ABSTRACTS

Better Together - Celebrating 60 years of partnerships, collaboration, and teamwork

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Oral Presentations

Session: Beavers and Restoration

The Castor conundrum: Implications for beaver related restoration

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Beaver-related restoration has quickly gained popularity in the past decade because it is often described as a novel and cost-effective strategy for promoting aquatic habitat restoration for listed salmonid species, and more recently, mitigating the effects of climate change. Despite growing support to integrate beaver into conservation planning, data regarding their population ecology is limited and the implementation of using beaver as a management tool is far outpacing research. A common misconception in promoting beaver populations is that an increase in beaver abundance leads to an increase in beaver dams, with concomitant ecological benefits. Yet, not all beavers build dams because dam construction is a facultative response that can vary due to several factors. Taken in combination, these challenges can lead to misdirected management actions that result in a greater likelihood of not meeting expected restoration outcomes. This presentation will cover some of the common misconceptions, inconvenient truths, and unforeseen consequences that should be considered when pursuing measures intended to bolster beaver activity in dynamic aquatic systems. Providing this crucial context will allow managers to decide on the appropriate actions to best manage watersheds that include beaver while maximizing their potential benefits.

BeaverHOODs: A Conceptual Model Guiding Restoration to Address Factors Limiting Beaver Management of Floodplains on Creeks in Eastern Oregon.

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A riparian restoration project which aspires to involve, or benefit beavers and/or their habitat in any way, is hampered from the start unless it explicitly considers the “beavers point of view,” including the beaver’s capabilities/needs and the external physical, hydrological, biological, and cultural factors limiting beavers’ ability to manage a given riverscape. BeaverHOODS (Beaver Habitat Opportunity Optimization Delineation Strategy) is a conceptual model that addresses this need by helping a restoration practitioner look at the landscape “through a beaver’s eyes” and incorporate this information into a restoration design, and expectations, in an intentional and strategic way. It helps focus planning at both the reach and watershed scale, by providing a line of inquiry and some customizable “rules of thumb” to help understand what factors are limiting beavers’ ability to manage riparian habitat for their own benefit, over multiple generations: rather than just occasionally “survive”. Based on over a decade of collaborative observations and implementation experience throughout eastern Oregon, BeaverHOODS evolved from the need to be able to stand on a stream bank and answer such basic questions

as: “Is this an appropriate location to work?” and if so, “What do I do here?”. And “how much do I do? Where do I do it? What don’t I need to do?” And “when am I done?” BeaverHOODS also provides food for thought regarding the interpretation of beaver sign; as well as the actual utility of conducting “beaver relocation”.

ODFW Beaver Updates: Action Plan, Private Forest Accord, and HB 3464

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Recent developments in the management of Oregon’s state mammal, the American Beaver (Castor canadensis), include: Oregon Department of Fish and Wildlife’s (ODFW) 3-Year Action Plan for Beaver-Modified Landscapes (2023), Oregon’s Private Forest Accord (2021), and House Bill 3464 - Relating to protecting beavers to mitigate climate change effects (2023). Collectively, these initiatives recognize the ecological benefits beavers provide to Oregon’s riverscape habitats and native fish and wildlife. This presentation will provide an update on these statewide initiatives and ODFW’s role in reducing human-beaver conflict through coexistence strategies; advancing site-appropriate, beaver habitat and modified-habitat restoration in coordination with knowledge partners and landowners; and providing tools and shared-information for beaver-related management and restoration.

BEAVER AND FISH PASSAGE CONSIDERATIONS

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This presentation will provide information on when Oregon Department of Fish and Wildlife’s (ODFW) fish passage authorization is required for instream beaver conflict resolution and habitat restoration actions, including but not limited to, beaver dam analogues, vertical post structures, post assisted log structures, pond levelers, exclusionary fencing, and artificial beaver dams. ODFW administers and enforces the state's fish passage rules and regulations. This presentation will provide an overview and summary of the fish passage rules and permitting procedures that apply to beaver conflict resolution and habitat restoration actions. Greg Apke, ODFW's Fish Passage Program Manager, will drill into the weeds for those planning, designing and implementing prospective beaver conflict resolution and habitat restoration actions projects that intersect fish passage in Oregon.

Monitoring Steelhead Response to Beavers and Bass in Thirtymile Creek, Oregon

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Thirtymile Creek is a tributary of the Lower Mainstem John Day River that supports a critical population of wild summer steelhead. A collaborative working group fostered by an Oregon Watershed Enhancement Board Focused Investment Partnership grant has created the possibility of achieving nearly catchment-wide beaver-based restoration. The goal of this work is to create quantitative improvements in the abundance and productivity of juvenile summer steelhead. This talk will summarize the seven years of steelhead monitoring data that have been collected thus far, outline current and future beaver-

based restoration designs, and describe the framework for future project evaluation and adaptive management as we move toward catchment scale beaver based restoration in this unique stream.

Session: Evaluating Habitat Conditions

Geospatial Analysis and Modeling of Stream Temperature and Fish Habitat in the Clackamas River Basin Project

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A basin-wide, stream temperature data gathering, geospatial network analysis of stream temperatures incorporating 15 covariates with salmonid-related parameters map overlays (thermal tolerance, distribution and High Intrinsic Potential) project is currently underway within the Clackamas River basin. This project is being performed by a consortium of public and private entities, including Portland State University (PSU), the Oregon Department of Fish & Wildlife (ODFW) and the Clackamas River Basin Council. The answers to two research questions are goals of this study: 1) Which combination of variables best explains spatial variation in stream temperature across the basin and at what scales, and 2) Can spatial modeling provide insights into the watershed's thermal regimes and inform future monitoring and habitat restoration strategies? To answer these questions, PSU is analyzing data pertinent for present day representations of stream temperatures and will estimate future stream temperature conditions employing IPCC-projected climate change scenarios (for the 2050s and 2080s). This project incorporates stream temperature data acquisition efforts within the basin at over 100 selected sampling locations utilizing currently operating and historic data loggers from 2021 through 2023. Additional historic data is being incorporated into the analysis.

The PSU data will also be utilized by ODFW to produce a series of multiparameter maps indicating thermal tolerances of salmonids, distribution of anadromy, and areas of High Intrinsic Potential. A project of this magnitude and level of accuracy, while also capturing the 2021 "heat dome" anomaly has never been undertaken within this basin. Results, coupled with the ODFW findings, will identify where fish habitat restoration and protection activities are most likely to succeed within the basin."

Variable stream temperature responses to riparian alternative buffer configurations across Oregon's Coast Range

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Stream temperature is a key factor for many ecological processes in streams, and limiting summer thermal increases is an important stream management goal. Contemporary forest practices require retention of riparian trees during harvest to maintain stream temperatures by maintaining low light conditions over stream channels. However, low light availability has been shown to limit primary production in headwater streams, potentially constraining upper trophic levels through bottom-up pathways. Groundwater discharge areas can provide cold water refugia in the summer. Variable retention buffers that allocate wider buffers at groundwater discharge areas in exchange for narrower

buffers elsewhere could potentially provide cold water protection while simultaneously increasing heterogeneity of stream light. Similarly, creating gaps in riparian buffers may also enhance light in patches while maintaining shade elsewhere. To understand relative responses of temperature to increasing light we explored riparian alternative buffer configurations in a large-scale before-after-control-impact experiment. We established 6 replicate blocks that each included an un-cut reference and four riparian alternative buffer designs (current practice, fixed width, variable retention, gaps). All sites were well shaded prior to treatment (shade > 85%). Shade responses to treatment ranged from a 5.7% increase (reference) to > 30% decrease with temperature changes from -0.98°C to +3.4°C. Reductions in shade were associated with increases in stream temperature. Post-treatment temperatures were elevated in alternative treatments relative to un-cut reference sites, but responses were highly variable within treatments. In contrast to our expectations, enhanced protection of groundwater discharge areas in our variable retention treatment did not consistently maintain pre-treatment temperatures and often increases were observed in the first post-treatment year. The magnitude of these responses was likely affected by blowdown associated with an ice storm, slash, or drier climatic conditions post-treatment. Continued post-harvest monitoring will assist in understanding multi-year stream temperature responses to alternative riparian treatments.

Swimming upriver: developing a coordinated approach to monitoring Oregon's thermal-scape and better supporting native fish species in a warming climate.

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Water temperature influences a wide range of biological responses from species phenology (e.g., emergence, migration) and growth, to community composition. Measuring water temperature has become increasingly relevant as a changing climate is already displacing native species and disrupting their ecology and survival in Oregon. The Oregon Department of Fish and Wildlife (ODFW) currently lacks sufficient data to describe water temperature over time and space, and this compromises our ability to quantify the associated threats to Oregon's native fish species now and into the future. We developed a plan that outlines an approach to water temperature research and monitoring that we hope will better inform fish, wildlife, and habitat management decisions and better support our native species. The plan includes four strategies: (1) continuous monitoring of the Oregon thermal-scape which includes broad and fine scale monitoring and the identification of cold water sources and patches, (2) the identification of species thermal tolerance thresholds, (3) forecasting future water temperatures, and (4) improving the integration of temperature and flow into models and decision frameworks. This work will be implemented best within a collaborative environment, using multiple tools, approaches, and funding. Our goal is to take a coordinated and thoughtful approach to water temperature monitoring to reduce costs, leverage additional value from individual efforts, ensure complementary, not duplicative efforts, and avoid inappropriate inference where it affects management actions.

Restoring Streams with Large Wood: An Analysis of Geomorphic Changes 7 Years Post-Restoration in Streams of Differing Size

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Large wood (LW) restoration is a popular strategy to improve habitat conditions such as deep pools, spawning gravel bars, and structural geomorphic complexity that benefit numerous fish species. While monitoring often focuses on long-term or short-term instream changes post-LW restoration, there's a knowledge gap regarding annual geomorphic changes over multiple years. In this study, we examined annual geomorphic adjustments (channel form and grain size) over seven years in three tributaries in the Mill Creek network (Oregon, USA). The data included cross-section surveys and surface pebble counts collected between 2014 (one-year pre-LW introductions) to 2021 (6-years post-LW introductions). We quantified cross-sectional scour and deposition and used pebble count data to assess sediment size percentiles and gradation coefficients. Our analysis revealed that stream size influenced geomorphic adjustment, with smaller streams experiencing increased scouring compared to larger streams over the 6 years. At the cross-section scale, the location of LW structures promoted increased scouring. Indeed, we found a strong relationship between the ratio of log jam volume to channel volume (LJ-C) and scour across all three sites. LJ-C ratios between 35 and 50% were associated with the most significant changes in scouring, while LJ-C values above 50% or LJ-C below 35% were correlated to low scour. Sediment size dynamics were more influenced by time since the restoration than by proximity to the LW jams. As such, the gradation coefficient decreases 5-6 years post-restoration in all sites. Our results provide insights into the long-term persistence and magnitude of instream changes associated with LW introductions in diverse stream systems, intending to inform and improve future restoration efforts.

Quantifying and defining habitat suitability at multiple scales for Oregon Coast juvenile salmonids

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Pacific salmon and steelhead are economically, ecologically, and culturally significant. They offer ecosystem services through marine derived nutrients and as a reliable food source to terrestrial vertebrates. Most Pacific salmon species exhibit some degree of anadromy, experiencing freshwater, estuary, and marine environments as part of their life cycle, and are consequently exposed to stressors in a variety of complex ways. The ways in which individuals interact with these environments, as well as the habitat requirements within each environment, are often dependent on the species of salmonid and their specific life history. Juvenile rearing is a sensitive time, making rearing habitat particularly important to understand. Scale also plays a fundamental role in ecology, and understanding the role of spatial and temporal scale in habitat suitability for juvenile Oncorhynchus mykiss and Oncorhynchus kisutch will be integral to informing conservation and management. In this research I will examine the environmental variables which define suitable habitat for co-occurring juvenile O. mykiss and O. kisutch in abundance and habitat preference. I will also compare the questions which can be answered about Oregon Coast rearing habitat using in stream data, and which variables collected on the ground can be replaced by remote sensing and process-based models. These objectives will be addressed through 1) multivariate statistical analysis of environmental variables and species abundances, 2) a random forest model selection procedure, and 3) development of techniques using remotely sensed data to model fluvial geomorphology and large wood recruitment potential. I found discernable patterns in habitat partitioning, with distinct selection of habitat variables between species. When estimating instream variables using light detection and ranging (LiDAR), I had the greatest confidence in predicting gradient as well as a range of width measurements.

Climate Change affects Non-Native Northern Pike and Smallmouth Bass Habitats in Western North America: Implications for Native Salmon

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The Pacific Northwest region (PNW) is renowned for its rich biodiversity and delicate ecological balance among its native aquatic fauna. The impacts of climate change and invasive species such as Smallmouth Bass and Northern Pike pose risks to the native Salmonids that have evolved within this unique ecosystem. PNW is among the most vulnerable basins to climate change which will continue to impact Salmonid species. Previous studies have found that Smallmouth Bass and Northern Pike substantially overlap with Salmonids in PNW. We improve on the existing studies by exploring the current and future niche overlaps of Smallmouth Bass and Northern Pike with Salmonid species in PNW. We hypothesize an increased niche overlap in the future, driven not only by the expansion in the distribution of Smallmouth Bass and Northern Pike but also by the preference of these invasive species, as well as Salmonids, for cold refugia. The increasing rarity of cold refugia due to climate change is anticipated to heighten the management challenge posed by Northern Pike, which leans more towards coldwater on the cool-cold spectrum compared to Smallmouth Bass, leading to greater overlap with Salmonid species in the future. We developed ensemble models for an updated assessment of the distribution of streams vulnerable to Smallmouth Bass and Northern Pike invasion in PNW. Our preliminary results show that climate change affects the availability of suitable habitats for Smallmouth Bass and Northern Pike differently in different stream orders. Middle order streams will have more potentially suitable habitats whereas higher order streams will lose habitat suitability in future (2080) under the moderate climate change scenario. Such insights allow us to anticipate and adapt to these evolving dynamics of Smallmouth Bass and Northern Pike and develop effective management strategies that can safeguard the native fish diversity and ecological integrity of PNW.

Climate-driven straying dynamics in anadromous salmon and steelhead: Research agenda for conservation

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Anadromous salmon and steelhead face unprecedented challenges due to climate change, and conservation efforts are primarily directed at protecting or restoring spawning, rearing, and migration habitats. However, in this presentation we argue that indirect impacts of climate change, specifically the dynamics of straying in both natural and hatchery-origin salmon, also warrant attention. While straying has adaptive value for natural populations, salmon's homing behavior, guided by olfactory cues in freshwater, is crucial for maintaining reproductive isolation and local adaptations. To address the knowledge gaps surrounding straying dynamics, the presentation proposes a research agenda focused on understanding the drivers, mechanisms, and consequences of straying. This includes investigating climate-linked drivers of straying, understanding wild fish stray rates, exploring the genetic and epigenetic basis of olfactory imprinting, and developing a systems approach for studying straying dynamics. Additionally, the impacts of altered water sources, transportation among hatcheries, and changes in release timing and location on straying rates are examined. The research agenda emphasizes

interdisciplinary collaboration and knowledge-sharing among researchers, managers, and stakeholders. Long-term monitoring programs are proposed to assess straying in both hatchery and wild populations. We call for an increased understanding of the demographic and genetic costs and benefits associated with straying. In conclusion, the presentation urges researchers and managers to consider the indirect effects of straying dynamics on the distribution and abundance of anadromous salmon and steelhead in a climate-altered future. Finally, we provide a brief summary of ongoing studies conducted at the Oregon Hatchery Research Center supporting several aspects of this agenda.

Session: Freshwater Mussels

Oregon Department of Fish and Wildlife Snorkel Surveys Get Some Mussels

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As part of a long-term conservation effort, the Oregon Department of Fish and Wildlife (ODFW) monitors juvenile salmonids (Oncorhynchus ssp.) and their habitat in Western Oregon. Monitoring is accomplished by habitat and snorkel surveys in randomly selected stream reaches. In 2010, ODFW collaborated with Xerces Society to collect data on freshwater mussels as part of this effort. The partnership resulted in the verification of mussels in waterbodies where their status was previously unknown and an analysis of mussels in the Coast Range, a large ecoregion within Western Oregon. Only one species, Margaritifera falcata, was observed in the Coast Range, though species in the Anodonta clade were observed elsewhere in Western Oregon. Naïve occupancy of M. falcata was 12.4%, with a detection probability of 45%. Observations frequencies were low in the northern watersheds and tended to increase as latitude decreased. Occupancy was positively correlated with boulder counts and coho salmon (O. kitsutch) abundance, and negatively correlated with stream gradient and percent secondary channel. Results informed the conservation status of mussels in Western Oregon and may focus additional surveys. Our partnership increased the value of an established monitoring program at negligible cost by exposing dozens of fisheries professionals to the ecology of freshwater mussels and provided needed data on these species. This partnership is illustrative of the benefits and limitations of “piggy-backing” to collect data on lesser known species and is informative to other agencies considering a similar effort.

Keagan Scully-Engelmeyer was the lead author of a manuscript published in Hydrobiologia (Kaegan Scully-Engelmeyer, E. Blevins, E. F. Granek, and R. Constable. 2023. Freshwater mussel populations in Pacific Coast Watersheds (Oregon, USA): occurrence, condition, habitat, and fish species overlap. Hydrobiologia 850: 821-839) that forms the basis of this talk. The manuscript can be found at: https://link.springer.com/article/10.1007/s10750-022-05127-w

Shell-ebration: Coquille's Hidden Mussels Come to Light

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Freshwater mussels in the Western United States have been in a steady decline over the last century. Moreover, the imperiled Western Ridged mussel has been vanishing from watersheds around the Pacific Northwest since the 1900’s. With an inkling of hope, the Xerces Society identified the Coquille

Watershed as having the greatest chance of containing live Western Ridged mussels across the Oregon Coast. The Coquille Watershed Association, in partnership with The Xerces Society, US Fish and Wildlife Services and OR Dept. of Fish and Wildlife, spent two summers searching for this elusive mussel species across the four main forks of the Coquille Watershed. Although the last sighting of Western Ridged mussel in the Coquille dates back to the 1980s, this project has confirmed the presence of them in all main forks of the Coquille River. Furthermore, the forks of the Coquille have been verified as habitats for the other two native mussel species in Oregon, namely the Western Pearlshell and Floater.

Inventory and Assessment of Freshwater Mussels in the Bureau of Land Management Prineville District, Oregon

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The BLM Prineville District Office has a requirement for Inventory and Assessment of Aquatic Species Services to be performed within their areas of responsibility. In 2020, the BLM initiated a project to improve understanding of the distribution, abundance, and management needs of freshwater mussel species occurring on public land and water, with the intent to use the data to assess land health, specifically determining if mussel habitats are spatially distributed across the landscape with a density and frequency of species suitable to ensure reproductive capability and sustainability.

A GRTS sampling design targeted perennial waterbodies identified by the NHD with ≥5th Strahler stream order. Only points associated with NHD segments falling within the Deschutes and Central Oregon Field Offices believed to contain resident fish populations were considered. Sampling locations were stratified across watersheds, including the lower John Day, upper John Day, lower Deschutes, and upper Deschutes and Crooked Rivers.

Over the first four years of this project (2020-2023), a total of 125 randomly-selected locations were visually surveyed for freshwater mussels, with repeat visits also conducted at approximately 18% (22) of sites. A total of 31 streams and more than 47 river kilometers were surveyed in reach lengths spanning 200, 300, or 400m, depending on bankfull width. Mussels of three genera were detected at nearly 53% of sites, and additional monitoring is planned for 2024.

Monitoring the effects of restoration and mitigation activities using 6000 PIT tagged freshwater mussels

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Murderers Creek, a tributary to the South Fork John Day River, is an important watershed for wild steelhead populations in the John Day system. The Murderers Creek Ranch Enrichment project, aimed at improving late season flow to support steelhead was implemented in 2023. This 2.5-mile-long project included the addition of 300+ structures, as well as removal of riprap and construction to improve floodplain connectivity.

Xerces Society, South Fork John Day Watershed Council and ODFW staff conducted a pre-project survey documenting an estimated 70,000 freshwater mussels within the 2.5-mile-long project, including both Western Pearlshell (Margaritifera falcata) and Floater species (Anodonta sp.).

In 2021, we implemented a mussel monitoring project to evaluate the effectiveness of mitigation measures, and to document the resulting effects of the restoration project on mussel survival. We PIT tagged 6,000 mussels and have been annually monitoring survival and displacement of mussels using mark-recapture methods.

Project partners include:
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Translocation and monitoring of Western Ridged Mussel (Gonidea angulata) prior to dam removal on the Klamath River, California.
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Freshwater mussels are vital to the health of rivers and streams, are powerful filter feeders that can improve water quality, and their presence can result in lower fish mortality and increased fish growth. Freshwater mussels cycle and store nutrients, which are then consumed by algae and bacteria, further cascading up aquatic food webs. In short, they are influential to the health of organisms and streams within which they reside.

However, they can also be sensitive to changes in water quality and quantity, habitat, and river health, and as such are among the most imperiled groups of animals globally. The Western Ridged Mussel (WRM) is considered an at-risk species and is currently under consideration for federal Endangered Species Act (ESA) listing. It has received a positive 90-day finding (July 2021) and is undergoing a species status assessment (SSA), with the 12-month finding targeted for completion in Fiscal Year 2025.

In fall 2023, the U.S. Fish and Wildlife, California Department of Fish and Wildlife, and Xerces Society collaborated to PIT-tag and translocate or monitor in place WRM from several large beds below one of the four Klamath Dams scheduled for removal, particularly within an 8-mile stretch of river downstream of Iron Gate Dam (IGD), where they are expected to experience high mortality due to sedimentation.

During the last two weeks of September, participants from many different Klamath Basin organizations and agencies assisted with surveys, collection, tagging, and, for some, translocating 6,779 WRM at six locations, including both collection and translocation sites. This presentation will cover techniques and methods, results from the effort, and plans for monitoring mussels that both remained in place and those that were moved downstream.

Salmonid Focused Habitat Restoration is Destructive…
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Salmonid-focused restoration can be destructive...to long-lived organisms like freshwater mussels...when they are not properly and carefully planned for.

Freshwater mussels are a First Food for Columbia Basin Tribes like the Confederated Tribes of the Umatilla Indian Reservation (CTUIR), and harvest of mussels remains a reserved treaty right for tribal members. Populations of freshwater mussels are declining rapidly and harvest of mussels is not currently possible. Mussels can form dense beds that provide invaluable ecosystem services on which salmonids and other aquatic life rely. Nutrient cycling, removal of toxins and pollutants, substrate bioturbation, water quality improvement, sediment stabilization, and other services are provided by mussels, but these are seldom considered as benefits to the ecological community when mussels are present in areas in need of habitat restoration.

Salmonid-focused restoration practices can result in long term suitable habitat for mussels. However, in the short term, restoration actions can be destructive and damaging to mussels. Mussels are not often considered in planning phases of restoration projects and, even when planned for, are frequently killed by actions like instream construction, dewatering, sedimentation, channel fill, or wood and boulder placement. Because mussels are long-lived (some species 80-100 years), sessile, and reliant on microhabitat characteristics that are not well understood, relocation of mussels outside of a project area to avoid damage during instream work in many cases results in 50-90% mortality and should be used only a last resort. Alternatives to relocation exist, and resources are available to help habitat restoration professionals avoid moving or damaging mussels during restoration work.

Given the current rate of mussel abundance and richness decline throughout the western US, habitat restoration projects should consider designs that protect and enhance mussels short term and long term. Especially for areas with dense, reproductive beds of mussels, significantly more effort needs to be taken to minimize disturbance and focus project design to restore rivers in a holistic manner. Single species restoration is destructive to often overlooked but highly valuable organisms like mussels, and their benefit to the river ecosystem should be considered in project planning.

Mussels provide significant services to their river community, but they need help from the restoration community to persist and survive. Restoration work is important...so are mussels. Let’s work together to protect, restore, and enhance mussel populations for the good of the entire river community!

Session: Deschutes Basin Spotlight

Exploring Angler Catch Composition Using An Individual Based Model
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Many wild steelhead populations along the Pacific Northwest coast are considered a conservation concern because of low run sizes. To balance conservation with recreational fisheries, managers often allow sport angling to continue by requiring anglers target hatchery-origin steelhead for retention, while requiring catch-and-release of wild steelhead. The Deschutes summer steelhead fishery is managed

using this approach, with creel surveys in place to monitor the fishery. These creel surveys provide a time series of the stock composition in angler catch. Stock composition of wild and hatchery-origin summer steelhead in creel data differs from the stock composition observed from fishery independent sources. Dam counts above and below the confluence of the Deschutes River in the mainstem Columbia River, as well as the composition observed at the Sherars Falls Adult Salmon and Steelhead Trap on the Deschutes River, suggest that in each year between 2000 and 2019 wild steelhead were 27-31% of the stock composition, yet the average stock composition of angler catch suggests 65% of the steelhead caught were wild-origin. Using an individual based model, this presentation will focus on exploring alternative mechanisms that could drive this discrepancy, with emphasis given to the expected bias driven by the retention of hatchery fish while wild fish are released. The potential impact of sympatric hatchery fish that are more susceptible to angling compared to the standard hatchery fishery (i.e., "biters") was also explored. After running through each scenario and parameterizing the model with conditions similar to the Deschutes river, we conclude that the most plausible explanation driving the difference in the proportion of wild fish in angler catch versus fishery-independent data sources is that wild fish truly have higher encounter rates and are more catchable than their hatchery counterparts in the Deschutes River.

Deschutes River Steelhead: What We Know, What We Don't Know, and What We Want to Know

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Fishing for summer steelhead in Oregon's Deschutes River is an iconic Pacific Northwest tradition. While we have an extensive dataset surrounding some aspects of Deschutes River summer steelhead—such as angler effort, angler catch, and adult abundance at Sherars Falls—many uncertainties remain about Deschutes steelhead. Some of these uncertainties include: the abundance and success of steelhead that spawn in the Mainstem Deschutes, the survival rate of steelhead fry which emigrate from ephemeral tributaries into the Mainstem Deschutes, and the population structure present among steelhead in the basin. Additionally, expanding naturalized populations of Coho Salmon are now present in the Deschutes River basin, and we have yet to quantify geographic overlap with rearing juvenile steelhead, nor evaluate what effect this expansion is having on steelhead productivity. This talk will synthesize the 'known-knowns' and 'know-unknowns' of Deschutes steelhead with a focus on what we need to know for future adaptive management of this steelhead population and fishery.

Growth, Population Density, and Creel Status Update of Redband Trout in the Lower Deschutes River

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The lower Deschutes River, Oregon, has one of the most robust redband trout fisheries in the region. Several multi-year investigations on the growth, condition, and density of redband have been conducted by Oregon Department of Fish and Wildlife (ODFW) over the past half-century. To evaluate trout angler success, historical trout creel surveys were conducted from 1951-1982 and long-standing trout creel has been completed since 1989. ODFW re-implemented trout investigations in 2015 to determine growth rates and coefficient of condition. In 2019, these efforts were expanded to include redband trout density estimates utilizing multiple-pass PIT tagging. This study summarizes growth, population density, and

trout creel to provide a status update of this notable resident native trout population on the Deschutes River.

Colonization of Coho Salmon in the Deschutes River

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Coho Salmon recently colonized the lower Deschutes River, Oregon, despite no evidence of historical occupation. The lower 160 kilometers of the Deschutes River is renowned for numerous anadromous and resident salmonid species. However, Coho Salmon were not observed or reported in biological sampling until 1995. The objective of this study was to evaluate the abundance, spatial and temporal distribution of a new population of Coho Salmon on the lower Deschutes River. Adult Coho Salmon were captured and tagged at the Sherars Falls Adult Salmon and Steelhead Trap from 2019 to 2023. Abundance was estimated by mark and recapture techniques, while distribution was determined by PIT tagging and subsequent detection locations. We found abundance increasing annually with fish having high fidelity to tributaries to spawn, especially the Warm Springs River. Numerous management and research questions remain on how or if this population will persist and what impacts may occur on other native fish populations.

Accounting for strays in abundance estimates of Deschutes River summer steelhead

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The Deschutes River, one of the iconic steelhead fisheries in Oregon, hosts an abundance of summer run steelhead. Stock composition within the fishery is comprised of natural and hatchery origin fish from the Deschutes River basin, as well as strays from throughout the Columbia River basin. Stray summer run steelhead have reproductive effects on both the genetic structure and abundance of steelhead in the Deschutes River basin, complicating recovery efforts and management decisions. Previous genetic work has found little genetic differentiation for Deschutes River origin steelhead when compared to nearby populations, suggesting that stray steelhead have made a significant contribution to spawning in this system. This influx of strays was likely exacerbated by the practice of barging steelhead smolts from the Snake River basin to the lower Columbia River, which resulted in many barged fish failing to home to their natal rivers. In addition to these strays that spawn in the Deschutes River, a portion of strays also utilize the Deschutes River as a temporary refuge on their migration. Recent PIT tagging efforts by ODFW have revealed that 9% to 17% of wild summer steelhead that ascend Shears Falls are temporary strays. These temporary strays currently inflate abundance estimates for the basin, creating an issue for management of wild summer steelhead.

Session: Monitoring Fish Movements

Recent Developments in Automated Fish Counting Technology at Hydroelectric Facilities

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Many hydropower facilities have on-going fish counting requirements, particularly for endangered salmonids in the Columbia and Willamette basins. While these operations provide essential data for conservation and management, they are often conducted manually from video footage or “live” by in-person fishery observers, which requires significant labor and introduces error from observer inaccuracy. This presentation will discuss a computer-vision camera system trained to count and classify fishes that is being jointly developed by Four Peaks Environmental Science & Data Solutions and MarineSitu. This technology has been trained and calibrated at sites in the Columbia River Basin and offers the potential to reduce data turnaround time and labor costs while improving count data accuracy. We will discuss challenges posed to the system from certain run conditions and species behaviors, how these obstacles will be tackled, and present preliminary results of validation studies of the system. We will also discuss future development plans, including underwater counting and stereo optics. Ultimately, we hope that this technology can improve fishery observation in multiple environmental contexts and continue to inform conservation efforts around dam operations.

Quantifying Adult White Sturgeon Movement in the John Day Reservoir, Columbia River

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White Sturgeon historically inhabit large river systems in Western North America and exhibit amphidromy, meaning they could move between freshwater and saltwater freely. Although some populations currently move through un-impounded river systems, or un-impounded parts of large river systems, other populations experience restricted movement and access to crucial habitat from the construction and operation of hydropower dams. The white sturgeon in the Columbia River have become reproductively isolated populations from the implementation of dams, resulting in declining recruitment particularly in the population segments within the middle and upper river impoundments. White sturgeon in the John Day Reservoir inhabit a modified environment that no longer resembles a free-flowing river. This population is exhibiting a concerning trend in population dynamics, based on the lack of observed recruitment, that could be related to the stress of their environment, habitat and resource availability, or other factors. Telemetry data collected in 2022 and 2023, from 58 acoustically tagged (Innovasea 69kHz tags) adult white sturgeon, were used to quantify movement through time for potential behavioral responses to changes in environment, with the purpose to identify any sex influenced refuge-seeking behaviors across years. To quantify each individual’s annual movement, the daily average river kilometer was used in a time series model to map the response of location change over time. The calculated values from this model were used to measure directionality and speed to analyze differences between sexes. Temperature measurements will be related to movement speed and directionality in a linear model to determine if individuals are moving away from high temperature areas into areas with lower temperatures. This movement model will provide a greater understanding of occupation dynamics and movement variation of white sturgeon within an impounded reservoir, potentially providing more informed management decisions for white sturgeon conservation.

Spring Chinook Salmon distribution pre and post habitat restoration in Catherine Creek, Northeast Oregon

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Chinook Salmon populations are in decline across the western United States. One important cause of these declines is the degradation of habitat in river systems. Catherine Creek (Grande Ronde basin, NE Oregon) was historically comprised of abundant wetlands, floodplains, and complex in-stream habitat but has now been largely simplified, including channelization for agricultural purposes. To conserve habitat for Chinook Salmon, several restoration efforts were completed on Catherine Creek from 2013-2016, including large wood and pool additions, side channel activation, floodplain reconnection, and off-channel water development. These restoration efforts span approximately 5.0 kilometers in the downstream portion of Catherine Creek where water temperatures increase during the summer months. We analyzed spawning ground survey data from 2009-2023 and juvenile snorkel data in 2015, 2017, 2020, and 2023. Juvenile sampling was conducted on approximately 1.0 kilometer of restored stream due to limited landowner access. Within the restored area, we observed an increase in spawner abundance and distribution post-implementation, but these results should be taken into context regarding abundance and distribution of spawners throughout the riverscape. Pre- and post- monitoring will allow further consideration of restoration efforts planned for primary Chinook habitat in upstream reaches of Catherine Creek. Additionally, these results provide baseline information for a concurrent study evaluating juvenile salmon dispersal from redds as a function of hatchery vs. natural spawner origin using parentage-based tagging.

Aquatic Organism Passage (AOP) Solutions at Culverts and Fish Barrier Management in North America
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Culverts, bridges, and similar in-water structures rank second only to dams in their obstruction of fish and other aquatic organisms. These structures have a detrimental impact on habitat connectivity for numerous species, as they restrict access to crucial spawning and rearing habitats. Significant efforts have been devoted to the removal and replacement of culverts to enhance aquatic organism passage (AOP). These projects are resource-intensive and may take years to complete. In addition, the number of AOP barriers is so numerous that many will not be addressed in a timely manner, if at all. However, there are many opportunities to improve AOP through barrier modification where removal or replacement is not feasible or timely.

This presentation aims to provide an insightful exploration of low-cost, rapid solutions for retrofitting culverts and similar structures to improve AOP. The spectrum of corrective actions will include retrofitting culverts with weirs and floating ramps to improve access and passage through the culvert. Real-world case studies will be presented to demonstrate how barriers can be modified to improve AOP. We will also describe Computational Fluid Dynamic modeling used to quantify the AOP benefits of these culvert modifications. Additionally, we will describe a Fish Passage Barrier Assessment and Prioritization program being used to plan and implement corrective actions to overcome AOP barriers on a watershed scale.

Deep Creek Vertical Slot Fishway – An Innovative Design to Restore Warner Sucker and Warner Lakes Redband Trout Access to Historical Habitat

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River Design Group, Inc. is working with a stakeholder group and local landowners to restore Warner Sucker (federally threatened) and Warner Lakes Redband Trout (species of concern) access to historical habitat in the Warner Basin, an endorheic basin in southcentral Oregon. Since 2012, RDG has coordinated with stakeholders to replace degraded irrigation diversions and provide passage in the three main basin tributaries. Oregon Department of Fish and Wildlife (ODFW) has monitored fish passage at upgraded diversions confirming fish passage through nature-like and technical fishways.

In 2023, we coordinated with the stakeholder group, water user, and contractors to construct a vertical slot fishway (VSF), an engineered passage structure designed to pass fish species of varied swimming abilities over a broad range of migration period flows. The designed VSF is a sloping rectangular channel separated into pools with transverse baffle walls. Each baffle wall has a vertical opening that extends the full water column depth, maintaining similar hydraulic performance with increasing stream stage. VSFs are preferrable for passing multiple species, perform under variable hydraulic conditions, and use less water to pass fish than other fish passage solutions.

Whereas fish ladders, including VSFs, are typically constructed from cast-in-place concrete, our design included an outer concrete channel with interior baffle walls made from milled high density polyethylene (HDPE). Design goals included developing a baffle design that could be easily replicated by a fabricator, and baffles could also be modified to maximize passage performance based on monitoring results. Loose cobbles were placed in the ladder to simulate a natural streambed, a treatment we anticipate will facilitate passage of the benthic-oriented Warner Sucker. An auxiliary water system was built into the ladder to meet passage criteria while also reducing ladder size. ODFW intends to monitor Warner Sucker and Warner Lakes Redband Trout passage in spring 2024.

Standardizing Tide Gate Monitoring along the Oregon Coast

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In recent years, the science linking barriers to tidal connectivity and their harmful effect on fish habitat and life cycle has been mounting. Outdated and malfunctioning tide gates stand in the center of this conversation along the Pacific Northwest Coast. Recent inventory efforts highlighting the vast number of outdated gates have shed light on the likely significant aggregated effect of these structures on ecosystem health and specifically juvenile salmonids due to loss of tidal marsh and estuarine connectivity. In turn, this has stimulated restoration efforts to remove or replace failing tide gate infrastructure across the state of Oregon. However, current understanding of the effectiveness of these projects has not kept pace with the number of new gates being installed. A standardization of restoration practices and monitoring protocols is needed to unite the tide gate community under a common framework. By building the baseline understanding of the effects of tide gate replacement and upgrade

on fish and estuary function, a shared understanding and common language can be established allowing for comparison among restoration projects, adaptive management strategies to be implemented, and determination of whether stated restoration goals are successfully achieved. The work presented here highlights the creation of a tide gate monitoring handbook that provides the framework for an integrated and cohesive state-wide tide gate monitoring strategy by standardizing monitoring practices and protocols for tide gate upgrade and replacement projects of all scales. It was created with the practitioner in mind and provides sample monitoring questions, timelines, equipment requirements, costs, and external resources to help project managers incorporate monitoring into their projects.

Session: Predator Prey Interactions

Predation of Adult Sockeye Salmon by American White Pelicans in the Columbia River

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Previously published research indicates that predation by piscivorous colonial waterbirds can limit the survival of some salmonid species and populations in the Columbia River Basin. Much of this prior research has focused on predation impacts to juvenile salmonids (smolts) by Caspian terns, double-crested cormorants, and several gull species. Unlike terns, cormorants, and gulls, however, American white pelicans are capable of consuming adult-sized fish. Of distinct concern are adult Sockeye Salmon which migrate past a breeding colony of pelicans on Badger Island located near the confluences of the Snake, Columbia, and Yakima rivers. To investigate the magnitude of pelican predation relative to all other sources of sockeye mortality (1 – survival), we used a state-space Bayesian model to analyze a dataset of PIT-tagged adult sockeye, incorporating live detections at fishways and the recovery of depredated tags on Badger Island. The model was used to estimate adult sockeye survival and predation probabilities (proportion of available fish consumed) as well as to explicitly infer the total number of sockeye consumed by pelicans during upstream migration from Bonneville Dam to dams on the Snake, Columbia, and Yakima rivers during 2014–2022. Estimates of predation probabilities ranged annually from 0.013 (95% credible interval = 0.005–0.024) to 0.081 (0.047–0.181), with total consumption ranging annually from 7,756 adults (2,839– 14,596) to 38,963 adults (24,254–61,369). Predation by pelicans was estimated to account for 5.7% (2.1–10.5%) to 18.8% (11.4–42.0%) of all sources of adult sockeye mortality within the study area. Results provide novel information on the effects of pelican predation on adult sockeye in the Columbia River basin. Future research will focus on understanding biotic and abiotic factors that are affecting adult sockeye susceptibility to pelican predation and the extent to which predation limits adult sockeye survival in the Columbia River.

Estimating American White Pelican Predation of Salmonid Smolt in the Umatilla River Basin.

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Predation rates of salmon and steelhead smolts by American white pelicans in the Umatilla Basin are unknown. Pelicans began appearing in the Umatilla Basin soon after artificial islands were created on the

Columbia River from dredge tailings in 1993. Badger Island pelican colony population growth from the artificially created island has expanded to over 6,000 birds. Weekly counts documented an average of 259 pelicans per day (April -June) with a maximum of 422 counted on the lower 129 km of the Umatilla River during 2023. Each pelican can consume 1.8 to 2.3 kg of fish per day. Based on feeding rates and average daily bird counts (259), pelicans could potentially eat more than 45,000 kg of smolts from the Umatilla River each spring.
An initial study design to evaluate stomach content and diet composition of American white pelicans was developed. A Unites States Fish and Wildlife take permit to effectively examine pelican stomach contents was not approved and required modifying our study. PIT tags provide an alternative method for estimating smolt predation rates. We fed 478 PIT tagged non-salmonid fish to pelicans to determine the deposition rate of PIT tags onto the colony islands by pelicans feeding in the Umatilla River. Thirty percent (146 or 30.5%) of the 478 fed PIT tags were detected on the colony islands by Real Time Research. Fifteen PIT tags from our naturally produced salmon and steelhead smolts were also detected on Badger Island. Expanded estimates of pelican predation of naturally produced steelhead smolts from Meacham Creek and the upper Umatilla River were 4.6% and 0.89% respectively. Predation rates of naturally produced spring Chinook smolts were similar (Meacham 4.9%, Umatilla 0.34%). Additional evaluations in 2024 and 2025 will provide information about the variability of pelican abundance, distribution, and predation of smolts within and between years.

Management to reduce Caspian tern predation on salmonids in the Columbia River
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Management of avian predators as an approach to enhance the survival of salmonids in Columbia River is currently underway. Predation by Caspian terns Hydroprogne caspia is a factor known to limit the recovery of some Endangered Species Act-listed populations of salmonids from the Columbia River basin, especially steelhead trout Oncorhynchus mykiss originating from the Snake and Upper Columbia rivers. This prompted the development and implementation of two separate management plans, one in the Columbia River estuary and the other in the Columbia Plateau region, to reduce the impact of Caspian tern predation on smolt survival. Caspian terns nesting at managed breeding colonies within the basin were relocated to alternative nesting islands created for terns outside the basin. Both plans were successful in significantly reducing smolt losses to terns nesting at managed sites; however, new developments have led to regression in smolt survival gains associated with tern management. Adaptive management to prevent terns at managed colonies from relocating to nest elsewhere in the basin and to improve nesting opportunities for terns outside the basin are now needed to maximize the potential survival benefits to salmonids from management. Adaptive management is also necessary to ensure the long-term viability of the Pacific Flyway population of Caspian terns, whose breeding population has substantially declined (> 50%) since tern management plans were implemented. Results of this presentation are from a recently published article in the journal Fisheries (Collis et al. 2023).

Bites to Biomass: Evaluating applied bioenergetics models to assess piscine predation on out-migrating juvenile salmonids.
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The Northern Pikeminnow Management Program (NPMP) is a piscine predator control program aimed at mitigating predation on out-migrating juvenile salmon and steelhead by the indigenous Northern Pikeminnow, in the Columbia Basin. To evaluate effectiveness of the NPMP, The Oregon Department of Fish and Wildlife (ODFW) employs a consumption index to track spatiotemporal trends in the predation of juvenile salmonids by Northern Pikeminnow, as well as monitoring for compensatory responses from other, introduced piscivorous fishes, including Walleye. The focus of this study is to assess the functionality of an R based bioenergetics modeling tool, Fish Bioenergetics 4.0 (FB4), as a rapid-assessment modeling approach with NPMP data and to calculate preliminary juvenile salmon and steelhead consumption by Northern Pikeminnow and Walleye. The application of bioenergetics is crucial for Walleye in the Columbia River Basin since a peer reviewed model doesn't exist for the region and there are indications that Walleye abundance and distribution is increasing. Due to variations in the spatial distribution of the two predators, a parallel analysis is unfeasible. Consequently, this preliminary analysis focuses separately on juvenile salmon and steelhead consumption by Northern Pikeminnow and Walleye downstream of Bonneville Dam and McNary Dam, respectively, using the Wisconsin bioenergetics framework within FB4. We integrate the modularity of FB4 to enhance the consumption model with biological and environmental values. Our initial results, estimated in grams of juvenile salmonids consumed, demonstrates the utility of FB4 to assess consumption trends. These results could enhance our knowledge of the dynamics of piscine predation in the Columbia River Basin.

Assessing enhanced methods to estimate piscine predation on juvenile salmon and steelhead in the Columbia River Basin

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The Northern Pikeminnow Management Program (NPMP), a multi-agency collaboration, has been reducing the total population and size structure of Northern Pikeminnow in the Columbia and Snake rivers to reduce predation on out-migrating juvenile salmon and steelhead as a mitigation requirement of the Federal Columbia River Power System, since 1990. The Oregon Department of Fish and Wildlife has been monitoring Northern Pikeminnow exploitation and estimating predation reduction to juvenile salmon and steelhead, relative to pre-program levels, since the implementation of NPMP using 'rapid assessment' models. These models do not incorporate multi-year recaptures into the exploitation estimate and the predation reduction model uses static estimates of Northern Pikeminnow bioenergetics and population. This study evaluated the efficacy and utility of using the Brownie Bird Band model in conjunction with the statistical package 'RMark' to estimate Northern Pikeminnow exploitation and population using ten years of mark/recapture data, below Bonneville Dam. Additionally, we evaluated recent bioenergetics models for Northern Pikeminnow in conjunction with the population estimate, below Bonneville Dam as a means to model annual predation reduction to juvenile salmon and steelhead. Our results indicate that implementing the Brownie Bird Band model within the RMark statistical framework could function as a rapid assessment model to estimate exploitation and the population of Northern Pikeminnow below Bonneville Dam. Furthermore, these results suggest there is

value in continuing to develop a predation reduction model based on estimates of exploitation paired with dynamic bioenergetics models for Northern Pikeminnow. NPMP will continue to evaluate these approaches to enhance estimates of piscine predation to juvenile salmon and steelhead as an adaptive management tool. This approach may prove useful to more effectively estimate predation to sensitive species, like ESA listed salmon and steelhead, from a suite of piscine predators.

Fish out of water: drying streams, steelhead (Oncorhynchus mykiss), and their invertebrate prey

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More than half of global stream networks are non-perennial, and the frequency and duration of stream drying events are projected to increase globally due to climate change and human activities. By studying trophic interactions in non-perennial streams, we can better understand how these systems function and inform management strategies for their conservation in both natural and human-altered contexts. Recent research highlights the use of non-perennial streams by terrestrial and aquatic organisms, including spawning habitat by endangered steelhead (Oncorhynchus mykiss) and coho salmon (Oncorhynchus kisutch) of the Pacific Northwest. Whether these fish are simply surviving in these systems or benefiting from unknown advantages remains unclear. Our goal is to determine if differences in prey availability in perennial and non-perennial habitats are a factor influencing steelhead use of non-perennial streams. We collected diet samples of wild juvenile steelhead (n=100 individuals) and benthic invertebrate communities (n=24 samples) from both perennial and non-perennial sections of Thirtymile Creek, a high desert stream in Oregon, USA, from May through July 2022. We compared the biomass, abundance, and diversity of the steelheads' diets and the benthic invertebrate communities between the two habitats. Steelhead diets did not significantly differ between habitats. Further analyses using nonmetric multidimensional scaling (NMDS) of invertebrates collected from non-perennial and perennial sections will allow us to explore how different environmental variables in the two habitats influence steelhead diet and macroinvertebrate communities. Overall, our findings can inform conservation practices for steelhead in different stream habitats by exploring the dynamics of habitat-specific dietary patterns. Understanding how organisms subsist in non-perennial systems can help protect endangered species such as salmonids and preserve unique biodiversity in changing environments.

All about that bass: some trouble for rearing steelhead

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Current recovery strategies for salmonids in the Columbia River Basin focus on improving salmonid habitat throughout their spawning and rearing range, however recent research indicates improving habitat quality alone may not be enough. Preliminary research in Thirtymile Creek suggests the presence of non-native smallmouth bass may suppress ongoing recovery efforts and have the potential to negatively impact future recovery efforts. In the Columbia River Basin, smallmouth bass currently occupy ~ 11% of summer steelhead critical habitat. Alarmingly, smallmouth bass are predicted to increase their range by 69% by 2080 under current climate change models (Rubenson and Olden, 2020. The upriver

range expansion of smallmouth bass is of particular and immediate concern to the recovery of salmonids in the John Day River Basin and may present a substantial hurdle to the success of ongoing restoration efforts. My thesis aims to quantify the impact, through bioenergetics modeling, non-native smallmouth bass have on wild summer steelhead in Thirtymile Creek, a tributary to the lower John Day River.

Session: Offshore/Nearshore Ecology

Offshore Floating Wind: a challenge for Oregon

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The aggressive development and implementation of floating offshore wind (FOSW) has challenged all of our regional management institutions. Our regional fisheries and land management agencies have scrambled to address a system that has multiple conflicting objectives. Attendance at BOEM sponsored meetings have illustrated strong opposition by community groups and a pause in FOSW development was requested by Oregon agencies, and the Federal delegation to deal with uncertainties and challenges. Considerably more mineral and energy resources are needed for manufacturing, installation and operations of FOSW compared with other methods renewable energy development. A 3MW floating plant in Oregon will likely need approximately 600 individual mooring lines, totaling over 700 miles of line. Marine biofouling associated with installation in the open ocean raises unprecedented biosecurity concerns not only resulting from the construction, but also the maintenance and operation of these facilities. Service and installation services will increase development and challenge regional deep-water ports. Hidden in all of this is the requirement that leasing of areas for offshore wind is tied to a requirement for additional leases oil and gas. Our state, federal, regional and tribal institutions will be challenged to address these proposals.

Evaluating Offshore Wind Farms as Other Effective Conservation Measures and Their Implications for Fisheries Management

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Offshore wind farms (OWFs) are increasingly being developed on U.S. coastlines, particularly on the U.S. Pacific Coast. This development raises concerns about their impact on fisheries and fisheries management due to displaced effort and loss of fishery-independent survey data collection on the continental shelf. Additionally, the U.S. is actively expanding its network of protected areas as part of the 30x30 initiative and OWF areas could potentially contribute as “Other Effective area-based Conservation Measures” (OECMs), though their value as protected areas is debatable because they are not planned to protect specific habitats or species. Previous research involving OWFs being placed along the Pacific Coast has examined impacts on endangered species (e.g., marine mammal entanglement), but it has not comprehensively assessed fisheries impacts or potential conservation benefits. We used a spatially explicit population model to investigate the effect on fishery effort and fishery management responses to potential OWF implementation, focusing on five groundfish species. Our findings indicate that the loss of fishery-independent survey data in OWFs causes information loss and reduced yield due to increased

uncertainty in estimates of stock biomass. Moreover, positioning the OWF in better habitat areas produces the best conservation outcomes, but also the greatest loss of fishery yield. Overall, our research underscores the intricate challenges and trade-offs involved in balancing OWF expansion with sustainable fisheries management and conservation efforts in U.S. coastal regions.

Green Crab in Oregon Part 1: Increased abundance of non-indigenous European green crab in Oregon bays and estuaries

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European green crab (Carcinus maenas; also known as "green crab") are a non-native species that has rapidly colonized temperate coastlines at several locations around the world where they are an aggressive invader with potential to disrupt communities of native shellfish (other crab, clams, oysters, etc.). Populations of green crab initially became established in San Francisco Bay before 1989, and then spread rapidly along the west coast over the period of 1996 to 1999. The numbers of green crab remained relatively low in Oregon bays and estuaries from 1997 to 2015, followed by a steady increase along the coasts of California, Oregon, Washington, and British Columbia during the period of changing ocean conditions and elevated seawater temperatures associated with the recent marine heatwave (2015 to 2021). Populations of non-native green crab have now become established in many bays and estuaries in Oregon. Monitoring data show that the Catch-Per-Unit-Effort for green crab captured in popular Fukui and/or crayfish traps deployed in the intertidal zone of Coos Bay currently averages about 4 to 6 crab per trap per day. In response to growing populations of green crab, Oregon Department of Fish and Wildlife (ODFW) began standardized sampling for green crab in Yaquina Bay and Alsea Bay on the central Oregon coast. Efforts are also underway to generate a risk assessment and management plan for green crab in Oregon.

Green Crab in Oregon Part 2: Distribution and Relative Abundance of European Green Crab in Yaquina Bay, Oregon

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After the recent increase in European Green Crab (EGC) populations in the coastal Pacific Northwest, Shellfish Program staff of the Oregon Department of Fish and Wildlife (ODFW) initiated a standardized, long-term monitoring program to document the distribution and relative abundance of EGC in Yaquina Bay, Oregon. We began deploying modified Fukui traps in April 2022 and have repeated the sampling almost every month at sites spanning 12 miles of Yaquina Bay. We have documented the areas where they are most abundant and have collected data on several biological measures and environmental variables throughout this effort. We targeted multiple habitat types but kept the tidal strata consistent at -2.0'. We have tracked the size and abundance of EGC, along with information on Dungeness crab, red rock crab, and other bycatch. We correlated these relative abundances with bottom salinity and temperature. Other associated pilot projects included using Fukui traps in Alsea Bay as well as deploying higher intertidal traps in Yaquina Bay. The highest densities of EGC (75% overall) were found between

river mile 5 and 8. Spatial and temporal trends in overall abundance, sex ratio, and size distribution have been documented. Monitoring efforts will continue to identify the environmental variables and species interactions that influence the distribution and behavior of this non-native species. One of the most interesting observations we made was the very high densities of juvenile Dungeness found in the upper estuary.

Ocean drivers and ecological consequences: Recent changes rocky reef invertebrate communities and kelp habitat along the southern Oregon coast

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Marine heatwaves and regional changes in ocean drivers influence nearshore ocean conditions and have profound consequences for rocky shore habitats and communities located along the southern Oregon coast. Most recently, the massive coastwide marine heatwave that originated in 2013-14 was followed by several years of warm El Nino conditions (2018-2020). These persistently warm ocean waters are associated with disruption of the community composition and complexity of Oregon's kelp beds, shellfish communities, and rocky reef ecosystems. Changes within the rocky reef habitats include declines in the spatial cover of bull kelp (Nereocystis leutkeana) and understory seaweeds, dramatic increases in densities of purple sea urchins (Strongylocentrotus purpuratus), starvation by abalone (Haliotis rufescens), and coastwide demise of sunflower sea stars (Pycnopodia helianthoides). Together, the magnitude of recent ecological changes to Oregon's rocky reef habitats, kelp beds, and communities of marine invertebrates is unprecedented in recorded history. The ODFW Marine Resources Program is working in collaboration with multiple stakeholders to characterize the current status of kelp, seaweeds, sea urchins, abalone, and sea stars that inhabit kelp beds at priority rocky reef sites in Oregon. Efforts are also underway within ODFW to re-evaluate the status and designation of these Species of Greatest Conservation Need. Few hypotheses specifically identify the mechanistic links among shifts in ocean conditions and the multiple ecological impacts observed in shallow subtidal habitats, and empirical support for direct cause-effect relationships is scant. Despite this shortcoming, the growing database of underwater observations provides anecdotal evidence that Oregon's nearshore marine ecosystem has experienced a consequential shift over the past 7-8 years. Additional research is needed to address important data gaps, and a coordinated coastwide monitoring program should be initiated to document new baselines and help foster adaptive management of Oregon's rocky reef habitats.

Kelp forests: Signs of change in the distribution of essential marine fish habitat in Oregon

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Kelp forests are essential fish habitat for marine species and support diverse fisheries in Oregon, ranging from urchin and abalone fisheries to nearshore groundfish fisheries. Recent collapses in kelp forest habitat along the US West Coast have brought new attention to these ecosystems and raised concern about the condition of Oregon's kelp forests. In order to assess the status of Oregon's kelp forests, the Oregon Kelp Alliance has been collecting new data and integrating it with historic data to assess how the extent of kelp forest habitat has changed over the last 30 years.

Drawing on aerial and SCUBA based methods, we document small-scale variability in kelp forest trends across the state. Critically, we show troubling decreases in kelp extent and density across much of Oregon's far south coast with declines centered around Port Orford and Brookings. These declines are likely related to a trophic cascade driven by predator overharvesting and disease, but we also examine preliminary evidence for other drivers as well. We also identify kelp forests that remain near their historical extent. This includes at least one kelp forest that has been expanding in area over the last several decades, as well as parts of the coast where kelp canopy was documented in 2023 for the first time. We discuss potential implications for several marine fisheries in Oregon as well as next steps for research and stewardship. This talk will provide a preview of the data, analyses, and conclusions that will be published in the 2024 Oregon Kelp Forest Status Report by the Kelp Alliance in June 2024.

Population and fishery trends of sea urchins in Oregon

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Red sea urchins (Mesocentrotus franciscanus) and purple sea urchins (Strongylocentrotus purpuratus) are ubiquitous to Oregon's rocky nearshore, they are important biogenic habitat, consumers, and prey, but also a fishery target. Populations have varied widely over the years and sea urchins have been at the forefront of community shifts in the rocky nearshore. For example, purple sea urchin populations were once carefully conserved; however, are now found in high abundance in areas where they were simply absent in the past. The fishery for red sea urchins in Oregon is similarly dynamic, beginning with a boom in the late 1980s, they were quickly depleted, requiring conservation measures. Recent environmental conditions have also changed red sea urchin populations and their fishery in unexpected ways. These widely dynamic species have required teamwork between fishery managers, scientists, and sea urchin divers to assess and manage.

Shifts in abundance of abalone and sea stars in response to environmental changes in Oregon's nearshore

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Recent shifts in marine environmental conditions have led to cascading effects in subtidal populations of marine invertebrates in Oregon's nearshore environment. Two species groups, abalone (Haliotis spp.) and sea stars have experienced population declines. Sea Star Wasting Disease (SSWD) events in 2014 caused widespread declines in sea star populations along the Oregon coast, deeply affecting predatory species including: Pycnopodia helianthoides, Solaster dawnsoni, and S. stimpsoni. Data from Remotely Operated Vehicle (ROV) and dive surveys (2010-2019) were evaluated through video review and direct count methodologies demonstrating extirpation in the populations of P. helianthoides and Solaster spp. Oregon Department of Fish and Wildlife (ODFW) survey data from nearshore dive surveys (2015-2022) demonstrate dramatic decreases in abalone densities coupled with simultaneous increases in purple sea urchin (Stronglyocentrotus purpuratus) densities following the loss of predatory sea stars. Abalone populations face numerous challenges including starvation due to loss of kelp, competition with an increase in purple sea urchins, and persistent uncertainties in reproductive success due to a lack of ideal

environmental conditions. Shifts in distribution and abundance of sea stars and abalone in response to changes in environmental conditions could have lasting implications for the ecological community, species diversity and species sensitivity in Oregon's nearshore.

Restoring Balance: Sea Otter Reintroduction and Nearshore Ecology in Oregon

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The Elakha Alliance presents a compelling exploration into the transformative impact of sea otter recovery on nearshore ecology in Oregon. This presentation delves into the ecological intricacies and far-reaching consequences of reintroducing sea otters within their historic habitat range along the Oregon coast.

Sea otters, once extirpated from Oregon's waters during the maritime fur trade, hold an important ecological role as a keystone species. By preying on sea urchins, sea otters foster the health of kelp forests, vital habitats that support a myriad of marine life. The intricate web of interactions among sea otters, sea urchins, and kelp forms the basis of a restored and balanced nearshore ecosystem.

This presentation draws on scientific research, policy development, and ongoing engagement efforts to provide insights into the dynamic relationship between sea otters and other marine species, and the potential cascading effects of sea otter reintroduction on nearshore systems in Oregon. The Elakha Alliance discusses the anticipated benefits, including enhanced biodiversity, increased fish populations, and improved habitat resilience. Furthermore, the presentation considers potential challenges and management strategies associated with sea otter reintroduction, acknowledging the importance of a holistic and adaptive approach.

An informed and engaged public is critical to successful species reintroduction. As efforts to reintroduce sea otters to Oregon gain traction, outreach to build public awareness and understanding is necessary to informed decision making. The presentation underscores the importance of collaborative efforts in shaping successful conservation strategies, recognizing the significance of local knowledge and stakeholder involvement.

“Restoring Balance: Sea Otter Reintroduction and Nearshore Ecology in Oregon" offers a comprehensive examination of the ecological and socioeconomic implications of sea otter reintroduction, emphasizing the potential positive outcomes for nearshore ecosystems and the imperative of promoting a harmonious coexistence between humans and these charismatic marine mammals.

The Global Kelp Forest Challenge and implications for the Oregon Kelp Forest Protection & Restoration Initiative

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Covering a quarter of the world's coastlines, kelp forests are one of the most widespread and valuable marine ecosystems on the planet, providing a range of important ecological, economic, and cultural benefits. They draw carbon from the atmosphere, produce oxygen, reduce damage from storms, improve water quality, and attract visitors to their rich biodiversity.
However, kelp forests across every continent are in decline, and over the past 50 years, 40–60 % of kelp forests have been degraded. A multitude of local pressures and climate change are threatening the survival of this vital ecosystem.

In Oregon, the majority of kelp forest habitat is found on the southern coast, concentrated on major offshore reefs. Some, like Orford Reef, have experienced abrupt declines in recent years. In response to these alarming declines, the Oregon Kelp Alliance was founded in 2019 to spearhead research and conservation efforts, aiming to safeguard and revitalize Oregon's essential kelp forests.

The Oregon Kelp Alliance, a member of the global Kelp Forest Alliance, has joined forces with other organizations to launch the Kelp Forest Challenge Roadmap with the goal of protecting and restoring 4 million hectares of kelp forest, globally, by 2040. In 2024, the Oregon Kelp Alliance will publish the Oregon Kelp Forest Status Report and Kelp Forest Stewardship Plan developed with funding from the NOAA National Centers for Coastal Ocean Science (NCCOS).

We'll review the Kelp Forest Challenge Roadmap, showcasing pilot case studies from across the globe that exemplify its key strategies. We'll then dive into specific approaches being tested in Oregon and those planned for the 2024 launch of the Oregon Kelp Forest Protection & Restoration Initiative. A panel discussion will follow to delve deeper into these practical applications.

Session: Fish Health

Predictions for salmon disease risk following reconnection of the upper and lower Klamath basin after dam removals
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Understanding disease and impacts on salmonid populations has been a collaborative effort in the Klamath Basin. Together with the OSU team (above), fish biologists and fish health specialists from tribes (Alex Gonyaw (The Klamath Tribes), Toz Soto (Karuk Tribe), Justin Alvarez (Hoopa Valley Tribe), Michael Belchik & Barry McCovey Jr (Yurok Tribe)), and government agencies (Sarah J. Bjork, Mark E. Hereford & Ted G. Wise (ODFW), J. Scott Foott, Anne Voss & Nicholas A. Som (USFWS), Thomas H. Williams (NOAA)) reviewed historical pathogen challenges to and diseases of Klamath River salmon and developed a framework to predict responses following dam removals.

The Klamath River, which runs over 400 km across the Oregon/California border, was historically the third largest salmon-producing river in the contiguous US. However, the construction of six dams to provide water storage for irrigation and hydroelectric power divided the river into an upper and lower basin for anadromous fishes, which lost fish passage. Subsequent alterations in temperature and flow

regimes drove infectious disease outbreaks that have become more numerous in recent decades. This year, the system is undergoing a major restoration event following the removal of the four lowermost dams. Salmon and their parasites will be redistributed throughout the basin. Our predictions of disease risk focused on Chinook Salmon, Coho Salmon and Steelhead/Redband Trout. We stratified the river into four sections based on fish and pathogen distributions, river conditions, and barriers to fish movement, prior to dam removals. Although the interplay of abiotic and biotic factors is complex, we predict a decrease in overall fish disease risk. It is critical that comprehensive research and monitoring programs capture changes during and after this ecosystem restoration.

Intestinal Disease in Adult Chinook Salmon: Geographic distribution, links to prespawn mortality and potential causes.

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Since 2009 we have been studying pathologic changes in adult Chinook Salmon in the Willamette River systems and their links to prespawn mortality (PSM). Fish in the river show a progression of intestinal disease through the summer through spawning. Intestinal lesions are characterized by degeneration and ulceration of the epithelium with concurrent severe inflammation in the lamina propria of the intestine and pyloric caeca. Importantly, this phenomenon is accelerated in PSM fish – i.e., severity of lesions these PSM fish are similar to post-spawned fish from the fall. We have expanded our surveys in 2022 and 2023 to adult spring Chinook Salmon from the Round Butte Hatchery, Deschutes River and White River, Washington. And in 2023 added adult fish from the Sandy River, Oregon (but held at the Clackamas Hatchery) and Minter Creek River Hatchery, Washington. The Round Butte, Sandy River as well as Willamette Hatchery River stock all showed profound intestinal disease. Fish collected early in the run from the Sandy River showed early, moderate forms of the disease. In contrast, fish from the White River, like 2022, and Minter Creek Hatchery had completely normal, intact intestines. Most interesting, these two runs of spring Chinook historically has had minimal PSM. We investigated the role Ceratonova shasta and Enterocytozoon salmonis with the disease. Whereas these intestinal parasites were common in some populations, we found no statistical links with severity of the disease. Presently, we see two possible causes for the disease; accelerated senescence driven by certain environmental or life history situations, or a novel, perhaps transmissible agent. The latter hypothesis is supported by observations in Washington. Similar to fish from Oregon, these fish spend the summer in freshwater before spawning, but the fish from two runs Washington showed no histologic signs of the disease.

Unexpected Threats: Parasite Infections in Reservoir-rearing Juvenile Chinook Salmon

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Juvenile Chinook Salmon hatched above Willamette Valley Project dams often rear in reservoirs and grow significantly larger than their stream rearing counterparts. This is believed to impart a significant survival advantage to juvenile salmon once they reach the ocean. However, we found that these reservoir-rearing juvenile salmon can be severely infected by the ectoparasite Salmincola californiensis

and a parasitic nematode, Philonema sp. We found S. californiensis infection rates in upper Willamette Basin reservoirs exceed 80% and Philonema infections in 35% of the fish we sampled. There was also evidence of parasite associated host mortality for reservoir-rearing Chinook salmon associated with severe infection loads of both parasite species. Laboratory studies further indicated that gill damage caused by juvenile stages of S. californiensis negatively affected the ability of juvenile to osmoregulate when exposed to saltwater up to four months post infection. This suggests that reservoir-rearing salmonids may experience high mortality upon ocean entry. Our results indicate that parasite infections that occur in reservoirs could contribute significantly to population declines of Chinook salmon that rear in these systems.

Novel Use of the Drug Doramectin in Salmonids to Control for Copepod Infections

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Copepod (Salmincola californiensis) infections contribute to significant morbidity and mortality in salmonid populations and can be a major contributor to pre-spawn mortality of adult salmon. Although there are few tools to treat copepods, no reasonably applied methods are currently available to treat non-feeding senescent adult salmonids safely and effectively that also comply with federal drug regulations. This study investigates doramectin, (Dectomax, Zoetis) an FDA-approved drug for treatment of parasites in cattle and swine, for use in salmonid fish. Juvenile Chinook salmon (Oncorhynchus tshawytscha) and rainbow trout (O. mykiss) were injected intramuscularly with a single dose of doramectin at 0.2, 0.4, and 1.0 mg/kg and monitored for 28 days. Mortality in the Chinook salmon was not significantly different from the control groups. Mortality in the rainbow trout was significant in the group dosed at 1.0 mg/kg with 40% mortality on day 5 post injection, and no significant mortality observed in groups dosed at 0.2 or 0.4 mg/kg. Adult Chinook salmon and adult rainbow trout were administered a single dose of doramectin intramuscularly at 0.2 or 0.4 mg/kg and held in a hatchery for 6-8 weeks. Copepod counts in fish that received doramectin at either dose were markedly decreased compared to control fish, with most treated fish having zero copepods, and no significantly mortality was observed in the adult Chinook salmon. These findings suggest a single dose of doramectin may be a safe, effective, and available tool to control for copepod infections in managed salmonids.

Aeromonas salmonicida, causative agent of salmonid furunculosis, isolated from the freshwater parasitic copepod, Salmincola californiensis

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Here we provide evidence that the freshwater parasitic copepod, Salmincola californiensis, can be a vector for Aeromonas salmonicida. While investigating effects of S. californiensis on Chinoook Salmon (Oncorhynchus tshawytscha) at the Oregon State University Fish Performance and Genetics Laboratory (FPGL), we tangentially observed that fish exposed to the infectious stage of the parasite (copepodids) developed furunculosis, caused by A. salmonicida. The FPGL uses ground water and has not had a history for A. salmonicida infections. We further investigated the possibility of S. californiensis being potential vectors. We obtained copepod-infected Chinook salmon juveniles from Lake Billy Chinook,

which were then experimentally infected with fluorescently-labeled A. salmonicida. Fish became infected with the bacterium, and it was detected inside the copepod egg sacs. We then evaluated copepod egg sacs that were collected from adult Chinook salmon from a freshwater hatchery with A. salmonicida infections using by either culture or PCR. The pathogen was cultured on Tryptic Soy Agar from 75% of the egg sacs, and 61% were positive by PCR. These three separate experiments indicate an alternative tactic of transmission, in addition to direct transmission of A. salmonicida as seen in hatcheries. This is yet another example of transmission of pathogens by parasites in salmonid fishes. The list include the hemoflagellate Cryptobia (Trypanosplasma) salmositica transmitted by leeches and A. salmonicida and IHN virus transmitted by sea lice in marine netpens. Moreover, stonefly nymphs (Paraperla frontalis) may also be vectors of A. salmonicida, in which salmonids feed on infect nymphs. Whereas A. salmonicida is readily transmitted amongst fish in hatcheries without a vector, the copepod may play an important role in transmission of the bacterium when fish are more dispersed, such as in high flow streams or rivers.

Beginning to look at cyclical intermittent fasting to prepare juvenile Chinook salmon for release into streams.

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Upon release, hatchery-reared juvenile Chinook salmon (Oncorhynchus tshawytscha) potentially undergo periods of anorexia of varying durations, presumably due to release associated stress. We initiated investigations of the use of intermittent fasting as a means to prepare fish for an anorexic state post-release. We ran fasting trials over 10 weeks with the following treatments: daily feedings of whole ration (1.2% body weight), alternating weeks between whole ration and half ration (0.6% BW) (essentially 75% total calories), and whole ration feedings for four days (1.2% BW) followed by 3 days of fasting. After an additional three weeks of conventional feeding for all fish, feed was withheld for a full week to determine if past feeding history affects future ability to tolerate fasting. Fish weights and lengths were recorded throughout the experiment to determine the effects on growth intermittent fasting had. At each sampling time point, fasted fish are compared to unfasted fish. We found fish exposed to cyclic intermittent fasting of 4 day on and 3 days off feed did not have significantly impaired growth and were able to better tolerate prolonged fasting as opposed to fish with no fasting history. Further works with this experiment include body composition determined by proximate analysis, fin damage observations, gut microbiome composition, and innate immune parameters.

The Emergence of Proliferative Kidney Disease in an Oregon Salmonid Hatchery

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Proliferative Kidney Disease (PKD) is of great economic and ecological concern for cultured salmonids in Europe and North America. It is caused by the myxozoan parasite Tetracapsuloides bryosalmonae (T. bryo), which alternates between a freshwater bryozoan and salmonid host. Although the parasite is endemic to Oregon, only four occurrences of T. bryo infections have been recorded in the state's fish hatcheries, all within the period of 1994 to 2001. This sparse occurrence changed however in 2020,

when a PKD outbreak caused severe mortality of juvenile Chinook salmon at Leaburg Hatchery (LBH) on the McKenzie River. In response, and given the parasite's unknown regional epidemiology, we commenced a multi-faceted monitoring program. Monthly from 2021 through 2023, water samples from the LBH inflow, raceways and outflow were collected and analyzed for waterborne parasite stages via qPCR, and fish kidney tissue was sampled for histology and PCR. Severe pathology of kidney tissues had a temporal correspondence to parasite detection in the inflow water samples. Our surveillance also revealed the onset of signs of disease and mortality after a minimum of 6 weeks with water temperatures ≥15℃ after fish exposure to the parasite. Preliminary results indicate that the onset of infections occurs in the late summer and causes 95% morbidity. These data now inform a) the parasite's spatiotemporal abundance and distribution in hatchery fishes at this site, and b) how both the density of waterborne parasite stages and water temperature relate to the severity of PKD in these fish.

An Assessment of Pathogen Risk to Juvenile Spring-run Chinook Salmon (Oncorhynchus tshawytscha) in the Upper Klamath Basin

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The Upper Klamath Basin (UKB) consists of a diverse assemblage of tributaries, lakes, and reservoirs in Southern Oregon. Historically inhabited by Spring-run Chinook Salmon, hydroelectric dam development in the 20th century cut off all anadromous fish passage to the UKB. With the removal of the four lowermost dams in the Klamath River, Spring-run Chinook Salmon will have access to UKB habitats again. Using sentinel fish exposures, we describe the risks of pathogens that may be encountered upon re-establishment. In spring 2022 & 2023 (once in April and May), replicates of Trinity River juvenile Spring-run Chinook Salmon, raised at Klamath Hatchery, were placed in cages at two sites - a tributary of the Upper Klamath Lake (UKL) and near the outlet of UKL. Within 24 hours post-exposure half the fish in each group were euthanized and immediately necropsied and the other half held in tanks and monitored for disease signs for 28-days, then euthanized and sampled. In 2022 & 2023, Flavobacterium columnare, Ceratonova shasta, and Ichthyophthirius multifiliis were detected at both UKB sites with different prevalence between months. Renibacterium salmoninarum was only detected in 2022. C. shasta, F. columnare, and I. multifiliis were more prevalent in May, associated with higher river temperatures, compared to April. In 2022, fish infected with F. columnare and I. multifiliis were treated with formalin to prevent mortalities and allow the development of internal parasites. Conversely, in 2023, fish were not treated with formalin to determine the morbidity from F. columnare and I. multifiliis co-infections. The detection of F. columnare and I. multifiliis is a concern for out-migrating juveniles in the UKB and throughout the Klamath mainstem, as these two pathogens are expected to be exacerbated with climate change.

Successful manifestation of pre-spawn mortality intestinal disease in a novel juvenile model of spring Chinook salmon

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Pre-spawning mortality (PSM) is a major hindrance for population recovery of Chinook salmon in the Willamette River basin. Based on histopathology, we previously documented a strong correlation between intestinal lesions and PSM in Spring Chinook Salmon in Oregon. We previously called this Gut Senescence Syndrome (GSS), but a more appropriate designation would be Adult Salmon Enteritis (ASE). It also occurs in many fish that survive to successful spawn in the fall. The lesions are characterized by loss of epithelium with concurrent inflammation of the lower intestine and pyloric caeca. Current hypotheses for the cause of ASE include accelerated senescence of the intestine in sexually mature Chinook salmon due to time in the river as adults, suboptimal environmental conditions or a specific, transmissible agent. The latter is supported by our observations of the complete absence of ASE condition in spring Chinook adults in two other rivers in Washington.
We developed a novel in vivo laboratory model to replicate ASE in juvenile Chinook Salmon (approximately 5g) in the laboratory. To mimic sexually mature fish, we immune suppressed these fish with dexamethasone implants and fasting. We then challenged them with oral exposure to intestinal tissues from adult fish from the Willamette River with ASE. The study was conducted for 7 weeks, with histology and mortality endpoints. At this time (12/16/2023), we are still waiting for some histology slides to be processed. However, we observed the identical intestinal lesions in some treated fish at 1-month post-exposure, showing that ASE can be reproduced in the laboratory in juvenile fish. "

Session: Klamath and Great Basin Suckers

Klamath Falls National Fish Hatchery Operations and Overview
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The Klamath Falls National Fish Hatchery (KFNFH) was designated in 2022 and continuously develops collection, spawning, and rearing techniques. Increasing capacity and improving fish rearing has allowed for several changes and we will discuss those changes as well as future plans.
KFNFH has been collecting larval Lost River Suckers and Shortnose Suckers since 2016 with our first fish released in 2017 and have been increasing our efforts ever since, with the facility having a production goal of 60,000 a year and the capacity to grow larger fish when construction is complete. This goal requires us to explore new avenues through studies to improve institutional knowledge. These projects include, refining methods of larval collection and rearing, spawning of wild adults and broodstock, and implementation of a genetic management plan for broodstock. Diet studies are being conducted and analyzed to help maximize growth and production for both species. Extended grow out studies including net pen operations and off channeling rearing are continuing for a more natural hands-off approach to production and in-situ rearing. Finally, we will present current but ever-changing construction plans for facilities and increasing capacity.

The Klamath Tribes' assisted rearing and repatriation of endangered c'waam (Lost River sucker) and koptu (shortnose sucker) suckers in the Upper Klamath Lake watershed
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The c'waam and koptu are closely related endangered sucker species, endemic to the Klamath Basin. These species populations began declining in the late 1960's as a result of several factors including, but not limited to habitat loss, habitat alteration, poor water quality, and predation. Early life mortality and lack of juvenile recruitment to spawning events is seen to be one of the largest components contributing to the species' decline. The c'waam and koptu are culturally significant species to the Klamath Tribes in that they are historically a first foods resource since time immemorial, and furthermore, they are part of the Klamath creation story. The efforts from the Klamath Tribes Ambodat Department Fisheries Program, in collaboration with the Klamath Falls National Fish Hatchery, aim to supplement the c'waam and koptu populations via assisted rearing during their vulnerable life stages. The sucker captive rearing program implements two collection strategies: fluvial larvae collection and gamete collection from adults. Larvae are collected on the Williamson River, while gametes are collected from c'waam and koptu adults captured in nets set near fluvial and/or adfluvial spawning areas. Juvenile c'waam and koptu are then reared in tanks until swim bladders are developed, and then subsequently reared in holding ponds for about 2 years, or until large enough to evade most of the imminent predation in the wild. When the suckers are deemed an appropriate size, the suckers are released in the spring or fall largely to known spawning locations and tributaries within the Upper Klamath Lake watershed and the historical Klamath Tribes' treaty boundary area as of 1954. All released suckers have implanted PIT tags and locations are monitored by the local USGS sucker recovery scientists.

Klamath Sucker Capture and Relocation Effort Associated with the Klamath River Renewal Corporation Project

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The Klamath River Renewal Corporation (KRRC) is an independent nonprofit organization formed by signatories of the amended Klamath Hydroelectric Settlement Agreement (KHSA). The KRRC is part of a cooperative effort to remove four hydroelectric dams for the purpose of re-establishing a more natural riverine habitat on the Klamath River. Prior to the removal of the hydroelectric dams, Resource Environmental Solutions (RES), the lead restoration contractor of KRRC, prepared the California and Oregon AR-6 Adaptive Management Plan (subplan of the Aquatic Resources Management Plan) and led the effort to salvage listed sucker species from three reservoirs prior to the drawdown starting in 2024. The sucker salvage work focused on salvaging and relocating federally endangered Koptu and C'wamm, also known as the shortnose sucker (Chasmistes brevirostris) and Lost River sucker (Deltistres luxatus) from three reservoirs, Iron Gate, Copco, and JC Boyle, within the Lower Klamath Project (LKP) reach of the Klamath River. This effort was led by a large team of fisheries biologists in collaboration with state and federal government agencies as well as the Klamath Tribes and River Design Group Inc. The effort was 14 days of salvage and translocation of suckers for the LKP. Two crews deployed trammel nets by boat each night with two or three net sets for 2-3 hours each. All suckers that were captured were processed and held in net pens prior to transport. Water quality data was collected throughout the effort to ensure minimal environmental stress on the listed suckers. All suckers salvaged were transported to either USFWS Lower Klamath National Wildlife Refuge or Klamath Tribes Fish Hatchery rearing facilities. This talk will summarize the salvage relocation efforts that were completed in 2023.

Does release size into net pens affect survival of captively reared juvenile endangered suckers in Upper Klamath Lake?

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High juvenile mortality prevents recruitment into the adult populations of endangered Shortnose Sucker (Chasmistes brevirostris) and Lost River Sucker (Deltistes luxatus) in Upper Kamath Lake, Oregon. To address the lack of recruitment, the U.S. Fish and Wildlife Service implemented the Sucker Assisted Rearing Program (SARP). Managers developing the rearing program lack information about how length at release relates to survival. To determine how initial length affects survival of captively reared juvenile suckers, we introduced juvenile suckers from the SARP into three net-pens in Upper Klamath Lake. The juvenile suckers ranged from 102 to 284 mm standard length, and each fish was tagged with a passive integrated transponder (PIT) tag. Estimated survival over 57 days was high in all net-pens (0.79–1.00) and remained high at two net-pens for 76 and 86 days. Adjusted survival curves resulting from a stratified Cox model with standard length as a covariate, indicated that length positively influenced predicted survival by as much as 41% at one site. During the study, pH and dissolved oxygen regularly exceeded no-effect thresholds at two sites and briefly reached lethal thresholds at the same two sites but did not coincide with the observed mortalities. Slower growth and the lowest survival were observed at the third site, where water quality never exceeded thresholds. A larger release size and the location of the net-pen can improve the survivability of juvenile suckers in net-pens in Upper Klamath Lake.

Modoc Sucker - the path to recovery and beyond

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The Modoc Sucker (Catostomus microps) occupies small streams in the upper Pit River drainage of southern Oregon (Goose Lake Basin) and northern California. The species was federally listed under the ESA in 1985. Principal threats to the species included its limited distribution, habitat degradation, non-native predators, and possible hybridization with the more abundant Sacramento Sucker. Recovery of the species has included addressing specific threats, resolving perceived threats through research, surveying for additional populations, introductions to suitable secure habitat and community outreach. Private landowner cooperation has been and continues to be essential for securing access to populations, carrying out conservation actions and developing non-confrontational attitudes toward the Modoc Sucker and its conservation. At this time the distribution of Modoc Sucker is broader than at the time of listing, habitat conditions have improved, non-native species have been controlled, hybridization has been investigated with modern genetic methods not available at the time of listing and determined to not represent a threat, and landowner attitudes are generally supportive of conservation efforts. Getting there has involved collaboration between all parties, development of personal relationships and plenty of on-the-ground effort. The Modoc Sucker has also demonstrated its resilience over nearly 40 years of climatic variation. In December 2015 U.S. Fish and Wildlife delisted the Modoc Sucker. Stewardship is now the responsibility of the local community - biologists, agencies and private landowners. Continuing conservation projects (wholly unfunded) include distribution surveys, general monitoring of habitat

conditions, non-native species suppression, and natural history investigations, as well as simply keeping up relationships and awareness of this fine little fish in the community.

eDNA metabarcoding for the detection of sucker and other native species in the Goose Lake Basin

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Detection of native fish species is inherently difficult, especially in arid lands ecosystems that exhibit seasonal wetting and drying cycles and flashy streamflows. Traditional sampling approaches such as electrofishing, minnow traps, and fyke nets are costly and time consuming to conduct, and typically require a skilled field crew. eDNA metabarcoding offers a low-effort, minimally invasive approach that can be used in conjunction with or apart from traditional sampling methods. Although eDNA cannot yet be used to gauge absolute abundances of fish, it has been shown to improve detection for many fish species when compared to traditional sampling approaches alone. Here we present results from two field seasons' worth of eDNA sampling and electrofishing in the Goose Lake Basin. This terminal lake basin is home to two species of sucker: the endemic Goose Lake sucker (Catostomus occidentalis lacusanserinus) and the recently delisted Modoc sucker (Catostomus microps). We compared our findings from electrofishing and eDNA analysis using two sets of primers ("MiFish" and "Metameta") and found that eDNA doubled the number of sites at which suckers and some other minnow species were detected and allowed for sampling efforts at a much broader spatial scale. Suckers were patchily distributed in high and low elevation sites throughout the Basin in the Thomas, Drews, and Dry Creek watersheds. This is the first test of the novel "Metameta" primer set developed based on the Oregon Biodiversity Genome Project's assembly of mitochondrial genomes for all of Oregon's fishes. Although neither primer set could discern between the two sucker species, single-species eDNA could be used in future efforts to detect habitat differences between suckers and other native fishes.

Assessing the Relationship Between Warner Sucker Abundance and eDNA for Use as a Possible Monitoring Tool

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The use of environmental DNA (eDNA) has recently emerged as a cost-effective and efficient tool for assessing the distribution of aquatic organisms. Additionally, an increasing number of studies have shown promising correlation between the concentration of eDNA in environmental samples and the abundance/biomass of target aquatic species, suggesting eDNA could provide a rapid and cost-effective index of abundance for fisheries management with minimal impact on the target species. The threatened Warner Sucker is endemic to the low-gradient streams and lakes of the Warner Basin. Management and recovery of this species will likely require repeated assessments of the species population status in streams. We conducted a pilot study to assess the relationship between eDNA concentration and Warner Sucker abundance in pools of Twentymile Creek in the Warner Basin. We systematically collected and filtered 1-L water samples throughout individual pools and conducted qPCR to quantify the amount of Warner Sucker eDNA. Mark-recapture estimates were subsequently

conducted in the eight pools using a Huggins closed-capture estimator and the relationship between abundance and mean eDNA quantity was assessed with weighted linear regression. We found the quantity of Warner Sucker eDNA to be significantly positively related to the fish abundance (n = 8, R2 adj = 0.802, p =0.0018). The best model included only mean eDNA calculated from all six water samples per pool. There was equivalent support for a model that also included mean weight (g) of captured suckers in each pool (delta AICc = 2.4), but not for abiotic factors (streamflow, pool size). There was high variability in eDNA quantity among samples within a pool, and our results suggest that a minimum of six water samples per pool may be required to accurately assess abundance through the collection of eDNA.

Session: eDNA

Exploring Lamprey Habitat Relationships: A Dual-scale Analysis in the Goose Lake Basin

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Lamprey are an ancient group of fishes which have been historically overlooked despite their ecological and cultural value. Although growing recognition for the species, particularly in areas such as Oregon which is home to roughly a quarter of all lamprey species, has helped generate interest in filling some of the many knowledge gaps.

Goose Lake Basin, an endorheic system found in a transition area between the south Cascades and northern Great Basin is home to two native species. The area hosts several unique species including 9 native fishes, yet is under threat due to climate change, fragmentation, and habitat degradation.

This study aimed to investigate habitat preferences for larvae of both species through a site level analysis(logistic) based on community oriented efish and habitat data collected in 2023, and a species distribution model for lamprey through a spatial stream network analysis (logistic) based on compiled efish/eDNA collected since 2007 and geospatial habitat data.

The site level analysis found that metrics such as percent riffles, fine substrate, slope, and canopy cover were more associated with lamprey presence compared with stream depth/width, or woody debris. The spatial distribution analysis identified canopy cover, upstream canopy cover, agricultural land use, upstream area, and slope as useful predictors throughout the basin. Additionally, the spatial autocorrelation evident among locations was incorporated into the model to provide more accurate predictions.

By combining insights from these complementary analyses, this research begins to fill broad level questions regarding habitat associations and potential distribution of lamprey throughout the basin. These findings contribute valuable information for future research and conservation efforts aimed at lamprey in the area.

Monitoring the relative abundance of Bull Trout in Oregon's North Fork Malheur core area using environmental DNA

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Environmental DNA (eDNA) analysis is a sensitive, cost-effective, and non-invasive method for assessing presence-absence of species of interest. Recent research indicates that the quantity of DNA amplified from an environmental sample may correlate to the relative abundance of the target species. Bull Trout (Salvelinus confluentus) is a federally listed char that is native to Oregon. The North Fork Malheur Bull Trout core area is the highest priority for conservation in Oregon, primarily because adult Bull Trout in this area exhibit several life histories (adfluvial, fluvial, and resident) and Brook Trout (S. fontinalis) are not present in critical habitat. Currently, annual spawning ground surveys are used to monitor abundance of Bull Trout in this core area. Herein, we present the objectives, design, and expected results of a study to assess the use of eDNA to monitor relative abundance of Bull Trout in the North Fork Malheur core area. We established 34 eDNA sample sites at approximately 500-meter intervals in the North Fork Malheur River and three headwater tributaries (Little Crane Creek, Sheep Creek, and Swamp Creek). Samples will be collected from sites twice annually in 2023 and 2024 with the first sampling season occurring in June and the second sampling season occurring in August. Based on the life history diversity present in this basin, we expect that DNA quantities in June samples represent abundance of juvenile and resident adult Bull Trout while quantities in August samples represent abundance of juveniles, resident adults, and migratory adults. We expect to observe a larger increase in eDNA quantity between June and August samples from sites where more redds are observed during September spawning ground surveys. Additionally, backpack electrofishing and snorkeling surveys will be completed in select locations to investigate if eDNA quantity is a function of Bull Trout abundance and spatial distribution.

Environmental RNA (eRNA) distinguishes sex and maturity in tanks containing Pacific Lamprey: results from a common garden experiment

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Unlike environmental DNA (eDNA), which typically infers the presence of aquatic organisms at the species level, environmental RNA (eRNA) has the potential to infer the presence of phenotypes at the population level (e.g., sex and maturity). We designed six qPCR assays for genes expressed in the gonad to test whether we could detect eRNA from sexually mature male Pacific Lamprey to develop eRNA as a tool for mapping spawning habitat. We implemented a “common garden” experiment following a factorial design by placing lamprey of known sex and maturity into tanks of water and sampling for their eRNA. To establish possible eRNA sources, we verified gene expression in three tissue types: gonad, gill, and liver. As expected, gene expression was significantly highest in the gonad of sexually mature males, with a 1.00- to 3.00 (ng/ul)-fold increase in gene expression. We detected eRNA in all 15 tanks and from all genes, though not every gene was detected in each tank. A Bayesian model estimated that for the gene SPATTA22_1, the mean eRNA concentration (ng/ul) in tanks containing sexually mature males was associated with a gene expression rate 30 times higher than any other combination of sex and maturity. However, the lower 98% confidence interval (5.87E-08; 95%CI: 1.49E-08, 1.54E-07) overlapped the upper limits of indeterminate larvae and juvenile males. Notably, the model indicated that both the half-life of eRNA in tanks and the eRNA extraction efficiency were exceptionally low, with a half-life of 12 minutes (3.48 to 31.2 minutes) and a mean efficiency of 0.29 (SD=0.25). To harness the power of eRNA, efforts should focus on improving extraction efficiency and consider the inherent high degradation rate of RNA

in the environment. Secondly, careful gene selection is paramount and should focus on genes expressed in tissues with significant environmental exposure and substantial upregulation (>3-fold).

Monitoring Chum Salmon Returns to the Lower Columbia River with eDNA

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Historically, Chum Salmon (Oncorhynchus keta) returned to the Lower Columbia River (LCR) to spawn in both Washington and Oregon tributaries, but overharvest and spawning habitat degradation caused populations to decline during the 20th century. Because of these declines, the LCR evolutionary significant unit was listed on the Endangered Species Act as Threatened in 1999. Today, the most robust Chum Salmon populations occur on the Washington side of the LCR, while most Oregon populations are functionally extirpated. Reintroduction efforts in Oregon are ongoing and supported by a conservation broodstock, habitat restoration projects, and outreach aimed at increasing awareness of Chum Salmon status in the state. These efforts are primarily focused in the coastal region where most individuals return to spawn volitionally. However, monitoring and outreach are needed in the other recovery populations, especially as reintroduction efforts expand. Environmental DNA (eDNA) is an effective way to determine the presence or absence of rare species in a system without the laborious efforts and costs associated with physical surveys. Furthermore, eDNA sampling techniques are simple and easily repeatable by non-experts, making the method a useful educational tool for a wide variety of stakeholders. Lastly, when eDNA samples are stored properly, they can be analyzed years after collection has occurred, making them useful for future projects. With the recent large returns of Chum Salmon to the LCR (2020–2023), it is likely that Chum Salmon distribution is expanding into areas where they have not been encountered by the public for decades. Thus, we created an eDNA monitoring program for Chum Salmon in the cascade region; partnered with local watershed councils, soil and water conservation districts, and local non-profits to source volunteers for sampling; and used results to help guide potential habitat restoration projects and reintroduction planning for Oregon Chum Salmon populations.

How to catch a parasite: using eDNA to track salmon pathogens and the invertebrate host

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Two myxozoan pathogens, Ceratonova shasta (Cs) and Parvicapsula minibicornis (Pm), are obligate parasites that cause disease in salmon in the Pacific Northwest. They require an invertebrate host, Manayunkia occidentalis (Mo, annelid), to complete their complex life cycles and are transmitted as waterborne spores. In this 3-year study, we used water sampling and quantitative PCR to track both parasites and their invertebrate host. Study sites (n=6)in the Klamath River's hydroelectric reach (currently inaccessible for salmon) were selected to collect baseline data and inform disease risk for returning anadromous salmon post-dam removal. Water was sampled from the river in 6 replicates of 1L monthly over ~6 months in 2021-2023. Samples were split; half filtered to collect spores (5µm) and the other half for DNA fragments (0.22 µm), then assayed against a reference to quantify spores/L (Cs and

Pm) or copies/µL (Mo). Each year, the Cs spores/L peaked later in the season, with the highest mean counts measured in late summer. The threshold value of 10 Cs-spores/L (which corresponds with 40% mortality in Chinook salmon) was exceeded at only 1 site during October in 2022, but counts above this threshold were detected in 6 samples in 2021 and 10 samples in 2023. A similar threshold value is not yet known for Pm. High spore counts for Pm (top 5%) were recorded in June through October, for all three years, 2021-2023. The eDNA approach for Mo was compared with traditional snorkel/SCUBA surveys and at each site where annelids were observed, we detected Mo eDNA in water samples. This study demonstrates that both myxozoans and their invertebrate host are present in the hydroelectric reach and provides baseline data for potential hotspots (parasites and hosts) that should be considered when undertaking restoration projects following dam removals.

Session: Marine Fishes

Evaluating a Semi-Pelagic Longline in Reducing Catches of Yelloweye Rockfish in the eastern North Pacific Ocean Halibut Fishery

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In commercial fisheries, the bycatch of non-targeted species results in a loss of income for commercial fishers, a loss of diversity, and negatively affects both the sustainability of the fishery and the ecosystem. The bycatch of yelloweye rockfish (Sebastes ruberrimus)—a species rebuilding from being overfished—can impact the catch efficiency of Pacific halibut (Hippoglossus stenolepis) in the eastern North Pacific Ocean Pacific halibut longline fishery. With the goal of reducing the catch of yelloweye rockfish without affecting the catch rate of Pacific halibut, we designed a semi-demersal longline that we fished for 8 days near the Heceta banks off the Oregon coast on the R/V Pacific Surveyor. Several floats at different points along the groundline elevated the hooks such that hooks were elevated in the water column from the seafloor up to an altitude of 14 m. Altitude was estimated by comparing depth recorders situated along the longline to the bottom depth measured by vessel instrumentation. We paired 12 experimental sets of this semi-demersal gear with 12 control sets of traditional longline gear. One notable result was that the semi-demersal longline reduced the catch of both yelloweye rockfish and Pacific halibut. Hook timers were placed on 12% of the hooks to determine time of catch. We found that the difference in average time of catch between yelloweye rockfish and Pacific halibut was not significant. We also recorded the location of hook set in each fish caught.

Predictive species distribution modeling of Yelloweye Rockfish (Sebastes ruberrimus) in Oregon's rocky reefs.

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Rockfish are critical mesopredators that play key roles in both marine ecosystem dynamics and recreational and commercial fisheries. However, since Oregon's rockfish fishery collapsed in 2002, one species' ecological and economic functions have remained severely depressed: Yelloweye Rockfish

(Sebastes ruberrimus). This fish's true population size has remained elusive due to the complexity of their preferred habitat and survey accessibility. Without accurate abundance estimates, resource managers cannot effectively regulate fishing industries or support functioning ecosystems. We propose to address this knowledge gap by mapping the distribution and abundance of Yelloweye Rockfish across Oregon's territorial seas with associated environmental data, using novel remote camera sensing technology that can survey rocky reefs without disturbing the habitat or removing sensitive species. This effort could then be used to inform future stock assessments of this species. To do this, we will create a predictive species distribution model (SDM) by coupling video camera derived abundance and density data with oceanographic and habitat data. The video lander data was collected by the Oregon Department of Fish and Wildlife from 2009 to 2021. The collated oceanographic data will be sourced from NOAA databases. While methods to conduct species distribution models are well established, applying in situ video lander data is an emerging application in marine ecosystems. The extension of remote camera surveys represents an important step forward in improving our knowledge of spatial ecology and resource abundance for marine species. The results of this research may be used to better manage Yelloweye Rockfish rebuilding efforts, guide fishers in better managing their quota in the mixed stock groundfish fishery, and to guide future monitoring efforts in rocky reefs off Oregon's coast. In this presentation I will discuss how SDMs are used in marine systems, the results of my research, and the collaboration needed for a successful project.

Impacts of Increasing Temperatures on Early Life History Stages of Tiger Grouper (Mycteroperca tigris) from Little Cayman, Cayman Islands

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The early life history stages of fishes are typically the most sensitive to environmental change, particularly with regard to temperature. With ocean temperatures projected to increase over the next fifty years, documenting the development of larval fishes is crucial to understand how these changes will affect population dynamics. Tiger Grouper (Mycteroperca tigris) is an economically and ecologically important reef fish distributed throughout the Caribbean that aggregates to spawn during colder winter months. We collected fertilized eggs from spawning events from the west end of Little Cayman, Cayman Islands, using established techniques from the Grouper Moon Project, and reared embryos and larvae at 25°C and 27°C (within current temperature variability) and 29°C and 31°C (within predicted elevated temperatures in the next 100 years) for up to eight days. Embryos and larvae were photographed, and measurements of various morphometrics were taken (i.e., standard length, total length, oil globule diameter, yolk sac diameter, body depth, etc.). Rates of egg ascension (e.g. buoyancy) for various eggs groups at different hours post fertilization were measured. We also compared our data to those previously collected for Nassau Grouper (Epinephelus striatus) to understand relative species' adaptability to changing environmental conditions. This project sought to describe early life history stages of Tiger Grouper and assess the impacts of various rearing temperatures on the development of early life history stages of Tiger Grouper. Along with this, Tiger Grouper development was compared to the development of Nassau Grouper reared across similar temperature profiles. Lynn Waterhouse (Scripps Institute of Oceanography), Bryce Semmens (Scripps Institute of Oceanography), Christy

Pattengill-Semmens (REEF), and Bradley Johnson (Cayman Islands Department of Environment) have played key roles in the success of this project.

The influence of upwelling-induced hypoxia on the abundance of larval fishes (Clupeiformes, rockfishes), their predators, and prey in the northern California Current

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In the northern California Current, hypoxia occurs on the shelf seasonally as a result of oceanographic and biogeochemical processes. Marine hypoxia threatens planktonic organisms, including the early life stages of fishes, through the reduction of oxygenated habitat, and can result in altered abundances and vertical distributions. Despite the potential for such drastic changes, there have been few studies that have quantified fine-scale effects of hypoxia on plankton abundances and distribution, in this region or globally. We used a towed in situ plankton imager (In Situ Ichthyoplankton Imaging System, ISIIS) with concurrent environmental sensors (e.g., dissolved oxygen, CTD) to sample plankton in inshore regions of the northern California Current in 2016, and 2018-2022. Individual random forest models were formulated for the abundance of larval fishes (Clupeiformes, Sebastes), and representative predators and prey, with the measured environmental values as the explanatory variables. Variable importance was calculated using permutation, and accumulated local effects plots were used to qualitatively describe the influence of oxygen and depth on plankton abundance. Interpolated plots for representative transects illustrate the relationship between oxygen and depth on the abundance of each group. Our results demonstrate that the influence of hypoxia on plankton groups is highly taxon specific, with Clupeiformes showing high abundance even in low DO waters, and the abundance of Sebastes increasing with oxygen. Predators (chaetognaths, Physonect siphonophores) showed a potential tolerance to hypoxia, while prey groups (appendicularians, copepods) had variable responses. The alteration of abundances and distributions of larval fishes and their predators and prey has the potential to restructure the planktonic food web, with ramifications for the coastal ocean ecosystem.

Spatial and Temporal Assessment of Vertically Migrating Myctophids as Biotransporters of Microplastics to Mesopelagic Food Webs

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Microplastics and semi-synthetic particles (<5 mm) pervade the marine environment, with their ingestion by marine fishes eliciting global concern. While fish exposed to microparticles in a laboratory setting have exhibited both sub-lethal and lethal effects, the diversity in material, morphology, and size of these contaminants in the ocean make it challenging to pinpoint the risks to wild organisms. Highly abundant, vertically-migrating myctophids play a crucial role in nutrient cycling between the epi- and mesopelagic zones, but may also serve as significant conduits for dispersing surface microparticles throughout the food web. Here, I examined the digestive tracts of newly-caught and museum-archived myctophids from the Northern California Current to determine (a) if myctophids caught closer to a presumed point source (i.e., Columbia River mouth) ingest more microplastics, and (b) if microplastic

ingestion has increased over time. The myctophids used in this study were provided by the Burke Museum, Scripps Institution of Oceanography, and NOAA Fisheries. There was no relationship between microplastic consumption and distance from the river mouth or differences between the stations. However, body depth (a proxy for size) and water temperature exhibited a significant, positive association in the best-fit model. The number of microplastics extracted from museum specimens sampled throughout the Pacific did not indicate an overall increasing presence trend over time, but a detailed analysis by geographic region identified a positive trend in microplastics presence for those myctophids captured near the continental United States. Approximately 30% of all specimens analyzed contained microparticles (~21% synthetic and ~79% anthropogenically modified), suggesting that myctophids are likely multidirectional transporters of these particles in Northern California Current food webs, with potential impacts on fisheries and human food systems.

Working better together to save a Caribbean marine icon.

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The Grouper Moon project, a conservation effort aimed at recovering an iconic Caribbean species, is a collaboration between the Reef Environmental Education Foundation and the Cayman Islands Department of Environment, in partnership with Scripps Institution of Oceanography and Oregon State University. This 2+ decade effort, aimed at the recovery of the IUCN Red-list Critically Endangered Nassau Grouper, is arguably now one of the most successful marine conservation projects in the entire Caribbean. This is in large part due to the strong partnerships, extensive collaborations, and substantial teamwork that formed and endured throughout the entire project history. The GMP now provides a template for conservation success on small islands; its results have been incorporated into Caymanian national conservation law and in UN-chartered regional fishery management plans, and the GMP was the recipient of the 2021 AFS William E. Ricker Resource Conservation Award. Here we detail how the project launched, how project partners came together to co-lead this effort, and how all involved worked better together to achieve the success that we've realized today. Alli Candelmo (REEF), Bradley Johnson , Phil Bush, Tim Austin, and Gina Ebanks-Petrie (CIDOE), and Leslie Clift (NOAA) have played key roles in the project success.

Adjusting the Scales: Localizing a National Framework for Equity and Environmental Justice to fit Oregon's Marine Fisheries

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In 2023, NOAA Fisheries released its first-ever national Equity and Environmental Justice Strategy. This sweeping report was created using extensive input from NOAA Fisheries staff and engagement with the public. The document serves to guide the agency as it focuses on serving all communities more equitably and effectively. The strategy it outlines includes three main goals and six corresponding objectives that are grounded in well-established social science concepts and fit to the context of NOAA Fisheries multiple service areas. The strategy charts the path the agency will take to incorporate equity and environmental justice into the services they provide to all communities at regional and programmatic levels. However, this framework can also serve as guidance for state and local fisheries scientists and

managers as they approach and perform their own partnerships, collaboration, and teamwork. This presentation argues that being "Better Together," as the theme of the 2024 ORAFS conference suggests, requires renewed considerations for equity and environmental justice. This presentation provides an overview of NOAA Fisheries Equity and Environmental Justice Strategy to support these considerations. Further, the presentation provides practical examples of how these considerations can be scaled to fit a suite of applications in the context of Oregon's marine fisheries science and management. The presentation offers an encouraging approach to reflexive, equitable, and effective partnerships, collaborations, and teamwork that redefine what it means to be "better together."

A tale of two surveys: Comparing two bottom trawl surveys examining young-of-the-year groundfishes in nearshore trawlable habitats

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Understanding the abundance and distribution of groundfishes is necessary for successful fisheries management. Many groundfish species spend at least part of their life cycle in nearshore habitats (continental shelf shoreward of 200 m depth). However, assessing groundfish species assemblages in nearshore habitats can be limited by the small size of early life history stages and the inaccessibility of the innermost nearshore (<55 m depth) to vessels employed in trawl surveys. To help improve the current understanding of nearshore assemblages, we compared catches from two spatially overlapping surveys. One is the West Coast Groundfish Bottom Trawl Survey (WCGBTS). The other is an ad-hoc beam trawl survey along the Newport Hydrographic Line. Our objectives were to evaluate the representativeness of nearshore fish communities in the WCGBTS and to assess if additional nearshore sampling would enhance the WCGBTS. We found significant differences in fish assemblages, oxygen, temperature, and salinity based on depth, season, year, and survey type. The WCGBTS is well-suited for sampling subadult and adult groundfishes in trawlable habitat. However, gear type and sampling location make the beam trawl survey better suited for sampling smaller individuals and species that live at shallower depths. The two most commonly occurring species in the beam trawl survey were Pacific sanddab (Citharichthys sordidus) and English sole (Parophrys vetulus), while the two most common in the WCGBTS were rex sole (Glyptocephalus zachirus) and Dover sole (Microstomus pacificus). The catch from the beam trawl survey had a mode standard length of 2 cm, contrasted with the WCGBTS' mode length (all length types combined) of 22 cm. We found that there is a transition in species assemblages where the WCGBTS ends (~55 m). Thus, while the surveys overlap in some capabilities, this analysis shows that a nearshore survey would complement the WCGBTS, providing an enhanced characterization of groundfish assemblages.

Decadal-scale variation in juvenile salmon growth in the Northern California Current (2000 – 2022)

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Early summer indices of growth for juvenile coho and Chinook salmon collected in the Northern California Current underwent a step-change between 2009 and 2012. Mean insulin-like growth factor 1

(IGF1) levels (an indicator of growth) differed significantly over succeeding decadal intervals (2000 – 2009 vs 2011 – 2022) with IGF1 levels since 2010 being consistently higher than found before 2010. Across the time series, IGF1 levels were correlated with a prey index for juvenile salmon derived from plankton samples collected in the upper water column during juvenile salmon surveys. There are no apparent correlations between juvenile salmon growth and basin-scale oceanographic indictors including the PDO, NPGO or ONI. Neither is there a correlation between juvenile salmon growth and upper water column temperatures concurrent with the survey. These data don't easily fit with current paradigms suggesting that variation in juvenile salmon growth and survival is correlated with California Current ecosystem productivity driven by variation in basin-scale ocean processes indexed by the PDO or ENSO. Indeed, the highest IGF1 level measured in the time series were found during the 2016 El Nino. Ecosystem processes underlying decadal-scale increases in growth of juvenile salmon since 2010 are not yet apparent.

Session: eCreel

An overview of Electronic Licensing Data in Oregon

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Beginning in 2019 the Oregon Department of Fish and Wildlife implemented a new recreational electronic licensing system (ELS) that allows anglers to choose whether they print their licensure on paper or keep it available electronically on a smartphone application. Anglers using the smartphone application must record their salmon and steelhead harvest on an electronic harvest card (etagging), analogous to the printed cards required by anglers with paper credentials. However, unlike fish reported on paper harvest cards, etagged fish are automatically uploaded and saved within agency databases. In contrast, paper harvest cards are voluntarily returned, often with incomplete, incorrect, or unreadable information. In addition to providing angler harvest, the new system contains license sales data, and information on angler demographics that can be used to indirectly examine effort shifts, temporal trends in the composition of out-of-area versus local anglers, and other statistics relevant to fisheries management, such as regulatory compliance. However, like any new data source, the system also propagates bias through known misreporting problems, angler compliance issues, and nuances within fishing regulations. This presentation will provide an overview of the data contained within the system, potential management applications for each data set, and examples of how erroneous conclusions can be made without fully considering the limitations within the dataset. Alternative methods, such as hybrid e-creels relying on mark recapture methodologies, will also be introduced as a potential way to mitigate some of the identified problems explored within the presentation.

e-Creel: A Novel Approach for Estimating Salmon Harvest

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In 2019, the Oregon Department of Fish and Wildlife began implementing an Electronic Licensing System (ELS) to effectively administer licenses and harvest tags for anglers, enhance regulatory enforcement, and reduce operating costs. Subsequently, Pacific Salmon Treaty (PST) researchers and managers in

Oregon are now able to attain expeditious, cost effective, and confident estimates of Chinook Salmon harvest through the development of e-Creel. The PST is an agreement between the United States and Canada with the intent to protect, conserve, and manage harvest of transboundary salmon stocks subject to both U.S. and Canadian fishing pressure. The 2019-2028 PST Agreement, Chapter 3, includes provisions for Individual Stock Based Management (ISBM) fisheries to be based on Calendar Year Exploitation Rate (CYER) metrics. One feature of the CYER metric is a need for estimates of differential harvest between the Escapement Indicator stock (EIS) within an aggregate and the representative Exploitation Rate Indicator stock (ERIS), represented through annual releases of 200,000 ad-clipped and coded-wire-tagged (CWT) Chinook Salmon from the Salmon River (North Oregon Coast aggregate) and Elk River (Mid-Oregon Coast aggregate). An e-Creel design incorporates capture-recapture techniques and produces harvest estimates of both EIS and ERIS populations with increased precision. Additionally, an e-Creel results in greater CWT recovery rates and is less expensive than traditional creels due to the exclusion of effort counts. This presentation will provide an overview of harvest estimation using the agency's new e-Creel methodology and illustrate how it is improving salmon management under the PST.

Building a better mousetrap: Incorporation of electronic licensing data in the Columbia River to estimate salmon harvest

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Creel surveys are an essential tool in the management of fisheries but are logistically challenging and time intensive. The Columbia River is home to several iconic salmon and steelhead fisheries that provide geographic and scope challenges to estimate harvest and manage quotas. The "Zone 6" fishery extends from Bonneville Dam to McNary Dam, covering approximately 144 river miles in three distinct reservoirs: Bonneville, The Dalles, and John Day. When this large sample area is paired with limited staff, managers are presented with a substantial challenge to collect sufficient data to base management decisions. Electronic creel (e-creel) may present a technology to augment existing 'paper' based creel surveys. Oregon Department of Fish and Wildlife (ODFW) implemented a pilot study to assess the efficacy of an e-creel methodology (Riggers and Jones 2022) that uses data collected in ODFW's Electronic Licensing System alongside a roving-access creel methodology. Creel samplers asked anglers whether harvested salmon and steelhead were tagged electronically (vs. the traditional paper method). The results of creel surveys were assessed using two models for three seasons of Chinook Salmon, one season for Coho Salmon, and one season for Sockeye Salmon in 2023. Results are preliminary but continued data collection may eventually provide managers valuable additional information, and may ultimately be incorporated in recreational harvest estimation methodologies. Additionally, this study will provide an estimate of the cost to implement an e-creel study relative to the additional data obtained. In total, this preliminary work may serve as a framework to enhance existing efforts to monitor harvest and improve management tools needed to monitor catch quotas for these socially, culturally, environmentally, and economically valuable species.

Accounting for Potential Sources of Error in e-Creel and Validation of a Novel Methodology Using an e-Creel Expansion Value to Estimate Harvest for Inland Fall Chinook in Northern Oregon Coastal Basins

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An e-Creel uses a combination of in-person creel interviews and Electronic Licensing System data to generate precise estimates of fall Chinook harvest for basins in which an e-Creel is conducted. A capture-recapture equation is used to generate harvest estimates and certain assumptions of immediate, compulsory tagging as well as accurate reporting of harvest within the Electronic Licensing System (ELS) are required; assumptions of compliance and location were examined. Anglers often incorrectly electronically tag fish as an ocean harvested fish when the fish was harvested inland (estuary or river). A non-compliance rate and marine location code error rate were generated. Marine location code error rates were examined, and these error rates differ by basin and year. The Coastal Chinook Research and Monitoring Program annually conducts e-Creels in the majority of the Pacific Salmon Commission Escapement Indicator Stocks and Exploitation Rate Indicator Stocks located in Oregon. A novel methodology using an e-Creel expansion value (i.e. harvest index) was used to generate harvest for additional Northern Oregon Coast basins. An e-Creel was conducted in three basins in which e-Creels are not routinely conducted to determine the effectiveness of this novel method. Annual harvest indexes (e-Creel expansion values) produce relatively precise basin specific estimates of harvest for all northern inland salmon stocks. Complications arise from marine location error rates which could be reduced with corrections to the ELS app used to electronically tag fish as well as educational efforts. Non-compliance rates need to be further evaluated to determine spatial and temporal variation.

e-Creel and ELS Applications and the Impacts of Regulation Changes

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There were regulation changes to Inland fall Chinook Salmon fisheries in 2022 and 2023. Major Chinook Salmon fisheries were closed or restricted to mark selective fisheries for conservation measures in 2022. Multiple basin specific bag limits were reduced in 2023. Electronic creel questions and Electronic Licensing System (ELS) data provided insight into shifts in angler harvest related to regulation changes. These shifts were examined by angler type (guided boat, private boat, and shore anglers) and shifts differed by basin. Harvest data analyses demonstrated regulatory non-compliance, particularly when it came to fisheries open specific days of the week. However, causes for non-compliance, such as deliberate poaching, confusion over regulation, etc., were outside the scope of this study. Harvest shifts suggested that changing one regulation can directly impact fisheries in basins with less restrictive regulations. In areas with conservation concerns, these interdependencies may lead to potential unintended consequences that put fishery management objectives at risk of failure. Ultimately, no regulation change or area operates in isolation and the complexity of regulations can result in unanticipated harvest. When regulation changes occur, e-Creel can be a tool used to monitor any unpredicted impacts to neighboring basins, allowing managers the opportunity to react with dedicated conservation measures, such as seasonal closures, or quota fisheries.

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

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

Session: Harvest Management

Real-Time Management: Using In-Season Technology to Manage Chinook Salmon Fisheries in Idaho
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Returns of hatchery-origin spring/summer Chinook Salmon to Idaho’s Clearwater, Snake, and Salmon rivers provide popular, highly utilized sport fisheries. Adult returns of specific hatchery stocks in excess of broodstock needs are split evenly into “harvestable shares” between sport anglers and tribal fishers. These fisheries are generally highly utilized and when the harvest shares are low and catch rates are high, harvestable shares can be reached quickly, forcing fishery closures. To maximize the number of fish available for harvest while maintaining broodstock needs, stock-specific returns are monitored and expanded in-season using PIT tag detections as fish ascend the ladders, first at Bonneville Dam, and then again at Lower Granite Dam. Additionally, return estimates for some stocks are further refined using in-season genetic tools. Harvest is monitored and estimated weekly using either mandatory check stations or intense roving creel surveys. All information is summarized and shared weekly via a teleconference call amongst regional partners to maximize coordination of harvest, broodstock collection, and impacts on wild stocks, resulting in streamlined management of these high-intensity, popular fisheries.

Do we need to change the way we collect landings data for recreational fisheries?
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Harvest data are collected to aid fisheries management decisions. Real time monitoring of quota-managed fisheries (including both catch and discards, i.e. bycatch) is vital to avoid exceeding quota. The Oregon Department of Fish and Wildlife’s (ODFW) Oregon Recreational Boat Survey (ORBS) currently utilizes 26 port samplers to collect these data for recreational fisheries along the Oregon coast, primarily via in-person interviews conducted when boats return to port. Catch can be measured directly, but accurate monitoring of bycatch requires (1) anglers accurately identify released species and (2) remember what they released. Due to event recall biases and variability in species ID skills, this can

introduce a high degree of uncertainty in recreational fisheries data. Electronic monitoring, which exists in the commercial fleet, may increase accuracy, and decrease labor for recreational fisheries monitoring. In this study, we tested the accuracy and feasibility of utilizing stereo-video photogrammetry as a form of electronic catch monitoring for the recreational charter fleet. The stereo-video system was tested during hook-and-line surveys on chartered recreational fishing boats with the ODFW Marine Reserves Program. During these surveys, we recorded all fish caught during the charter trips via stereo-video. We then compared the accuracy and total effort of the stereo-video methodology against traditional methods of collecting size, length, and species composition data.

Visual and Genetic Stock Identification of a Test Fishery to Forecast Columbia River Spring Chinook Salmon Stocks Two Weeks into the Future

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Modern fisheries management strives to balance opposing goals of protection for weak stocks and opportunity for harvesting healthy stocks. Test fisheries can aid management of anadromous fishes if they can forecast the strength and timing of an annual run with adequate time to allow fisheries planning. Integration of genetic stock identification (GSI) can further maximize utility of test fisheries by resolving run forecasts into weak- and healthy-stock subcomponents. Using five years (2017 – 2022) of test fishery data, our study evaluated accuracy, resolution, and lead time of predictions for stock-specific run timing and abundance of Columbia River Spring Chinook Salmon (Oncorhynchus tshawytscha). We determined if this test fishery 1) could forecast at coarse stock resolution utilizing visual stock identification (VSI) that classifies Spring Chinook Salmon into "lower" versus "upriver" stocks intercepted prior to when they split into two major upstream destinations, Willamette Falls (Rkm 196, "lower stock") and Bonneville Dam (Rkm 234, "upriver stock") and 2) could be enhanced with GSI to forecast at higher stock resolution. VSI accurately identified coarse stocks (83.3% GSI concordance) and estimated a proxy for abundance (catch per unit effort, CPUE) of the upriver stock in the test fishery that was correlated ($R^2 = 0.90$) with Spring Chinook Salmon abundance at Bonneville Dam. Salmon travel rates (~8.5 Rkm/day) provided predictions with two-week lead time prior to dam passage. Importantly, GSI resolved this predictive ability as finely as the hatchery broodstock level. Lower river stock CPUE in the test fishery was correlated with Willamette Falls abundance ($R^2 = 0.62$) but could not be as finely resolved as achieved for upriver stocks. We described steps to combine VSI and GSI to provide timely in-season information and with prediction accuracy of ~12.4 mean absolute percentage error and high stock resolution to help plan Columbia River mainstem fisheries.

Monitoring and trends in the Buoy 10 recreational salmon fishery in the Columbia River estuary

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The Buoy 10 recreational salmon fishery in the Columbia River estuary is a popular destination for anglers from the Pacific Northwest and around the world. This fishery at the mouth of the Columbia River originated in the late 1930s and has been monitored and reported on since 1946. The Buoy 10 fishery was distinguished from the ocean fishery in 1982 and has been monitored and reported

separately since then. This section of the Columbia River is managed jointly by Oregon and Washington Departments of Fish and Wildlife who aim to provide sustainable fishing opportunities while balancing conservation needs. Pre-season management plans are developed for the fishery each year depending on annual salmon run-size forecasts. Currently, the most sought after species in this fishery are Chinook Salmon Oncorhynchus tshawytscha and Coho Salmon Oncorhynchus kisutch. Similar to other mixed-stock fisheries, Buoy 10 managers face challenges like avoiding over-exploitation of stocks listed under the Endangered Species Act, adhering to allocation agreements between recreational, commercial, and tribal fishers, and being mindful of apportionments for other sections of the Columbia River. Fisheries managers rely on fisheries monitoring data to make in-season regulation changes if necessary. To accurately represent the fishery, fisheries monitoring requires sufficient sampling rates and coded wire tag recoveries. In this presentation we will describe Oregon's current methods for monitoring the Buoy 10 recreational salmon fishery, implemented improvements and future monitoring considerations. We will also describe trends in harvest, effort, and angler types. Partnerships between programs and agencies remain critical to ensuring tailored fisheries monitoring with robust, accurate data integral to effective fisheries management. In the face of a changing climate, fisheries may become more challenging to predict and manage; continued and evolving fisheries monitoring programs will aid in understanding new dynamics and variability.

Managing Myths of the Columbia River Fisheries

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Management of a complex resource system such as the Columbia River fisheries often inspires some level of misinformation or myth. From rumors of fishery depletion to beliefs on new alternative gear programs, misleading information about our policies generate confusion from the public and our partners. A goal of the Columbia River Management Unit of the Washington Department of Fish and Wildlife is to address these myths head on and ensure that our stakeholders have the best information about our management processes. We generate a serious of commonly heard misconceptions about Columbia River management and provide the truths buried behind these myths. Through clearer and frequent communication with stakeholders, the achievement of our management and conservation goals can be made easier.

Co-Management of Columbia River Treaty and Non-Treaty Fisheries

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The history of co-management of treaty and non-treaty Columbia River fisheries under the U.S. v. Oregon Court case and its associated Management Agreements has provided numerous benefits to both the fish resource and the treaty and non-treaty resource users. Columbia River fisheries are intensively managed and the Co-management processes developed under the U.S. v. Oregon Court case have helped bolster the scientific and technical processes and have helped improve the ability of all the parties to fairly share the resource. It has been especially important to protect and enhance treaty

protected fishing rights and has also helped improve how fisheries fit into overall conservation and rebuilding objectives.

Steelhead management: A story of Who's on first, What's on second, and I Don't Know's on third.
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Wild summer steelhead populations in the Columbia River are depressed relative to historical abundances. The prohibition on commercial sales in non-tribal fisheries has been in place since the mid-1970s and mainstem recreational fisheries have allowed only retention of hatchery-origin fish since the mid-1980s. Additionally, wild Columbia River summer steelhead are currently protected under the federal Endangered Species Act (ESA). However, impacts to these stocks do occur through incidental catch and release mortalities in commercial fisheries and in recreational fisheries targeting salmon and/or hatchery steelhead in the mainstem Columbia River. Columbia River fishery managers are required to determine ESA impacts on wild summer steelhead populations with limited direct stock-specific information. I will describe how managers use data collected at the Bonneville Dam sampling facility to model stock composition of non-retained steelhead in Columbia River fisheries.

When spring Chinook are not spring Chinook: Using indexes of abundance in management of complex mixed-stock fisheries
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Commercial, recreational, and tribal fisheries occurring in the mainstem Columbia River encounter multiple salmon and steelhead species and multiple stocks within a given species. Under the U.S. v. OR Management Agreement, the parties have developed a management framework predicated on indexes of abundance and harvest rate indexes to describe the effects of fisheries on salmon and steelhead stocks of interest, including those listed under the federal Endangered Species Act. This has resulted in a systematic approach to co-management of harvest, allowing fishery managers to maximize harvest potential to the extent possible within conservation constraints in near-real time while ensuring necessary protections for stocks of concern.

International Chinook Salmon Fisheries Management Challenges
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In the North Pacific region, Chinook salmon serve as a keystone species and are deeply ingrained in the culture, economy and way of life. However, Chinook salmon also face a myriad of threats, including changing environmental conditions, habitat loss and fishing pressures. Taking appropriate management actions to ensure these fish can persist into the future is of the utmost importance. Since salmon migrate vast distances in the ocean and recognize no borders, the Pacific Salmon Treaty (PST) was ratified in 1985 between Canada and the United States to establish cooperative management of Pacific salmon between the two countries. Chapter 3 of the PST focuses on Chinook salmon management, defines fisheries management regulations for both countries to prevent overfishing and ensures that both countries

receive benefits equal to the production of salmon originating in their waters. Current challenges associated with the implementation of the PST include accounting for changing fisheries management strategies (such as increased mark selective fisheries), interpreting and appropriately responding to tasks outlined in the 2019 PST Agreement, and addressing differing views on new modeling and management approaches. The critically-important and dynamic nature of bilateral Chinook management reflects the ongoing need to balance continuity and adaptability in ensuring the sustainable management of Chinook salmon fisheries.

Depths of Despair: The Unintended Impacts of Harvest Rules Changes
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Climate change and broader resource strains has increased the need for higher regulated access to natural resources within the United States. These policies often reflect a broader interest in environmental protection yet, despite the net-benefit of the protection or reduction of use of these resource-systems, the resource-users are often negatively impacted. The individuals who engage in resource-system-based work often have highly specialized knowledge and skills, making a change in their ability to engage in their job particularly challenging. With fluctuations to these systems inevitable, understanding the impact of a substantial managerial rule-change on the health and wellness of these populations is vital to ensure fair and equitable outcomes. I examine the banning of gillnets within state-water fisheries along the state coasts of the United States from the early 1980s to the 2020s. The economic and ecological impact of these changes have been the topic of decades of work, but the sociological impact of the rule changes has been less examined. I examine the relationship between a net-ban policy and health and wellness of commercial fishing communities through drug and alcohol related deaths. Utilizing restricted CDC data, census economics data, and fishery management plans or legislative bills, I conduct analysis which examines the relationship between the implementation of a large rule change and health.

Session: Fish and Fire

Changing our lens, wildfire and fish in moist-forest environments
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Wildfire is a critical formative disturbance process that affects land and water in ways that we are only just beginning to understand. How is it that those of us in Western Oregon can have lived in fire-formed landscapes and yet generally considered wildfire a nuisance at best, and a catastrophe at worst? This reflects a static approach to our landscapes that may be adaptive for permanent human development, but is inconsistent with the dynamism of the natural world. In this presentation, we will review the historic role of wildfire in the west, as well as our evolving understanding of how wildfire effects aquatic ecosystems in our post-2020 world view. There is much to consider about the effects of fire on human infrastructure and water, as well as on ecosystems over short and long time frames. Finding the nexus between the need for static human infrastructure and the dynamism of functioning aquatic ecosystems may be possible as we work together to understand the effects of wildfire on both systems. It may just

be that wildfire is the extreme and ongoing disturbance that can force a change in our lens to see our lands, our rivers, and natural processes differently. Clearly, human management cannot stop wildfire, so how can we learn to live with it? Maybe the resilience of our native aquatic ecosystems can provide some answers.

Vulnerability of Pacific Northwest Aquatic Ecosystems to Wildfire

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Wildfire risk to aquatic ecosystems in the Pacific Northwest is a growing concern, but this risk is not equally distributed across the region. Furthermore, risks vary among valued endpoints and may be perceived differently by drinking water providers, forest managers, and fish biologist. There is a need for risk assessments that can help understand and efficiently communicate about the role of fire in a given watershed and propose and explore options so that fire can keep playing this role while maintaining valued ecosystem services. In this presentation we describe a wildfire risk assessment approach that incorporates spatial variation in the mechanisms driving post-wildfire aquatic ecosystem responses across the Pacific Northwest (e.g., see Roon et al. in this session). Our approach combines metrics that capture variability in drivers of risk (hydrology, climate, geology, ecology, and human land use) to create composite indicators that could be used to visualize and communicate wildfire risk to aquatic ecosystems in a digestible form. Our goal is to provide risk maps that are transparent, flexible, informative, and credible. Help shape our products; come to this talk and tell us what you need to know about wildfire risks to aquatic resources you care about and manage!

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.

Exploring spatial variation in aquatic ecosystem responses to wildfire in the Pacific Northwest

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Recent shifts in wildfire regimes has increased interest in spatially explicit models and indices that characterize the vulnerability and risk that wildfires pose to fish and aquatic ecosystems (see Ebersole et al.'s talk in this session). These models are of interest to both resource managers and scientists to aid in the development of testable hypotheses and guide resource management decisions. However, there is substantial uncertainty about wildfire risk to aquatic ecosystems and how ecosystem responses vary spatially across different regions. Here, we applied a dynamic food web simulation model to explore the influence of spatial variation on aquatic ecosystem responses to wildfire in the Pacific Northwest. In the model we varied riparian forest and instream physical channel conditions to represent different locations of the Pacific Northwest that may contribute spatial heterogeneity to aquatic ecosystem responses to fire. This included variation that may occur with different positions along a river continuum (small headwater streams vs. larger river floodplains) and the unique thermal and flow regimes associated with different ecoregions within the Pacific Northwest (westside vs. eastside forests). We then used the model simulations to compare unburned conditions to low, moderate, and high fire severity conditions.

Simulations were run for 50 years to capture the initial and longer-term effects from wildfire. Collectively, model simulations seek to explore the extent to which fire effects on aquatic ecosystems are likely to vary according to the ecological context of where a fire takes place. As a result, insights as provided by these model simulations can act as conceptual models which can be used to improve understanding, generate new hypotheses, and inform wildfire risk assessments for the region.

Disclaimer: The views expressed here are those of the authors and do not represent the view or the policies of the US government.

A Watershed-Scale Approach to Assessing Coastal Cutthroat Trout after Wildfire in Oregon Cascades Headwaters

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Recent shifts in the wildfire regime in many regions have increased concerns about the effects of wildfires on water quantity, water quality, and aquatic ecology. However, there is currently limited understanding of the short-term effects of large, high-severity wildfires on aquatic systems, including in the Pacific Northwest. Given the random nature of wildfires, few studies have been able to make comparisons to pre-fire data, further limiting our understanding of fire effects on fish populations. In 2020, the Archie Creek Fire burned 531 km2 of forests in the Umpqua River basin of the Western Cascades of Oregon. The burned area included the Hinkle Creek Paired Watershed Study (HCPWS), which was the location for research on the effects of forest harvesting on water quantity, water quality, and fish populations from 2001–2011. In the second and third years after the fire, we replicated methods from the HCPWS (single-pass electrofishing in stream pools) to estimate relative fish biomass and abundance through the mainstem South Fork Hinkle Creek. We made a longitudinal comparison of mass and density of age 1+ Coastal cutthroat trout (Oncorhynchus clarkii clarkii). Mean cutthroat biomass was approximately 182% greater after wildfire (13.7 g/m2, SD = 17.1) compared to the overall mean biomass from the original HCPWS (4.9 g/m2, SD = 4.28). Mean cutthroat density in pools was also about 89% greater after wildfire (0.48 fish/m2, SD = 0.47) compared to the original HCPWS (0.25 fish/m2, SD = 0.21). By quantifying fish in every pool through the mainstem of South Fork Hinkle Creek, our study provided a high-resolution, watershed-scale assessment of response to wildfire disturbance in headwater streams in managed westside forests of the PNW. The preliminary data from this unique opportunity to assess fish response to wildfire suggests positive, short-term effects of fire on cutthroat trout.

Post-fire effects on aquatic vertebrates in 30 Oregon streams with varying burn severity

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Wildfire frequency and intensity are expected to increase in many forested regions globally. Aquatic biota face multiple wildfire-induced changes in physical, chemical, and biological conditions, and these can vary with burn severity, post-fire weather, geomorphic events, stream features, and fluctuate over

time. Aquatic vertebrate responses range from extirpation to increased densities or no observed change. Because of the unpredictable nature of wildfires, many fire studies are limited in replication, further contributing to highly context-dependent biotic responses. We evaluated aquatic vertebrate populations and communities in the first three years post-fire across 30 fourth order streams within the Riverside, Beachie Creek and Holiday Farm fires to assess fish, amphibian, and crayfish trends over a range of post-fire aquatic habitat conditions. Pronounced changes in physical characteristics were observed with burned canopy cover ranging from 15 to 95%, with concomitant changes in stream light and temperature. In addition to multiple species of trout and salmon, these streams collectively contain fish (dace, sculpin, and lamprey), amphibian (salamanders and frogs), and crayfish species often ignored in many salmonid focused post-fire studies allowing us to also evaluate aquatic vertebrate community structure. Preliminary findings suggest that within the first three years, total vertebrate biomass was greater and age-0 trout size was larger in streams draining more severely burned watersheds. However, relative to landscape variables (position, elevation, or pre-fire stand age) vertebrate communities were minimally influenced by fire severity or extent. The lack of high intensity precipitation following these fires allows this study to uniquely evaluate wildfire effects unconfounded by major geomorphic changes and further contributes to the growing body of empirical data on the persistence of aquatic vertebrates in post-fire conditions.
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Twenty years of change in bull trout (Salvelinus confluentus) habitat quality in the Metolius River tributaries affected by the B&B Fire of 2003

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The Metolius River bull trout population is a stronghold in the Lower Deschutes River Core Area in the US Fish and Wildlife Service Bull Trout Recovery Plan. Many of the streams are fed by groundwater sources and have low water temperatures. The B&B Fire of 2003 burned 65% of the bull trout spawning and rearing habitat in the Metolius River tributaries. Habitat inventories since 1996 show that large wood densities increased as much as 200 to 300 pieces/km following the wildfire, on four of the five major spawning streams. Pools/km and pools > 1m/km increased on Jefferson Creek and Roaring Creek. Residual pool depth increased on two reaches. Percent pools increased on Roaring Creek and Jefferson Creek to 20 and 30%, respectfully. Percent side channel habitat, important habitat for juvenile bull trout, increased in upper reaches of Jack Creek and Roaring Creek to 18 and 28 percent, respectively.

Summertime water temperature was monitored in tributaries of the Metolius River since 1993 using calibrated data loggers. Peak seven-day average maximum temperatures were assessed from the period before the B&B Fire in 2003 and for the period after the fire. Peak seven-day average maximum water temperatures following the wildfire increased by an average of 1.2 oC, with the range of 0.52 to 2.62 oC. Water temperature increased the most during the 5 to 7 years immediately following the wildfire and was most pronounced on smaller streams. Water temperatures of the five major bull trout spawning streams within the B&B Fire remain suitable for spawning and early rearing due to the discharge volume of the streams and the groundwater influence. The Metolius River watershed continues to provide high

quality habitat for bull trout as indicated by peak redd counts in the past two years (1046 and 1223 redds).

Burning Questions: Exploring Wildfire's Influence on Coldwater Fish Habitats in an Endorheic Basin
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The Goose Lake Basin is a unique, high desert environment home to many wetlands that are critical habitats for native fish. This closed lake basin system is especially sensitive to climate-mediated disturbances such as shifting thermal regimes, drought, and wildfire. We evaluated wildfire impacts on habitat quality for redband trout and other coldwater native fishes in the Goose Lake Basin. Our objectives for this project were to: examine post-fire habitat change in affected areas, compare thermal regimes, and compare redband trout abundance between burned and unburned sites using a Before-After-Control-Impact (BACI) study design.

We analyzed 2022 NAIP imagery to classify burn extent and intensity in the study area and describe changes in vegetation and canopy cover. Data from HOBO loggers deployed at 15 sites in the Thomas Creek sub-basin were used to investigate the proportion of time temperatures exceeded the thermal maximum for coldwater fish. A BACI study design and stratified multi-pass electrofishing sampling throughout burned and unburned sites allowed us to make direct comparisons among fish abundance and distribution between 2007 and 2022 data.
Water temperatures in burned and unburned portions of the Thomas Creek sub-basin did not appear to differ substantially for the time period monitored.

Water temperature logger data indicate that most sites in the Goose Lake basin sustained water temperatures within the optimal thermal range for redband trout. Streams were more likely to dewater than to reach lethal temperature levels, indicating potential issues such as habitat connectivity and availability. Fish communities appear to differ between burned and unburned areas in the Thomas Creek watershed; however, it is unclear whether this is driven by changes in habitat caused by fire or drought. Monitoring data from 2023 (a wetter year) and quantifications of habitat change will help to clarify these relationships.

Effects of wildfire on streambed grain size distributions in the area of the Northwest Forest Plan
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Understanding the long-term impact of wildfire on aquatic habitat relies on the collection of ongoing data over long time periods. As such, long-term effects are not well understood in the Pacific Northwest. Further, long-term data is not widely available and pre-fire reference data is often lacking. However, in Western Washington, Oregon, and Northern California, the Aquatic and Riparian Effectiveness Monitoring Program (AREMP) collects in-stream habitat data to support management of forest lands under the Northwest Forest Plan (NWFP) (24.5 million acres). Data collection for this program began in 2002 and includes 1411 sites nested among 219 randomly selected watersheds with at least 25% federal

ownership that are surveyed on an approximately 8-year return interval. Wildfire has occurred at sites across the geographic range of the AREMP program since monitoring began in 2002. Of the 1411 sites, 843 (60%) have experienced wildfire in some portion of their contributing pour point catchments at least once since 1984. In this study, we examine how streambed surface grain size distributions (GSD) have changed pre- to post-fire for 119 AREMP sites whose contributing pour point catchments have burned once in the years between surveys (providing both pre- and post-fire data). This analysis investigates which landscape characteristics, including burn severity, may influence how streambed GSDs change after wildfire in the area of the NWFP. This study demonstrates a valuable approach for utilizing long-term monitoring programs to identify aquatic habitat vulnerability or resiliency to wildfire.

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Salmonid Short-Term Responses after Wildfire and Post-Wildfire Restoration

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Wildfire is a naturally occurring and important disturbance process in the Pacific Northwest. However, as climate changes, typical wildfire behavior, intensity, and extent is changing. The effect of high intensity wildfires on river habitats of native aquatic biota, such as salmonids, in this region is not well understood due to the infrequent return interval of wildfires in dense moist-forest areas, such as the Oregon Coast Range and Western Cascades. Thus, research exploring pre- and post-wildfire conditions, and effects on aquatic habitats, is needed for effective management.

In this study, the distribution of salmonids in a portion of the Rock Creek watershed, Oregon, is evaluated using pre- and post-wildfire datasets. Restoration of habitats after the Archie Creek Fire is assessed. Data included salmonid numbers from snorkel surveys conducted before and after the Archie Creek Fire, along with air and water temperature, aerial imagery, and wildfire burn severity maps. We found observable patterns in water temperature during and after the fire that may impact fish health and food source availability. In general, salmonid species showed high variability in their post-fire density changes that could not be fully explained by fine-scale differences in burn severity, water temperature, or in-stream large wood presence.

Watershed-scale post-fire restoration and monitoring

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Like many other east-side tributaries of the Willamette River, a majority of the Molalla River watershed burned in the Labor Day fires of 2020. As the only major undammed east-side tributary of the Willamette, restoring the Molalla River following the fires was a priority for the Oregon Department of Fish and Wildlife and the US Bureau of Land Management. When post-fire habitat restoration funding became available in late 2021, our team, including private landowner Fruit Growers Supply Company,

developed a plan for conducting watershed-scale restoration that would address post-fire issues faced by salmonids: mitigating increased sediment inputs in the headwaters from hillslope failure, retaining spawning gravels and creating scour pools in middle reaches, and creating or protecting thermal refuges downstream. We will share the development of our plan, implementation progress, and how it might be applied in other watersheds. In addition, we will share insights on pre- and post-fire monitoring and research based on our experience in the Molalla.

Session: Aquatic-Riparian Links

Conceptual foundations of research and management of riparian areas

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Riparian management was first codified under the Riparian Doctrine of English Common Law and the Napoleonic Code. Thomas Jefferson led early regulation of riparian property rules, as well as structural channel modification and flow diversion. Much of the legal framework of modern riparian management rests on the social and legal principles of these early land use policies.

The science of riparian areas in the 20th century developed from studies of hydrophilic plant communities, and definitions of riparian areas originally were based on hydric soils and unique plant communities. Fred Swanson, Jim Sedell, and Jim Hall developed the Forest-Stream interactions project in the H.J. Andrews LTER Program. In 1991, the group published a BioScience article—An Ecosystem Perspective of Riparian Zones—which developed a conceptual framework for riparian areas based on ecological functions of the ecotone between aquatic and terrestrial ecosystems. Several major concepts expanded on this perspective to further identify longitudinal and lateral interactions. One of the major perspectives was the River Continuum Concept in 1980, which describes the longitudinal patterns in aquatic ecosystem that emerge from the interactions between terrestrial and stream ecosystems. A landscape component of riparian areas not directly addressed by the RCC was floodplains, which were explored in the Flood Pulse Concept in 1989. The subsequent Flow Pulse Concept in 2000 extended the Flood Pulse Concept to include flow related riparian changes throughout the river network. The concept of Reciprocal Subsidies pioneered by Shigero Nakano in 2001 created a perspective of riparian interactions that includes transfer of energy and organic matter from streams to terrestrial ecosystems and vice versa.

Management of riparian areas has tracked scientific understanding of the ecological patterns and processes of aquatic-terrestrial ecotones. Land management prior to the 1970s largely ignored the ecological values of riparian areas. Forest harvest, agriculture, and urban development provided little if any protection for lands adjacent to streams and rivers. Streamside buffers in the early 1970 were based primarily on hydric soils and unique riparian plant associations, and dimensions of riparian management zones were based on operational compromise rather than ecological processes. In 1990, the Willamette National Forest developed Riparian Management Guidelines, which stated that riparian-dependent resources receive first priority in forest management along streams, lakes, and wetlands. Removal of riparian vegetation for timber harvest was required to be justified both ecologically and administratively. It included a margin for risk in riparian management policies. All floodplains were included in no-harvest

riparian management areas, and both intermittent and perennial streams had no-harvest riparian management areas of differing dimensions based on ecological considerations.

The Northwest Forest Plan in 1997 created one of the largest landscape management plans ever created and the management of riparian reserves were a central ecosystem component of the Plan. While the NW Forest Plan was ground breaking in many respects, one of the most revolutionary approaches was the definition of the boundaries and dimensions of riparian reserves based on three-dimensional zones of ecological functions, including, organic matter input, shade, large wood delivery, and unique microclimate. This remains a truly innovative distinction from most state and federal riparian management rules that are based largely on administrative compromises after consideration of ecological values.

Over the last 50 years, riparian restoration has become a major component of land management in the United States and other countries. Benefits of riparian restoration have been documented widely, but riparian restoration poses an inherent risk if the timeframes of recovery are not balanced with loss and degradation. Riparian losses occur immediately upon deforestation and degradation. Recovery of ecological function requires decades to centuries after restoration is implemented. If land management and mitigation are based solely on acres restored and acres degraded, the lag in recovery of riparian function leads to overall long-term degradation of riparian resources and ecological processes. Land management and mitigation must be based on equivalent ecological functions rather than simple spatial extent.

Advances in our knowledge and management of riparian areas over the last 50 years have been revolutionary and the pace of new research and innovative riparian conservation is increasing rapidly. Through our collective efforts to better understand riparian resources and their ecological processes, we can enact even more of the possibilities of these very special places.

Potential ecosystem-level responses along the mainstem of rivers after a major wildfire

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Recent increases in the severity and extent of wildfires in the American West has prompted increased attention to better understand post-fire impacts on streams and rivers. Existing research has predominantly focused on the physical changes of stream habitats, such as the warming of water and the pulsed delivery of wood, sediments, and nutrients downstream. Yet, our understanding of the ecosystem-level related responses to fire remains limited, particularly within broader spatial contexts. Here, we will examine spatial patterns of ecosystems function (i.e., microbial, aquatic vertebrates, and riparian wildlife) along several kilometers of the mainstem of Lookout Creek, Oregon during pre-fire conditions and develop competing hypotheses to evaluate potential postfire responses. Our hypotheses are rooted on ecological theory and consider links between community composition and surrounding landscapes as predictable from headwaters to downstream. Yet, habitat patchiness and heterogeneity set the context for these ecological processes. In addition, watershed and landscape-level processes can interact with channel geomorphology resulting in differential quality of stream habitats and thus,

regulate the variation of aquatic communities. This work will help guide development of further hypotheses concerning long-term trajectories of stream ecosystems after wildfires.

Past-present and future of forest-stream interactions at the HJ Andrews Experimental Forest

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Forested streams are strongly influenced by the age, stage, and structure of streamside (riparian) forests. Historic logging practices in Oregon often included cutting right to the water's edge and removing stream wood. In many cases, this led to a reduction in fish abundance. However, in other cases, canopy removal led to an increase in fish abundances. Contrasting responses of fish to forest management has led to differences in how people articulated and perceived the potential effects of logging for stream fish. These studies, however, generally only consider the period shortly after forest management. At the HJ Andrews Experimental Forest, we had the opportunity to return to sites that were initially assessed in the late 1970's, shortly after forest management, in which an overall increase in fish biomass was documented after logging (relative to nearby sections of stream with old-growth riparian forests). Since the initial study streamside forests regrew and canopies closed over the stream to the point where many of the formerly logged sites were darker than the old-growth reference sites to which they were initially compared. We found that nearly forty years after the initial surveys, the relative increase in fish that was documented in the 1970's had declined, and in three of the five paired study sites, the managed stream switched from having greater fish biomass relative to is paired old-growth forest reach to having lower fish biomass than this old-growth reference site. Now, the forests have changed again. Over the past summer (2023) fire (rather than forest management) has removed canopies and killed trees along the stream. Using what we have learned from past studies, we present a series of hypothesized responses about how stream fish will respond to the Lookout Creek Fire in the coming years, decades and century.

Linking stream environments and population processes to body size and condition of trout and salamanders across small watersheds

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Body size and condition are declining in freshwater vertebrates owing to climate change, with new evidence also pointing to density-dependent and -independent influences. Using a model-selection framework, we tested three hypotheses of factors affecting body size and condition, including density-dependent, density-independent, or a combination of both for trout and salamanders in 41 sites over 7 years. In the best-supported models, stream size, trout densities, and stream are predictors of body size and condition, whereas year is also important to trout size, reinforcing the combined density-dependent and density-independent hypothesis. Trout condition and body size of trout and salamanders increase with stream size, likely corresponding to major ecosystem changes occurring along the stream continuum. Salamander size, and trout condition and size increase upstream or with increasing elevation in small streams possibly because there is less competition upstream. Trout densities appear to influence both size and condition of both taxa, with higher density positively influencing size and negatively influencing condition. Stream affects both response variables suggesting that the geophysical setting of streams strongly shapes body size and condition.

Supporting stream and riparian protection by advancing knowledge of upstream distribution limits of trout

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Stream fish populations rely on healthy riparian environments to persist. In turn, fish act as umbrellas for protecting aquatic and riparian communities from various anthropic disturbances, such as forestry. However, implementing effective riparian management regulations is challenged by fragmented and incomplete knowledge of fish distributions. The UPstream Regional LiDAR Model for Extent of Trout (UPRLIMET; Penaluna et al. 2022) represents a significant advancement for predicting the distribution of fish-bearing streams in western Oregon. UPRLIMET uses longitudinal stream metrics: elevation, slope, drainage area, and upstream network length to generate predictions of fish occurrence. In contrast, the lateral dimension (e.g., floodplain morphometry, riparian vegetation) has not yet been fully incorporated. As small streams are epitomes of aquatic-terrestrial interactions, we hypothesize that the characterization of lateral controls can improve the predictive accuracy of UPRLIMET when applied to broader and more heterogeneous areas. Here, we provide an update on the objectives and development of UPRLIMET+ (Plus) for the Pacific Northwest region of the U.S. (Oregon, Washington, and Northern California). We will discuss the benefits of collaborative data collection between public and private partners, combined with topographic and climatic models of higher-resolution and refined lateral metrics. With these efforts, we aim to provide the most accurate and consistent map of fish-bearing streams for the region in support of effective riparian and aquatic conservation.

Evaluating the effects of riparian forest thinning on coastal cutthroat trout in northern California watersheds using empirical data and bioenergetics modeling

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We evaluated the effects of riparian forest thinning on resident coastal cutthroat trout (Oncorhynchus clarkii clarkii) in northern California watersheds via a manipulative field experiment and a before-after-control-impact design. Experimental thinning treatments reduced riparian shade by 20-30% along five 150-200-m reaches. To explore fish responses to thinning treatments, we combined empirical observations of cutthroat trout density, biomass, and growth with bioenergetics modeling. Riparian thinning was associated with increased cutthroat trout biomass across multiple seasons one year after treatment, but had minor effects on trout density. Cutthroat trout growth rates varied more among seasons than due to thinning treatments, peaking in spring and overwinter relative to summer. Bioenergetics modeling provided insights into the mechanisms driving cutthroat trout responses to riparian thinning. For example, cutthroat trout responded to thinning-induced increases in stream temperature and reductions in prey energy density via higher consumption rates. However, bioenergetics analyses also indicated that the magnitude of consumption changes were small, so thinning had little influence on cutthroat trout growth potential. Collectively, these preliminary findings

suggest that in the context of the cool, forested study watersheds, coastal cutthroat trout appeared largely resilient to riparian thinning one-year post-treatment.

Riparian Vegetation Protection and Monitoring in Mine Tailings

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Precision monitoring is rarely conducted when it comes to riparian planting along restored reaches of streams. General plant density counts are completed regularly; however, survival and recruitment of specific plants is rarely pursued. To address this, the Confederated Tribes of the Warm Springs Reservation of Oregon (CTWSRO) completed two separate planting efficacy studies on the Oxbow Conservation Area (OCA) located on the Middle Fork of the John Day River within a historically dredged reach of stream. These two studies were similar in location, but differed drastically in monitoring efforts, with the original 2012 study counting all woody stems in established cross-sections along the riparian, which included recently installed plantings and existing woody stems, and the subsequent 2021 study using real-time kinematic positioning equipment to electronically tag 330 installed plants along the riparian to track survival of only installed plants. The first study showed variation in survival and additionally recruitment in monitoring plots, whereas the 2021 study showed little survival in installed plants, with almost a fifth of the plants installed lethally browsed by small rodents in the first-year post-installment. Through both monitoring efforts key lessons were learned for future planting efforts within the OCA. The two that are potentially easiest and most impactful to address are 1) established plants will successfully recruit new plants in the area; therefore, protecting these plants may lead to quicker revegetation of the stream than intentional plantings and 2) fine meshed fencing is necessary in conjunction with currently installed eight-foot exclusionary fences in protecting newly installed plants from browse by smaller animals that can pass through or under the larger meshed eight-foot fencing when plants in the area are rare. By addressing these and additional lessons learned, we may see more success in the revegetation of riparian areas along dredge mined streams.

Session: Native Fishes

Urgency and Adequacy: Snake River Anadromous Fish Management Update

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Anadromous fish in the Snake River basin are cultural and ecological cornerstones. Their historical ubiquity is well documented, but their contemporary plight and the necessary restorative measures have lacked urgency - this appears to be changing. A vision for restoring these iconic species to healthy and abundant levels was established by a diverse group of sovereign entities and stakeholder parties through the Columbia Basin Partnership (CBP) Phase 2 Report. The National Marine Fisheries Service outlined a suite of actions necessary to achieve the CBP mid-range goals by 2050, which includes breaching of the four lower Snake River dams as a centerpiece action in their Rebuilding Interior Columbia Basin Salmon and Steelhead report. The Confederated Tribes and Bands of the Yakama Nation, Confederated Tribes of the Umatilla Indian Reservation, Confederated Tribes of the Warm Springs Reservation, Nez Perce Tribe, State of Oregon, and State of Washington advanced the Columbia Basin Restoration Initiative (CBRI)

which is being supported by the United States Government Commitments as part of a Stay to long-standing litigation on the Columbia River System Operations. In addition, this presentation will describe the current status of stocks relative to goals. Adult returns of wild-origin Snake Basin stocks in 2023 were; ~7,500 spring/summer Chinook salmon, ~15,000 steelhead, ~9,000 fall Chinook salmon, and <100 sockeye salmon). With the exception of fall Chinook salmon, all were well below even the lowest management threshold required for ESA-delisting and also resulted in many populations at or below quasi-extinction thresholds (50 or fewer spawners). Hatchery-origin returns make up a vast majority of the total number of salmon and steelhead returning to the Snake River basin, however hatchery-origin returns continue to be below their mitigation goals (i.e. not meeting promised compensation for hydro-system impacts). Consistently achieving adequate returns of anadromous fish into the Snake River basin requires a shift in focus from one of not increasing failure risk (jeopardy standard) to one of achieving success (healthy and abundant).

Modifications to Rearing Environments as a Method for Reducing Domestication Selection in Hatchery-reared Steelhead

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Since the decline of salmonid populations in the Pacific Northwest, supplementation programs have become frequently implemented by hatcheries as a way to protect and conserve wild stock. However, hatchery-reared fish have lower fitness than wild fish which is likely due to adaptation to the hatchery environment, i.e., domestication selection. Fish that excel in the hatchery do poorly in the wild meaning traits which are selected for in the hatchery are maladaptive in the wild. Size at release is correlated to survival at sea therefore, fish that are able to grow quickly in the hatchery are likely inadvertently experiencing selection in the hatchery for whatever traits make them perform well in that environment. Size is also highly correlated to family identification, so only certain families are represented in fish returning from the ocean to spawn. Larger fish tend to be more aggressive and bolder than smaller fish. Any change to advantage small or shy fish and reduce the variation in size among families would also decrease the opportunity for selection under hatchery conditions. Using families of steelhead (Oncorhynchus mykiss) I tested three different modifications to the hatchery environment that were hypothesized to reduce the variation in size among families: (1) the addition of structure to rearing tanks; (2) increased water flow; and (3) grading fish into separate tanks based on size. There was very little reduction in variation in body size among families between the tanks that received the structure treatment, tanks that had increased water flow, and control tanks that received no modification. There was an increase in growth overall in the tanks treated with increased water flow, but families that were the smallest in the control tanks remained the smallest in the treatment tanks. There is no evidence that the simple environmental modifications here reduce variation in size at release and would be effective methods for decreasing domestication in hatcheries. Despite the structure and flow studies being done at different facilities, there was high correlation among family means across the two treatments and their controls at both hatcheries, indicating the effect of family identity on size is very strong and not easily manipulated by simple changes to the hatchery environment. I then tested a more direct approach to manipulating growth under hatchery conditions by grading fish based on size into small body length, medium body length, and large body length groups to promote growth in the small fish with excess food

and low densities, and slow growth in the large fish with restricted feeding and high densities. While the reduction to variation in size among families was statistically insignificant, the growth of the "large" group and "large" families was successfully reduced. Mean length in the "large" group was less than the means in the "medium" and "control" groups. This is likely due to the small fish which did not grow any faster in the graded tanks and it may be that a physiological or behavioral factor is restricting the small fish from growing any faster even under ideal conditions. The reduced variance in families due to the decreased growth of the large fish indicates that grading could be a tool used by hatcheries to lessen selection on salmonids. But first, further investigation is necessary into the factors limiting growth in smaller fish.

Patterns of Spring Chinook Salmon fry emergence and dispersal across the Middle Fork John Day River basin

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There is strong selection on salmon emergence timing to maximize survival through alignment with long-term patterns of optimal rearing conditions, which could be disrupted by climate change induced shifts in temperature, flow, and precipitation patterns. Timing of emergence relative to high flows, available floodplain habitat, and distance dispersed from redds could have profound effects on patterns of growth and survival of juvenile salmon. We sampled emerging Spring Chinook (Oncorhynchus tshawytscha) fry from sites distributed across the mainstem of the Middle Fork John Day River from 2019 to 2022 to determine emergence windows and to characterize longitudinal and lateral dispersal from redds using genetic parentage assignments to link individuals to their maternal parents spawning location. Sampling occurred within areas affected by in-stream and floodplain restoration that are in various stages of recovery and implementation. We found that the fry emergence window occurred from mid-March to mid-May, which has not changed from a similar study completed over 40 years ago. Our results indicate a slight declining trend in annual cumulative thermal units during Chinook egg incubation period, although long-term temperature records are limited. We also found that fry only dispersed in the downstream direction, with the median recorded dispersal at 0.8 km (95% range: 0.05 - 12.6 km), although many fry dispersed much further and up to 20 km. We also found that restoration stage and variable flow patterns, can affect the type of habitat that fry utilize. Most fry dispersed less than a kilometer from where they were born and most heavily utilized floodplain habitat that was adjacent to the main channel. These findings highlight the importance of considering the arrangement of spawning and rearing location for restoration planning and implementation, suggesting that efforts targeting the fry like stage may be most effective just downstream of concentrated spawning.

Native and Nonnative Species Response to the Colonization and Subsequent Suppression of Northern Pike

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The expansion of Northern Pike Esox lucius outside its native range into the western states of North America is a growing problem due to their negative effects on fish communities. Illegally introduced

Northern Pike were first detected in Box Canyon Reservoir, in northeast Washington, in 2004. By 2010, the Northern Pike population was estimated at more than 10,000 individuals. Between 2012 and 2019, gill net suppression was conducted, which reduced Northern Pike catch-per-unit-effort in Box Canyon Reservoir by 97.3% and their biomass by 98%. From 2011 to 2019, four standardized surveys were conducted to track changes in the Box Canyon Reservoir fish community. There was a 55.5% reduction in biomass of native species, which showed no signs of recovery during the study. Conversely, the biomass of nonnative species increased 31% over the same period. Based on the number of fish captured, the relative proportion of biomass from native species declined 82% between 2004 and 2019, compared to the relative proportion of biomass from nonnative species which increased in number by 26% over the 15-year study. Most nonnative species also declined during Northern Pike colonization from 2004 to 2011, but, after intensive suppression, rebounded during the response period from 2014 to 2019. As an apex predator, Northern Pike had a significant impact on the fish community over a relatively short period (seven years) in Box Canyon Reservoir, and likely acted as a catalyst to increase the rate of replacement of native species by nonnative species, and contributed to an increased pace of taxonomic homogenization occurring in the reservoir.

Riverscape Patterns of Habitat Use and Growth in Sprague River Juvenile Redband Trout (Oncorhynchus mykiss newberrii)

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Stream temperature is a pressing research topic in the Pacific Northwest because ongoing warming threatens culturally and economically important cold-water fishes. Stream temperature varies across landscapes at multiple spatial and temporal scales, but our understanding of how fish integrate this variation across life stages and different life histories remains relatively limited. We explored the Sprague River, a seasonally warm watershed in the Upper Klamath Basin, to learn how spatial and temporal heterogeneity in water temperature interact to influence rearing redband trout (Oncorhynchus mykiss newberrii). We used backpack electrofishing, boat electrofishing, and snorkeling to identify areas of disproportionately high trout abundance and then evaluated their growth and movement throughout the year. We identified 3 areas of high juvenile trout abundance. Two were in cooler stream segments that had the highest levels of groundwater input. In contrast, the third area was warm, but had the highest gradient of the entire riverscape. All three areas supported rapid growth and many juveniles migrated to productive downstream lentic habitats within their first year of life. Surprisingly, the warm, high gradient habitat sustained positive growth during summer as temperatures exceeded 26 C. To elucidate mechanisms driving the use of high gradient habitat, we measured dissolved oxygen throughout the Sprague River Basin and estimated fish consumption rates from bioenergetics models. This revealed that the warm high gradient reach had uniquely high dissolved oxygen minimums (i.e., those expressed at night) and high foraging opportunity. These results imply that factors such as dissolved oxygen and food abundance can strongly mediate temperature-occupancy relationships and that different types of landscape features can translate into hotspots of rearing productivity.

Genetic Characteristics of Redband Trout of the Metolius River

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Interior Redband Trout (Oncorhynchus mykiss gairdneri) are a species of conservation concern. From the 1930s to 1995, hatchery origin rainbow trout, primarily the Cape Cod strain, were stocked in the Metolius River to support the fishery. Soon after the hatchery stocking was discontinued, genetic research based on allozyme and mitochondrial DNA markers revealed that redband trout near the headwaters had signatures of hybridization with the hatchery stock (Williams et al. 1997). As a follow up to that work, we sampled fin tissue from 132 O. mykiss from the Metolius River in 2021. We used updated genetic markers to examine the current levels of introgression in collections from throughout the Metolius and compare Metolius collections to other populations in the Deschutes River. Comparisons between natural-origin redband trout collected in the Deschutes and Metolius River indicated that sample collections were found to be genetically distinct based on watershed. Despite previous work by Williams et al. (1987), current Metolius River Redband Trout do not appear to be descendants of, or hybrids with, the previously stocked Cape Cod strain of O. mykiss.

Since stocking has been discontinued, evidence of introgression has not been detected and the adult population of native redband trout in the Metolius River has rebounded. Redd counts have increased from 141 redds in 1996 to between 1000 to 2000 redds in recent years. Spawn timing shifted from a December peak in 1991-1992, to a February/March peak. We conclude that collections of redband trout from the Metolius River currently have little remaining impact from hatchery-origin fish.

Exploring the Understudied Diversity of Shorthead Sculpin in the Pacific Northwest

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Many gaps in our understanding of non-game fish diversity in the Pacific Northwest remain. The Shorthead Sculpin (Cottus confusus), which inhabits cold, oxygen-rich habitats on the upstream slopes of the Cascades and the Rocky Mountains, stands out as notably understudied. Given its disjunct distribution and inclusion of several divergent mitochondrial haplotypes, Cottus confusus likely represents a collection of distinct evolutionary lineages that may merit species-level recognition. This research aims to delineate species boundaries, estimate divergence times, and elucidate the biogeographic history of lineages within Cottus confusus in a comprehensive phylogenomic and morphological analysis. Towards that end we have collected new voucher specimens and associated DNA samples from 22 distinct creeks and rivers across the Pacific Northwest. Combined with historical museum specimens from 54 locations across Washington, Oregon, Idaho, and Montana, these form a robust dataset poised to unravel the genetic and morphological diversity within the current concept of C. confusus. During the meeting, we will share a preliminary genomic phylogeny based on a large panel of single-nucleotide polymorphism (SNPs), detail the geographic distribution of genetic lineages within Cottus confusus, and discuss future investigations of their evolutionary history and morphology. Our methodology, rooted in modern phylogenomic analysis and 3D cranial CT-scanning, will help overcome the historical challenges in separating the elements of this species complex using traditional morphology and mitochondrial sequencing alone. Final products will include a refined reconstruction of boundaries within the species complex, a robust identification key, and improved understanding of the intricate relationship between genetic diversity and physical characteristics. Investigating Cottus confusus offers

crucial insights into their susceptibility to global warming, especially in the context of diminishing cold habitats.

Variability in Growth Rates of White Sturgeon below McNary Dam on the Columbia River

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The construction and continued operation of the Federal Columbia River Power System for , has effectively chopped what was once one White Sturgeon population stretching from the mouth of the Columbia River to Windermere Lake in the upper Columbia and Shoshone Falls in the Snake River into numerous distinct population segments, and has impeded their migration and habitat use throughout the Columbia Basin. We use growth rates as one of several metrics to estimate the current health of populations and size classes within. Recent analysis of annual growth rates of certain size classes of White Sturgeon varies greatly over relatively short periods of time, with growth rates increasing as much as 400% or decreasing as much as 90% over just a four to six-year period in the lower portion of the Columbia River (downstream of McNary Dam). The variability in growth rates is occurring simultaneously in the impounded reaches between Bonneville Dam and McNary Dam but does not seem to be occurring in the free-flowing reach below Bonneville Dam . This study is an initial investigation into potential factors that could affect White Sturgeon growth rates, such as environmental variables (e.g., climate index) and biological factors (e.g., food availability). It is likely a combination of factors are affecting growth rates of White Sturgeon in the impounded reaches of the lower Columbia River. Identifying those factors would aid managers in predicting future size-specific abundances and setting conservative, sustainable exploitation rates.

Ending an era: The current status of Oregon Chub and how we got here

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Oregon Chub Oregonichthys crameri, a small minnow endemic to the Willamette Valley, was listed as endangered under the federal Endangered Species Act (ESA) in 1993. Factors implicated in the decline of this species included changes in flow regimes and habitat characteristics resulting from the construction of flood control dams, revetments, channelization, diking, and the drainage of wetlands. This species was further affected by predation and competition from nonnative species such as Largemouth Bass Micropterus salmoides, crappies Pomoxis sp., sunfishes Lepomis sp., bullheads Ameiurus sp., and Western Mosquitofish Gambusia affinis.

In February 2015, Oregon Chub became the first fish removed from the list of endangered species due to recovery (Federal Register 2015). Their status improved through long-term habitat protection, restoration, and management; improved in-stream flow management; creation of new populations through translocations; and the discovery of previously undocumented populations. Since delisting the species has continued to be closely monitored and managed, guided by a nine year Post-Delisting Monitoring Plan, and a managed-flow floodplain study. This presentation will summarize the coordinated efforts of multiple agencies to improve the status of Oregon Chub over the years. It will emphasizing

lessons learned and provide a summary of the status of Oregon Chub in 2023, the final year of post-delisting monitoring.

Submerged Insights: Navigating Wallowa's Waters through Snorkel Density Surveys

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The Wallowa River basin, a major tributary of the Grande Ronde River in Northeast Oregon, has had targeted small-scale fish population surveys in the past, but no large-scale juvenile fish population surveys. Snorkel density surveys provide a simple low-cost way to survey a wide area while collecting information on fish species composition, size structure, and habitat use. Our snorkel surveys are conducted across 30 sites within the Wallowa River basin. Survey sites were randomly selected based on public/private land access, with 9 sites occurring on completed restoration projects located on private land. This project has two goals: 1) Provide understanding of the current juvenile salmonid distribution and density within the basin. 2) Determine the fish use of restoration projects compared to unrestored and wilderness sections of river.

Grande Ronde River Lower Valley Fish Inventory, 2022

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Salmonids emigrating through the Grande Ronde Valley experience disproportionately high mortality rates relative to adjacent river reaches. Predation by nonnative fishes has been identified as potential limiting factors for out-migrating juvenile salmonids. However, little is known about the fish assemblage in the Grande Ronde Valley. To address this uncertainty, Mount Hood Environmental conducted a fish inventory using a multi-gear capture approach in sections of the Grande Ronde River and Catherine Creek that flow through the Grande Ronde Valley. The purpose of this project was to document species composition and determine the extent to which large nonnative predators are present in the valley.

Sampling was conducted in August and September of 2022. Six different active and passive gear types were used to sample for a total of 1,544 hours. We captured 14,649 fish which consisted of 15 different species, seven of which were non-native to the subbasin. Catch-per-unit-effort was standardized to account for gear type selectivity, providing an unbiased assessment of species composition. Additionally, 593 fish were PIT-tagged to facilitate future monitoring of fish movements throughout the Grande Ronde River subbasin.

Multiple piscivorous species were present, including native northern pikeminnow and non-native brown bullhead, smallmouth bass, largemouth bass, and white crappie. We also observed an abundance of other nonnative fishes such as pumpkinseed and common carp, and it is not well understood how these species may impact juvenile salmonids. Given the spatial extent, abundance, and size distributions of species (both native and non-native) captured, it is likely predation and interspecific competition with juvenile salmonids is prevalent throughout the Grand Ronde Valley.

Is anyone looking out for all those other fishes?

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Listed species get a considerable amount of attention (and funding) in the fisheries management and conservation world. In the Northwest much of this "conservation space" is taken up by anadromous salmonids. However, other native fishes generally receive attention only when they reach a level of threat sufficient to possibly consider them for listing and regulatory obligations under the Endangered Species Act - examples include the Oregon Chub, Borax Lake Chub, Warner Sucker, Modoc Sucker, and Klamath suckers. The Pacific Lamprey's rise to conservation prominence came only after the establishment of the Pacific Lamprey Conservation Initiative, following an unsuccessful petition to federally list the species. The questions I ask is, who is keeping track of all the other native fishes, and how do we address their conservation needs?

How cold-water fish cope with summer in large rivers

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

Coastal Cutthroat Trout Movements, Growth, and Survival in the Long Tom River Basin

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From 2010 to 2015, the Long Tom Watershed Council and Oregon Department of Fish and Wildlife studied the seasonal movements of coastal cutthroat trout (Oncorhynchus clarkii clarkii) in two major drainages within the Long Tom Watershed. In these two drainages both resident and fluvial life-history coastal cutthroat trout are present. The goals of the study were to track fish exhibiting resident or fluvial life-history and to characterize the seasonal movements (timing and duration) of these fish. In order to monitor cutthroat trout movements around the two drainages, we captured cutthroat trout using stationary fish traps, sein nets, and backpack electroshockers. The fish were marked with Passive Integrated Transponder (PIT) tags and tracked with recaptures and PIT tag array stations. Over the course of the study, recaptures also provided data related to fish growth and survival.
Our data is presented on an individual fish basis without statistical analysis. This is because the greatest value in the data is how individual fish behaved. With so many recaptures, it was possible to follow the growth and movements of an individual fish over the course of many months and sometimes years. This has given us the opportunity to study fish as individuals rather than as one of many.

Unsolved mystery: the origin of westslope cutthroat in the John Day

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In Oregon westslope cutthroat trout only occur in the upper John Day basin. I examine what we know and don't know about how they may have gotten there, whether they are native or introduced, and why they are not found in other drainages in Oregon and SE Washington. Their origin and distribution are also considered in the context of cutthroat evolution and occurrence in other portions of their range.

Science co-production: the Oregon Bull Trout experience

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Calls for co-produced science to support fisheries management decisions are becoming increasingly common. Recent work on Bull Trout (Salvelinus confluentus) provides instructive examples of what the process of co-production might look like. Co-production involving local knowledge in developing species distribution models and applying these models with partners to evaluate recovery priorities for Bull Trout in Oregon represent linked efforts that have assisted planning for conservation investments. On a local level, several applications of structured decision making have involved longer-term and more intensive forms of engagement and co-production of models to specific, on-the-ground decisions such as species introductions, influences of barriers, and other factors that are often in play for recovery of Bull Trout. Whereas it is clear to most experienced practitioners that fisheries management involves people as much as it does fish, emerging concepts, tools, and applications involving co-production promise to greatly improve both ecological and social outcomes.

Session: Film Festival

Film 1, Judy's Creek (5:09)
Follow ecologist, educator, and author, Dr. Judy Li, into the world of caddisflies, the artisans of the aquatic world. With contagious passion, Judy shares how her childhood curiosity led to a career in freshwater science, and how she has found ways to share the joys of science with audiences of all ages.

Film 2, Place (8:14)
Follow Cayuse Tribal Member, Gabe Sheoships, into an ancient cultural practice, and discover the connections between migratory fish, urban forests, and community stewardship... and the work one group is doing to re-build the strength of these connections for future generations.

Film 3, Salmon Watch 5 parts played back to back (about 21 minutes for all 5)
Produced in partnership with the Salmon Watch program of the World Salmon Council and its many partners, this 5-part short film series serves as an introduction to salmon and their ecosystems for middle-school through college-level learners in physical or virtual classroom settings. The series is modeled after the Salmon Watch field trip experience, following 5 key topics (riparian ecology, water

quality, aquatic macroinvertebrates, salmon biology, and stewardship), each hosted by Salmon Watch volunteer educators.

Session: Working with partners

How to get (and give) feedback that is actually helpful: writing, presentations, meetings
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Receiving helpful feedback is critical in conducting good science and management, whether feedback occurs in meetings, on written documents, or for a practice presentation. However, it is common to solicit feedback – only to receive comments that are distracting, confusing, or not applicable. When feedback goes awry, this wastes both your time and the time of the people who gave it. People want to be helpful! You need advice! This talk will discuss strategies, tips, and tricks, which I have found helpful, in getting and giving useful feedback. This includes how to know and tell others what you need, how to not get derailed among feedback you receive, and how to give feedback that is substantial, helpful, and kind. Here's hoping this leads to smoother meetings, fewer paper/presentation draft iterations, and more productive teamwork.

A fish bio's reflections on 40 years with the American Fisheries Society
James Capurso
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James Capurso is the Pacific Northwest Regional Fisheries Biologist for the USDA Forest Service with 40 years of fisheries management experience. Throughout his career, he participated in the American Fisheries Society. The state chapters he calls home are in Idaho and Oregon. In this presentation, he reflects upon his participation in this professional society, with a focus upon learning and development, community, and relationships.

Cow Creek Band of Umpqua Tribe of Indians Fisheries Program
Colby Gonzales
Cow Creek Band of Umpqua Tribe of Indians
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The Cow Creek Tribe has been involved in fisheries management in the Umpqua Valley for many years. Working with other agencies at hatcheries, acclimation facilities, adult collection sites, and on fish habitat restoration projects. The future is looking bright for fish.

Reel Wisdom: Exploring the Impact of Catch and Release Angling on Salmon and Steelhead
Benjamin Briscoe
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Mark-selective recreational fisheries are a conservation tool used to protect depressed stocks of salmon and steelhead while allowing for harvest of hatchery-origin fish. The quantity and duration of these

fisheries are often managed using rough assumptions of hooking mortality combined with estimates of natural-origin fish capture in the fishery. Studies designed to estimate hooking mortality have produced highly variable results among species and size classes of fish, gear types, and environmental conditions. This diversity of results is evident in the complexity and incongruity of regulations within and between watersheds. We are partnering with the Pacific States Marine Fisheries Commission to develop a regional hooking mortality meta-database and statistical tools to empirically inform salmon and steelhead recreational fisheries management. In contrast to a traditional meta-analysis, this database will compile raw data from disparate studies into a unified relational database. Phase 1 of this project includes the creation of a web application that will allow managers to easily query a comprehensive record of hooking mortality data. Here, we summarize findings from hooking mortality datasets to be incorporated in the database, including recently published results from our fieldwork on the Cowlitz River, Washington.

An Index of Biotic Integrity for Macroinvertebrate Stream Bioassessment Conducted by Community Scientists

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Macroinvertebrates can be used as indicators to assess the health of stream ecosystems that fish and other aquatic organisms depend on. For over 15 years, community scientists have worked with stream managers to collect macroinvertebrate data that can be used to monitor the biologic integrity of streams. Here we describe the development of a regional index of biotic integrity specifically designed for community science. We have modified the pre-existing professional Index of Biotic Integrity (IBI) to develop an IBI for macroinvertebrate data that has been collected through community science programs. We used community science and professional data collected at 78 stream sites in the Puget Lowlands and Willamette Valley ecoregion in the Pacific Northwest to develop, calibrate, and validate a CS-IBI at these sites. Community science data had more variation and were taxonomically coarser than the professional data, but we found that IBI scores and assemblage data were statistically similar between the professional and community science data. CS-IBI scores were significantly and negatively related to the percentage of agriculture and land development in the watershed. Even with the increased variability seen in community science data, our findings suggest that the CS-IBI responds similarly to the professional IBI across a variety of human influences. While we do not recommend using the CS-IBI in regulatory settings, we believe development of community science IBIs helps grow and strengthen public relationships and supports environmental managers' efforts to monitor and restore degraded streams in a timely matter. Our hope is that the CS-IBI will help improve the reliability of community science bioassessment data and can be utilized as a model for how agencies can create a regionalized macroinvertebrate IBI to use in watershed management plans.

Collaborative data exchange in the Pacific Northwest through the Coordinated Assessments Partnership

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Co Author: Jen Bayer

Management and recovery of salmon and steelhead requires quality data to guide best practices, adaptive management, and recovery assessments. Collaborating on regional data standards and accessibility leverages individual projects and investments, improving regional recovery success and providing a greater understanding of the impacts of fish and ecosystem restoration and recovery on a broader, economic scale. The Coordinated Assessments Partnership (CAP), co-led by StreamNet and PNAMP, has been working to enhance access to derived salmon and steelhead information for the Columbia River Basin and the broader Pacific Northwest to inform management and recovery of salmon and steelhead. The CAP facilitates structured data sharing among multiple partners, including tribes and, federal and state agencies, who submit and maintain their data in the publicly available Coordinated Assessments data exchange (CAX) along with the metadata that provides the appropriate information for data citation and attribution. We will discuss the drivers that led to CAP's successes in data sharing efforts, limitations including capacity of partners, the benefits gained by local and regional participants, and how we have applied the same process to develop the Hatchery Coordinated Assessments data exchange (HCAX). We will illustrate how CAP data supports federal regulatory decision-making and how the improved quality control of the data and detailed metadata has increased the value for research and management decisions. This data standardization and accessibility has allowed the development of automated tools for data access and processing, facilitating open, reproducible science. The metadata included in CAX provides the necessary information to support proper data citation and attribution.

Geospatial Visualization of Willamette River Decadal Assessment Data: A Bridge for Science, Education, and Community Engagement

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The Willamette River Decadal Assessment project is a 3-year intensive sampling effort conducted in 10-year intervals that began in 2011 and serves as a cornerstone for understanding the river's ecosystem. The primary assessments conducted include fish assemblages and distribution, riparian zone categorization, and physical water characteristics.

Secondarily, the intensive nature of this project allows extensive collaboration with other researchers and groups to investigate other questions. Some of these investigations include eDNA efficacy testing, invasive species predatory impacts on native fishes, speciation inquiries, and water chemical analysis.

Here we use geospatial analysis techniques to visually represent these datasets and inquiries for educational engagement, scientific investigations, and community involvement and outreach. We used QGIS software to map sampling efforts on satellite imagery allowing us to tie the project's primary and secondary objectives to specific areas on the river. Furthermore, these maps provide the ability to connect restoration anchor habitats to the project's primary data providing information to watershed councils, land trusts, and other community groups. Additionally, these maps along with a project website provide public accessibility for outreach and education.

Our work demonstrates the bridge between scientific research, education, and community involvement. Geospatial analysis not only refines our scientific understanding but also transforms data into accessible

tools for engaging communities along the Willamette River. By visualizing the project's intricacies, we establish a vital link between research outcomes and the broader public, promoting environmental awareness.

Session: Pink and Chum Salmon

Pink and chum salmon on the high seas: highlights from the 2022 Pan Pacific Winter Expedition
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Co Authors: Jackie King, Sara Gilk-Baumer
In late winter 2022, an international fleet of five ships from the U.S., Canada, and Russia conducted a coordinated survey of Pacific salmon high seas habitats across 2.5 million km2 of the North Pacific Ocean. The goal was to document salmon use of pelagic habitats during winter to understand factors regulating salmon survival. Across all ships, a total of 2,364 Pacific salmon (Oncorhynchus spp.) and steelhead (O. mykiss) were caught at 131 stations using surface trawls, gill nets, and longlines; this total included 680 chum (O. keta) and 102 pink (O. gorbuscha) salmon. This talk will describe the distributions, size, origins, growth rates, and diets of these high seas pink and chum salmon, with comparisons to winter cruises to the Gulf of Alaska in 2019 and 2020. Both species were widely distributed east-west across the study area from 171° to 135°W, but chum salmon were caught across a wide range of latitudes, while pink salmon were largely restricted to warmer waters in the south. Both species originated from populations around the Pacific Rim (Asia to the Pacific Northwest). Despite the numerical dominance of pink salmon across the North Pacific Ocean as a whole, surprisingly few pink salmon caught. As more and more results from the expedition come in, we can fully describe the ecosystems that supports salmon on the high seas and understand how salmon use varies at both short and long time scales.

The pink salmon invasion of the North Atlantic
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Co Authors: John Iwan Jones, Bryony Townhill, Gordon Howard Copp
In the second half of the 20th century, pink salmon were deliberately introduced into Russian rivers around the White Sea. In 2017, large numbers appeared in rivers around the north-eastern Atlantic. The pink salmon stock has been increasing since then, with the highest number of records from North Norway.
Intrusions of invasive pink salmon have generated concern about the impact on native fishes in all countries where they have been seen. The EU-funded PinkSIES project sought to understand the pink salmon invasion of the North Atlantic using stable isotope analysis (δ13C, δ15N). Project objectives included a) determination of the pink salmon feeding grounds at sea, and potential competition with native Atlantic salmon, b) projection of future changes in these feeding grounds due to global warming, based on field metabolic rates of both salmon species, and c) assessment of the ecological role of pink salmon juveniles in rivers.

We collected muscle tissue, scales, and otoliths from >500 fish caught around the North Atlantic. The distribution of pink salmon feeding grounds at sea was established using a base map of δ13C, which suggested that their feeding grounds expand across a wide area of the North Atlantic (unpublished results). δ15N indicated that pink salmon feed on prey from a variety of different trophic levels at sea (unpublished results). Further results will be presented at the symposium.
In 2022, pink salmon smolts were caught in Scotland and Iceland, providing the first evidence of successful recruitment in these regions.

This study was carried out under the PinkSIES project which has received funding from the European Union's Horizon 2020 Research and Innovation Programme under the Marie Skłodowska-Curie grant agreement No 101026030.

Pink Salmon in the North American Arctic: Natural Expansions from the Pacific or Invasions from the Atlantic?

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Co Authors: Kristen Gruenthal, Sara Gilk-Baumer

Climate and human induced shifts in Pink Salmon distribution have been documented across the Northern Hemisphere, including expansion into Arctic regions. An improved understanding of the origin of expanding salmon populations will benefit research and management of the species. We present genetic observations of Pink Salmon (Oncorhynchus gorbuscha) expansions into the Alaskan and Canadian Arctic to shed light on the relative roles of climate and human influences on the distribution and establishment of these expansions. To do this, we genotyped baseline Pink Salmon collections from the natural range across the Pacific Rim, from Norwegian rivers that represent secondary colonizations from stocking operations in the White Sea (1956-1979; 1985-1999) of Magadan region stocks, and from the Great Lakes that represent secondary colonizations from an accidental release (1955) of a British Columbia stock. We then genotyped samples of Arctic Pink Salmon for evidence of: origin, deviation from the strict 2-year life history found in their natal range (but not in some introduced areas), and self-sustaining populations. For origin, we test the hypothesis that North American Arctic individuals originate from natural colonization from the Pacific Ocean or from invading populations resulting from the successful White Sea stocking. We screened 298 amplicons in a genotyping-in-thousands by sequencing panel, to examine conformance to Hardy-Weinberg Equilibrium expectations, heterozygosity, and genetic relationships to baseline populations.

An updated coastwide baseline for genetic stock identification of chum salmon: a key resource for examining stock-specific marine migration and harvest

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Co Authors: Kristen Gruenthal, Sara Gilk-Baumer

Interannual variation in ocean survival among important chum salmon stocks has been observed in recent years across the Pacific-wide range of the species, leading to questions about the mechanisms driving these changes. Genetic stock identification is the premier method for distinguishing among

stocks in fishery mixtures. The method requires a baseline representing all potentially contributing stocks screened for genetic markers that have adequate levels of variation in allele frequencies among stocks. We present a new single-nucleotide polymorphism (SNP) baseline containing genetic data from over 42,000 fish and 91 loci that builds on previous baselines. The baseline was assembled using genetic data from tissue collections sampled over the past 37 years, with contributions from Korea, Japan, Russia, U.S., and Canada made possible through organizations like the NPAFC and PacSNP. In the baseline analysis, we assessed the identifiability of each reporting group by analyzing up to 100 mixture samples with varying compositions drawn from the baseline without replacement and used leave-one-out cross-validation and novel visualization methods to interpret correct allocations to stock and directionality and magnitude of incorrect allocations for individual assignments of fish. The baseline can distinguish 23 fine-scale and 7 broad-scale reporting groups making it a useful tool for estimating the contribution of stocks present in mixtures of fish caught on the high seas. The baseline is also capable of individually assigning fish to 5 reporting groups making it useful when pairing individual fish data with stock of origin. Due to these capabilities, this baseline is a key resource for examining stock-specific patterns of migration, harvest, and mortality in the northern Pacific Ocean and will be made publicly available for use by other researchers.

The Next 10 Years of Effort Needed to Restore Oregon's Chum Salmon

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Co Authors: Erik Suring, Chris Lorion, Jim Brick

Small or functionally extirpated populations face a myriad of ecological, demographic, and societal barriers on the road to recovery. Scientists facilitating recovery efforts meet these challenges in a variety of ways, including: habitat restoration, supplementation from in situ or ex situ populations, and/or directed educational outreach in local communities. But, it is rare for these approaches to be consistent enough over time, especially given limited resources (i.e., time and funding), to recover small populations either efficiently (i.e., as quickly as possible after population decline) or effectively (i.e., as directly as possible). One example of this phenomenon are the Oregon populations of Chum Salmon (Oncorhynchus keta) in the lower Columbia River, which are part of the Columbia River Evolutionary Significant Unit that has been listed as Threatened on the Endangered Species Act since 1999. Over the last ten years, efforts to recover Oregon populations have ranged from establishing a conservation broodstock with gametes from Washington, outplanting adults or eyed-eggs via remote site incubators in unoccupied tributaries, conducting research on factors limiting survival at various life stages, and implementing habitat restoration projects in partnership with local watershed councils. However, most reintroduction strategies are limited by the number of adult Chum Salmon that return to the system, meaning that when returns are low, even if personnel and funds are available, reintroduction efforts essentially cease. Here, we show our plans to improve reintroduction efforts for Oregon's Chum Salmon in the coming decade. Recent high adult returns can be used to bolster the conservation broodstock, test different outplanting strategies, and provide an opportunity for volunteers to participate in the recovery process. Combined with a multi-pronged monitoring plan and stakeholder support, this approach may allow these populations to maintain their size and meet recovery metrics, especially if freshwater and marine environmental conditions continue to be favorable.

RREDDS Action Plan for Restoring Chum Salmon Resulting from Outreach and Studies of the Youngs Bay and Big Creek Watersheds

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Return of the Redds (RREDDS) is an exciting collaboration campaign between the North Coast Watershed Association (NCWA), local landowners, the forest products industry, nonprofits, state and federal agencies all united around a common goal: To revitalize the once abundant Big Creek and Youngs Bay watersheds and chum salmon populations. The NCWA has spearheaded this collaboration to examine the historical presence, current situation, and future potential of chum salmon (Oncorhynchus keta) in the Youngs Bay and Big Creek watersheds of the Lower Columbia River region through a technical assistance grant and a stakeholder engagement grant awarded by Oregon Watershed Enhancement Board. The resulting understandings of the area's history, issues within the watersheds for chum, current restoration techniques to address these issues, and plans to put them to use will be presented.
https://www.returnoftheredds.com/action-plan

Session: DEI

How to: Developing Effective DEI Programs

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This session will focus on ways to develop successful DEI programs through the use of polices and protocols effective in shifting your organization's culture. We will focus on creating structural change within your organization, through highlighting a few specific examples. These examples will be drawn from nearly a decade as a DEI practitioner in higher education STEM fields. This session will be useful for individuals at every level of an organization.

Planning an Equitable Future: Empowering Diverse Voices

Christine Moffitt
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Many institutions and communities are working to change the face of leadership and develop strategic plans that include BIPOC voices. In natural resource management and education, access to safe environments must be elevated in the development of policy that can provide equity. To change a legacy of economic and social segregation embedded in many institutions and policies, we need increased conversations and input from all communities to understand their basic needs and plan for changes that are needed. How can we empower hidden voices and collectively prioritize challenges of environmental safety and economic security in policy analysis? I provide historical and recent examples of failure and success that can increase equity and understanding.

We're Better Together -- Diversity, Equity and Inclusion Provide a Strategic Advantage for Conservation

Sami Godlove
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A commitment to Diversity, Equity, and Inclusion (DEI) is not just a moral imperative, but a strategic advantage for conservation and environmental organizations. By incorporating diverse voices and fostering equitable workplaces and communities, environmental organizations can enhance innovation, improve decision-making, and deepen community engagement. This presentation will discuss Oregon Wild's ongoing efforts to strengthen the organization's internal and external DEI work and highlight some of the successes and challenges in meeting those goals.

Part 1 Diversity Champions, a community of practice that grows competence for inclusive leadership

Ana Lu Fonseca
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This talk will feature the Diversity Champions Program and how it has offered a comprehensive framework for integrating the nine competencies for Inclusive leadership within the four core modules of the program. This session introduces participants to the nuanced world of diversity, equity, and inclusion (DEI) within agricultural development.

The Diversity Champions Initiative empowers Extension Programs to embrace the nine key competencies for a culturally minded leader. This dynamic integration ensures that Extension initiatives for agricultural development are informed, inclusive, and reflective of our interconnected world.

Competency 1: Appreciating the Complexity of Identity

- Diversity Champions embrace and respect the multifaceted identities within communities, acknowledging the profound influence of identity on engagement and outcomes in agriculture.

Competency 2: Recognize the Process and Outcomes of Socialization

- Understanding the impact of socialization, Champions adapt their approaches to mitigate biases and nurture equitable engagement among diverse stakeholders.

Competency 3: Utilizing Inclusive and Affirming Language

- Diversity Champions champion inclusive and affirming language, fostering a welcoming environment that respects and values diverse perspectives.

Competency 4: Embracing Collaboration Across Differences

- Extension Programs led by Champions celebrate diverse voices and experiences, weaving a rich tapestry of ideas and strategies for agricultural development.

Competency 5: Practicing Cultural Humility

- The Initiative instills cultural humility, reminding Champions that continuous learning is the key to effectively engaging with diverse communities.

Competency 6: Attending to Environmental Factors

- Champions consider the environmental context, adapting their agricultural practices to ensure sustainability and resilience in a changing world.

Competency 7: Engaging Here and Now

- Through the Initiative, Extension Programs are encouraged to engage actively with the present moment, addressing current needs and challenges in the communities they serve.

Competency 8: Regressing Past and Present Inequities

- Diversity Champions take proactive steps to rectify past and present inequities, promoting a fair and just agricultural landscape.

Competency 9: Maintain Global Consciousness

- A global perspective ensures that Extension Programs think beyond borders, recognizing the interdependence of agriculture in a globalized world.

The Diversity Champions Initiative transforms agricultural development by nurturing leadership that values diversity and inclusivity. Extension Programs that embrace these competencies are sowing the seeds of a more equitable and sustainable future. "

Part 2 Diversity Champions, a community of practice that grows competence for inclusive leadership

Ana Lu Fonseca
Oregon State University
analu.fonseca@oregonstate.edu

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STEM camps for high-school-age students from underserved communities: The OSU-ELY Experience
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Co Auhor: Bessie Joyce
The OSU-Environmental Leadership for Youth (ELY) Program (https://ely.oregonstate.edu/) organizes and runs summer camps for high-school-age students from underserved communities. These multi-day, campus-based residential camps are led by Extension Faculty from the OSU Department of Fisheries, Wildlife, and Conservation Sciences with assistance from faculty across campus. There are two versions of ELY camps, one targets youth from underserved communities (primarily Hispanic and first-generation college students) and is offered as part of the larger OSU Migrant Summer Program. The other camp is designed with indigenous youth in mind and includes culturally appropriate activities carried out under the guidance and with the participation of members of the Confederated Tribes of the Coos, Lower Umpqua and Siuslaw Indians (CTCLUSI) and in partnership with Southwestern Oregon Community College. The main goals of these camps are to increase the knowledge, awareness and interest of youth in environmental stewardship, community leadership and to inform them about college programs and professional careers related to natural resources. Each camp can accommodate 20 to 30 high-school students during one entire week in either July or August. Although based at the OSU Corvallis campus, these camps offer attendees a variety of outdoor experiences such as river floating, river snorkeling, intertidal zone exploration, prairie walks and forest hikes involving plant and bird identification, and canoe paddling. During field trips, emphasis is placed on visiting river restoration projects, learning about ongoing research projects, and the work of community organizations such as watershed councils. The on-campus activities include laboratory tours, demonstrations of animal tracking, identification of aquatic insects and fish, and visits to the vertebrate collections at OSU. Students attend presentations on college pathways towards careers in fisheries and wildlife, forestry, oceanography and earth sciences and they also receive information on financial aid opportunities and online programs of study.

Session: Habitat Restoration Evaluations

Microhabitat conditions and habitat configuration influence juvenile salmonid use of off-channel features in the Cedar River
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Off-channel habitats are crucial for juvenile Pacific salmonid Oncorhynchus spp. freshwater rearing, but many of these habitats have been lost to human development of river floodplains. While there is a clear need to restore and reconnect off-channel habitats to help recover imperiled salmonid populations, there is uncertainty regarding what characteristics to prioritize when constructing off-channel habitats to maximize the salmonid rearing capacity of these features. To help clarify this uncertainty, we evaluated whether microhabitat conditions, the spatial configuration of habitats, or both microhabitat conditions

and habitat configuration influenced juvenile salmonid densities within constructed and naturally formed off-channel features of the Cedar River (Washington State, USA). We measured microhabitat conditions (water velocity, water depth, cover, and large wood density), habitat configuration (habitat type [side channel or backwater], distance from the mainstem, and feature width), and salmonid densities at randomly selected sample units. Water velocity and water depth strongly influenced sub-yearling Chinook Salmon, sub-yearling Coho Salmon, and yearling Coho Salmon densities, although the relationships varied among the species/life stages and some relationships changed through the spring sampling season. Cover and wood density also affected salmonid densities, but the relationships were weaker than for velocity and depth. Habitat configuration influenced salmonid densities as well, although the relationships varied among the species/life stages and between habitat types. For example, within backwaters sub-yearling Chinook densities were highest close to the mainstem river but yearling Coho densities were highest far from the mainstem. Additionally, sub-yearling Chinook and Coho densities were highest within intermediate-width side channels, while yearling Coho densities were highest within both narrow and wide side channels. Overall, our results indicate that both microhabitat conditions and spatial configuration influence juvenile salmonid densities within off-channel habitats. Our results also suggest that restoration practitioners should carefully weigh tradeoffs among design alternatives because different habitat configurations will differentially benefit certain species or life stages.

Estimating juvenile salmon estuarine carrying capacities to support restoration planning and evaluation

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Co Authors: Kai Ross, Meghan Camp, Jason Nuckols, Claire Ruffing

The goal of this study was to provide a simple and robust tool to estimate habitat capacity for juvenile Chinook (Oncorhynchus tshawytscha) and coho salmon (O. kisutch) to support salmon recovery and restoration planning. We assimilated over 4,500 unique estimates of published juvenile densities (e.g., fish/m2) in estuarine and floodplain habitats. These data were used to derive frequency statistics (e.g., quartiles) to estimate carrying capacities for species, life stage, and habitat types. We applied these scalars in a habitat expansion approach to available spatial data describing current, historical or potential, and predicted (based on seal level rise) habitat extents for 16 Coastal Oregon estuaries (or deltas) to estimate carrying capacities. This system-scale application was intended to inform restoration planning and prioritization, and we found that current carrying capacities (based on 75th percentile springtime (Apr-Jun) densities) ranged from 2,902 to 33,817 fish/delta for Chinook salmon and 2,507 to 20,206 fish/delta for coho salmon. These current capacities represented losses of 3 to 72% for Chinook salmon capacity and 2 to 67% for coho salmon capacity. Estimated carrying capacities were predicted to decline by 2 to 54% with 1.4 m of sea level rise in systems that are projected to lose vegetated tidal wetland habitat, while a 1 to 320% increase in capacity was predicted for systems that are predicted to increase in area with sea level rise (if tidal connectivity is restored). Finally, we demonstrate how the tool can be used to support restoration planning by applying the scalars to restoration scenarios and project examples. There is opportunity to refine the tool including; improved mapping of habitat extent and quality (including development of floodplain datasets); integration of additional data on juvenile salmon

use, densities, and residence time (to support estimates of production); and integration of landscape connectivity models to improve capacity estimates.

The Shifting Habitat Mosaic: Wood Dynamics Are Critical

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Co Authors: K.C.Yazzie, Christian Torgersen, Daniel Schindler

Understanding how aquatic biota respond to the spatial and temporal complexity of rivers is a major challenge for developing appropriate management and conservation practices for these critical ecosystems. The shifting habitat mosaic (SHM) is a conceptual model of how rivers evolve, provide resilience to disturbances, and maintain the habitat complexity supporting aquatic biodiversity. We tested the SHM in using a high-resolution record of habitat conditions and the abundance of 3 species of Pacific salmonid over 28 continuous kilometers of the mainstem of Elk River, Oregon over a 10-year period. The spatial and temporal variability of large wood at spatial scales of 0.1–1.5 km was 2-3 times greater than was observed at coarser scales, 6–24 km. During the same period, large wood abundance and channel depth in habitat units were positively associated with the abundances of Pacific salmon and these associations were maintained among years, despite the considerable spatial reorganization of large wood. Preliminary results point to a clear need for river management to maintain the disturbance regimes and aquatic - terrestrial linkages that characterize the wood and other dynamic components of aquatic habitat. This suggests a shift from focusing on static habitat characteristics at local scales, such as altering stream channel structure with semi-permanent wood structures, to the restoration of key ecological processes that generate dynamism at the watershed level.

Restoration as a Collaboration in the Lower Columbia River & Estuary

April Silva
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Working in isolation on restoration projects is like being a hydrologically disconnected slough, restore the connection and the system dynamics evolve; this is what restoration practitioners in fisheries and wetland science need to do in order to best connect and evolve these important habitat restoration projects. Site level habitat restoration is often opportunistic and isolated, both in terms of other restoration sites and organizations. Coordinated restoration and research efforts under the Columbia Estuary Ecosystem Restoration Program (CEERP) have resulted in a strong collaborative of restoration practitioners who's varied experience and willingness to share data and lessons learned has greatly furthered restoration science around fisheries in the Lower Columbia River and Estuary. The Columbia River Estuary Study Taskforce (CREST) has completed over thirty restoration projects within the tidal reaches of the Columbia River, incorporating standardized protocols to inform an estuary wide data base, and incorporating the latest science to inform restoration designs. This includes incorporating climate change, carbon sequestration, new restoration approaches, and socioeconomic concerns into restoration design as the science continues to evolve. CREST's juvenile salmon habitat restoration project record is built not only under the CEERP, but also through community and agency partnerships; and oh man have we learned some lessons about communication and expectations!

How Collaborative Priorities Change with Community Context of Floodplain Restoration Projects

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River restoration projects are inherently interdisciplinary, requiring support and input from multiple parties for successful implementation. But the nature and focus of collaboration depends on the organizational context and funding mechanisms for a given project. This presentation will explore these varying collaborative priorities through comparison of two floodplain restoration projects in the Pacific Northwest with different community and landscape contexts. The first project, located on Johnson Creek on a space-constrained, municipally-owned urban floodplain of Portland, Oregon, is led by City government. The second project, located on the South Fork (SF) Toutle River flowing through mixed ownership timberland settings in Southwest Washington, is led by a non-profit organization. Contrasting space constraints, risks, funding sources, landownership, and interested parties lead to starkly different collaborative efforts over the course of project development, planning, and design. In the municipally funded urban project, collaborative efforts focus greatest within and across City governments tasked with designing, approving, and managing the project area after restoration. In the timberland setting, collaborative efforts emphasize engagement of external partners, including grant funders, landowners, and permitting agencies. Furthermore, the differing space-constraints of these projects lead to alternate design priorities and collaboration needs to manage and communicate risks and benefits. This presentation will incorporate lessons learned from these project examples in hopes of supporting more effective planning and design of future river restoration projects according to their community context.

Poster Presentations

Instream substrate trends in the Northwest Forest Plan area from 2002 to 2024

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Stream sediments are the result of hydrogeomorphic processes occurring across multiple scales and are directly related to habitat needs for aquatic biota. Forest management and other land use activities can influence sediment storage, retention, and transport. Road networks in particular have been found to increase erosion and fine sediment deposition in streams. The presence of some fine sediment along the channel bed is normal and benefits some species, but excess fine sediment deposition can be detrimental. The Aquatic and Riparian Effectiveness Monitoring Program was established to track the status and trends in watershed conditions resulting from the implementation of the Northwest Forest Plan on federal lands. Here, we present preliminary findings showing trends in streambed substrate (percent fines and percent bedrock) and particle size distributions (D16, D50) from 21 years of instream surveys (2002-2023) by the Aquatic and Riparian Effectiveness Monitoring Program. Substrate trends demonstrated considerable spatial variability across aquatic provinces and watersheds. Overall, fine sediments declined in the transect-based sampling representative of all habitats.

Western Division American Fisheries Society and You!

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What can the Western Division of the American Fisheries Society (WDAFS) do for you? This poster is the starting point of a conversation with chapter members about how WDAFS can benefit you and you can benefit WDAFS. Division members represent a tremendous array of fisheries workers involved in all aspects of the fisheries profession. The collective diversity and expertise of our members is the basis of an intimate and unparalleled familiarity with fisheries resources and issues within our geographic region. The Western Division hosts a regional annual meeting; supports our ten chapters; sponsors committees that address issues important to chapter members; helps students and early career professionals through travel grants, scholarships, and continuing education opportunities; presents awards that recognize the hard work and dedication of peers across the western US and Pacific Islands; awards small grants; and, publishes a newsletter. By engaging with WDAFS you can get broader exposure for your work, grow your professional network beyond your state or chapter, enhance your leadership skills, expand your impact, and give back to the fisheries profession at a larger scale. Visit with us to learn more about WDAFS and how you can help!

Unraveling the effects of wood addition on stream habitat and Coho Salmon abundance via a BACI Study in Little River, California.

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Declining native fish populations in systems with diminished habitat have prompted considerable effort on river restoration projects. However, post-restoration monitoring to quantify success at restoring riverine habitats and improving native biota populations remains relatively limited, and when present, is often restricted to pre-post data without a control reach. To strengthen post-treatment conclusions about wood addition effectiveness, the California Department of Fish and Wildlife performed a Before and After Control Impact (BACI) study along the Little River in northwest CA, assessing stream geomorphology metrics and fish counts before and after restoration treatment. This BACI study involved monitoring two reaches of the Little River: one without alterations (Control reach) and another with additions of integrated artificial wood structures (Impact reach). Stream habitat metrics including bankful width, thalweg depth, dominant substrate, embeddedness, and stream habitat unit (pool/riffle) were quantified at regular transects along the approximately 1000m impact reach and an approximately 800m control reach. The abundance and species/size class of all salmonids in both reaches were estimated using mid-summer snorkel surveys. We assessed responses in thalweg depth, wetted width, pool frequency, and Coho Salmon young-of-year (0+) and 1+ or older counts. In the pre-treatment year (Year0), both reaches had similar proportions of pool habitat. After wood additions, post-treatment years 1 and 3 saw a total of about an 8% decrease in pool habitat for the wood addition reach but a 16% decrease for the control reach. By year 5, both reaches had increased pool habitat with a 17% increase in the impact reach and a 9% increase in the control reach. In the snorkel surveys, Coho Salmon YOY count

showed positive change in years 1 and 3 in the impact reach relative to the control reach. However, during year 5, Coho Salmon YOY counts returned to pre-treatment levels in both reaches.

Attack of the Clones: Tracking Aggressive Repetitive Interactions in the Sea Anemone Anthopleura elegantissima

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The aggregating anemone, Anthopleura elegantissima, inhabits Oregon's rocky intertidal and forms colonies of genetically identical clones and intraspecific competition for space results in agonistic behaviors between the colonies. Following contact with a non-clonemate anemone, A. elegantissima uses specialized fighting tentacles called acrorhagi to discharge neurotoxin into its opponent's epidermal tissue. Aggression in A. elegantissima has been previously documented, but little is known about how aggression intensity changes over a temporal scale. Here, we hypothesized that repetitive exposure to a non-clonemate would lead to increased aggressive interactions because of the elevated stress levels resulting from readily inflated acrorhagi. Aggression was induced by engaging thirty-six pairs of non-clonemates in close proximity for one hour over four consecutive days. After the fourth day, the anemones were kept separate for five days before one final interaction to determine how aggression intensity changes over time. Video footage of the interactions was then scored for tentacle contact, acrorhagi attacks, time spent in a defensive posture, and movement away from each other. We observed a significant relationship between acrorhagi status before and after each fight, indicating aggressive interactions took place. In preliminary results we found that the time an anemone spent in a retracted state increased throughout the five fights, suggesting that retraction may be the primary defensive action over running away from an opponent. Better understanding these aggressive interactions will help us predict how different A. elegantissima colonies will expand and contract over time in Oregon and the West Coast of the United States.

Riparian bryophytes: habitat for aquatic macroinvertebrates and responses to cattle and wild ungulate disturbance.

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Bryophytes (mosses and liverworts) are an overlooked riparian vegetation group that influence food web dynamics because they harbor high populations of aquatic invertebrates. However, their importance to aquatic invertebrates in Pacific Northwest streams has not been investigated. Additionally, little is known about how common land management practices and disturbances impact bryophyte abundance. We sampled 12 sites including six mid-order stream reaches, three headwater stream reaches, and three flood-plain wetlands (seeps) within the Meadow Creek watershed, northeastern Oregon during six sample periods (Spring, Summer, Fall of 2022 and 2023). At each site aquatic macro-invertebrates were sampled from bryophytes and from the streambed. We sampled bryophyte abundance (percent cover), composition, and depth (cm) across four ungulate treatments (1. Complete ungulate exclusion; 2. Elk and deer; 3. Cattle; and 4. Cattle, elk, and deer). Bryophytes contained macroinvertebrate densities that

were > 10 times the density found in the nearby unvegetated streambed. Bryophytes supported distinct communities of macroinvertebrates compared to the streambed. Most orders including Ephemeroptera and Trichoptera were more abundant in bryophytes; Chironomidae was particularly abundant in bryophytes compared to the streambed. Complete ungulate exclusion (9 years) resulted in ~ 10 times greater biomass of riparian bryophytes compared to areas grazed by cattle and/or wild ungulates. Riparian bryophytes were important habitat for aquatic macroinvertebrates across a wide variety of water body types in the Meadow Creek watershed (headwaters, mid-order streams, floodplain wetlands), and supported distinct invertebrate communities. Therefore, land managers and restoration practitioners should include riparian bryophytes in stream restoration and conservation efforts because of their potential influence on riparian food webs. Conservation of riparian bryophytes and associated macroinvertebrate communities will likely require management of large ungulates, both cattle and elk in riparian areas.

A Visual Guide to the Growth and Development of Juvenile Freshwater Mussels in Western North America

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North America has the most diverse and abundant assemblage of freshwater mussels in the world, with over 300 species across the continent. And yet freshwater mussels are one of the most imperiled taxonomic groups in North America, with 127 of approximately 300 species considered extinct, possibly extinct, critically endangered, endangered, or vulnerable (IUCN, 2022). West of the continental divide there are approximately three genera of freshwater mussels, and they are among the most poorly understood freshwater mussels in North America. The Confederated Tribes of the Umatilla Indian Reservation (CTUIR) includes western freshwater mussels among their traditional subsistence foods, also known as First Foods, and the CTUIR has established a project within their fisheries program aimed at researching and restoring freshwater mussels throughout CTUIR historic territory. The CTUIR Freshwater Mussel Project operates a research lab at Walla Walla Community College in Walla Walla, WA where the three genera of western freshwater mussels are artificially propagated, and the incremental development of each life history stage is studied for each species of western freshwater mussel. This poster will provide a visual guide to the development of juvenile freshwater mussels produced and observed in the CTUIR Freshwater Mussel Artificial Propagation Lab.

Canopy Cover and Aquatic Vertebrate Responses to Alternative Riparian Buffers Adjacent to Oregon Coast Range Streams

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Headwater tributaries play an important role in shaping the physical and biological composition of larger streams and rivers. Alterations to these smaller water bodies can have impacts on water quality, nutrient levels, temperatures, and the overall ecosystem, including its biotic components such as fish. In recognition of the vulnerability of these riparian areas and their influence on downstream systems, forest management practices have incorporated riparian protection zones in the form of riparian buffers.

The initial implementation of buffers was intended to protect and support native fish, particularly stream salmonids. By many measures, these protections have been successful, however, as implemented, most buffers are uniform in size and shape and there has been increased interest in modifying the design to allow for greater spatial heterogeneity in both aquatic and terrestrial systems. With this in mind, it becomes imperative to assess alternative forest buffer strategies and evaluate how they affect (positively or negatively) stream fish and other aquatic vertebrates. To investigate the impact of different buffer shapes on streams affected by timber harvest, we conducted a Before-After Control-Impact (BACI) study across 27 streams in Western Oregon. Focusing on aquatic vertebrate biomass, we analyzed responses one year after treatment relative to two years pre-treatment from the implementation of one of four buffer shapes (current practice, fixed width, gaps, and variable retention) relative to a comparable uncut (reference) stream. We found no consistent responses in fish or total vertebrates associated with the type of treatment however, there was a significant positive relationship between the change in canopy openness and the change in vertebrate biomass. This finding is evidence for a potential bottom-up response in aquatic apex predators in these managed headwaters where temperatures remain below critical levels even after harvest. These results have important implications for regulations around forest management practices and riparian protections.

Native and non-native fish species facing instability in high-risk basin

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The Goose Lake Basin encapsulates the border of South Central Oregon and California, serving as an example of uncertainty from wildfires and drought. Native endemic species such as Goose Lake sucker and Goose Lake redband trout, along with other species including speckled dace and fathead minnows, make the basin an area of concern for federal and state agencies, as research on the area has been limited in past years and nonexistent for over a decade except for an ongoing study started in 2022. Prior to ongoing research, the most recent study was conducted in 2007 by ODFW.

We expect to find varying species abundance comparatively to 2007 based on lack of management and varying snowpack. Environmental DNA (eDNA) is an emerging non-lethal tool used to detect aquatic organisms in water. We used a combination of electrofishing and eDNA collection to sample over 70 sites across the basin in 2022 and 2023. Habitat sampling was added to the 2023 season to further understand correlation between species abundance and metrics such as the number of woody debris present and substrate composition. Results suggest that abundance varied by species, with redband trout being more prevalent in 2022 than in 2007. Tentative results from the 2023 season suggest that redband trout prefer areas with greater quantities of woody debris and streambeds dominated by gravel and cobble. Overall, this project will provide updates on species distribution throughout the basin, allowing managers to support at-risk species. Habitat sampling will allow managers to prioritize restoration efforts.

Efforts toward development of a standardized visual survey protocol for western North American freshwater mussels

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Freshwater mussels are among the most endangered organisms globally. Several species of freshwater mussels occur across the Pacific Northwest region in a range of aquatic habitats, although recent evidence indicates their populations may be declining in both abundance and range. Data collected through recent survey efforts by federal, state, tribal, and NGO biologists, using both traditional techniques and emerging technologies such as eDNA, have improved understanding of species' current ranges. However, better understanding of population-level trends has been limited without standardized protocols and metrics for surveying and evaluating western mussel species. While protocols exist for freshwater mussel species elsewhere, these are generally aimed at accurately assessing populations in biologically diverse watersheds, and sampling mussel beds where handling is necessary for species identification. In western North American watersheds, the freshwater mussel fauna is less speciose, visual surveys are generally sufficient for identification, and freshwater habitat varies widely across the species' range, spanning both large river basins and ecoregions. As a result, there is a need for survey protocols that account for these differences. Recent collaborative efforts to develop a visual survey protocol for western species of freshwater mussels, with the intent to help standardize data collection, are described here and should serve to improve status and trend analyses to support conservation efforts.

Utility of Parentage Based Tagging for Research, Monitoring, and Evaluation of Hatchery Programs within the Columbia River Basin

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Salmon and steelhead hatchery programs in the Columbia River Basin (CRB) play a critical role in supporting healthy population abundances and mitigating the effects of hydrosystems. Hatchery managers require effective ways to conduct research monitoring and evaluation (RME) of the programs and stocks that they manage. Parentage-based Tagging (PBT) is a modern genetic tool that has several advantages beyond conventional tagging methods (e.g., coded wire tags, physical marks, and passive integrated transponders) for RME applications including being relatively inexpensive, attaining up to 100% tag rates, no tag-shedding, and non-lethal tag recovery from any life stage. PBT Baselines for Chinook salmon and steelhead were initiated in 2008 within the Snake River basin and expanded by 2012 to attain high expected tag rates for all hatcheries upstream of Bonneville Dam. Combining RME information collected via PBT from adult returns to hatchery programs with other RME efforts that utilize PBT provides a means for hatchery managers to track abundances, run timing, and harvest utilization of the stocks that they manage in a comprehensive manner throughout the CRB. Our objective for this study was to demonstrate the utility of PBT for comprehensive RME by testing observed vs. expected stock composition of Chinook salmon and steelhead passing Bonneville Dam in 2023. We found that expected tag rates of 36 Chinook salmon collections (N=44,584) averaged 89.2% (52.9 – 100%) and 8 steelhead collections (N=1,308) averaged 93.1% (62.8 – 100%), which largely agreed with observed tag rates except for rare cases including intentional integration of natural origin fish in broodstocks. Similarly, we explain rare deviations from expectations of age and stock composition and Bonneville Dam stock-specific abundances, which if routinely monitored could be helpful to hatchery managers.

Umpqua Chub: Using eDNA to find a population thought to be gone for 93 years

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Following the discovery of Umpqua Chub (Oregonichthys kalawatseit) in the North Umpqua River for the first time in 93 years by Brooke Penaluna in 2019, I utilized eDNA to investigate the full extent they inhabited the river. From August 3rd to August 11th 2023, samples were collected every 2 miles on the North Umpqua River from the confluence with the South Umpqua River up to Deadline Falls, as well as on major tributaries (Sutherlin Creek, Little River, Cavitt Creek, and Rock Creek) covering most of the modeled habitat in the system. In total 24 samples were collected covering over 38 river miles. The samples are currently being processed by the Pacific Northwest Research Station for Umpqua Chub, Smallmouth Bass, and Western Ridged Mussels.

Exploring methods and uses for recovery of salmonid coded wire tags from digestive tracts of piscine predators in the Snake River.

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The Northern Pikeminnow Management Program (NPMP) is a multi-decade collaborative effort to reduce predation on juvenile salmonids through the re-structuring of the Northern Pikeminnow population, which includes an active biological monitoring and evaluation component. Through the NPMP, the Oregon Department of Fish and Wildlife (ODFW) has analyzed digestive contents to track piscine predation of juvenile salmonids. Concurrently, juvenile salmonids have been injected with coded wire tags (CWT) for decades by numerous agencies. The recovery of these CWTs in piscine predator digestive tracts may provide an additional source of stock or species information from predated salmonids in the Columbia River Basin. We tested the ability to retrieve ingested CWTs from diet samples of known piscine predators and investigated the potential insight on predation of juvenile salmonids. ODFW collected 1,263 stomach contents from Smallmouth Bass (n=882), Walleye (n=344) and Northern Pikeminnow (n=37) in the four lower Snake River reservoirs. We used a metal detector to scan for CWT presence, and chemically digested the stomach samples to isolate CWTs, and then read them. Using our updated methods, we were able to successfully detect CWTs in the field and obtain 14 CWTs combined from the three species in the lab, followed by a query of the Regional Mark Information System to acquire data on species, release size, location, and date. These initial results indicate that expanding this effort may broaden our ability to estimate predation impacts to hatchery releases, creating a better understanding of predator-prey dynamics.

Effects of large woody additions on instream habitat for Coho Salmon in California streams

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Despite their historical abundance along the west coast of North America, Coho Salmon (Oncorhynchus kisutch) have been steadily declining over the past two centuries. An important factor linked to this species' decline is habitat degradation and in particular loss of complex habitat. Restoring the streams which these fish rely on for feeding, spawning, and refuge is essential for ensuring the longevity of Coho Salmon populations. To improve instream habitat, restoration often involves the installation of structures to increase habitat complexity. Boosting habitat complexity of streams increases Salmon survival by providing places for fish to rest out of the main current and hide from predators. This study examines stream response to the addition of large wood (LW) as it relates to improving aspects of Salmon habitat. We evaluate wood addition restoration projects conducted across 15 streams throughout northern California. Data on instream shelter complexity, percent covered, stream depth, pool frequency, substrate composition, and snorkel survey fish counts were recorded before restoration, and again three years after restoration for all locations. We assess overall changes following restoration and how the observed change in habitat features and fish following restoration relate to larger stream features such as size, gradient, and latitude. Preliminary results indicate mixed responses to restoration.

Assessing superimposition of listed tule fall Chinook salmon redds using aerial and ground surveys on the White Salmon River, WA

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Upriver bright (URB) fall Chinook salmon reared and released from the Little White Salmon and Willard National Fish Hatcheries are known to stray into the White Salmon River. Interactions between hatchery-origin URB strays and ESA-listed tule fall Chinook salmon are believed to lead to a loss in productivity of the native tule population through hybridization and redd superimposition. Tule fall Chinook salmon generally spawn earlier in the fall (September – October) which puts their redds at risk to superimposition by URB fall Chinook salmon that typically spawn later (late-October – November). Superimposition may result in egg displacement and reduce egg-to-fry survival leading to a loss in productivity of the tule fall Chinook population. A feasibility study conducted in the fall (September – November) of 2022 found a surprisingly high incidence (71 percent) of tule redds superimposed by URBs in the lower White Salmon River. Redd locations were documented during weekly ground surveys using ArcGIS Field Maps and an Arrow RTK GNSS Receiver resulting in centimeter-level location accuracy. The degree of overlap and level of disturbance to tule redds were used to document superimposition. In 2023, weekly ground surveys were supplemented with aerial surveys using an unmanned aerial vehicle (i.e., drone) to provide high-resolution georeferenced imagery of spawning grounds. Independent observers reviewed and identified redds from weekly imagery to distinguish superimposed redds. Results based on imagery from drone surveys and counts from ground-based surveys will be compared to evaluate methodologies and estimate aerial observer error. The relative percent of tule redds that were superimposed will be discussed, as well as potential spatial or temporal components to superimposition. Results from this study will be used to make informed decisions and potential changes to the methodology of surveys in 2024.

Identifying and locating sensing and signaling receptors in the fish parasite, Ceratonova shasta

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Myxozoans are spore forming cnidarian endoparasites, responsible for fish diseases including whirling disease, enteronecrosis, proliferative kidney disease, hamburger gill disease, and soft flesh disease. Like their free-living cnidarian relatives, myxozoans have an organelle called the nematocyst, consisting of a tubule that discharges explosively when triggered by host contact. In free-living cnidarians, nematocysts are used for capturing prey and deterring predators, but in myxozoans they are used for attaching to their hosts to begin infection. The precise factors that trigger myxozoan nematocysts remain largely unknown. We propose that an understanding of the host-sensing mechanism could lead to a method for blocking the parasites and preventing infections. To understand this mechanism, we are investigating how the myxozoan salmonid parasite Ceratonova shasta senses its fish host and fires its nematocysts. C. shasta causes enteronecrosis and death in both wild and hatchery-reared salmon and trout, and is an excellent model for investigating myxozoan structure and function. We began by sequencing and assembling genomic and transcriptomic data from C. shasta. We then searched these data for sensing and signaling genes known from the free-living model cnidarian Hydra vulgaris and found that C. shasta has a distinct cnidarian P2X chemoreceptor and a TRPA mechanosensor, which represent clear targets for inhibiting spore function. Accordingly, we designed an antibody that binds to P2X and are now using Western blots, proteomic analyses, and immunofluorescence staining to confirm the presence of this receptor and visualize its location on the spore. Western blot bands suggest the presence of expected P2X monomers and dimers, which we are confirming by proteomic analysis. After confirmation of the identity and location of the P2X sensor, we will conduct fish infection experiments with a range of chemical inhibitors to see which successfully block C. shasta infection of fish.

Aquatic macroinvertebrate predator response to varied riparian buffer geometry in headwater streams of Western Oregon

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Headwater stream ecosystems are closely connected with the surrounding forest landscape and in turn associated management practices. In the Oregon coastal range, forestry is the dominant land use, and protections to ensure continued headwater stream function in this region focus on maintaining an area of unmanaged forest next to the stream (i.e. riparian buffers). In many areas buffer configurations are of uniform width, which simplifies regulatory prescriptions, but may not allow for maximum ecological protection and functionality. This study investigates the influence of different riparian buffer geometry on aquatic invertebrate predator abundance, richness, and density in 10 headwater streams across the Oregon coastal range. Within stream ecosystems the meso-predator functional group is an important community to consider in evaluating upper trophic level responses, but most research focuses on apex vertebrate predator (fish and salamanders) responses rather than invertebrate meso-predators. Elucidating invertebrate predator response to varied riparian buffer geometry will provide important context for overall stream productivity that can help us to understand the implications of resource management decisions. This study was conducted using a before-after control-impact (BACI) design that was replicated across two blocks of five streams. Riparian buffer configurations included: control, current

practice, fixed-width, gaps and variable retention. We assessed aquatic macroinvertebrate predator responses for four years, including two years pre-treatment and two years of post-treatment. Overall, macroinvertebrate predator abundance was generally greater after harvest for variable retention and canopy gap treatments. It was also greater for fixed width and current practice treatments in the Walton block, but not Valsetz. Genus richness increased in all treatment sites at the Walton block relative to their reference following harvest. In the Valsetz block genus richness response to treatments were inconsistent. Relationships between stream habitat changes associated with different buffer treatments and the magnitude of macroinvertebrate predator responses were variable.

Comparative catch of Mountain Whitefish at rotary screw traps in the Grande Ronde basin.

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Long term rotary screw trap data in the Grande Ronde basin offers information not only on target species like Chinook and Steelhead, but also a glimpse into incidental species like Mountain Whitefish (MWF). Focus on MWF has shifted in the Grande Ronde, and without historical comprehensive survey data available, managers look to data from these long term, historical projects. Data on Mountain Whitefish was gathered from screw trapping data at five sites in the Grande Ronde basin, starting in 1993, to give a catch per unit effort based on trapping days. This data may provide information to guide MWF management and helps understand if there are potential reasons for concern.

Effects of hot summer nights vs. hot summer days on stream temperature

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Stream temperature is a critical component of aquatic systems in the Pacific Northwest. It is well-documented that increased stream temperatures affect aquatic life by increasing stress in cold-water salmonids and other native organisms resulting in decreased vigor and possible mortality. One of the main factors influencing stream temperature is air temperature. Many studies have looked at the influence of maximum air temperatures on stream temperature but few have looked at the influence of minimum nighttime temperatures on stream temperature.

Typically, stream temperatures are at their lowest in the early morning. However, sometimes atmospheric conditions prevent cooling, resulting in minimum nighttime temperatures in the high 60s to low 70s (degrees Fahrenheit). A rare look at stream temperature trends is offered by the 25 years of data at sites in the Umpqua Basin Reference Temperature Project (funded primarily through the Partnership for the Umpqua Rivers as well as The North Umpqua Foundation, The Steamboaters, Bureau of Land Management, and Oregon Watershed Enhancement Board). The timing of the yearly seven-day average maximum (7DAM) stream temperatures was compared to the three-day average maximum and minimum daily air temperatures. The highest 7DAM stream temperatures for the period of record did not consistently correspond with the periods of maximum air temperatures; instead, they corresponded with the time of the highest nighttime air temperatures for several occurrences across the sites.

The pattern of diurnal fluctuation of stream temperatures allows for a temporal refuge for cold-water organisms. Since one of their largest stressors is high stream temperatures, the ability to predict periods of high stream temperatures assists aquatic resource specialists in understanding stream dynamics and effectively managing the fishery.

Further analysis of this data is warranted to further describe the stream and air temperature relationships.

Brewed for Thought: Community-driven Discussions Create Connections in the Coos Bay Area

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In 2022 we founded and began running Brewed for Thought, a series of monthly events that bring together folks from the Coos Bay area for an evening of discussion on topics ranging from fisheries sustainability to bay area community projects. Funded by a University of Oregon DEI grant and hosted by 7 Devils Brewing Company, our main goal in creating Brewed for Thought was to fill a gap we perceived in the established ecosystem of idea-sharing around topics with a scientific or environmental focus. Different from many seminars offered in this community, we aimed to create a uniquely discussion-based format, where the whole room joins in the conversation, guided by one or more invited experts in the topic of focus. Across the course of 8 months, we held 8 events on the following discussion topics centered on the local Coos Bay area: Invasive Species, Community Care, Restoration Ecology, Natural Hidden Gems, Coho Salmon, Estuary Management, Science Communication, and Land Conservation. Attendees at each event numbered from 25-59 and came from widely varied backgrounds: local fishers and boat captains, academics ranging from undergraduate- to faculty-level, representatives from local organizations including Oregon Department of Fish and Wildlife, South Slough National Estuarine Research Reserve, Wild Rivers Land Trust, Oregon Shores Conservation Coalition, Rogue Climate, Coos and Coquille Watershed Associations, Bureau of Land Management, Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians (CTCLUSI), United Way of Southwestern Oregon, and many others. The outcomes of our Brewed for Thought events have been greatly beneficial to attendees in a variety of ways: connections were created for collaborations on current and future projects, networking opened up avenues for career development, ideas were exchanged on issues pertinent to the local community, and many organizations enjoyed a welcoming platform from which to share important news, opportunities, and resources.

Predators as samplers: using diet data to inform prey distributions and densities in the Gulf of Alaska

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We know that distributions of groundfish predators respond to localized prey abundances and that prey availability influences habitat quality for predator species. Currently, survey methods in the Gulf of Alaska (GOA) do not adequately sample prey species (e.g., euphausiids, forage fishes, benthic invertebrates) and the capacity to expand survey scope is limited. Therefore, we are using diet data from key groundfish predators to quantify spatiotemporal variation in prey densities throughout the GOA. Joint species distribution models (JSDMs) will be used to quantify relationships between prey and their environments with each predator treated as a sampling unit. JSDMs provide a multivariate context to

quantify species correlations and improve model performance for more rare taxa. Focal groundfish predators include Pacific cod (Gadus macrocephalus), Pacific halibut (Hippoglossus stenolepis), Pacific ocean perch (Sebastes alutus), sablefish (Anoplopoma fimbria), and walleye pollock (Gadus chalcogrammus). We will use the following covariates to model habitat effects on prey distribution and density: depth, slope, bathymetric position index, degree of rockiness, and the occurrence of structure-forming invertebrates. We will address potential climate drivers by including regional modeling system (ROMS) products (e.g., zooplankton abundance, bottom temperature) from the GOA Climate Integrated Modeling (GOACLIM) project. We will also include spatial, temporal, and spatiotemporal covariates to account for latent processes. Model construction will be done using the tinyVAST R package (Thorson, in development). Prey predictions will then be used as ecological covariates for species distribution models used to define essential fish habitat for groundfish predators in the GOA.

Biogeographic variation in black rockfish life history traits from California to Alaska

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Life history traits play a pivotal role in shaping the dynamics of marine populations. Reproductive strategies and growth rates impact species resilience and vulnerability to environmental changes and fishing pressures. For species with broad geographic ranges, we must quantify the effects of spatial variation before we can begin to effectively quantify changes through time. Life history information informs state-based stock assessments by identifying separate stocks, setting appropriate fishing regulations, and fostering sustainable management through a comprehensive understanding of life history traits. Black Rockfish (Sebastes melanops) hold great value within the California Current and Gulf of Alaska. The current lack of biological information for Black Rockfish hinders assessing the impact of environmental change on their ecosystem, impeding our understanding of species-specific responses, population trends, and the development of conservation practices for biodiversity and ecosystem health. Our research will address this informational void by quantifying life history traits of Black Rockfish throughout this range. Sampling sites will span four well-established biogeographic breaks from California to the Gulf of Alaska, including: Point Arena, Cape Blanco, Columbia River, and Cape Flattery. Black Rockfish will be sampled during directed hook-and-line fishing trips and salvaged from recreational and/or commercial landings. We will estimate spatially explicit age and growth. Histological methods to assess length- and age-at-maturity, and commonly used techniques to quantify fecundity will be used. This work involves close collaborations among academic scientists, state and federal agencies, and local fishery stakeholders to facilitate the generation of research products that have direct utility for fisheries management. Results will be made available to refine stock assessment models in California, Oregon, Washington, and Alaska. This work will also provide a baseline for studies focused on climate impacts on black rockfish and the ecosystems in which they are a key component.

Comparing migration patterns and early ocean residence across hatcheries of interior Columbia River spring Chinook salmon

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Interior Columbia River (ICR) spring Chinook Salmon (Oncorhynchus tshawytscha) is included in three Evolutionarily Significant Units, two of which are listed under the Endangered Species Act. Currently, <10% of juvenile ICR Chinook salmon collected in coastal waters are wild. The increased application of genetic parentage-based tagging (PBT), allows us to determine if, and how, juvenile migration patterns and early ocean residency vary across hatcheries and between hatchery and wild fish. We examined 259 ICR yearling spring Chinook Salmon collected in coastal water during late May 2021 by NOAA's Juvenile Salmon and Ocean Ecosystem Survey (JSOES). We quantified variation in the size and timing of ocean entry and early ocean growth across 12 ICR hatcheries and wild yearlings. We also determined if JSOES collections were representative of releases from these 12 hatcheries. We used otolith structural and chemical analyses to reconstruct migratory patterns. Hatchery release data was gathered from Regional Mark Information System. We determined that the relative ocean catch abundance from these 12 hatcheries was reflective of release data, although the mid-Columbia hatcheries, Carson and Little White Salmon, were overrepresented in our catch. Mean ocean entry ranged from 15 Apr to 21 May, with fish from the Snake River entering earliest and upper Columbia the latest, while wild fish entered continuously throughout the entry range. There was hatchery-specific variation in size and timing at ocean entry, although there were no relationships between size or mass at tagging and size at capture. However, variation in length at capture was positively correlated with otolith size at ocean entry ($r = 0.75$). Longer-term examination of hatchery-specific migratory behavior can improve our understanding of early marine residence and variation in survival rates across discrete hatcheries and geographic regions.

eDNA work on the fish (and potentially pathogen) communities in the Upper Klamath

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Amidst climate change pressures and scheduled dam removals, the Upper Klamath River Basin offers a unique opportunity to study ecological shifts. Our research employs Environmental DNA (eDNA) to characterize the fish community, contributing to a spatial occupancy model and comparing eDNA to traditional surveying methods.

Navigating climate-induced changes and dam removals, we assess fish species composition, distribution, and abundance using eDNA. The study aims to construct a spatial occupancy model, revealing habitat preferences and utilization patterns across a broad landscape. By comparing eDNA to traditional surveying methods, we evaluate its efficacy in capturing fish community dynamics, providing insights into advantages and limitations, and advancing eDNA application in freshwater ecosystems. Additionally, it establishes a benchmark for ongoing and future assessments, continually refining our understanding of aquatic biodiversity in the face of environmental transformations and defragmentation."

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

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In order to design a successful fish passage facility, it is important to understand how out-migrating juvenile salmonids transition through a given reservoir. An understudied and critical component of that behavior is the depth at which fish approach and explore the dam forebay. We used a novel pressure-sensitive acoustic telemetry tag to provide additional information for the fish passage facility that PacifiCorp is designing for downstream passage of juvenile salmonids at Yale Dam on the Lewis River, WA. During the 2023 outmigration, juvenile Chinook Salmon, Coho Salmon, and steelhead were implanted with acoustic transmitters and tracked through Yale Lake using acoustic telemetry. A subset of these fish was implanted with an Advanced Telemetry Systems SS300P pressure tag to track the depth of tagged fish as they moved through and explored the forebay region of the dam. Tags were found to be accurate to within several centimeters, after correction for atmospheric pressure and offset. Study fish implanted with pressure tags approached and spent most of their time within the forebay near the surface. For all three species, more than 95% of all detections were within 20 feet of the surface, and half the time they were within 6 feet of the surface. Both median swimming depth and maximum sounding depths were greatest among juvenile Chinook, although sounding behavior was also observed among juvenile Coho and steelhead. Most study fish (79% of Chinook, 90% of Coho, and 96% of steelhead) sounded to depths greater than 25 feet, and some (34% of Chinook, 18% of Coho, and 28% of steelhead) dove to 100 feet or more, which likely reflected attempts to seek passage through Yale Dam. This information will be combined with ongoing Computational Fluid Dynamic modeling efforts to help determine the location, orientation, and operational regime of the future downstream collection facility.

Reducing Catches of Smaller-Sized Sablefish in the U.S. West Coast Bottom Trawl Fishery

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The bycatch of non-targeted species results in a loss of income for commercial fishers, a loss of diversity, and negatively affects both the sustainability of the fishery and the ecosystem. In the U.S.West Coast groundfish bottom trawl fishery, Dover sole (Microstomus pacificus), thornyheads (Sebastolobus spp.), and sablefish (Anoplopoma fimbria) together form an important fishery harvested as the DTS complex. In this bottom trawl fishery, the DTS complex is the most valuable fishery in terms of catch and value, with the sablefish being the most economically important stock. However, the price that shoreside facilities offer for smaller-sized sablefish (i.e., <50 cm) is negligible compared to larger-sized adult sablefish. Allowing the escapement of smaller-sized sablefish maximizes the economic value of sablefish for fishers and promotes the future propagation of the stock. In a study area off the Oregon coast, we tested the efficacy of a flexible sorting grid with 9.5 cm squares inserted anterior of the codend in lowering the catch rate of juvenile sablefish without significantly impacting the catch rate of the larger sablefish. With 12 fishing days on the F/V Last Straw, we fished 17 experimental tows with the sorting grid inserted, and 17 control tows with the standard bottom trawl configuration. Unpaired analysis showed lower catch rates for smaller-sized sablefish than for larger-sized sablefish with the sorting grid inserted.