mortality. The list of identified parasites is exhaustive, and three were designated major concerns and causes of PSM; *Ichthyophthirius multifiliis*, *Ichthyophonus* spp., and *Cryptobia salmositica*. Whereas the prevalent myxozoan *Ceratonova shasta* is usually not a significant cause of PSM, we documented a unique situation at one location where renal infections were prevalent and associated with PSM in multiple years. Understanding pathogen impacts during spawning is crucial for salmon sustainability, as the unique semelparous nature of Pacific salmon makes this terminal phase critical for the continuation of this vital species.

A call to action: Tribal leadership mobilizing to prevent Pacific lamprey extinction in the Columbia River Basin and beyond

Professional

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Pacific lamprey are native to the Columbia River Basin and historically returned in the millions. Over the past 50 years, however, their numbers have declined sharply. Columbia River Basin tribes were the first to recognize these losses, sound the alarm, and take action to restore lamprey and prevent localized extirpation. In 2003, Pacific lamprey were petitioned for listing under the Endangered Species Act, but the listing was found unwarranted, in part because of limited available information. In response, tribes pressed for immediate and urgent conservation action. In 2008, Tribal leadership united regional partners to form the U.S. Fish and Wildlife Service's Pacific Lamprey Conservation Initiative (PLCI). This collaborative effort was created to restore and conserve Pacific lamprey and to prevent further declines across their U.S. range in the absence of ESA protections. A core strength of the PLCI is its relationship based and inclusive structure, which brings together all partners with shared interests in lamprey conservation. Through the development of Regional Management Units, technical and policy committees, and a multiagency Conservation Agreement, PLCI partners have committed to working collaboratively to improve lamprey status and support continued harvest and traditional Tribal use. The partnership also emphasizes raising awareness of the ecological and cultural significance of Pacific lamprey while advancing on-the-ground actions to halt declines. This

partner-driven, tribally led approach ensures that lamprey conservation progresses from multiple directions while consistently centering Tribal leadership as the guiding force behind recovery.

Investigating effects of dam operations on passage metrics for juvenile Chinook salmon at Willamette Valley Dams using rotary screw trap records

Professional

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High head dams in the Upper Willamette River have contributed to listing of Spring Chinook salmon (Oncorhynchus tshawytscha) as threatened under the Endangered Species Act. Since a 2021 court injunction, the US Army Corps of Engineers has implemented operational measures at Willamette Valley System dams to improve fish passage. Similar measures are ongoing following a Biological Opinion from the National Marine Fisheries Service in 2024 that included an Adaptive Management (AM) Program with monitoring of juvenile Chinook salmon via rotary screw traps (RSTs). This study used RST records to understand effects of hydrological variables associated with dam operations on mortality and injury metrics. We analyzed data from >10,000 juvenile Chinook salmon captured in RSTs below multiple dams in periods before (2010-16) and with injunction measures (2021-24). For each trap event (1-2 days), operators recorded conditions of captured fish (live/dead/injured) and fish length. Hourly hydrological data available included forebay elevations, discharge by route (spillways, regulating outlets, turbines), and total dissolved gas (TDG). Where fish passed through multiple dams, we determined conditions experienced at each dam by estimating a travel time distribution between dams using acoustic tag data from previous studies. We then used machine learning to construct a Bayesian network (BN) to quantify the linkages between the probability of a fish being dead (Pd) and several key variables. Across dams, mean Pd under mean conditions was found to be <0.2 and decreased significantly with the injunction measures. Mortality increased with fish length and the BNs found interactions between length and both forebay elevation and spill discharge. Mortality also increased with spill discharge, but the effect of forebay elevation depended on availability of surface spill and RO routes. Results from such BNs can be used to highlight potential tradeoffs between measures to inform the AM Program.

The Hutton Highway: Advancing Visibility and Representation of Emerging Fisheries Scientists in Hawai‘i

Student

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The American Fisheries Society Hutton Junior Fisheries Biology Program is the only national paid summer internship for high school students interested in fisheries and aquatic science. Since 2000, Hutton has supported more than 850 students across all 50 states, Puerto Rico, Guam, the Trust Territories, Canada, and Mexico, with a strong emphasis on increasing access to fisheries careers for students from historically underrepresented backgrounds. Over the past decade, 60% of scholars have been women, 57% identify as BIPOC, and 69% of alumni have gone on to pursue degrees in fisheries or related biological sciences. Student participation in the Hutton program in Hawai‘i has previously been rare due to limited funding, applications, and mentorship placement. This year, the Hutton Program steering committee and the Western Division Recruitment and Retention Committee expanded the Hutton Program in Hawai‘i by increasing awareness of the program among local high school students and fundraising to support Hutton placements in the islands. Because of the ecologic, economic, and cultural importance of fisheries resources in Hawai‘i, it is especially important to engage local students in fisheries science. Hawai‘i is uniquely positioned to offer placements that extend beyond

traditional Western science settings, including culturally rooted and community-based organizations where students can learn place-based stewardship and traditional ecological knowledge alongside research. This presentation will share outreach efforts, partnerships, and early outcomes from working to bring Hutton fellows to Hawai‘i, along with reflections on how student-led initiatives can help build more inclusive pathways into fisheries science.

Differential reproductive success of ocean-migrating and captive-maturing spring-run Chinook salmon reintroduced into the San Joaquin River

Professional

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Captive breeding programs are often relied upon to supplement natural populations and reintroduce extirpated populations. But understanding the reproductive success of captive-reared individuals is critical to understanding program effectiveness. A captive-breeding program was established in 2012 to reintroduce spring-run Chinook salmon to the southern edge of their range in California's San Joaquin River. This captive-breeding program performs two types of fish releases each year in the San Joaquin River: (1) release of captive-produced juveniles that will outmigrate and mature at sea, and (2) captive-mature adults that were fully reared in captivity and released into the San Joaquin River as another source of natural reproduction. In 2017, ocean-maturing adults (i.e., the captive-produced juveniles) returned to the San Joaquin River for the first time in 65 years. Ocean- and captive-maturing fish can differ in fitness metrics like reproductive success. Therefore, we compared reproductive success among these two groups using genetic-based tagging (i.e., parentage analyses) to assess relative contributions of these two release strategies to natural production. We investigated what factors (e.g., release type, body size, age) are important to reproductive success and discuss implications for captive-breeding programs to support conservation of imperiled species.

Current Monitoring Efforts on the Warm Springs Reservation and the Potential Benefits of a Deschutes RiverLab

Professional

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The Fisheries department of the Confederated Tribes of the Warm Springs Reservation of Oregon (CTWSRO) has conducted research, monitoring, and evaluation of native salmonid populations on the Lower Deschutes River and its tributaries for the past 50 years. The long-term goals of the Department are to effectively manage native fish populations, create sustainable harvest opportunities for tribal members, and to preserve culturally significant species for future generations. Several species-specific research questions drive our contemporary research and monitoring efforts. For wild spring Chinook, we are presently investigating methods to reduce pre-spawn mortality. For Bull Trout, we are seeking to better understand factors contributing to population declines, investigating the prevalence of migratory and resident forms within different streams, and assessing mechanisms (e.g. interference competition, genomic extinction) that mediate deleterious interactions with invasive Brook Trout. The Deschutes RiverLab will allow CTWS Fisheries Department personnel to collaborate with agencies, academic institutions, and interested parties. Such collaborations will provide excellent opportunities to share findings, conduct interdisciplinary research, and foster partnerships among all who work and recreate within the basin. These partnerships and collaborations will ultimately improve the ability of the CTWS Fisheries Department to achieve our long-term goals.

Untangling complex drivers of Snake and Columbia River Chinook salmon marine survival and maturation age using structural equation modeling

Professional

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Obstacles to persistence and recovery of Snake and Columbia River Chinook Salmon populations include low marine survival and recent declines in fecundity linked to return of younger spawners. Marine survival and maturation are integrated responses to both marine conditions and effects that carry over from experiences in freshwater habitat. Hierarchical Bayesian Structural Equation Modeling (SEM) has several useful capabilities for marine life cycle modeling, including (1) integrating predictions of survival and maturation age into a single model, (2) capturing both interannual variability in the marine environment and freshwater carryover effects that vary intra-annually, and (3) explicitly representing complex networks of causal relations in the marine ecosystem. We apply the SEM approach to examine drivers of smolt-to-adult survival and age-at-return of Snake River spring/summer and Upper Columbia spring Chinook Salmon from outmigration years 1998-2022. Covariates in our model include indicators of oceanographic variability on the Washington shelf, Columbia River plume dynamics, predators, prey community composition and abundance, as well as the fork length and passage timing of outmigrating smolts. Preliminary results indicate wintertime environmental conditions and water mass properties related to alongshore currents are important predictors of spring environmental conditions and the distribution of piscivorous fish predators. Interannual variations in survival are linked to spring oceanographic conditions during early marine residence, piscivorous fish predators and variability in Columbia River plume dynamics, whereas age-at-return responds to marine growth. Within-year variations in survival and age-at-return are associated with fork length and migration timing. Our findings demonstrate the promise of SEM for elucidating causal drivers of Chinook Salmon population dynamics and predicting future change.

Evaluation of Whirling Disease Distribution and Measures of Infection in Colorado River Cutthroat Trout in LaBarge Creek, Wyoming

Student

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Salmonid whirling disease caused by the invasive parasite *Myxobolus cerebralis* (MC), first detected in the U.S. in 1956, has spread widely, causing declines of up to 90% in some wild salmonid populations. Colorado River Cutthroat Trout (CRCT), already threatened by habitat loss, invasive species, and disease, now occupy only 13% of their historic Wyoming range. Despite extensive restoration efforts in LaBarge Creek, CRCT numbers remain critically low. My study examined the potential role of whirling disease in limiting CRCT recovery by assessing spatial distribution of MC and infection load, and by comparing two diagnostic approaches: the traditional Pepsin–Trypsin Digestion (PTD) method and a quantitative Polymerase Chain Reaction (qPCR) assay. Sampling of wild fish and a sentinel-caging experiment with naïve fish showed that MC infection is largely restricted to the LaBarge Creek mainstem and the lower reaches of its tributaries, while upper headwater areas remain free of infection. PTD and qPCR performed similarly in detecting infection, and parasite maturation was unnecessary for qPCR-based detection. Additionally, detections of the water-borne environmental stage of the parasite varied strongly over the diel cycle and eDNA sampling was not an effective substitute for sentinel fish, at least using the methods in this study. Taken together, these findings indicate that whirling disease is established across much of the drainage and may be hindering CRCT

recovery in the LaBarge Creek restoration area, and that qPCR on fish tissue is an efficient and reliable method for assessing infection.

Quantifying the effects of the 2021 Bootleg Fire on suspended-sediment and total-phosphorus concentrations and loads from the Williamson and Sprague River Basins to Upper Klamath Lake, Oregon, 2008-25

Professional

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As wildfire activity increases across the western United States, quantifying sediment and nutrient transport following large burns is increasingly important for anticipating impacts on water resources, aquatic ecosystems, and the effectiveness of watershed restoration and total maximum daily load (TMDL) implementation. Wildfire can accelerate suspended-sediment and nutrient transport at the watershed scale, potentially degrading water quality and altering lake trophic dynamics. In the semiarid Upper Klamath Basin of Oregon, elevated total phosphorus (TP) loading has contributed to hypereutrophication in Upper Klamath Lake (UKL) for many decades. The Williamson River, a major tributary to UKL, is listed as impaired for excess phosphorus and sedimentation, leading to a 2002 TMDL aimed at reducing external sediment and nutrient inputs. Since 2008, the U.S. Geological Survey has monitored TP and suspended-sediment concentrations and loads in the Williamson River and its primary tributary, the Sprague River. High-frequency turbidity and streamflow measurements support surrogate regression models that quantify constituent transport across a wide range of hydrologic conditions. This long-term dataset provides a valuable baseline for evaluating watershed-scale disturbances. The 2021 Bootleg Fire burned 413,000 acres, predominantly within the Sprague River basin, creating conditions that can mobilize ash, sediment, and nutrients along the fluvial network and into UKL. Comparing pre- and post-fire TP and suspended-sediment dynamics improves understanding of how wildfire influences constituent delivery to UKL and the potential implications for lake water quality.

A Data Science Approach to Quantifying Fish Passage Through Dams

Professional

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Dams disrupt the natural life cycles of migratory riverine fish, posing significant challenges to their survival. Addressing these connectivity issues requires interdisciplinary collaboration between biologists and data scientists. At Pacific Northwest National Laboratory (PNNL), researchers integrate ecological expertise with data science to study fish passage and survival. PNNL's fish passage projects focus on anadromous fish species, using various technologies such as radio telemetry (RT). Two studies conducted at U.S. Army Corps of Engineers operated dams – Mud Mountain Dam (MMD) in Washington State and Foster Dam in Oregon – used RT to evaluate fish passage and survival. At MMD, adult Chinook salmon (*Oncorhynchus tshawytscha*) implanted with RT tags were tracked as they returned to spawning grounds via a Fish Passage Facility (FPF). The FPF, located on the White River, aids adult fish passage through trap-and-haul methods, transporting fish upstream of MMD. Post-construction evaluations were conducted over four summers (2022–2025) to quantify fish movement (delays) and estimate the ability of the FPF to attract and collect adults. At Foster Dam, RT-tagged juvenile Chinook salmon and winter steelhead (*O. mykiss*) were monitored to evaluate survival rates and travel times during ocean-bound migration through the Santiam and Willamette rivers. The main goal was to determine if nighttime spillway operations resulted in higher survival rates compared to daytime turbine operations. Efforts to automate fish tracking and streamline data

analysis aimed to reduce manual data processing. However, challenges like the noisy nature of RT data and unpredictable fish behavior required tailored algorithms to ensure accurate results. These projects highlight the importance of interdisciplinary research to improve the evaluation of fish passage and survival, contributing to the goal of ensuring safe passage for anadromous fish.

Management of adult Chinook salmon broodstock at Willamette Hatchery

Professional

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Willamette Hatchery (previously Oakridge Salmon Hatchery) has been managing salmon and trout since 1911, and raises fish for USACE mitigation for the Hills Creek, Lookout Point, and Dexter dams. Every year it hatches and rears over 5 million Chinook salmon (*Oncorhynchus tshawytscha*) collected from broodstock that return to the Willamette River at Dexter dam. This broodstock program has seen significant struggles, as the pre-spawn mortality rate of the returning adults is quite high, some years being over 50%, leading to program constraints and management concerns. Among the challenges is holding the adults in one earthen and gravel pond for adult holding that was constructed in 1940 with very little flow. Here we describe adaptive approach to broodstock management with the goal of minimizing pre-spawn mortality and meeting production expectations. Fish are collected at Dexter dam in June, where they are sedated with Aqui-S (eugenol), then inspected for wounds and categorized for sex. Fish are then provided medications to prevent and manage infectious disease and parasites, including Oxytetracycline, Erythromycin, and Doramectin. They are also provided Thiamine hydrochloride injections. The fish are then transported in very lightly loaded and frequent trips to another adult facility 1.5 hours away with adequate concrete holding ponds. During transport, they may receive salt, diquat dibromide, and/or propolyaqua. During holding and until spawning, fish are kept calm and receive regular topical treatments of formalin to control for external fungus Saprolegnia, and may also receive salt baths as needed, until they are spawned in September. These changes have significantly improved pre-spawn mortality in the adult broodstock. In 2025 to total pre-spawn mortality was 2%. We will continue to use new and creative techniques to manage pre-spawn mortality in Willamette spring Chinook salmon.

Investigating Egg Thiamine Concentration and Early Rearing Mortality of White Sturgeon in the Upper Columbia River

Professional

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White Sturgeon (*Acipenser transmontanus*) retention from the upper Columbia River has been abysmal, as very little to no young of the year have been recovered during surveys near John Day region for the past ten years. Additionally, larval white sturgeon are notoriously hard to start in a hatchery and often perish due to starvation, with captive-reared populations experiencing very high mortality in the early weeks after hatch. This project investigates thiamine concentrations in the eggs of females spawned at Yakama Nation Fisheries at the Marion Drain facility. Thiamine (vitamin B-1) is an essential nutrient necessary for metabolism but is especially important in the development of juvenile fish, as thiamine deficiency complex (TDC) can occur in larval fish when maternal thiamine stores are low. We collected eggs from each of the spawned 6 females for 3 years and analyzed thiamine vitamers by HPLC, and in 2023 identified a range of thiamine from 1.15 to 6.18 nmol/ egg. Interestingly, early rearing survival

may be correlated to these egg thiamine levels, although more investigation is warranted. We hypothesize that supplementing larval sturgeon with thiamine at spawning and after may prevent mortality, encourage getting onto feed, and improve their survival in the hatchery setting.

Securing the Modoc Sucker - the path to delisting

Professional

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The Modoc Sucker, *Catostomus microps*, is a small sucker found in the upper Pit River and Goose Lake basins of northeastern California and southern Oregon. Federally listed as endangered in 1985, it was secured, and then delisted in 2015 - the second fish to be recovered and removed from endangered species status. At the time of federal listing, recovery goals included: range expansion, habitat restoration, population increase, evaluation of genetic hybridization with the Sacramento Sucker, eradication of non-native predators, and landowner outreach and education. Successful recovery involved addressing each existential threat, or perceived threats, and determining that the species was secure for the foreseeable future. While conservation of the Modoc Sucker was the administrative responsibility of the U.S. Fish and Wildlife and other agencies over thirty years, ultimate success in the recovery program depended on the actions and efforts of individuals.

Evaluating genetic structure and reproductive success following a multi-lineage Gila Trout reintroduction

Student

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Many imperiled species suffer from reduced genetic diversity resulting from habitat fragmentation and isolation. As a result, maintaining and enhancing genetic diversity through reintroductions and translocations has become a core goal of conservation interventions. Here, we evaluate a recent-mixed source reintroduction for Gila Trout *Oncorhynchus gilae*, an imperiled salmonid native to the American southwest. Remnant populations of Gila Trout represent five genetically distinct lineages which have been managed in near-complete isolation since the species was listed in 1966. Gila Trout have low species-wide genetic diversity, with certain lineages showing reduced fitness that is characteristic of inbreeding depression. In 2020, the New Mexico Department of Wildlife translocated captive-reared Gila Trout from all five lineages into the restored Whitewater Creek Watershed in the Gila National Forest. Mixed-source reintroductions such as the Whitewater project have the potential to improve genetic viability of inbred and bottlenecked populations, thereby improving fitness and decreasing extinction risk. However, due to the potential for outbreeding depression, these projects must be evaluated to determine their fitness outcomes and inform future efforts. Here, we present preliminary results from post-reintroduction genetic sampling of a segment of the reintroduced population. We genotyped 845 founders from all five lineages and 1,103 wild-caught fish using a GT-seq panel with 432 SNP and microhaplotype loci to assess 1) which lineage(s) have higher reproductive success and 2) if cross-lineage hybrids are being produced and at what rate, an early indication of the fitness implications of outcrossing Gila Trout lineages. These results will inform the efficacy of outcrossing lineages as a component of Gila Trout recovery.

Effect of parental origin on juvenile spring Chinook Salmon post-dispersal summer growth and survival

Professional

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Early life history growth and survival of stream-rearing juvenile salmonids are the result of complex interactions between parental phenotype and genotype, biophysical conditions, and density-dependent effects, among innumerable other influences that shape phenotypic variation within and among cohorts. Juvenile dispersal from redd locations to rearing habitat is a fundamental process influencing growth and survival, and can be evaluated using parentage-based tagging (PBT) to link spatial patterns of spawning locations with the subsequent rearing distribution of their offspring. While experimental studies have assessed effects of parental origin (e.g., hatchery-reared vs. natural-origin) and dispersal on metrics of offspring fitness (e.g., growth and survival), few studies have empirically evaluated how parental origin and dispersal shape patterns of post-dispersal growth in wild populations where spatiotemporal variation in biophysical factors such as temperature, habitat quality, and juvenile density add further layers of complexity. Following a PBT study (2023 spawning locations, carcass sampling and parental origin, 2024 parr sampling) conducted in Catherine Creek, a tributary of the Grande Ronde River, we returned to a subset of parr sample sites along a longitudinal gradient in fall 2024 following initial parr dispersal sampling to recapture PIT tagged and genotyped individuals. We evaluated the effect of parental origin, rearing location, dispersal distance, and parr genetic sex on mid-summer growth and survival in juveniles captured in both July and September.

Hybridization of Coastal Cutthroat Trout and Steelhead at the southern tip of their range

Professional

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Assessing the amount and type of hybridization between Coastal Cutthroat Trout (*Oncorhynchus clarkii*) and Steelhead/Rainbow Trout (*O. mykiss*) is important for the conservation and management of these species. We sampled Coastal Cutthroat Trout and Steelhead/Rainbow Trout from the Eel River, CA, to the Umpqua River, OR to evaluate hybridization. We successfully sequenced >1,300 individuals from >75 sampling locations using restriction site-associated DNA sequencing (RADseq). This study highlights sampling locations with a relatively high incidence of first-generation hybrids, and locations where putative Coastal Cutthroat Trout above barriers show varying degrees of *O. mykiss* introgression. Furthermore, comparison of genetic identification with field identification reveals hybrids are difficult to distinguish from the parental types in the field and pure Coastal Cutthroat Trout and Steelhead/Rainbow Trout are sometimes misidentified regardless of the fishes lifestage or the observers experience.

Results of long-term evaluation of habitat restoration projects in the Columbia River Basin: Recommendations from BPA's Action Effectiveness Monitoring Program

Professional

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The Bonneville Power Administration's Action Effectiveness Monitoring (AEM) Program was designed to address the pressing need for detailed information on the physical and biological effectiveness of common salmon *Oncorhynchus* spp. habitat restoration techniques in the interior Columbia Basin and provide recommendations for future river restoration projects. Over a ten-year period, we evaluated more than 125 barrier removal, large wood placement, riparian planting, and floodplain restoration projects using a combination of extensive post-treatment and before-after control-impact monitoring designs and detailed field sampling of riparian, fish, and habitat metrics. Evaluation of complete barrier removal projects indicated that juvenile salmon and steelhead O. mykiss rapidly colonized newly accessible habitats and that their numbers above former barriers were similar to downstream previously accessible reaches. Large wood placement projects found significant improvements in pool area and numbers and juvenile steelhead, Chinook, and coho salmon abundance following wood placement. Riparian planting projects showed improvements in for species richness and for woody plant abundance, but planting methods (restoration type, invasive species removal, and watering), site level physical factors, (precipitation, elevation, and geology), and time since restoration influenced project success. Floodplain projects showed modest improvements in side channel, floodplain, and instream metrics and significant increases in numbers of juvenile steelhead and coho salmon. For each of these four major restoration project types, we provide adaptive management recommendations to improve design and success of future projects. Based on lessons learned from AEM and other large monitoring programs, we also provide recommendations for programmatic evaluation of restoration programs and projects including new methods to evaluate increasing large and complex floodplain restoration projects.

Developing flow-ecology relationships to quantify streamflow reduction impacts on native fishes in Oregon

Professional

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Streamflow conditions influence habitat availability and water quality for native fishes in stream and river ecosystems. As a result, reductions in streamflow, especially during summer low flow months, have the potential to negatively affect native fish populations. However, quantitative flow-ecology datasets linking fish population responses to different degrees of streamflow alteration are currently lacking in Oregon. Such information would be valuable to identify ecological thresholds and determine how streamflow alterations affect native fish populations. To address these knowledge gaps, Oregon Department of Fish and Wildlife's Water Program is conducting a "percent of flow" study to develop empirical flow-ecology relationships for native fishes in Oregon and quantify streamflow reduction impacts under a range of flow reduction levels. To do this, ODFW is sampling fish populations and measuring discharge above and below points of diversion in streams that are impacted by water withdrawals for irrigation or other consumptive uses. As part of this effort, ODFW has sampled fish and streamflow in 38 stream reaches and collected over 10,000 individual fish across 8 species in western and eastern Oregon streams. Preliminary data suggest that reductions in streamflow associated with water withdrawals can negatively affect native fish populations relative to natural flow conditions, but responses vary among fish species. Moving forward, ODFW plans to continue data collection to expand the dataset to different regions and native fish species across the state of Oregon. Once complete, study results will be used to guide streamflow recommendations for native fishes in places where quantitative instream flow data are currently not available.

Homing by potamodromous trout and char in Pacific drainages of the USA and Canada – a literature review and synthesis

Professional

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Potamodromous fish populations that complete their life cycles in freshwater can home to specific areas for reproductive and non-reproductive reasons. This presentation, based on a recent literature review, synthesizes evidence regarding homing by potamodromous trout (genus *Oncorhynchus*) and char (genus *Salvelinus*) in Pacific drainages in Canada and the USA. The review evaluates the methods used to study homing, the prevalence of homing, the mechanisms of homing, and factors that affect the prevalence of homing at the population level. Tools and techniques used to study homing in potamodromous trout and char included tagging, telemetry, behavioural experiments, otolith microchemistry, and genetics. Quantitative estimates of rates of homing were surprisingly rare and varied considerably between species and populations. There were very few studies of the mechanisms or cues used for homing by potamodromous trout and char. However, evidence suggests that well-studied mechanisms of reproductive homing by anadromous salmonids (Salmonidae) also apply to some degree to potamodromous trout and char. Anadromous salmonids are known to use olfactory navigation to imprinted chemical cues in natal stream water, with amino acids considered the primary constituents used for navigation. Conspecific cues play a complementary or secondary role in navigation. Characteristics of the habitat, such as stability over time, and life history, such as variation in age-at-maturity, are the main factors affecting population-level rates of homing for potamodromous trout and char. This review highlights current knowledge gaps and suggests directions for future research on homing in potamodromous fishes. Improved understanding of how mechanisms of homing interact with anthropogenic changes to ecosystems may result in better-informed decisions that would ultimately benefit the conservation of potamodromous trout and char.

The Human Dimensions of Cold Water Refugia: Building Relationships for Stream Temperature Monitoring and Restoration at Watershed Scales

Student

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Elevated stream temperatures pose well-documented risks to salmonids in Oregon, undermining growth, reproduction, and long-term population resilience. Because rivers are hydrologically connected, meaningful improvements in temperature conditions rarely result from isolated projects. Instead, they increasingly depend on long-term collaboration across fragmented governance systems spanning public and private lands, many agencies, and diverse organizational missions. These collaborations are demanding, requiring practitioners to navigate differences in authority, incentives, expertise, and institutional culture while sustaining engagement over time. This talk presents the results of a qualitative research study investigating the practices by which fisheries managers and conservationists cultivate relationships as part of their everyday collaborative work on stream temperature. Drawing on semi-structured interviews with government and nonprofit practitioners in the Deschutes and North Umpqua watersheds, this talk synthesizes how practitioners evaluate partnership and adapt engagement strategies to ultimately shape collaboration and ecological outcomes. By making relationship-building practices more visible and actionable, this research offers practical guidance for collaborative initiatives, such as emerging RiverLabs, that depend on durable, cross-sector partnerships to co-produce watershed solutions.

Advancing Fish Passage Monitoring Through AI Automation, Detection, Classification, and Enumeration

Professional

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Video-based monitoring at anadromous fish passage facilities requires extensive manual review, often demanding hundreds of hours of expert effort and yielding variable results. This labor-intensive workflow limits the spatial and temporal resolution of monitoring programs and constrains the ability to generate timely biological information. To address these challenges, we developed a high-throughput artificial intelligence (AI) pipeline for automated analysis of fish passage video at a fish ladder on the lower Mokelumne River, California—an important migration corridor for both natural- and hatchery-origin Chinook Salmon (*Oncorhynchus tshawytscha*), steelhead (*O. mykiss*), and Pacific Lamprey (*Entosphenus tridentatus*). The system integrates deep learning and machine learning models to detect fish, classify species, and identify important demographics such as sex, length, and fin-clip status. In addition, a tracking module links detections across frames to enumerate individual fish and estimate passage rates, producing standardized outputs that are directly comparable to metrics from traditional manual review. A suite of QAQC tools allows for review of classifications (spot checks) and also flags detections that are under a specified confidence threshold for manual review. The modular architecture allows rapid site-level adaptation through retraining on locally sourced image data, enabling efficient deployment across diverse monitoring facilities and species assemblages. By improving throughput, repeatability, and objectivity, this automated workflow significantly reduces analytical bottlenecks and supports more frequent and comprehensive assessments of migratory fish populations. Ultimately, the system aims to enable biologists to shift effort from manual data extraction toward ecological interpretation and management decision support, representing a substantial advancement in fish passage monitoring technology.

Resurfacing the Policy Perspective- How changes in the Clean Water Act, NEPA, and other regulations have changed road impacts analyses and conservation planning

Professional

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Road projects often have a federal nexus which leads to interagency coordination and robust environmental review. Whether located on publicly-managed lands or intersecting private lands, involvement of Federal Highways Administration or state and local level transportation departments often triggers some level of public involvement and project impact review. Over the past thirty years, I have seen similar types of road projects adopt varying types of impact mitigation depending on the current mix of regulatory practices. Revisions to the Clean Water Act (CWA), the National Environmental Policy Act (NEPA), the Endangered Species Act (ESA), and other federal programs we depend on to support fish passage design, sediment control, water quality parameters, and species protection have changed and, in some cases, limited mitigations we can integrate into projects and reduced the funding and political will to support these project components. Court decisions to move the interpretation of regulations to the courts and away from the agency scientists also affect how components or approaches designed to protect or enhance aquatic ecosystems are received by decision makers. The new rules require some different approaches, but they do not mean that aquatic scientists have no way forward to have input on road project designs. It is helpful to know the way we got here, and perhaps collaborate on ways to hold our ground for aquatic conservation.

Forecasting spring Chinook salmon abundances amid a changing climate

Professional

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Accurately forecasting salmon populations is becoming increasingly difficult as global change causes shifting salmon-environment relationships and novel conditions. We explored broadly applicable forecasting choices, including model type, time series length, covariates, and ensemble approaches in the study system of spring Chinook salmon (*Oncorhynchus tshawytscha*) populations in Oregon's North and South Umpqua Rivers. Models with covariates out-performed those without covariates based on out-of-sample cross-validation. Incorporating the negative effect of warm stream temperatures provided the greatest improvement in forecast performance, although other covariates were also important. Top-performing models were fit on shorter time series, likely both because environmental coefficients reflected recent trends and temperature covariates were available. However, testing many models and including short time series increased the risk of spurious relationships. The most accurate forecasts occurred when top performing models were combined into an ensemble forecast. Our results emphasize the value of environmental covariates in salmon forecasting but highlight the need for approaches that mitigate risks of overfitting and increase effective management in a changing climate.

Investigating the Native Range of California's Endangered Anadromous Salmonids

Professional

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Salmon are vital components of marine and freshwater ecosystems and essential to California's Indigenous peoples; however, several native salmonids are vulnerable to extinction or extirpation. The statewide reduction of California's salmon populations necessitates integrative approaches to investigate their history and biogeography. Working in collaboration with the Amah Mutsun Tribal Band, the Esselen Tribe of Monterey County, and California State Parks, this project employs archaeological datasets to help define which salmon were historically present in coastal central California streams over the last ~7,000 years. The research is pertinent for the endangered Coho salmon, as their historical biogeography is debated. Researchers argue that Coho salmon are not native south of the San Francisco Bay, while others suggest Coho are native as far south as Santa Cruz County. The field of archaeology is uniquely situated to inform the debate of salmon biogeography, given the preservation of animal remains in archaeological sites and the broad use of resources by Native Californians, which provides a wealth of baseline environmental information. Applying collagen peptide mass fingerprinting and ancient DNA, we identify which salmon were native to coastal streams to help tribal and state resource managers prioritize stream protection and restoration, water allocation, and inform land-use practices.

Perspectives on Chinook salmon management and outlook for recovery in Puget Sound 25 years after ESA listing

Professional

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Puget Sound Chinook salmon were listed as threatened under the Endangered Species Act (ESA) in 1999 due to widespread declines and significant habitat loss. In the decades since listing, abundance has continued to decline for most populations in the ESU. This has occurred despite observed decreases in fishing mortality. It is unclear whether the rate of habitat loss has changed appreciably but is becoming clear that the current pace of habitat restoration is not sufficient to affect meaningful progress toward delisting. While management actions under ESA primarily focus on natural origin (wild) Chinook, the primary management tool to support fisheries is hatchery production. This creates a large disconnect between fisheries management and parties focused on ESA recovery. In this talk, I will explore some of these issues and data limitations that exacerbate Chinook management with a focus on Tribal fisheries.

Modern Tools for Ancient Fish: Movement Patterns of White Sturgeon in the lower Columbia River

Professional

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Movement patterns of White Sturgeon (*Acipenser transmontanus*) in large, regulated river systems remain poorly understood, particularly with respect to size-dependent patterns and environmental drivers. We used long-term passive integrated transponder (PIT) tag data to evaluate spatial and temporal movement of subadult and adult White Sturgeon. Individual encounter histories from mark-recapture records were reconstructed to quantify movement within and among reservoirs over time. Movement rates and reservoir transition frequencies were examined across size classes and seasons. Detection data from fish ladders at Columbia River mainstem dams were queried to identify directional movement and timing of reservoir transitions. To explore potential drivers of movement, fish detections were integrated with environmental covariates, including water temperature and dam outflow. This study leverages existing monitoring and detection data to assess how biological and environmental factors interact to influence White Sturgeon movement in a highly regulated river system. Results are expected to improve understanding of connectivity between reservoirs and inform population assessment assumptions and management strategies for White Sturgeon in the lower Columbia River.

Observations of the Klamath River estuary fish community before, during, and after dam removal drawdown

Professional

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As the required point of transition from marine to riverine systems for diadromous fish, estuaries provide unique and vital habitat for holding, rearing, and shelter. Since the drawdown of the Iron Gate dam and Copco Lake and J.C. Boyle Reservoir release in early 2024, the Klamath River estuary has been affected by the resulting sediment load. The full sediment release from the dam removals was expected to range from 5.5 to 8.8 million cubic yards, much of which is expected to make its way through the river and to/through the estuary over time. To better understand the impacts of dam removal on the estuarine fish community, four complementary sampling methods (Baited Remote Underwater Videos (BRUVs), light traps, seining, and water filtration for eDNA metabarcoding) were undertaken monthly (except for high-water months) at three sites in the lower estuary beginning in June of 2023. Through June 2025, 13206 fish were caught in the light traps. Light trap catch is typically dominated by three-spine sticklebacks, with daily catch combined for the three sites averaging 2777. These high catches were seen in the

fall months (Aug - Nov) of 2023; in 2024 combined catch averaged 342 for the same months, a sign of fewer fish or the limited efficacy of the light traps in silt-laden water. BRUV video analysis was of limited utility for several months following drawdown, with visibility greatly reduced. Future analysis will describe catches using other methods and integrate publicly available sediment size and suspended solids concentration values.

Molecular Detection of *Enterocytozoon schreckii* as a Marker for Premature Senescence and Prespawn Mortality in Chinook Salmon

Professional

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Prespawn mortality (PSM) is a major obstacle to conservation of spring Chinook salmon (*Oncorhynchus tshawytscha*) in the Pacific Northwest, with rates approaching 100% in some Upper Willamette River populations. Disease is increasingly recognized as a key driver, yet the specific pathogen-host interactions underlying PSM remain poorly characterized. *Enterocytozoon schreckii* is a microsporidian parasite infecting intestinal enterocytes of adult Chinook salmon and is associated with adult salmon enteritis (ASE), a condition that may compromise gut function during the energetically demanding spawning migration. We propose that *E. schreckii* infection serves as a marker for premature senescence and subsequent PSM. Development of qPCR assays targeting *E. schreckii* has revealed the parasite is substantially more prevalent than histopathology alone indicated, as conventional microscopy underestimates infections due to the small spore size and patchy tissue distribution. Molecular tools detect earlier, lower-intensity infections invisible to histological screening, fundamentally changing our understanding of prevalence in returning adults. These advances complement broader efforts to develop nonlethal pathogen surveillance for PSM-associated agents. Recent work using environmental DNA (eDNA) at trap-and-haul facilities demonstrated that pathogen shedding by adult Chinook salmon can be detected and quantified in holding and transport water, supporting the feasibility of monitoring disease dynamics without lethal sampling. Together, these molecular approaches provide a framework for integrating pathogen surveillance into salmon management, enabling real-time assessment of disease status and informing biosecurity strategies to reduce PSM in imperiled populations.

Freshwater survival and seasonal movement of PIT tagged wild juvenile coho salmon, in off-channel habitat of an Interior-Fraser system in British Columbia

Professional

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In the Deadman River, a tributary of the Thompson–Fraser River system, passive integrated transponder (PIT) tags are used to estimate freshwater and marine survival and to quantify movements of wild juvenile coho salmon between the mainstem river and adjacent groundwater-fed side channels. In previous years, wild coho were tagged and released in the mainstem channel to estimate freshwater survival. The results suggested that juvenile coho preferentially rear in small tributaries and off channel habitats and should be further explored. Four groundwater-fed side channels were subsequently identified as potentially high-quality rearing habitat. In 2025, an intensive PIT mark–recapture study and in-stream PIT array were implemented to evaluate survival, as well as the timing and frequency of entry and exit of tagged individuals in these habitats. Residency into the fall was high in two sites, and low in the others, and survival varies across all four habitats.

What we know or don't know or think we might know and wish we knew. A shallow multi-decadal dive into ODFW's fish management, monitoring, research, and knowledge gaps in the Lower Deschutes River, OR

Professional

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The Oregon Department of Fish and Wildlife actively manages sport fisheries, conducts long-term population monitoring of salmon, steelhead and trout, while advocating for conservation, recovery and habitat protection of all native fish species in the Lower Deschutes River Basin. We will explore and discuss past research and monitoring projects, ongoing monitoring, and knowledge gaps that could help management of sport fisheries and conservation of native fish in the Deschutes River.

Rapid Loss of Genetic Diversity in Isolated Populations of Bonneville Cutthroat Trout (*Oncorhynchus clarkii utah*): Management Considerations

Student

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Loss of genetic diversity due to anthropogenic factors is occurring rapidly on a global scale, putting many species at risk of extirpation and extinction. Bonneville Cutthroat Trout (*Oncorhynchus clarkii utah*) from the Snake Range (Nevada, USA) are particularly vulnerable to these threats due to their restricted distribution and small population sizes. Historically, the Snake Range had many Bonneville Cutthroat trout populations, but by the 1980s, only four remained. Since the 1990s, three of these populations have been used to reintroduce several other Bonneville Cutthroat Trout populations throughout the Snake Range. To investigate how these Cutthroat Trout are responding to anthropogenic factors, we used low-coverage whole-genome sequencing to assess the population genetic structure and genetic diversity of recent samples (2019-2022) compared to previously collected samples (2003-2010). We document low genetic diversity in all populations evaluated and report that all populations with historic comparisons lost between 29.4%-93.1% heterozygosity within a ~15-year period. Furthermore, we find that populations that were reintroduced with multiple strains of Cutthroat Trout had the highest genetic diversity. We discuss how low genetic diversity and heterozygosity loss could impact the resilience of these populations, as well as how different management strategies could alleviate these issues.

Insights into the ocean ecology of immature/maturing Columbia River Chinook Salmon, gleaned from pop-up satellite tags

Professional

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Chinook salmon is an iconic species found throughout the west coast of North America and supports many valuable fisheries. While in the ocean, relatively little is known about the ecology of this species, despite the fact that individuals frequently reside there for the majority of their lives. To study the migration patterns, behaviors, and habitat occupancy of the large immature and maturing ocean phases of this species, we attached pop-up satellite archival tags to Chinook salmon throughout the Bering Sea and Gulf of Alaska. Tissue samples were also collected from the tagged fish to determine individual stocks-of-origin. For this talk, we present details on the migration behavior and habitat occupancy of 19 tagged Chinook salmon (75.9 ± 5.0 cm FL; mean ± SD) with Columbia River stock-of-origin assignments. Satellite tags

provided an aggregated ~1,300 days of data with individual deployments averaging 68 days (range=25–187 days). Most likely movement paths of tagged Columbia River Chinook salmon indicated direct southeasterly movements from Alaska to the Pacific Northwest, primarily over continental shelf and slope habitats. Individual movement paths ranged from 70 to 3100 km (1,608 ± 910 km; mean ± SD), during which tagged Chinook salmon occupied depths ranging from 0 to 444 m (individual means 18–117 m) and water temperatures of 2–20°C. The information gained in this study provides key insights into the critical, yet little understood, life stages of immature and maturing Columbia River Chinook salmon.

The Northwest Power Act: guiding mitigation for the hydrosystem for over 45 years

Professional

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The Northwest Power Act of 1980 occupies a unique and important space within the overlapping governance of the Columbia Basin. The Power Act called for creating the Northwest Power and Conservation Council and provided three directives: 1) to develop a Fish and Wildlife Program to mitigate for the negative effects of the hydroelectric system on fish, wildlife, and their habitats, 2) to incorporate this Program into a 20-year Power Plan that assures the NW of an adequate, efficient, economical, and reliable power supply, and 3) to inform and involve the public. The first Fish and Wildlife Program was developed in 1982 and has been regularly updated through a transparent, public process that draws on expertise from throughout the Columbia Basin. In this talk, we will review the environmental and power-planning history leading up to the Northwest Power Act, requirements of the Act, formation of the Council, and its ongoing roles and responsibilities in the Pacific Northwest. Next, we will describe the elements of the Fish and Wildlife Program, including how it is funded, implemented, and amended. Over its 45-year history, the Fish and Wildlife Program has proven to be a durable and flexible approach toward mitigation, drawing on a long history of collaboration and decision making. Although the landscape of the Northwest has changed, the value of this Program is just as important today as it was in 1980.

The Klamath Tribes' c'waam and koptu Assisted Rearing Methodology

Professional

Sharpes Barrera, Carlie; *The Klamath Tribes, carlie.sharpes@klamathtribes.com*

The c'waam (*Deltistes luxatus*) and koptu (*Chasmistes brevirostris*) are closely related endangered sucker species, endemic to the Klamath Basin. They hold deep cultural significance as traditional first foods and part of the Klamath creation story. Since the late 1960's populations have declined as a result of several factors including, but not limited to: habitat loss, habitat alteration, poor water quality, and predation. Upper Klamath Lake, once eutrophic, has become hypereutrophic with annual cyanobacterial blooms and anoxic events. Early life mortality and low juvenile recruitment are key factors in their decline. The Klamath Tribes' Ambodat Department, in partnership with the Klamath Falls National Fish Hatchery, works to supplement populations through assisted rearing during vulnerable life stages. The Klamath Tribes goal is to release 300 mm juveniles, which requires over three years of rearing. Optimal water quality is critical for growth, but nutrient-rich well water causes hypereutrophic conditions in rearing ponds, raising pH beyond optimal levels for juvenile survival. In 2025, the Tribes implemented a pond maintenance protocol using a lanthanum-based phosphorus binder and peroxide-based biodegradable algaecide to combat hypereutrophic conditions. Compared to 2024, this resulted

in significantly lower pH and higher allometric growth rates. Traditional growth metrics like length and weight differences can be misleading do to variable starting sizes. Allometric growth rate, which uses logarithmic scaling relative to body mass, offers a more robust comparison across individuals. These results inform improvements in rearing methods and support the Tribes' goal of releasing healthy 300 mm c'waam and koptu juveniles to their native habitat.

Evaluating the effect of noise on the development, behavior, and return rates in hatchery-reared Chinook Salmon

Student

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The National Fish Hatchery System's role in supplementing declining fish populations is critical to achieve U.S. conservation objectives. However, hatchery-reared fish often exhibit lower fitness and survival compared to their wild counterparts. This difference is potentially due to environmental factors unique to hatchery environments. This study sought to understand the relationship between hatchery-derived noise and early rearing habitat on the development, sensory physiology, swim performance, and survival of Chinook Salmon *Oncorhynchus tshawytscha*. Before first feed, juvenile Chinook Salmon were reared in two different rearing habitats (Heath trays and Redd Boxes). After feeding began, fry were transferred to enclosures with one of three noise conditions: quiet (noise abated), ambient hatchery noise, and continuous white noise treatment (150 dB re 1 µPa). Each month (Feb-April) we analyzed growth metrics, body-to-brain-weight ratios, lateral line neuromast number, and inner ear cell counts. In April (pre-release), we also analyzed swimming performance, then tagged and released fish to quantify adult return rates. We observed moderate differences in fish length in April, shortly before fish were released. Neither sensory development nor swimming behavior was substantially impacted by rearing environment or noise exposure. However, we saw significant differences in return rates between noise treatment groups. We found that fry exposed to broadband white noise were significantly less likely to return to the hatchery, where quiet- and ambient-treatment fish had higher return rates. Our findings indicate that chronic high-intensity noise exposure in hatcheries can negatively affect return rates for hatchery-reared Chinook Salmon, highlighting the importance of soundscape management to optimize fish fitness.

Life-Stage–Specific Distribution Patterns of Endangered Suckers in Upper Klamath Lake, OR Inferred from a High-Density Acoustic Telemetry Array

Professional

Sholtis, Matthew; *USGS, msholtis@usgs.gov*

The recovery strategy for endangered Lost River (*Deltistes luxatus*) and Shortnose (*Chasmistes brevirostris*) suckers in the Upper Klamath Lake recovery unit relies on understanding spatial distributions that drive survival and recruitment. While adult Lost River suckers are currently managed as a single population, survival disparities between river- and shoreline-spawning aggregations suggest distinct habitat use. Furthermore, a lack of data on juvenile survival and dispersal limits the assessment of recruitment bottlenecks. To resolve these uncertainties, we used passive acoustic telemetry to characterize movements across life stages and species over a two-year period (2024–2025). Adult Lost River suckers from both spawning populations were surgically implanted with Innovasea 69 kHz acoustic transmitters in Spring 2024 (n=198) and Spring 2025 (n=45). Additionally, the study was expanded to juvenile sucker habitat selection by tagging a total of 459 juvenile suckers, comprising a mix of both species, during Fall 2024 (n=156) and Fall 2025 (n=303). Post-tagging dispersal was monitored via a high-density array of up to 90 acoustic receivers within Upper Klamath Lake. Detection events were analyzed to

describe spatial and temporal distributions in habitat use of adult Lost River suckers by spawning groups, and juvenile suckers by species. This study will deliver high-resolution maps of the distribution of both adult Lost River populations and juvenile sucker species, helping identify potential causes of mortality and guiding spatially explicit management and restoration efforts.

Understanding the thermalscape: Quantifying the structure and drivers of thermal heterogeneity across scales in the Willamette River Basin

Professional

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Stream temperature varies across spatial and temporal scales, resulting in a diversity of riverine thermal dynamics, which we refer to collectively as the 'thermalscape'. The thermalscape expands on the idea of a riverscape, a continuous view of the entire spatially heterogeneous scene of the river unfolding through time. We look to explore the thermalscape across Oregon's Willamette River Basin (WRB) by incorporating remote sensing, in-situ observations, and modeling to paint a holistic picture of thermal patterns at multiple scales—from the entire stream network to reaches, channel units, and microhabitats. We combine recent in-situ stream temperature data at 788 sites (2011-2025, from the U.S. Geological Survey [USGS], and state and federal partners) with the NorWeST in-situ database (1993-2011) to assess spatial and temporal heterogeneity across the WRB. We also compile airborne thermal infrared (TIR) remote sensing imagery for over 1,600 km of rivers surveyed by USGS and federal and state agencies in 1999-2024 to provide high-resolution snapshots of riverine thermal heterogeneity at multiple spatial scales. We leverage these datasets with a generalized additive model (GAM) of stream temperature (daily mean temperatures at >9,000 National Hydrography Dataset medium resolution reaches) that provides temporally and spatially consistent data and a framework for interpolating and extrapolating higher-resolution observational information across the basin. We integrate these three data sources across scales to enhance understanding of the structure and drivers of thermal variability. Improved understanding of riverine thermal heterogeneity across the WRB is essential to understanding water supply and demand for humans and fisheries, particularly prized Chinook salmon. This work is part of a larger USGS Integrated Water Availability Assessments and Next Generation Water Observing Systems in the WRB.

Cooperative Research Training Through Collegiate Fishing Competitions and Micro-Certification

Professional

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Cooperative Research is rapidly emerging as a critical strategy for expanding fisheries data collection amid growing monitoring demands and constrained agency budgets. By building structured partnerships between management agencies and resource users, it strengthens both scientific capacity and public trust. Despite its growing importance, there is virtually no dedicated educational pathway—let alone experiential programs—preparing future fisheries professionals to lead Cooperative Research initiatives. To address this gap, we developed a hybrid education–sport model that delivers Cooperative Research training through immersive, field-based collegiate competition. Rather than teaching collaboration conceptually, students practice stakeholder engagement and recruitment, data integrity, and applicability to fisheries management. The framework was piloted in fall 2025 with the Washington–British Columbia Chapter of the American Fisheries Society (AFS) through an event called Cascadia Catch, and then expanded in winter 2026 across the Western and North Central divisions of AFS through

Hardwater Havoc. Hardwater Havoc operated as a six-week intercollegiate competition pairing weekly fishing challenges with structured “Metric Missions” that required students to analyze real-world datasets generated during the event. These missions introduced foundational fisheries management concepts—including Catch Per Unit Effort, fish length distributions, zero-catch data, sampling bias, and hypothesis development—while linking performance to competency-based micro-certifications. In total, 18 postsecondary institutions submitted nearly 5,000 documented catches and logged more than 2,000 hours of on-ice effort, demonstrating that collegiate competition can serve as a scalable training platform for Cooperative Research while expanding fisheries data capacity. If you want to find out which schools claimed the title, come to the presentation.

How Anticipated Climate Warming May Influence Growth and Metamorphosis in Pacific Lamprey

Professional

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Pacific Lamprey undergo a true metamorphosis. During this process they transform from a blind, filter feeding larvae that burrows into fine sediments into an eyed, free-swimming parasite that attaches to animals to feed on tissue and blood. Metamorphosing animals can be vulnerable to environmental changes that directly or indirectly cue metamorphosis, and little is known about how changes to water temperature, food (or productivity), and individual growth may act synergistically to affect if Pacific Lamprey metamorphose or the timing of metamorphosis. Similar to life stage transitions in other fish, like smoltfication in salmonids, experiments on some parasitic lamprey suggests they require certain energy reserves to trigger this metamorphosis. Since feeding stops during metamorphosis and it is an energetically taxing, maintaining or accumulating enough energy to complete the process may be critical. For instance, cold winter temperatures may be necessary to maintain their overwinter body condition (e.g. through reduced metabolism) for metamorphosis to occur the following summer. To examine how such factors may influence Pacific Lamprey metamorphosis, we collected lamprey that were relatively likely to undergo metamorphosis based on their body size and condition and exposed them to winter temperature treatments representative of extreme climate change and to different auxiliary feed treatments. This design was an attempt to evaluate whether treatment combinations would reduce the proportion of fish undergoing metamorphosis and change the timing of this process. Pacific Lamprey encounter a wide range of environmental conditions over their geographic range, and there is evidence that growth and age-at-metamorphosis can differ on basin scales. Understanding what factors influence lamprey metamorphosis may elucidate potential mechanisms for how anthropogenic and natural changes in ecological conditions could influence demographic changes in lamprey populations.

Treaty Selective Fishing Experimentation: Failures and Success - Nisqually River

Professional

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The Nisqually River watershed, like most of southern Puget Sound, has a long history of hatchery enhancement. Hatchery production is currently necessary for sustaining harvest that natural production cannot support due to habitat degradation and reduced population productivity. The Nisqually Tribe (Nisqually) initiated hatchery production in 1979 at Kalama Creek Hatchery and in 1990 at Clear Creek Hatchery with the sole purpose of supporting harvest. After Chinook was listed as threatened in the Endangered Species Act (1999), recovery exploitation rates were imposed on the wild Nisqually Chinook severely hampering treaty

harvest particularly on abundant hatchery Chinook. Nisqually has been successfully fishing with gill nets since time immemorial and currently implements a limited treaty gill net fishery on the Nisqually River. Nisqually hatchery Chinook are heavily marked and returns average ~94% hatchery, an ideal location for selective fishing. To balance recovery and support treaty harvest, Nisqually tested several selective gear types over the years to determine the feasibility and acceptance of implementing a selective fishery to take advantage of the hatchery returns and limit impacts to wild Chinook. Presentation will include pros and cons of gear types explored including catchability, fisher's acceptance, and bycatch issues as explored over the last 15 years.

Pink Salmon competition effects on Snake River Steelhead: Marine-phase dynamics across odd–even cohorts

Professional

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Odd-even oscillations in North Pacific Pink Salmon (*Oncorhynchus gorbuscha*) abundance have been implicated as a driver of interspecific competition affecting salmonid growth and survival, yet the timing and demographic pathways of these effects remain unresolved for Snake River Steelhead (*O. mykiss*). We analyzed adult Steelhead trapping data from Lower Granite Dam (2009–2025), comprising approximately 36,000 wild fish from 10 genetic stocks, to test whether pink salmon competition influences steelhead abundance and whether effects are associated with ocean entry or the final year of ocean residence. We fit age- and stock-structured Bayesian state-space models to annual trap counts that explicitly account for sampling effort and trap efficiency. Models structured by ocean entry year revealed coherent odd-even patterns in total and age-specific abundance, with reductions in odd-year cohorts consistent with competition during early marine residence. In contrast, models structured by the final ocean year showed opposing age-specific responses, with positive effects for age-1 fish and negative effects for age-2 fish that largely cancel when aggregated, eliminating a consistent odd-even signal. This pattern reflects cohort mixing, as age-1 fish in odd last-ocean years derive from even ocean-entry cohorts while age-2 fish in odd last-ocean years derive from odd ocean-entry cohorts, producing opposing age-specific responses rather than a shared final-year competition effect. These results identify ocean entry as the primary window of Pink Salmon-mediated competition and underscore the importance of parity-aware forecasting and age-structured inference in steelhead population assessments.

Eggboxes: A unique perspective to salmon supplementation

Professional

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The Shoshone Bannock Tribes have been using Eggboxes as a means of boosting production in tributaries to the Upper Salmon River over the Past 2 decades. Through the trials and tribulations, The tribes has developed a unique incubator design, that fits their needs to incubate chinook salmon eggs and release progeny in snowpack dominated high elevation streams. The efforts are unique to the Upper Salmon Basin and bring an alternative perspective to Salmon Recovery efforts. This presentation serves as an overview of the Shoshone Bannock Tribes efforts. Past and present, successes and failures, goals and objectives.

Columbia River Water Quality Issues and Drivers - Can We Restore Columbia River Salmon?

Professional

Soscia, Mary Lou; *Columbia River Basin Initiative, MaryLou.Soscia@jacobs.com*

Mary Lou Soscia will provide a background and overview of the Columbia River Basin, including Tribal Governments and key entities throughout the Basin. She will discuss priority Water Quality issues: Water Temperature and Toxics. The temperature discussion will include information on the Columbia River Mainstem Temperature Total Maximum Daily Load, Cold Water Refuges, NPDES Dam Permits, and the emerging challenge of Data Centers. The toxics discussion will include a background on concern about human health exposure to tribal high fish consumers, and effect on toxics in salmon restoration work. As a result, the Columbia River Basin Restoration Act was passed in 2016 and a wide range of toxics reduction actions and monitoring is occurring throughout the Basin to reduce toxics. Mary Lou spent 38 years working for the US Environmental Protection Agency with 30 years focused on leading work efforts on Columbia River Basin water quality issues. Mary Lou created the Columbia River Toxics Reduction Program and a Basin wide collaboration with diverse members. Mary Lou retired from EPA in 2023 and currently works for Jacobs Engineering as a Senior Scientist focusing on the Columbia River Basin.

Coho Monitoring on the Oregon Coast: Past, Present, and Future

Professional

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From 1950 through 2004 spawning surveys for coho salmon were conducted in standard index areas along the Oregon Coast to assess trends in the escapement to natural spawning grounds. Multiple reviews indicated that this method did not provide the level of monitoring detail needed for management of Oregon's coho salmon populations. In 1990 a stratified random sampling (SRS) program was initiated to address these inefficiencies and provide annual estimates of the abundance of naturally spawning Oregon Coastal Natural (OCN) coho. Sites were surveyed about weekly through the fall/winter coho spawning season to generate an area-under-the-curve (AUC) estimate of the number coho spawning at each site. The AUC estimate and the proportion of hatchery coho were then used to generate estimates of the abundance and proportion of hatchery coho in naturally spawning coho populations by ODFW management district and basin groupings. This methodology was used for the 1990 through 1997 spawning seasons. As part of the implementation of the Oregon Plan for Salmon and Watersheds (OPSW) in 1998, ODFW established an integrated monitoring program for Oregon coastal salmonids using the Environment Protection Agency's (EPA) Generalized Random Tessellation Stratified (GRTS) sampling design to establish a shared set of random, spatially balanced sample points. Beginning in 1998 the GRTS design replaced the SRS method for selection of spawning ground surveys in the OC Coho ESU and was implemented as a 27-year rotating panel design to be completed in 2024. After completion of the program, it was necessary to reevaluate the design due to decreased funding and survey effort. In 2025 effort was made to leverage prior years data to help inform future monitoring and to evaluate the use of models to inform population estimates.

To Swim or Not To Swim: Optimizing Performance of Spring Chinook Salmon Reared in Circular Tanks

Professional

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Aging infrastructure, water usage, and changes in hydrologic patterns are forcing Salmon hatcheries throughout the Columbia River Basin to rethink how they operate. Circular tanks with single pass water systems or that reuse water (RAS) are replacing traditional style concrete raceways. The shift in the geometry and water dynamics between these two different rearing environments on the surface may seem insignificant. However, the increased exercise that these circular systems provide compared to the slack-waters of traditional style raceways is measurably different, and as such, may have major implications for the phenotype of juvenile salmonids being reared in these new systems. While there is evidence that this increased exercise has benefits, some hatchery programs are struggling to adjust rearing protocols to harness those benefits. We are currently conducting both small and large scale experiments on juvenile spring Chinook salmon to assess the physiological effects of different exercise regimens on juvenile salmonids. This talk will provide some preliminary data from this research.

Genomic outcomes from a multi-generational genetic rescue experiment with Greenback Cutthroat Trout

Professional

Sparks, Morgan; *Rocky Mountain Research Station, morgan.sparks@usda.gov*

Fragmented landscapes are an increasingly prevalent factor in stream fish management and conservation and may lead to isolation and potentially severe reductions in genetic diversity and fitness. Greenback Cutthroat Trout (*Oncorhynchus clarkii spp*), provide an extreme example of this phenomenon. Extirpated from their native range in the South Platte River basin of Colorado, these fish have persisted in a single, small, out-of-basin population in isolation for over a century. Genetic data indicate this population has low levels of genetic diversity likely leading to the low fitness they display relative to sister subspecies. To understand the extent of fitness differences within and among subspecies and how specific genomic regions or features may contribute to fitness, we present the results of a multi-generational genetic rescue experiment and highlight results from the second generation of this work. To rescue Greenback Cutthroat, they were mated with Colorado River Cutthroat Trout (*O. c. spp*) and survival and growth data, along with tissue samples were collected from hybrid, pure Greenback, and pure Colorado River offspring. Hybrid offspring were then raised to sexual maturity and mated with one another or backcrossed with pure Greenbacks. We used genotyping-by-sequencing to assess genomic differences in their offspring and its influence on mortality or survival. Specifically, we examined genetic features that may be contributing to higher survival within and among families in this second generation of crosses, as well as differences in hybrid F2 and Greenback Cutthroat backcrossed offspring. The results of this work inform not just the explicit recovery goals of this ESA listed species, but serve as a model for isolated stream fishes across the West.

From Stories to Science: Relationality with Pacific Lamprey

Professional

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Pacific lampreys have been around for approximately 400 million years and continue to hold a special place in the environment and in tribal communities. Since time immemorial Pacific lamprey, or asúm, have shared themselves with Indigenous people along the Pacific Rim.

Relationships with lamprey are shaped by stories, place, and knowledge carried across generations. Kaitlynn's journey as a Tribal fisheries biologist is a reflection of her understandings of lamprey developed through cultural teachings, education, and field experience. Growing up hearing stories of lamprey at Lyle Falls on the Klickitat River and learning through Ichishkíin language classes, early teachings helped shape her understanding of lamprey as more than a species, but as relatives connected to place and story. Through experiences studying lamprey in the Columbia River Basin and the Southern Oregon Coast, later studying abroad in Aotearoa (New Zealand), she encountered similar relationships between people and kanakana (lamprey). These parallels highlight how cultural knowledge surrounding lamprey is found across the world, carried not only through rivers and ecosystems but also through language, teachings, and stories. Drawing from research, field work, and experience with the Columbia River Inter-Tribal Fish Commission
(CRITFC) Lamprey Project and tribal partners, this talk reflects on how relationality with lamprey emerges through lived experience, stewardship, and the knowledge passed down from generation to generation.

Colossal Catch and Release: Oversize White Sturgeon Encounter Data through Creel in Impounded Columbia River Reservoirs

Professional

Stackhouse, Abigail; *Oregon Department of Fish and Wildlife, abigail.f.stackhouse@odfw.oregon.gov*

White Sturgeon (*Acipenser transmontanus*) is a colossal creature that has captured the curiosities of biologists, anglers, and fish-lovers alike. This native species is iconic in part due to its sheer magnitude, being the largest freshwater fish in North America and is culturally significant to Tribes and residents along the Pacific coast. The Columbia River Basin has a large population of White Sturgeon, which are impounded by a series of dams, creating reservoirs. Oregon Department of Fish and Wildlife manages creel surveys for a 147-mile stretch in Bonneville, The Dalles, and John Day reservoirs for recreational fisheries. This survey occurs during the non-retention season of sturgeon, but records data on effort and encounters of the catch and release fishery. For management purposes, sturgeon are broken into three size classes: undersize, legal, and oversize (> 54" fork length). For many anglers, the challenge and thrill of landing an oversize White Sturgeon is a bucket-list item, making these prodigious prehistoric fish a popular pursuit in the region's year-round catch and release fishery. Oversized sturgeon are of particular importance to fisheries managers as well, as these animals are sexually mature adults, which are critical to the reproductive success and sustainability of the population. The data generated from creel interviews and effort counts provide spatial, temporal, and size class-specific information that can offer valuable insight into catch and release dynamics for oversize White Sturgeon in the basin.
Creel survey data from 2023-2025 were analyzed to determine inter- and intra-annual trends between April and November by reservoir.

Oregon Chub population dynamics in floodplain habitats influenced by managed flow

Professional

Starcevich, Steven; *Oregon Dept of Fish & Wildlife, stevenstarcevich@gmail.com*

The Oregon Chub *Oregonichthys crameri* is a small floodplain minnow that was once widely distributed in the Willamette River Basin. The decline in distribution of this endemic species and reduction of off-channel habitats led to its federal listing as endangered in 1993. The listing led

to a recovery plan, extensive surveys, and chub translocations to unoccupied sites. Populations discovered during surveys and introduced as a recovery action improved the known status of the species and led to their delisting and research into potential limiting factors. Flood control dams were identified as a potential factor influencing chub status. To understand how dam operations influenced chub habitat and abundance and other fishes, we sampled annually 33 chub-occupied sites from 2009-2022 in floodplains downstream of dams in the Santiam, McKenzie, and upper Willamette basins. The objectives of this study were to assess population status and trend of chub and other fishes, describe the relationship between the managed flow regime and site characteristics, and evaluate the factors influencing chub populations.

Using a community modeling approach to gain insights into niche space crowding for Chinook Salmon on their seaward migration

Professional

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The downstream migratory corridor represents a time of great change for juvenile Chinook salmon. Despite intensive quantification of abiotic parameters and potential predator dynamics on the migratory corridor, we lag behind in understanding how the remainder of the biotic community may help or hinder this journey. Here we use an occupancy modeling approach along with multiple decade-scale bycatch datasets to reconstruct probable fish communities at a fine spatial grain from the headwaters of the Salmon River to Lower Granite Dam, and a resource-space based approach to estimate niche crowding dynamics on the Hutchinsonian hypervolume of Chinook salmon smolts at the same grain. Single-species occupancy model results concur broadly with testing datasets and other historical sampling records, and suggest patterns of species addition with increasing stream size. Discrete-space niche overlay models suggest that only 5.9% of the Chinook Hutchinsonian hypervolume is unoccupied at the regional species pool scale, with a mean occupancy of 2.68 species in any point of the hypervolume. When combined with species distribution models, potential realized niche space was as high as 30% in headwaters, but approached community-wide minimum (5.9%) in the mainstem Salmon River. Similarly, mean weighted occupancy of hypervolume was as low as 1 species in natal habitats, and approached 2.5 species in the Snake River. These results reflect ecotonal changes at natal and migratory corridor junctions in the Salmon River, and again at the Salmon-Snake River confluence, with an increasingly crowded Hutchinsonian hypervolume for juvenile Chinook Salmon as they migrate downstream. We discuss next steps in exploring which, if any, of these dynamics may result in changes to migration speed or growth.

Speeding Recovery: Restoration Collaboration in the Hood River Basin between Tribes and Watershed Groups

Professional

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Located within the ceded territories of the Confederated Tribes of the Warm Springs Reservation of Oregon (CTWS), the Hood River basin supports a high diversity of anadromous and resident fish populations, including ESA-listed steelhead and bull trout, as well as Chinook and coho salmon. Over time, the basin has experienced a myriad of habitat modifications—including dam construction and removal, irrigation diversions, floodplain development, and timber harvest—limiting fish populations of cultural significance to the Tribes. For years, the CTWS Hood River Habitat Program has worked collaboratively with the Hood River Watershed Group (HRWG) to conduct and support restoration projects throughout the

basin aimed at addressing the limiting factors to population productivity. In this presentation, the collaborative relationship between Tribes and watershed groups will be highlighted through the case study of restoration work conducted in the Hood River basin. Past and upcoming projects will be explored, including lessons learned and the holistic approach to watershed restoration being implemented conjunctively by CTWS and the HRWG. How can funding be strategically leveraged? How can material shortages for projects be addressed through partnership and innovation? Join us to learn more about the work that occurs when Tribes and watershed groups work side by side to restore habitat from headwater streams to the mainstem river, and the fisheries that depend on this approach.

Embedding Community-Led Science into the Governance of Hawai‘i's Pūpūkea Marine Life Conservation District

Student

Stephenson, Callie; *University of Hawai‘i at Mānoa, callies@hawaii.edu*

Adaptive management proposed for the Pūpūkea Marine Life Conservation District (MLCD) on O‘ahu, Hawai‘i exemplifies collaboration between community members, academic partners, and natural resource managers. The locally-based community stewardship non-profit organization Mālama Pūpūkea-Waimea (MPW) was contracted by the local government to execute a three-year Biological Carrying Capacity (BCC) study to provide empirical data and recommendations for adaptive management related to the potential overuse of the marine reserve by humans.The BCC study focused on the heavily impacted Kapo‘o (Sharks Cove) region to collect rigorous scientific data to create management recommendations. Results demonstrate clear ecological degradation linked to persistent, elevated visitor density. Since 2022, in-water human presence in the Kapo‘o Tidepools has increased by 214%, remaining persistent year-round. BCC surveys confirmed that physical damage to coral increased significantly with human density, with an estimated 40% probability of observed damage on coral colonies in hotspots of visitor use. Concurrently, non-schooling fish abundance and species richness declined year-over-year across zones. Using non-linear analysis of the relationship of non-schooling fish abundance and surrounding human density, we quantified a conservative threshold of 1 human per 10m radius in the Kapo‘o Tidepools after which precipitous declines in fish abundance are likely, and extrapolates to a maximum acceptable visitation of 27–31 individuals at any given time for the entire area. These findings culminated in recommendations to the State and City governments for adaptive management. This project provides a useful case study in academic partnership, local stewardship, and natural resource management.

Sandy River Basin Climate Change Analysis

Professional

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Fish scientists and managers are increasingly calling for the consideration of a rapidly changing climate in habitat restoration plans. Since 2007, the Sandy River Basin Partners have followed an aquatic restoration strategy that is rooted in analysis of limiting factors for salmon and steelhead throughout the Sandy Basin (Oregon) for restoration based on existing habitat conditions. Monitoring has validated modeled increases in adult returns and freshwater production over time. In light of predicted climate-driven shifts in in-stream conditions, an analysis was conducted of water temperatures, flows, and certain flow-dependent habitat variables anticipated by 2040 and 2080 and their predicted effects on salmon and steelhead populations in the Sandy. This analysis was used to help identify types of actions and their

location in the basin most likely to be effective at offsetting those effects. Future water temperatures, flows, and population responses were modeled using Spatial Tools for the Analysis of River Systems / Spatial Stream Network 2 (USFS), Precipitation Runoff Modeling System (USGS), and Ecosystem Diagnosis and Treatment (ICF), respectively. Limiting factors were identified across various scales for fall and spring Chinook, Coho, and winter steelhead. At the basin-scale, the primary limiting factor predicted in 2080 was maximum water temperature primarily in the lower mainstem river, where all anadromous life-histories must pass. A list of possible actions was built through a multi-agency effort, ranging from relatively straightforward to potentially very challenging, using climate change analysis results as a guide. Subsequent population modeling will evaluate which actions (type/location) are likely to be most effective. Results of this work will guide the Sandy River Basin Partners in directing restoration efforts and resources to where they will most effectively support and safeguard salmon and steelhead populations under future climate conditions.

Assessing the timing and distribution of Green Sturgeon within the U.S. Navy's Northwest Testing and Training study area

Professional

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Green Sturgeon *Acipenser medirostris* are an anadromous species native to the west coast of North America and are comprised of two distinct population segments (DPS). The Northern DPS are considered a Species of Concern by NOAA fisheries, and are known to spawn in the Klamath, Eel, and Rogue rivers in northern California and southern Oregon. The Southern DPS are federally listed as a threatened species under the U.S. Endangered Species Act, and are known to spawn only within the Sacramento River basin in southern California. After hatching and rearing in freshwater, Green Sturgeon of both DPS eventually move into marine waters and spend a substantial portion of their lives the marine environment north of their natal rivers in the eastern Pacific Ocean. Upon reaching sexual maturity, Green Sturgeon make periodic migrations (estimated to occur every 2-6 years) to their natal rivers to spawn. Since 2020, the U.S. Navy has contracted with the Washington Department of Fish and Wildlife (WDFW) to assess the timing and distribution of Green Sturgeon within their Northwest Training and Testing (NWTT) study area. Through a multi-agency collaborative effort, we were able to analyze acoustic telemetry data from 622 Green Sturgeon along the west coast between Vancouver Island, BC and the Sacramento basin in California. The objectives of this project were to 1) document the occurrence of sDPS Green Sturgeon implanted with acoustic transmitters within the NWTT study area, 2) evaluate the seasonality of Green Sturgeon presence within the NWTT study area by evaluating seasonal distribution across their range, and 3) characterize the timing and frequency of marine migrations between the Pacific Northwest and their natal spawning grounds. This work contributes to the body of knowledge on Green Sturgeon distribution in the marine environment and the potential risks imposed on these at-risk populations throughout their life cycle.

Transparent management inputs – data workflows incorporating GitHub

Professional

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Recent changes in Oregon coast Coho Salmon (*Oncorhynchus kisutch*) monitoring and downstream fisheries management information inputs gave us the opportunity to review our

data and analysis workflows and share them using GitHub. We consolidated publicly available Oregon Department of Fish and Wildlife Salmonid Life Cycle data and published the R code used to process individual site data into a coast-wide marine survival index (MSI) in a GitHub repository. These data also feed into the Oregon Coast Natural marine survival forecast and the forecast code with covariates was also shared in GitHub. The availability of the data and code improved the Pacific Fisheries Management Council review of the new MSI analysis and Oregon Production Index Technical Team (OPITT) review for fisheries management. The GitHub repository could be cloned by reviewers and fisheries managers for assessment prior to meetings; there were 53 repository clones in the days leading up to the 2026 OPITT meeting.

What influences fish survival and recovery after fire? A meta-analysis across Western North America

Professional

Svatos, Emma; *Oak Ridge Institute for Science and Education, svatosec@gmail.com*

Wildfires are increasing in frequency and intensity globally, with particularly strong effects across western North America. Fire impacts propagate through stream networks, altering hydrology, nutrient and sediment loading, habitat structure, and aquatic biotic communities. Although fire is a natural disturbance in many western ecosystems, shifts in fire regimes may pose increasing risks to fish populations. Despite a growing body of research over the past several decades, fish responses to fire remain highly variable, and the influence of factors such as fire severity, disturbance intensity, time since fire, landscape context, and regional climate is not well understood. To address this uncertainty, we conducted a systematic review and meta-analysis of abiotic and fish responses to wildfire and prescribed fire across Western North America. We synthesized fish response data from more than 50 peer-reviewed studies in the western United States and analyzed responses using ordinal logistic regression, classifying effects as positive, negative, or no discernible change following fire. Across taxa, fish populations generally declined following fire. However, salmonids showed evidence of recovery over time, particularly for abundance and presence metrics. Fish responses were moderated by disturbance intensity, land cover, hydrology, and regional climate. Reduced likelihood of population decline and more favorable recovery trajectories were observed in Mediterranean climates (e.g., western Oregon and coastal California) and following prescribed fire. Salmonids exhibited similar patterns, with an additional finding that post-fire drought was associated with improved recovery trajectories, likely due to reduced post-fire flooding and channel scouring. Together, these results clarify how fish respond to fire across western landscapes and identify the conditions under which fire is most likely to disrupt fish populations and the pathways through which recovery occurs.

Global patterns in stream responses to fire: how we study, what we know, and what we're missing

Professional

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Human activities and climate change are driving increases in wildfire worldwide, promoting research around the globe into the effects of fire on flowing freshwaters, including biodiversity, ecosystems, and water quality. Despite decades of study, responses remain difficult to generalize. We conducted a systematic review to identify what has been studied thus far, how fire affects flowing freshwaters and associated fauna, and key knowledge gaps. Of the 363

studies synthesized, over half were published in the past decade. Most research is conducted in North America (269 studies) and the remainder of the globe is mostly understudied relative to fire occurrence. Studies primarily examine wildfires rather than prescribed burns, focus on high or mixed severity burns, and rely on short-duration control-impact designs with limited pre-fire data. Research is concentrated in small streams (<5,000 ha) and large rivers (>100,000 ha) and focuses on abiotic responses more often than biotic responses. Abiotic responses typically increase post-fire or show no effect and often recover within a decade. Over time, water temperature and light are more likely to increase, whereas flow, nutrients, turbidity, and contaminants tend to recover. Response direction is moderated by disturbance intensity and landscape context, with low-severity fires and prescribed burns reducing elevated responses, and high severity, forest harvest, elevation, and flood/scour events amplifying effects. Regarding the reorganization of biotic communities after fire disturbance, invertebrates tend to reassemble (composition shifts) while vertebrates often restructure (changes in population structure). Despite the hundreds of published studies, research is lacking regarding ecosystem-level processes, non-macroinvertebrate or Salmonidae taxa, tropical and Arctic regions, and consistent reporting of fire characteristics. Addressing these gaps across spatial scales will improve and inform fire and water management.

Trends in stream ecosystem biota over a gradient of post-fire conditions in western Oregon

Professional

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With wildfire frequency and intensity increasing in many forested regions globally, aquatic ecosystems face multiple fire-induced changes in physical, chemical, and biological conditions which can vary with burn severity, pre-fire conditions, post-fire geomorphic events, and time since the fire. Because of the unpredictable nature of wildfires, many fire studies are limited in replication, further contributing to highly context-dependent biotic responses. In this study, we evaluate aquatic habitat conditions, ecosystems processes and aquatic biota from 30 fourth-order streams within the first five years after the Riverside, Beachie Creek and Holiday Farm fires in western Oregon. We observed pronounced differences in riparian canopy conditions with burned canopy cover ranging from 15 to 95% and resulting in concomitant changes in stream light and temperature, however we observed limited fire-induced physical habitat changes potentially driven by the lack of landslides or channel reorganization events in our focal watersheds following these fires. Fish, amphibian, and crayfish densities and assemblages were surprisingly high and stable in even the most severely burned watersheds. We also evaluated primary production and macroinvertebrate abundances and communities to better understand the influence of fire on aquatic ecosystem processes, water quality and aquatic food webs. Overall, this work contributes to the growing body of empirical data on the persistence of aquatic ecosystem function in post-fire conditions in western Oregon. The views expressed in this abstract are those of the authors and do not necessarily represent the views or policies of the U.S. Environmental Protection Agency.

A best practice guide to half-duplex (HDX) PIT tag interrogation in larger rivers; examples tracking Bull Trout in the Upper Willamette Basin since 2001

Professional

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Full- and half-duplex (HDX) PIT tag interrogation systems are functionally very different, and like AM and FM radio, these differences can be exploited in different applications. HDX-systems offer many advantages for fisheries monitoring in remote, free flowing rivers. With HDX-systems, there is no need for vibration suppression or waterproofing of the antenna, the low drag profile permits swim-through orientation of the antenna, and multiple antennas are not needed to achieve stream-width detection, antenna repairs can be done quickly in the field, sites are easily moved if needed and require less power. These attributes contribute to HDX being a cost-effective solution for many applications outside of the Columbia River Basin, allowing the installation and maintenance of multiple independent interrogation sites where you might otherwise have been limited to a single site. I will share our best practice guidelines for HDX-antenna construction and installation, system status monitoring, and provide examples from bull trout monitoring in the Upper Willamette Basin.

N-PAcT: Unifying Acoustic Telemetry Data Collaboration for Large-Scale Discovery

Professional

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Acoustic telemetry data provides essential information on marine species distribution, habitat use, and connectivity, aiding the implementation and assessment of marine zoning. Acoustic telemetry technology is an effective method for tracking marine animal movements, although it can be expensive and logistically challenging due to the need to maintain receiver arrays. Individual researchers typically deploy and maintain localized receiver arrays that are project-specific, with limited data sharing capabilities. For highly mobile species, the lack of infrastructure to share detections across research programs limits the power of acoustic telemetry methodologies. While acoustic data sharing networks are well established along other US coastlines, the West Coast has lagged behind. The Northeast Pacific Acoustic Telemetry Node (N-PAcT; [npact.aoos.org] (http://npact.aoos.org)) was established in 2025 and aims to shift perspectives from localized efforts to national and international collaboration to better understand animal movements and support effective management of mobile species. N-PAcT serves as a platform to integrate data from a multitude of researchers across jurisdictions spanning from Alaska, USA, to Baja California, Mexico. N-PAcT is interoperable with the Ocean Tracking Network (OTN), which has well-established infrastructure to enable data sharing across research groups, including detection matching with other nodes and affiliated networks,and rigorous quality assurance and quality control (QA/QC) of ingested data. This collective approach will break down geographical and logistical barriers, thereby transforming individual studies into powerful, cohesive projects by providing a clearer, more complete picture of animal movement in the northeastern Pacific Ocean. Participation in N-PAcT can provide numerous benefits to researchers through data sharing across research groups, with utility of the N-PAcT database highlighted through several case studies.

Lessons from the Wenaha River: Translating the monitoring of a wild population to adaptive management of hatchery programs

Student

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The Wenaha River is a wild fish sanctuary for spring Chinook Salmon, *Oncorhynchus tshawytscha*, that neighbors a large hatchery supplementation program. The spawning grounds have been surveyed since 1949, but sampling efforts have been challenging after a major fire in 2015, reducing the ability to recover carcasses. Monitoring remains essential for the Wenaha River's wild run as it serves as one of the few comparative baselines available to gauge supplementation success. Recent spawning ground surveys indicate that hatchery-origin spawners have consistently exceeded the management target for a proportion of hatchery origin spawners (pHOS) threshold of 0.05 (5%) in the Wenaha River, most of which originate from the Lookingglass Creek stock. This raised concerns about potential ecological and genetic impacts on this natural population. To address this, an intensive sampling approach was taken to assess monitoring methods and evaluate the natural population and hatchery strays. Incorporation of passive integrated transponder (PIT) tag antennas, live fish observations, and increased survey frequency over two field seasons resulted in an enhanced data set to assess new estimation methods. Application of the weighted proportion of hatchery origin spawners (pHOSw) helped evaluate spatial and temporal overlap between hatchery and natural-origin spawners. Bayesian modeling approach helped address small sample sizes and provided estimates of variability. Results demonstrated that seasonal PIT antennas may provide alternative estimates of total spawner abundance and pHOS.
The pHOSw approach revealed that there is little to no separation of hatchery and natural origin spawners in the Wenaha River. This work additionally contributes to monitoring objectives of the Lower Snake River Compensation Plan. Findings provide insight into hatchery stray distribution, improve inference from limited sample sizes, and support adaptive management of hatchery supplementation programs.

Timing Matters: Improving Survival of Smolts Through Automated Releases

Professional

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Salmon and steelhead smolts are subject to numerous environmental factors, like physical barriers and predation, that impact survival and influence behavior during migration. Throughout Western North America, trap-and-transport is used to bypass dams with the goal of reducing mortality of these anadromous populations. However, smolts are more often released during the daytime when predation rates are notably higher. A novel automatic release system from Whooshh Innovations, called the NightFlight, opens and closes at specified times to mitigate risk of predation. Acoustic telemetry was used to compare the survival rates of two groups of Atlantic salmon (*Salmo salar*) smolts released during the day and at night. The study found that survival was 46% higher for smolts released overnight, opposed to smolts released under standard practice. These findings support the preferred practice of overnight releases commonly applied to Pacific salmon, while providing a potentially more practical approach for managers to implement within current practices. Further, the NightFlight system is simple and low-cost solution for reducing stress by allowing smolts to acclimatize after transport.

The use of Full Mitochondrial Genomes for Cutthroat Trout Taxonomy and Species Delimitation

Student

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Since the 2015 Cutthroat Trout Taxonomy and Evolutionary Biology special workshop held at the annual meeting of the American Fisheries Society, many scientists have been working together to create a revised taxonomy for Cutthroat Trout using a combination of geography,

geology, morphology, and genetics. This workshop ultimately led to the 2018 book titled Cutthroat Trout Evolutionary Biology and Taxonomy. This book highlighted profound and ancient diversity within the Cutthroat Trout species complex, though it did not create a clear path for future species delimitation and taxonomic revision. Since 2018, next-generation sequencing methods have allowed for the compilation of vast amounts of DNA sequence data, greatly increasing our ability to investigate intricate evolutionary scenarios within the Cutthroat Trout species complex. Here, we investigate the evolutionary relationships within the Cutthroat Trout species complex using 148 full mitochondrial genomes spread across their entire native range. Complete mitochondrial genomes are particularly useful for this purpose because they can be readily assembled from next-generation sequencing datasets and even recovered from historic and degraded specimens, allowing broad comparisons between extant and extinct lineages. Our results do not support that Coastal, Westslope, Lahontan, and Yellowstone Cutthroat Trout are substantially more distinct than Uncompahgre, San Juan, Greenback, Rio Grande, Yellowfin, Green River, or Bonneville Cutthroat Trout. Our analyses further highlight both ancient and recent diversity within the Cutthroat Trout species complex, while also illustrating complications that stem from attempting to draw a line in the sand.

The Removal of Kellogg Dam: How a Fish Passage Project grew into a Multi-beneficial Community Project

Professional

van Riessen, Amy; *North Clackamas Watersheds Council, amy@ncwatersheds.org*

The Kellogg Creek Restoration & Community Enhancement Project is led by a four-entity leadership team including the North Clackamas Watersheds Council (NCWC), American Rivers, the City of Milwaukie, and the Oregon Department of Transportation (ODOT). For decades there has been a grassroots movement to remove Kellogg Dam, a fish passage barrier that blocks anadromous fish access to the entire Kellogg-Mt. Scott watershed, a tributary to the Lower Willamette River. As various partners were brought to the table to discuss project feasibilty, the project objectives were expanded beyond fish passage to include habitat restoration, strengthening community access to nature, and updating public infrastructure. The project is located in an urban center, and is technically very challenging to design and implement. But the urban locale has also created amazing opportunities for river stewardship, community-driven science, and research partnerships. During this presentation, a member of the project design and leadership teams will share some of the challenges to successfully move this complex restoration project forward from conceptualization to design and permitting. They will discuss how the expansion of the project goals and creation of research opportunities has made them eligible for a wider range of funding sources and garnered broader public support. And lastly, they will highlight how pre-implementation research projects have supported the design and informed the future construction effort.

25 Years of collaboration. Building resiliency for Yellowstone Cutthroat Trout, Water Quality/Quantity, and Agricultural producers in the Teton River Basin

Professional

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Friends of the Teton River (FTR) is a nationally recognized leader in science and community-based watershed protection and restoration. FTR was founded in 2001 by a diverse group of stakeholders, including farmers, anglers, scientists, agency personnel, and conservations interests who were concerned by the declines in water quality and the Teton

River fishery. Using science as its foundation, FTR works closely with a diverse group of community members, local stakeholders, regional representatives, and state and federal agencies, to implement on-the-ground projects and programs. With little data available at the time of inception, FTR conducted a variety of rigorous studies and research to learn about this unique watershed. Today, our mission is to restore and conserve the Teton River Watershed, ensuring a lasting legacy of clean water, healthy streams, and a thriving wild fishery. We implement programs and projects founded on sound science, community education, and cooperation with landowners, citizens, and agency partners. Our vision is to be a model for watershed conservation that puts science into practice, celebrates a diverse culture of stewardship, and implements locally based solutions that support Teton Valley's economy, ecology, and the community.

Coho salmon life history strategies amid an unfolding invasion in Tierra del Fuego

Professional

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Tierra del Fuego (TDF) is located at the southern tip of South America, where 50% of freshwater fish diversity is represented by exotic salmonids and coho salmon (*Oncorhynchus kisutch*) constitutes the most recent invasion. Coho salmon juveniles were first recorded in 2019, and since then the species has successfully self-sustaining populations in 15 basins. This study aims to analyze the life history of coho salmon during the freshwater residence stage. Monthly field surveys were conducted over 18 months in five rivers draining into the Beagle Channel. Juveniles were captured using backpack electrofishing and measured for fork length and body weight. Spawn and hatch timing were predicted using underground water temperature data and observed emergence timing with the R package 'hatchR'. Freshwater growth was modeled using the Gompertz equation and population-specific relative weight (W_r) was calculated. In the Lapataia River, multiple spawning events were predicted, with embryonic development lasting 65-100 days and five emergence events observed between late winter to early summer. It showed the longest freshwater residence time (1.3 years) with a growth coefficient of 0.18 month-1 and an asymptotic fork length (FL∞) of 92.84 mm. This river showed low thermal variability and the highest winter mean temperature (3.9°C). In contrast, a longer embryonic development period (129 days) was estimated in the Varela River, where a single emergence event was observed in summer. In this river, the age at smolt was shorter (1.1 years), and the growth coefficient higher (0.44 months-1) with a FL∞ of 62.03 mm. The thermal range was wider (0.2-12.1°C) and the mean temperature during winter lower (0.8°C). Lapataia and Olivia were the only rivers with mean W_r values below 100. This ongoing invasion highlights coho salmon's capacity to adjust life history strategies with local adaptations during freshwater range expansion at high southern latitudes.

Aligning pre-season salmon forecasts with management risks and rewards

Professional

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Setting salmon and steelhead fisheries depends on forecasts of returning adult abundance. Forecast accuracy is important for sustainable fisheries. Overestimates may result in overharvest, whereas underestimates may unnecessarily restrict fishing opportunity. The aversion of managers to these outcomes is not necessarily equal. For instance, the

consequences of too low a forecast may be preferred over too high a forecast. Here, I propose using tools from decision analysis to evaluate pre-season forecasting methods. I show a straightforward framework for comparing forecast methods across varying scenarios of risk aversion and desired outcomes. With careful articulation of management priorities, this approach provides a transparent and reproducible method for incorporating risk preferences alongside predictive accuracy for evaluating forecast methods.

Genomic perspectives on history and movement of Yellowstone cutthroat trout across their range

Professional

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Yellowstone cutthroat trout are threatened throughout their range by hybridization, habitat alteration, and displacement by non-native species, and now occupy approximately 42% of their historic distribution. In addition to these pressures, there have been extensive human-mediated translocations across the subspecies range over the past century. However, the genetic consequences of these stocking efforts remain poorly understood. This information is critical for identifying appropriate broodstock sources and guiding repatriation and conservation strategies. We analyzed a densely sampled reduced-representation genomic dataset comprising more than 4,000 individuals from 200 populations. Using phylogenetic and ancestry-based approaches, we evaluated patterns of connectivity and relatedness across basins and regions. We detect strong signatures of historical biogeography alongside widespread evidence of extensive anthropogenic translocations. Although genetic homogenization is common, local ancestry is also often retained. Additionally, in populations representing human-mediated mixtures of Yellowstone cutthroat trout lineages, we find evidence that alleles associated with local adaptation can persist in the face of gene flow. Together, our results demonstrate how genomic data provide high-resolution insight into both deep historical processes and recent anthropogenic alterations, with strong potential to inform and guide conservation and management of this iconic subspecies.

Assessing long-term geomorphic change from large wood additions in an Intensively Monitored Watershed experiment

Student

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Natural wood regimes in many rivers have been disrupted by human development, leading to simplified, single-threaded, incised channels disconnected from their floodplains. Process-based restoration is increasingly used to restore wood-driven processes, particularly in the Pacific Northwest to support recovery of ESA-listed salmon and steelhead. Low-tech process-based restoration (LTPBR) was developed as a cost-effective alternative to conventional engineering approaches, avoiding extensive earth moving, heavy machinery, and additional riparian disturbance. However, geomorphic responses to LTPBR wood additions designed to mimic natural wood regimes remain largely unquantified. We present 15 years of habitat data from the Asotin Creek Intensively Monitored Watershed experiment evaluating post-assisted log structures (PALS) and large wood (LW) additions to improve steelhead production. Using an adaptive management framework, we installed 654 wood structures across 14 km (~2,500 pieces of LW), followed by eight years of maintenance that added ~4,000 additional pieces. High-resolution topographic surveys of six reaches (three treatment, three control) conducted in 2012–2017 and 2022–2023 were used for geomorphic change detection and geomorphic unit delineation. All treatment reaches shifted from balanced sediment budgets to net deposition

following implementation, whereas controls showed no consistent trend. Increased sediment storage corresponded with greater geomorphic heterogeneity as planar channel areas were converted to bars, riffles, and pools. A large wildfire and subsequent floods likely increased sediment supply and wood recruitment, amplifying long-term responses; however, deposition remained consistently greater in treatment reaches. Long-term monitoring indicates that LTPBR and maintenance enhanced wood regime function and geomorphic condition, though continued maintenance and time may be needed to achieve healthy, self-sustaining riverscape processes.

Patterns in Piscine Predator Diets Caught in Hydropower Dam Tailrace Areas on the Columbia River

Professional

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Anthropogenic activities in the Columbia River Basin have contributed to disruptions across a wide spectrum of natural ecosystems including aquatic habitats. Aquatic food webs in disturbed systems are inherently complex and dynamic. Hydropower dams impounded large sections of mainstem river areas in the Columbia River Basin, subsequently re-structuring core processes in aquatic habitats related to food webs and predator-prey dynamics. Understanding the ecological processes in this highly modified system, to generate management actions, is a complicated task compounded by changing physical conditions and the presence of non-native species. American Shad (*Alosa sapidissima*) were introduced on the West Coast of the United States in 1871 and have been recorded in the Columbia River Basin since 1876. Millions of adult shad migrate from the ocean to reproduce in the Columbia River Basin each year. Juvenile shad represent a potential significant prey source for piscine predators in the region yet little is know about the effect of juvenile shad in the diets of piscine predators. This study evaluates trends in the timing and quantity of juvenile shad in the digestive tracts of piscine predators caught adjacent to two hydropower dam powerhouse tailrace areas on the Columbia River from 2006 – 2024. The results demonstrate spatiotemporal variability in the timing and magnitude of juvenile shad in the digestive tracts of piscine predators and supports that prey availability in impounded areas of the Columbia River Basin are influenced by these non-native forage fish. Tracking the impacts of non-native prey contributions to the diet of piscine predators, that also prey on ESA listed salmon and steelhead, is essential to guide management actions aimed at mitigating anthropogenic disturbance in aquatic ecosystems and assist in recovering ESA listed salmon and steelhead in the Columbia River Basin.

Evaluating a Hybrid Capture Approach for Next Generation Sequencing of Salmon Viruses

Professional

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Viral pathogens pose a significant threat to salmonid aquaculture, yet detection and full-genome characterization for molecular epidemiology remains challenging for samples with low viral loads. To address this problem, we developed and evaluated a targeted hybrid capture (HC) next-generation sequencing (NGS) approach optimized for the enrichment of all known salmon viruses. This custom HC panel targets more than 9,000 publicly available sequences across 18 viral families, including all salmon viruses reportable to WOAH. Additionally, the panel was supplemented by unpublished salmon viral sequences derived from archived diagnostic case materials thereby expanding the known diversity of salmon viruses covered and strengthening the relevance of our custom HC panel relative to preexisting comprehensive viral HC panels.

Preliminary experiments have demonstrated the targeted HC approach greatly enhances recovery of complete viral sequences and reduces per-sample costs, particularly when compared to untargeted (unenriched) metagenomic sequencing approaches. Duplicate sequencing libraries with (enriched) and without (unenriched) HC treatment were built from RNA derived from salmon viral cultures (e.g., infectious hematopoietic necrosis virus) and sequenced on an Illumina NextSeq1000. The proportion of reads mapping back to viral genome in the HC (enriched) libraries was orders of magnitude greater than those from the untargeted (unenriched) libraries. Raw sequence data generated from our custom HC panel were then dropped into our automated bioinformatic pipeline to generate annotated salmon viral genome ready for downstream applications (e.g., genetic/phylogenetic analyses and/or submission to GenBank). Together, our HC panel and bioinformatic pipeline enhances the capacity for the rapid detection and genomic characterization of known and emerging salmon viruses, strengthening national aquatic animal health surveillance capacity.

Further evidence for the resilience of cutthroat trout to wildfire in Pacific Northwest headwater ecosystems

Professional

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Wildfires can be substantial and visually striking landscape disturbances with widespread forest mortality that can lead to shifts in the thermal, biogeochemical and ecological conditions. In the aquatic systems that drain through these burned forests, both light availability and temperature frequently increase after fire. It has been suggested that these temperature increases in headwater ecosystems can lead to declines in abundance or condition of coldwater fish due to increased metabolic activity. While theoretically sound, recent empirical studies from headwater ecosystems across Western Oregon have found limited support for this hypothesis in regard to cutthroat trout. Indeed, these studies have documented persistence and even increases in trout biomass in the first few years after wildfire. Mechanistically, resilience of trout to wildfire impacts has been attributed in part to increasing basal resources that promote production of aquatic macroinvertebrates, which in turn allows for greater consumption that compensates for increased bioenergetic costs of elevated temperatures. In this study, we quantified summer fish abundance and biomass as well as biofilm and macroinvertebrate biomass in three headwater streams from the central Oregon Cascade Mountains: two impacted by the 2023 Lookout wildfire fire and one in a nearby unimpacted stream. All three study streams are of similar size and were surveyed in an earlier 2014 study. In 2025, we resampled the same reaches within each stream. Given the time difference between pre-fire surveys and post-fire sampling, we focus here on relative changes in fish at impacted sites compared to the unimpacted site. We found fish biomass and condition increased after wildfire in impacted sites relative to the unimpacted site. The impacted sites also experienced a relative increases in macroinvertebrate biomass, providing support for the bottom-up food resource hypothesis as a mechanism for trout resilience.

From River to Insights: An End-to-End Fish Data System with PostgreSQL

Professional

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Washington Department of Fish and Wildlife (WDFW) collects field data on salmon and steelhead populations across diverse landscapes and in collaboration with numerous partners. The scale, variability, and complexity of this work have historically posed significant challenges

to centralized data management. To address these challenges, WDFW developed Fish Traps and Surveys (FTS)—a flexible, PostgreSQL-based data system supported by a web application and multiple field data collection tools. Designed to accommodate a wide range of study designs and monitoring approaches, FTS emphasizes adaptability, data integrity, and usability across programs. Adoption within the agency has been strong and continues to grow as more teams integrate their workflows into the system. This presentation will share key lessons learned from developing and implementing FTS, highlight successes and ongoing challenges, and outline WDFW's vision for expanding and refining the system to meet future monitoring and management needs.

Quantifying Road-Stream Crossing Barriers and Prioritization Challenges Across the Intermountain West

Student

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Road-stream crossings represent a pervasive form of stream fragmentation across the landscape, yet many of these structures remain unassessed in the Intermountain West, creating uncertainty in aquatic connectivity planning. This study inventoried road-stream crossings across Montana and Wyoming to evaluate their role as fish passage barriers and assess how uncertainty from unassessed structures affects connectivity prioritization efforts. We utilized the North Atlantic Aquatic Connectivity Collaborative (NACC) Rapid Assessment protocol to assess road-stream crossing structures and employed assumption-based and prediction methods to analyze how uncertainty introduced by unassessed barriers influences the NACC Prioritization Tool. Preliminary results reveal a high abundance of fords in Montana and Wyoming, which pose significant assessment challenges due to non-uniform construction methods. The proportion of significant severe barriers among assessed road-stream crossings was relatively low (~9%), with Montana exhibiting greater overall fragmentation of river systems than Wyoming. Analyses quantifying the effects of unassessed structures on prioritization outcomes are ongoing. This research will improve the accuracy of connectivity assessments and inform strategic barrier removal prioritization in the Intermountain West.

Developing a Fish Age Composition Database: Lessons Learned & Future Considerations

Professional

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Reliable estimates of age composition are an integral component of the technical management process in Pacific Salmon Commission fisheries management. These data are used in forecasting stock abundance, assessing freshwater fisheries' impacts, and estimating escapement to the spawning grounds by age. Scale analysis is the preferred method of estimating age composition of natural stocks of Pacific salmon. Each year, several biologists from different projects within the Oregon Department of Fish and Wildlife (ODFW) analyze thousands of lines of biological data from Fall Chinook Salmon monitoring. The data is generated from creel, mark/recapture, trap, and spawning ground surveys. The data stretch back 30 plus years and cover all major coastal basins in Oregon. The challenges are that the data are vast and diffuse; the data are housed within a mixture of Access databases and hundreds of electronic spreadsheets. In 2016, ODFW set out to create and use a centralized, relational database housing all of the biological data from coastal Chinook Salmon monitoring

from the West Region. The following presentation covers the objectives of the project, as well as lessons learned and future considerations.

The influence of genome structure on hybridization between native and introduced trout species in the Kootenai River Basin

Student

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Hybridization with nonnative species can lead to adverse consequences such as the genomic extinction of native species. For over 50 years, hybridization between Rainbow Trout *Oncorhynchus mykiss* (RBT) and Westslope Cutthroat Trout *O. lewisi* (WCT) has been a major concern for the persistence of native populations of both species in their native ranges. Much work toward understanding this issue has focused on the influence of environmental conditions in facilitating resistance to or expansion of hybrid swarm formation. Furthermore, it has been long established that RBT×WCT hybrids are generally viable. Because of this, the role of genetic incompatibilities has been underexplored in hybridization dynamics. We used genomic data from the Kootenai River Basin, Montana to describe patterns of admixture across space and across the genome in native Redband Trout *O. m. gairdneri* (IRT), WCT, and their hybrids with invasive Coastal Rainbow Trout *O. m. spp.* (CRT). We found that most hybridization occurs between IRT and CRT and that this is likely mediated by a large inversion complex on chromosome 5 (Chr05). Furthermore, we found that some Chr05 genotypes found in introduced CRT are likely incompatible with WCT, leading to variability in hybridization outcomes. While selection likely occurs against these incompatible hybrids, intraspecific introgression into native IRT populations can help overcome this and facilitate the formation of multispecies hybrid swarms. These data strongly suggest that genomic architecture may play a strong—and previously unrecognized—role in hybridization dynamics between these species. Clearly, additional work is required to understand the role of genome architecture and genetic incompatibilities in driving hybridization dynamics beyond the Kootenai.

Just Keep Swimming: Outmigration Survival of Upper Klamath Basin Juvenile Chinook Salmon

Professional

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The removal of four impassable hydroelectric dams on the Klamath River is providing salmonids with the opportunity to return to their historic range within the upper Klamath River watershed. Successfully reestablishing salmon populations in the upper Klamath River basin requires juvenile salmon born in upper tributaries located in Oregon be able to outmigrate through the upper sections of the river. The Klamath River, immediately downstream of Upper Klamath Lake, poses several potential challenges for outmigrating juveniles, including two flow-control dams that are not scheduled for removal (Link River and Keno dams), major water diversions, and water quality concerns. We used experimental releases of radio-tagged juvenile Chinook salmon to evaluate outmigration survival through this reach, from the outlet of Upper Klamath Lake at Link River Dam downstream through Keno dam to JC Boyle Reservoir. Tagged juvenile Chinook were able to pass downstream through both dams. The estimated survival rate for downstream migrants was lowest in the reach immediately below Link River dam. Water temperature and flow were measured to determine if there were environmental effects on movement rates and survival of second year fish, of which there were mixed results.

Beyond the Pebble Count: A Remote Sensing Method for High-Resolution Mapping of Grain Size and Salmon Spawning Habitat at the River Scale

Professional

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River-bed grain size is a fundamental driver of channel morphology and aquatic habitats, yet high-resolution mapping of submerged grain size across large spatial extents has remained a challenge in aquatic science. This study demonstrates a novel approach that pairs bathymetric lidar point clouds with georeferenced pebble counts to quantify median and 84th percentile grain size (D50 and D84, respectively) at 1 m² resolution across 260 km of diverse river corridors in Oregon's Santiam River Basin. Maps of grain size were then used to estimate the amount of suitable spawning areas for Spring Chinook salmon throughout the basin. By moving from site-specific measurements to continuous, river-scale characterizations, this approach provides a framework for data informed adult salmon outplanting strategies, restoration prioritization, and habitat management decisions.

Evaluating patterns of spatiotemporal microbial decomposition before and after a wildfire, Lookout Creek Basin, Oregon

Student

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Wildfire is a defining disturbance in river networks of the Pacific Northwest, altering physical structure, organic matter inputs, and the microbial processes that underpin ecosystem function. However, interpretations of post-fire recovery depend strongly on perspective, including the spatial scale examined, the habitat considered, the temporal window of observation, and access to true pre-fire data. I evaluated how wildfire effects on microbial decomposition vary across aquatic and riparian habitats, elevation gradients, seasonal temperature regimes, years since fire and burn severity within the Lookout Creek Watershed of the H.J. Andrews Experimental Forest following the 2023 Lookout Fire. Using standardized cotton strip assays, I quantified microbial decomposition rates across burned and unburned stream and riparian sites spanning multiple elevations and burn severities and compared post-fire responses to experimentally measured pre-fire benchmarks. To disentangle field-based variability from temperature-driven effects, I paired field measurements with controlled laboratory incubations simulating winter thermal conditions. Together, these complementary approaches reveal how fire-altered environments mediate microbial activity across space and time. Preliminary data showed that decomposition responses varied by habitat and scale, with riparian and aquatic systems exhibiting distinct sensitivities to burn severity and temperature. In some cases, post-fire decomposition rates approached or exceeded pre-fire levels, highlighting ecosystem transformation rather than a simple return to prior conditions. By focusing on microbial processes at the base of aquatic and riparian food webs, this work improves our ability to anticipate broader ecosystem trajectories following wildfire and underscores the value of integrating multiple spatial and temporal perspectives to inform management in fire-disturbed landscapes.

Parallel lives: What contrasting hatchery and wild fish life cycles reveals about conservation and management

Professional

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Hatchery and wild fish populations share river systems, ocean migrations, and conservation challenges, yet research often advances along separate paths. A comparative view of hatchery and wild fish life cycles highlight how integrating ecological, physiological, and behavioral perspectives can improve outcomes for both. This talk uses examples on Pacific salmonids to illustrate how examining parallel life stages (spawning, incubation, early rearing, imprinting, migration, and survival) reveals where hatchery and wild fish diverge and how knowledge from each domain can inform the other. Across multiple species, OSU and other researchers have explored how early developmental environments shape later-life performance, including domestication selection, mate-choice behaviors, and the physiological and genetic mechanisms underlying olfactory imprinting. These studies, designed with direct input from state, tribal, academic, and hatchery partners, show that traits expressed in the hatchery can profoundly influence post-release behavior, straying, habitat use, and productivity in natural systems. At the same time, ecological research on habitat variability, climate-driven flow and temperature regimes, and predator-prey interactions has informed new hypotheses about how to design rearing environments, modify release strategies, and align hatchery practices with wild fish population dynamics. By interpreting these results through the lens of matched life-cycle stages, we highlight practical opportunities for integration: co-produced research on imprinting and migration, shared datasets linking rearing conditions to adult returns, collaborative experiments on diversified release timing, and emerging work on epigenetic responses to environmental change. Together, these efforts demonstrate how research across multiple disciplines can reduce blind spots and generate actionable insights that neither hatchery nor ecological communities could achieve alone.

From basin to network: RiverLabs as a national model for collaborative, place based water science

Professional

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River management challenges in the Deschutes River Basin echo a broader national need to address water conservation issues shaped by ecological complexity, complex governance, and increasingly urgent climatic pressures. Across the country, practitioners are being asked not only to generate new science, but to do so in ways that honor diverse knowledge systems, build durable relationships, and translate insights into action. Here, we outline the emerging RiverLabs model: a scalable, place-based framework for collaborative water research, education, and engagement that is being piloted in the Deschutes and designed for transfer to other watersheds nationally. RiverLabs function as real-world learning sites where researchers, students, tribes, agencies, and community partners jointly test ideas, generate shared data, and co-produce solutions. Drawing from work underway in the Deschutes River and parallel efforts in the Suwannee River (Florida) and Poudre River (Colorado), we describe a model for how place-based laboratories could create consistent structures for comparative learning and relationship building. These examples highlight our efforts in building on principles of collaborative practice: transparency, shared goal-setting, responsiveness, and adaptive management. By synthesizing lessons across these basins, this talk will introduce the conceptual foundations of a national network of RiverLabs that supports interdisciplinary training, strengthens community-engaged science, and helps practitioners navigate the complexities of modern river management. The Deschutes RiverLab is one site in what could become a connected, multi-basin system for learning, experimentation, and collective problem solving.

The relationship between recovery criteria and recovery monitoring can lead to a match/mismatch conundrum for listing decisions: Just consider Bull Trout

Professional

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The listing of a population under the Endangered Species Act (ESA) may lead to the development of a recovery plan with specific legal requirements. The most useful recovery plans generally include criteria by which to assess population recovery as well as monitoring plans to guide evaluations of whether criteria are achieved. Monitoring plans associated with recovery often focus on traditional ecological characteristics such as population abundance, trends in abundance, distribution, and connectivity. However, recovery plans and their criteria are increasingly being focused on the reduction of threats. Monitoring plans that are focused on ecological characteristics are, at least in part, a logical mismatch with recovery plans that have threats-based recovery criteria. For example, Bull Trout in the U.S. are currently listed as threatened under the ESA. The recovery plan for Bull Trout and the criteria within call for 75-100% of the primary threats to their persistence to be managed effectively. Yet, mismatched with these criteria, monitoring plans to inform the recovery status of Bull Trout have generally focused on traditional ecological characteristics. Despite the prevalence of these types of monitoring plans for Bull Trout, there are instructive examples in which an explicit evaluation of threats did match with recovery criteria and, in turn, was used to inform ESA status assessments. For species such as Bull Trout, the most useful monitoring plan for assessing recovery status would guide explicit and quantitative evaluations of threat scope and severity, determine how effectively threats are being mitigated, and match with the criteria for recovery.

Monitoring prespawn mortality of spring Chinook salmon in the Upper Willamette River

Professional

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Prespawn mortality has been monitored in spring Chinook populations in the Upper Willamette River (North Santiam, South Santiam, McKenzie, and Middle Fork Willamette) since the early 2000's. These populations are listed as threatened under the Endangered Species Act. Losing adult salmon before they can spawn successfully can limit productivity and recovery of these runs. Female carcasses recovered during spawning ground surveys were examined for the presence eggs. The percentage of female carcasses that still had all of their eggs is used to estimate prespawn mortality within a spawning population. Within the different tributaries prespawn mortality can range as high as 80-90% of spawners. Temperature exposure during adult migration and holding before spawning is the main cause. Developing strategies to reduce prespawn mortality will allow these populations to be more resilient. These monitoring data provide important context for understanding mechanisms causing prepsawn mortality and effects on the spawning populations.

Advancing Data Integration Through Coordinated Assessments

Professional

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Effective natural resource management depends on the ability to integrate, share, and apply data across jurisdictions, agencies, and geographies. The Coordinated Assessments

Partnership (CAP) initiative brings together state, tribal, and federal partners to standardize priority salmon and steelhead population metrics and make them accessible for regional decision making. This talk will provide an overview of recent progress implementing the CAP strategic plan, highlighting how shared data standards, streamlined workflows, and collaborative exchange are improving the availability and usability of regional information across the Pacific Northwest. Using examples from the Columbia River Basin and cross border data partnerships, the presentation will illustrate how coordinated data products support recovery planning and program accountability. Key lessons from more than a decade of collaborative data management will be discussed, including approaches to building trust across organizations, sustaining long term partnerships, and adapting to emerging data needs. The session will conclude with a look ahead to next phase strategic priorities—modernizing infrastructure, integrating new data categories, and expanding the network of contributing partners—to ensure that coordinated data continues to meet the region's evolving science and policy requirements.

The Essential Role of Independent Science in identifying critical management actions for salmon and steelhead recovery in the Columbia River Basin

Professional

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Independent scientific review was initiated in the Columbia River basin in 1989 with the formation of the Scientific Review Group (SRG), to assist regional fisheries managers and administrators by providing independent review of issues critical to management of declining salmon and steelhead populations. Coincident with the initiation of independent scientific review in the basin, was the 1991 publication in Fisheries of "Pacific Salmon at the Crossroads: Stocks at Risk from California, Oregon, Idaho and Washington" by Willa Nehlsen, Jack Williams, and the late Jim Lichatowich. They identified 214 remaining native salmon and steelhead stocks facing high or moderate risk of extinction and the loss of more than 106 major populations on the West Coast. Their paper concluded with a call for regional actions needed to sustain the remaining wild stocks and included recommendations for recovery actions at both short-term and long-term scales. Recommendations in the paper were insightful and helped inform subsequent review work over the next several decades. The SRG's successor review groups (ISG, ISAB, ISRP), continue to provide independent scientific review of critical uncertainties in regional salmon recovery efforts, technical review of specific projects and programs, and recommendations for improved science-based management and recovery actions. Critical issues and themes raised in the Salmon at the Crossroads paper have been validated and expanded by the independent science groups over the 37 years since independent review was initiated through the group's writings, presentations, and publications, both collectively and as individual scientists. Major themes and recent restoration efforts continue to emphasize the important linkage between salmon, their habitat template, life history diversity and resilience, particularly when access to historical spawning habitats are restored as recently demonstrated in the Elwha and Klamath River basins.

What does success look like? A vision for restoring salmon populations in California and throughout their range

Professional

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The focus of the presentation will be presenting a framework to understand extinction risk of Pacific salmon and steelhead that forms the foundation of recovery, conservation, and

management of anadromous salmonids and their habitat in California and throughout their range. Following ESA-listings of Pacific salmonid throughout nearly all California coastal basins, communities reliant on salmon and steelhead seek successful restoration of fish populations. However, defining restoration success remains a critical question for fisheries, Tribal communities, agencies, communities supporting fisheries, and other stakeholders and user groups. Does success constitute a specific numerical target of fish, a certain level of fishing opportunities, or a resilient baseline fish abundance capable of offering a range of user opportunities? The focus is on a conceptual framework for determining the successful reduction of extinction risk for salmon and steelhead populations in California and elsewhere. In addition, a framework for monitoring programs that sequences activities appropriate for each population or groups of populations, diversity stratum, and ESU/DPS is proposed, mostly contingent on where each population, diversity stratum, or ESU/DPS is in terms of viability and broadscale recovery.

Conservation Genetics of White Sturgeon (*Acipenser transmontanus*) in the Columbia River

Professional

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White sturgeon are the largest freshwater fish in North America. The largest reproducing population, in the Columbia River Basin, is fragmented by hydroelectric dams, and exhibits segments characterized by declining abundance. Conservation aquaculture using natural-origin (NOR) broodstock is being applied for fisheries recovery in reaches with persistent recruitment failure, but concerns remain about the impacts to natural populations through potential for reduced effective population size and genetic diversity (Ryman-Laikre effects) as well as introduction of spontaneous autopolyploids. To understand the opportunities and constraints of supplementation, we estimated the total number of breeders, inbreeding effective number of breeders, and genetic diversity of NOR young-of-year (YOY) cohorts from the lower Columbia reaches, as well as across sequential addition of hatchery-origin (HOR) cohorts in the heavily hatchery-supplemented reaches of the middle Columbia. In addition, we simulated cohorts of outplanted hatchery offspring, incorporating several parameters that are expected to affect the realized effective number of breeders and genetic diversity. Finally, we estimated the frequency of ploidy variants in NOR adult and YOY samples and across early life stages for HOR samples. Results suggest that, except in notable cases, natural origin cohorts represent a high proportion of unique breeders. Moreover, while there appears to be potential for greater Ryman-Laikre effects from hatchery supplementation when the dynamics of supplementation are highly variable, controlling several parameters can help maintain an adequate number of breeders to reduce the long-term effects on genetic diversity. Results also indicate that spontaneous autopolyploidy (SA) variants are rare among natural-origin individuals, and lower survival of SA variants in early life stages, along with efforts to limit SA in the hatchery, reduce the impact of SA in supplemented populations.

From Assessment to Implementation: Leveraging Perspective to Prioritize and Advance Climate Resilient Design in California's Salmonid Hatchery System

Professional

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Following a comprehensive climate change resilience assessment of 21 California Department of Fish and Wildlife (CDFW) hatcheries, the program has moved from assessment to implementation. Phase 1 identified infrastructure vulnerabilities from increasing air and water

temperatures, hydrologic variability, and production constraints. While site-specific risks vary, all facilities depend on a declining cold-water supply for salmonid rearing. The assessment identified long-term improvements and investments needed to sustain production under projected climate conditions. A multi-criteria prioritization framework was developed to identify facilities most susceptible to near-term impacts and most critical to the statewide hatchery system. Criteria included infrastructure condition, climate impacts, water supply reliability, power limitations, production capacity, mitigation obligations, biosecurity, and cost. Quantitative scoring and qualitative considerations were used to establish an objective ranking to target improvements with the greatest benefit to CDFW's overall climate resiliency strategy. Seven hatcheries advanced to Phase 2, including preparation of plans and specifications for resiliency upgrades. By March 2026, designs will reach the 60% milestone. Current efforts focus on water supply redundancy, hydraulic conveyance modifications, thermal management, and partial recirculating aquaculture systems (PRAS) to reduce water demand while providing flexibility. Design is being developed in 3D building information models (BIM) to support interdisciplinary coordination, constructability review, and stakeholder visualization. With the power of perspective provided by the prioritization process and multidisciplinary contributors, this presentation will discuss the development of hatchery improvements to address water supply, biosecurity, temperature management, and water demand, while meeting CDFW's production and mitigation goals and improving operational flexibility.

Native fish conservation and management through Washington State's Aquatic Biodiversity Study

Professional

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Understanding the distribution of aquatic organisms is fundamental to understanding their ecology and effectively managing species; however, geographic distribution data for many of Washington's non-game freshwater fish and shellfish remain incomplete. Environmental DNA (eDNA) analysis enables broad-scale sampling of species distributions within a relatively short time frame. Metabarcoding uses a similar collection approach but applies conserved primers shared across multiple taxa to detect entire species assemblages from a single sample. Predictive occupancy modeling extends inference to larger, unsampled geographic areas and produces spatially explicit estimates of occurrence. Together, these tools allow visualization and comparison of multi-species occupancy without requiring individual surveys for each species of interest, enhancing the ability of a single effort to provide a more holistic view of aquatic ecosystems. In 2023, in response to declining biodiversity driven by habitat loss and degradation, non-native species, disease, and climate change, the Washington Department of Fish and Wildlife (WDFW) received legislative funding to advance biodiversity efforts for underrepresented non-game species. This investment supports characterization of aquatic biodiversity across Washington, including species distributions, relative abundance, and habitat associations for native freshwater fish and shellfish. In Phase I of the Aquatic Biodiversity Study, we are collecting eDNA metabarcoding data to inform multi-species occupancy models (MSOMs). These models provide managers with accessible, spatially explicit occupancy estimates and support the inclusion of diverse aquatic taxa in restoration planning and in-water project review. Using examples from MSOM outputs across multiple Washington basins, we demonstrate the implementation of this approach and outline priorities for future phases of the work.

No data, no trouble; using decision science sensitivity analyses to make informed management decisions to support fish migration in data-poor systems

Professional

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Establishing safe passage for migratory fish through water diversion facilities is often a priority for resource managers. Mitigation measures to reduce impacts of water diversions on migratory populations are often species and river specific and are often based on ad-hoc or trial and error. Modelling-based approaches to decision-making can significantly reduce cost and time to achieve successful mitigation, but managers are often reticent to adopt a modelling approach due to concerns over lack of data. However, modelling approaches that have built-in capacity to evaluate assumptions through a range of uncertainty through sensitivity analyses can allow decision-makers to assess both the degree of parameter uncertainty due to lack of data and how the inherent uncertainty affects alternative management decisions. These modeling approaches can also highlight where future research effort and dollars are best spent, or whether implementing the decision immediately has the largest payoffs for the output of interest, typically survival. Here, we explore such an approach by combining disparate and varying quality data on steelhead (Oncorhynchus mykiss) smolt migration and hydraulic modelling data. We illustrate that a perceived lack of data does not preclude using the best available science combined with assumptions based on expertise, or even hand-wavy guesses to make informed decisions. We determined that in a southern California watershed, with a few good studies on smolt migration integrated with a larger distribution of missing or poor-quality data, one would make the same decision, regardless of the uncertainty in parameters. This provides the risk-averse manager with a method to make quick, low-risk decisions that benefit the resource in question.

A Tool for Prioritizing Gravel Augmentation Reaches for Sediment Starved Rivers

Professional

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Gravel augmentation is a widely used restoration technique used to improve habitat below dams including salmonid spawning habitat. However, gravel augmentation can be cost-prohibitive, and it is often unclear which stream segments have the highest potential to benefit spawning salmonids. A tool to help prioritize reaches for gravel restoration could aid managers in making good decisions. To address this need, we convened a group of fishery managers to create Intrinsic Potential (IP) habitat models. We used stream attributes related to salmonid spawning habitat: elevation, width, and gradient, from the synthetic stream channel dataset NetMap. We then used the IP models to develop a flexible tool for identifying high spring-run Chinook Salmon (*Oncorhynchus tshawytscha*) IP along ~100 m reaches based on a conceptual model developed by the fishery managers. The tool allows for the inclusion of winter steelhead (*O. mykiss*) IP spawning habitat and allows users to incorporate mean August stream temperature maxima under recent conditions and projected under future climate change, land ownership (public or private or both), reach access distance, distance to and type of gravel sources, and relative gravel movement potential. We demonstrate three strategies for the Upper Rogue River basin, Oregon, USA: 1) Spring Chinook Salmon Strategy, 2) Co-occurrence with Winter steelhead Strategy, and 3) Climate Change Strategy. We demonstrate that altering management priorities influences which stream reaches are identified for gravel augmentation. In the three strategies we compared, a small number of current conservation reaches located downstream of spring Chinook Salmon spawning were identified using the tool. In addition, we identified a small number of reaches with no conservation strategy for winter steelhead spawning that meet

prioritization criteria. Furthermore, under a climate change scenario, new gravel source permitting could expand the set of viable augmentation reaches.

Enhancing Field-Based Fish Injury Assessments Using AI-Driven Image Analysis

Professional

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Fish passage studies are critical for evaluating the effects of hydropower infrastructure on juvenile salmonid injury and survival, and for informing the design of effective fish passage facilities. A field-based injury and survival assessment of balloon-tagged juvenile Coho salmon (Oncorhynchus kisutch) was conducted at Howard A. Hanson Dam (HAHD), a flood risk management dam located on the Green River, Washington State. Fish were recollected and recovered following dam passage. Injuries were evaluated with established manual injury assessment protocols, providing baseline biological information on the impacts of dam passage used to inform the design of a new fish passage facility. Building on this field study, a proof-of-concept approach for automated fish injury assessments was developed using images collected during manual field assessments. These traditional methods rely on anesthesia and subjective visual assessment, which can introduce human bias, inconsistency, and additional stress to fish. To address these limitations, AI-driven image analysis was applied using convolutional neural networks (ResNet architectures) and custom Vision Transformer models to classify fish injuries from images. Model development incorporated balanced datasets and data augmentation techniques to improve robustness and reduce overfitting. Together, these efforts demonstrate how conventional field-based injury assessments can be improved with AI-image analysis to standardize and scale fish injury assessments while reducing stress to fish. This integrated approach supports more efficient biological monitoring and provides a foundation for future non-invasive assessment tools capable of informing hydropower design, operation, and regulatory decision-making.