Abstracts

56th Annual Meeting – Bend, Oregon

March 4-6, 2020

Oregon Chapter of the American Fisheries Society

Handle with caution! The often overlooked effects of handling and tagging

Nick Ackerman
Portland General Electric
nick.ackerman@pgn.com
Coauthors: Garth Wyatt, Dan Cramer, Maggie David
Oral Presentation

The handling and tagging of fish is a necessity in a wide variety of the activities with which fish biologists busy themselves. Research, monitoring and evaluation, implementation of fish passage, and fish culture require handling and/or tagging. Typically, it is assumed (whether stated or not) that the effects of such are negligible. We are comfortable with these assumptions because we have taken reasonable precautions and there is literature to support our case. Rarely are these assumptions challenged because there typically are not in situ data to refute them. Violations of our assumptions may be compounded by assuming wild fish response to handling is similar to hatchery fish. This presentation will highlight a couple of case studies in which the effects of tagging and handling of fish were directly or indirectly quantified in fish tracking studies. These case studies focus on the effects of tagging and handling on wild salmonids and how those effects may have influenced the results of fish passage evaluations. Our experience should be considered in broader context, particularly where wild salmonids are handled such as in research and fish passage programs.

Incorporating Habitat Information to Improve Salmon Stock-Recruitment Analysis

Milo Adkison
University of Alaska Fairbanks
mdadkison@alaska.edu
Poster Presentation

In overharvested or even well-managed salmon populations, escapement is generally kept below abundances that produce strong density-dependent reductions in productivity. The result is that abundance data contains little information about at what abundances these effects occur, and how strong they are. In other words, the carrying capacity of the habitat is poorly known. The amount and quality of habitat can be valuable auxiliary information, if coupled with studies of the amount of a certain type of habitat each fish requires. In this study, I present a methodology to supplement Chinook stock-recruitment data with a watershed area-carrying capacity relationship developed by Parken et al.

(2006). I examine under what circumstances and to what extant incorporating this auxiliary habitat-based information improves inferences about optimal escapement goals and harvest rates.

Effects of altered flow regimes on invertebrate hosts of salmon parasites in the Klamath River

Julie Alexander
Oregon State University
alexanju@oregonstate.edu
Coauthors: Nicholas Som, Nicholas Hetrick, Jerri Bartholomew, Heather Robinson
Oral Presentation

The (natural or otherwise) flow regime -timing, magnitude, and duration of extreme events- affects the structure and function of rivers worldwide. A lack of synthesis of the consequences of flow regime and aquatic nuisance species limits our understanding of the multitude of ecological effects flow alterations have on riverine ecosystems. The Klamath River presents an interesting model for developing and testing related hypotheses because flow regime and salmon parasites appear to be linked. We identified ecologically relevant hydrological attributes of flow (e.g. antecedent conditions, duration, magnitude, timing and seasonality, rate of change, frequency) that operate within the temporal hierarchy of the flow regime and examined responses of invertebrate hosts of the salmon parasites. We synthesized data from multiple datasets collected over a 10 year period, and hope the mechanistic links we describe can be used to develop and test hypotheses of variable flow hydrological-ecological responses in a cause-effect framework that will have value for both salmon disease research and flow management in the Klamath River and beyond.

Linking post-fire ecosystem responses to catchment characteristics to map wildfire vulnerability of aquatic ecosystems across the Pacific Northwest

Vance Almquist
USEPA
almquist.vance@epa.gov
Coauthors: Joe Ebersole, Mussie Bayene, Ryan Hill
Oral Presentation

Abstract: Across the Pacific Northwest the size and frequency of wildfires has been steadily increasing over the last two decades, potentially further stressing the region's aquatic ecosystems. However, aquatic ecosystems vary widely in their responses to wildfire, with some systems having muted responses while others appear to be highly sensitive. Importantly, understanding the causes of the variability is needed to inform the development and implementation of regional risk mitigation strategies. At a broad level there are two primary sources of variability in ecosystem responsiveness to wildfire disturbance; the ecological characteristics (food webs, population, etc) and the physical context (elevation, geology, climate) in which the ecosystem is embedded. Herein we focus on characterizing the physical drivers of differential responses to develop an index of catchment vulnerability to wildfire impacts. We present a bootstrapping approach to calculate a spatially explicit estimate of the mean vulnerability index for each catchment along with bounding estimates of uncertainty. We then use this

approach to generate a map of the wildfire vulnerability and its associated uncertainty for the entire Pacific Northwest. To validate the usefulness of the vulnerability index we compare the aggregated values of the index from individual fire scars to post-fire synoptic observations of biological conditions in several streams across the region. The results of this work provide a new, regionally coherent tool for coordinating and implementing large-scale decision making by land management agencies. Finally, this work represents a significant first step toward developing the knowledge and tools needed for designing and enhancing ecosystem resilience in the face of environmental pressures.

Decoding a battle to the death: myxozoan infection in rainbow trout

Benjamin Americus
Oregon State University
benjamin.americus@gmail.com
Coauthors: Damien Barrett, Jerri L. Bartholomew, Stephen D. Atkinson, Gema Alama-Bermejo
Oral Presentation

Ceratonova shasta is a parasite of salmon and trout in the Pacific Northwest. The Klamath River Basin is one of the areas most heavily affected by C. shasta. In June 2019, 80% of juvenile chinook sampled in the system were infected with C. shasta. Despite extensive hatchery enhancement of Chinook and coho stocks, salmon populations have continued to decline in part due to C. shasta-related mortalities in both returning adults and out-migrating juveniles. Alongside warmer waters, reduced discharge, habitat modifications and dam removal, C. shasta is an additional, potentially lethal stressor to salmonids in the Klamath River, and across the entire Pacific Northwest. RNA-Seq is a powerful, molecular tool for characterizing fish health. It is used to quantify gene expression, particularly in response to environmental stressors. Its value lies in the ability to characterize many features of fish health from a single, potentially non-lethal sample. For infections with pathogens like C. shasta, RNA-Seq provides information on disease severity and host-parasite interactions. Here, we present the first paired fish and parasite transcriptomic characterization of a myxozoan infection. We use RNA-Seq to investigate host and parasite gene expression, to better understand the molecular war being waged inside the fish as infection progresses. We exposed rainbow trout to C. shasta and collected time-series RNA samples, then sequenced these on an Illumina platform. We sorted fish and parasite read datasets using reference libraries, then we performed differential expression analysis, indicator gene identification, co-expression analyses, and metabolic pathway mapping. We identified large suites of co-expressed parasite genes and a coordinated, though ultimately unsuccessful, host immune response by the fish. These findings identify hallmarks of lethal infection and provide a framework from which to compare fish sampled from the environment.

Linking scale growth to variation in Puget Sound Chum Salmon abundance and productivity

Austin Anderson
WDFW
ajand311@gmail.com
Coauthors: Andrew Claiborne, Marisa Litz, Mickey Agha, Lance Campbell
Oral Presentation

An improved understanding of the mechanisms that influence productivity and abundance of Puget Sound (PS) Chum Salmon is critical for accurately determining the number of harvestable fish and for identifying years of conservation concern. Recent research has found environmental factors (e.g., Pacific Decadal Oscillation) and the abundance of potential competitors (Pink Salmon) during the first few years of marine life are related to trends in age-at-maturity and productivity of PS Chum Salmon. Relatively little, however, is known about how marine growth varies in relation to environmental factors and population productivity for PS Chum Salmon. The two primary objectives of this study are A) to identify the relationship between environmental factors, population productivity, and marine growth in PS Chum Salmon, and B) to develop stock specific indicators of survival and productivity that utilize marine growth and environmental factors for forecasting. The study is focused on 3 spatially distinct stocks: Skagit River, South Sound, and Hood Canal fall-run Chum Salmon that exhibit decreasing, stable, and increasing productivity, respectively. We analyzed n=4,320 scale samples of fish from brood years 1997-2012 to estimate growth during each year at sea for returning age classes 3_1, 4_1, and 5_1. We will present relationships between marine growth, population productivity, population abundance, and a variety of abiotic and biotic indices including Pacific Decadal Oscillation, North Pacific Gyre Oscillation, sea surface temperature, and Pink Salmon abundance. Indices will be incorporated into a multivariate framework and models that best capture variation in productivity will be ranked after undergoing hind-casting validation. The results of this study lead to better understanding of the ocean ecology of Chum Salmon and could improve pre-season forecast performances, as current estimates are largely derived from naive models of recent year recruit-per-spawner averages that are insensitive to years of unusually low and high survival.

Assessing thermal tolerance of native fish species across variable thermal regimes

Kara Anlauf-Dunn
Oregon Department of Fish and Wildlife
kara.anlauf-dunn@oregonstate.edu
Coauthors: Erika Eliason
Oral Presentation

Measuring stream temperature has become increasingly relevant as a changing climate, compounded by human alterations, threatens to displace aquatic species and disrupt their ecology. Developing a strategy for monitoring water temperature has become a priority for the Oregon Department of Fish and Wildlife (ODFW) with the purpose of improving the information on which to make management decisions. The overarching goals for ODFW are to obtain year-round stream temperature estimates across the state of Oregon. Given the need for state coverage and efficiency, we are evaluating methods that will provide precise and accurate estimates of different components of the thermal regime. We are

also collecting complimentary information relating these data to species needs by measuring multiple physiological traits (e.g. metabolic performance, thermal tolerance) of native fish species in response to changing water temperatures. We hope to describe the phenotypic responses to acute thermal stress across species and populations and evaluate the variability in these responses across species and populations. We intend to use these data to hypothesize how changing thermal regimes will influence species distributions and survival (e.g. variation in plasticity across species) so we can better manage Oregon's native species.

Size and abundance of aquatic vertebrates along 10 km of the mainstem of Lookout Creek, OR

Ivan Arismendi
Oregon State University
Ivan.Arismendi@oregonstate.edu
Coauthors: J Andres Olivos, Gwen Bury, Brooke Penaluna, Jeff Snyder
Oral Presentation

The objective of this study is to assess and understand how and why population size and structure of Coastal Cutthroat Trout and Coastal Giant Salamander differs along a river continuum. We examined spatial patterns of vertebrate distributions within 10 km of the mainstem of Lookout Creek, OR during 1-week of intensive sampling. We estimated aquatic vertebrate relative abundances and size structures using single-pass electrofishing without blocknets and digital imaging analysis. In addition, we characterized pool geometry (pool length and width, depth, surface area, and location) to explore how biophysical templates may influence spatial variability in the distribution of these two aquatic vertebrates. We found a strong influence of pool size and its location within the network on the abundance of aquatic vertebrates. Larger and deeper pools located downstream were used by larger animals in lower densities. In contrast, smaller and shallower pools located upstream contained a higher density of animals, but individuals were smaller. Our findings provide insights about potential density-dependence mechanisms driving animal densities that are modulated by the geometry of pool habitats.

Pernicious plastics and besieged bivalves: Microplastics in OR razor clams and oysters

Britta Baechler
Portland State University
baechler@pdx.edu
Coauthors: Elise Granek, Matthew Hunter, Kathleen Conn
Oral Presentation

Microplastics are an ecological stressor with implications for ecosystem and human health when found in seafood. We quantified microplastic types, concentrations, anatomical loadings, geographic distribution, and temporal differences in Pacific oysters and Pacific razor clams collected from 15 Oregon coast sites. Organisms were chemically digested and visually analyzed for microplastics, and material type was determined in a subset of particles using Fourier Transform Infrared Spectroscopy (FTIR). Microplastics were present in organisms from all sites sampled. On average, whole Pacific oysters and Pacific razor clams contained 10.95 ± 0.77 and 8.84 ± 0.45 microplastics per individual, respectively.

Contamination was quantified but not subtracted from averages. Over 99% of identified particles were microfibers. Spring samples contained more anthropogenic debris than summer samples in oysters but not razor clams. This study provides a baseline of microplastics in Oregon bivalves and is the first to determine Pacific razor clam concentrations.

Use of a Side Scan Sonar to Describe Habitat Condition in the Columbia Slough

Eric Bailey
Oregon Department of Fish and Wildlife
ebglassworks@gmail.com
Coauthors: Matt Strickland
Poster Presentation

Large river habitat is often difficult to describe across sampling seasons due to environmental factors such as high winter flows and turbidity that limits visibility. The Oregon Department of Fish and Wildlife's Aquatic Inventories Project have been exploring methods that can accurately and efficiently collect habitat information across non-wadeable habitats. Using an 1199CI HD Humminbird side imaging system set to obtain continuous sonar imagery from a small johnboat, we surveyed over 35 kilometers of habitat in the Columbia Slough (Portland, Oregon) across a two week period in May, 2019. The slough was divided into seven individual reaches and four channel types. Data were downloaded using SonarTRX version 17.1 and visually displayed with Google Earth Pro. We measured every piece of wood that met minimum size criteria along with the area of rock substrate and artificial structure. Depth, width and length measurements of the slough were collected at spatially representative transects based on boat speed. Our goal is to develop methods for state-wide application and the Columbia slough was viewed as an opportunity to describe habitat in a more controlled environment outside of complex or technical flow influence (ex. rapids and channel sinuosity). Results of this survey will help inform us on future protocol development and applicability of side-scan sonar use across various non-wadeable habitats.

CRPA Restoration Projects

Pete Baki
ODFW
pete.baki@comcast.net
Coauthors: Katherine Nordholm
Oral Presentation

The Oregon Department of Fish and Wildlife and the Department of Transportation are implementing a Culvert Repair Programmatic Agreement (CRPA) that allows ODOT to make short term repairs to culverts while providing a net benefit to native migratory fish over the status quo by improving fish passage conditions at the repair location. As part of the agreement, ODOT has agreed to provide $2 million at the beginning of the 5 year agreement and an additional $50,000 per project past 40 projects to an ODFW managed fund. To offset delayed full fish passage at culvert repair locations, ODFW uses these funds to work on high priority off highway fish passage projects statewide. ODFW recently

released the 2019 Fish Passage Priority List and is working to address the highest priority projects that have willing landowners. This talk will describe the projects that have been completed and those that are planned that are using these CRPA Restoration Funds.

Borax Lake Chub: summary of recent monitoring and the status of a southeast Oregon endemic
Brian Bangs
Oregon Dept. Fish and Wildlife
Brian.Bangs@oregonstate.edu
Coauthors: Chris Allen, Alex Harrison, Alan Mauer
Oral Presentation

Chinook Spawning Distribution in the Middle Fork John Day Basin
Chris Bare
ODFW
christopher.m.bare@state.or.us
Coauthors: Joseph Lemanski
Oral Presentation

We have been conducting a census of wild spring Chinook redds in the Middle Fork John Day River basin since 2000 to provide status and trend information that will help assess the long-term effectiveness of habitat restoration projects in the basin. As with other Spring Chinook populations in eastern Oregon, Middle Fork redd abundance has declined through the past twenty years, with counts ranging as high as 563 in 2000 to as low as 29 in 2017. We analyzed redd distribution to determine the effects of smaller-scale environmental changes, habitat degradation and restoration, and spawner density. Redd locations indicate that stream restoration efforts have increased spawner abundance in certain reaches. Stream reaches in the margins of the spawning area appear to only be utilized during higher density spawner years, suggesting a potential population sink. Such events highlight the need to increase quality and quantity of spawning habitat in the Middle Fork.

Mortality of Endangered Juvenile Lost River Suckers Associated with Cyanobacteria Blooms in Mesocosms in Upper Klamath Lake, Oregon
Ryan Bart
USGS WFRC Klamath Falls Field Station
rbart@usgs.gov
Coauthors: Summer Burdick, Danielle Hereford, Carla Conway, Diane Elliott
Oral Presentation

Unsustainably high mortality within the first two years of life prevents endangered Lost River suckers (Deltistes luxatus) in Upper Klamath Lake, Oregon, from recruiting to spawning populations. Massive blooms of the cyanobacterium Aphanizomenon flos-aquae and their subsequent death and decay in Upper Klamath Lake are associated with high pH, low oxygen saturation, high total ammonia

concentrations, and spikes in the cyanotoxin microcystin. Poor water quality within Upper Klamath Lake is considered the most likely cause of juvenile sucker mortality, but mechanisms causing high mortality are not known. We introduced PIT-tagged age-1 Lost Rivers suckers to three mesocosms in Upper Klamath Lake to determine the timing of juvenile sucker mortality relative to environmental conditions. Sucker mortality was inferred from a lack of movement detected on remote PIT tag detection equipment located at three depths within each mesocosm. We recorded pH, temperature, and dissolved oxygen hourly near the benthos and surface. We also compared hazard rates to weekly concentrations of total and un-ionized ammonia and microcystins, sampled within mesocosms. Lower mean daily pH and temperature, that occurred after the death of cyanobacteria, were most correlated with high hazard rates. Mortality did not occur during periods of hypoxia, but hypoxia preceded periods of higher mortality at two of three sites. Mortality occurred over a protracted time and moribund fish showed signs of prolonged stress including infestations of Ichthyobodo sp.

Weapons of Microdestruction: A Conversation about the intersection of the Arts and Science

Jerri Bartholomew
Oregon State University
bartholj@science.oregonstate.edu
Oral Presentation

At their core, science and art are processes used to describe the world around us. Historically, these disciplines were closely linked, but this connection weakened with increasing specialization in science during the past century. However, scientists and artists are reconnecting to explore how these disciplines can inform and enrich each other. I will discuss my own research on a group of enigmatic fish parasites, the Myxozoa, and how I use art to explore and inform my science. This diverse group of parasite are most closely related to free-living Cnidaria, and their adaptation to parasitism leads to some interesting biological questions. But the arts offer another perspective for exploring and communicating about myxozoan structure and function and how these organisms fit into a river ecosystem. In addition to my own work, I'll talk about collaborations with other artist and musicians and how to encourage interdisciplinary conversations.

Top 5 Myths in Natural Resource Communication

Kelly Biedenweg
Oregon State University
kelly.biedenweg@oregonstate.edu
Oral Presentation

Communication in the natural resources is based on both interpersonal and science communication. In this presentation, I will briefly describe these key fields of communication and how they play out in fisheries science. I will then focus on five common myths influencing how we, as natural resource managers and scientists, communicate with others about our work. The myths will be debunked using relatable scientific studies. 1) Providing information will change someone's mind. 2) Raising awareness will improve the environment. 3) People who make detrimental natural resource use decisions are

ignorant or uniquely biased. 4) Open participation to everyone is necessary for buy-in. 5) Demonstrating your expert knowledge is the most important factor for gaining public trust.

Effects of Catch-and-Release Practices on Coho Salmon Mortality in the Lower Cowlitz River

Ken Binder
Mount Hood Environmental
kcbinder54@gmail.com
Coauthors: Ian Courter, Forrest Carpenter, Benjamin Briscoe, Thomas Buehrens
Poster Presentation

Mark-selective fishing is a tool used throughout the Columbia River Basin to conserve natural-origin salmon and steelhead where anglers target hatchery-origin fish for harvest. Although natural-origin fish are caught and released, it is assumed that these practices reduce prespawning survival rates. Therefore, mark-selective fishing can result in fishery closures if creel survey data reveals excessive catch-and-release of natural-origin fish. However, assumed catch-and-release mortality rates typically do not account for specific aspects of fisheries that may significantly alter survival of angled fish. Factors such as water temperature, angling gear/tactics, landing net types, species, and run timing are not accounted for because empirical data is lacking. In 2017, a three-year angling study on the lower Cowlitz River, Washington was initiated to gather data for this purpose. As of December 2019, 2,044 coho salmon (Oncorhynchus kisutch) have been tagged and released into the lower Cowlitz River. Approximately half of the tagged fish were angled while the other half were captured in a fish trap for use as controls. Tagged control and treatment fish were recaptured at the Cowlitz River salmon hatchery, through creel surveys, or through angler self-reporting programs. Differences in recapture rates between control and treatment groups were used to infer angling effects on survival. Relative recapture rates of treatment fish varied dependent upon angling tactics (bobber dogging, bobber, cast gear, cast fly, etc.) and terminal gear types (bait, lure, baited lure, jig, or fly) used. Our preliminary results indicate that fish caught by lures have a higher recapture rate than those caught on baited offerings. Among popular angling methods for coho, twitching jigs and casting spinners had some of the highest recapture rates while common methods for using baited offerings, such as using bobbers, had lower rates comparatively.

The 'Silver Screen': Determining mitigation requirements for Coho Salmon entrainment through fish screens at a municipal water diversion

Julie Binder
Mt. Hood Environmental
julie.binder@mthoodenvironmental.com
Coauthors: Ian Courter
Oral Presentation

Over 20,000 surface water diversions exist throughout the Willamette Basin. While many of these diversions are thought to entrain fish, few studies have been implemented to validate that assertion and explicitly quantify the amount of entrainment occurring. In cases where mitigation for fish impacts is

required, it may be necessary to conduct a formal evaluation of fish entrainment. However, these types of evaluations can be difficult due to an inability to recapture entrained fish. We conducted an entrainment evaluation at a large municipal water diversion, Spring Hill Pumping Plant, on the Tualatin River and resolved this issue by installing a customized fish trap behind the existing fish screens. Juvenile Coho Salmon were marked and released adjacent to the pumping plant. Recaptured fry were used to estimate entrainment probability at the facility. A simple population model was later constructed to estimate impacts of entrainment on salmonid populations in the basin. Population-scale impact rates were then used to define the habitat mitigation measures necessary to maintain facility compliance with Oregon fish screen regulations.

Isolation and downstream emigration drive persistence of cutthroat trout near American Falls Reservoir: Implications for cutthroat trout conservation

Dan Bingham
Cramer Fish Sciences
dan.bingham@fishsciences.net
Coauthors: Preston Buckskin, Hunter Osborne
Oral Presentation

Cutthroat trout are a species of concern across significant portions of their native range, including much Oregon. We analyzed 67 SNPs to describe the genetics of Yellowstone Cutthroat Trout Oncorhynchus clarkii bouvieri in seven tributaries near American Falls Reservoir, Idaho. We detected Yellowstone Cutthroat Trout in all but one site despite significant historical stocking of Rainbow Trout O. mykiss. Three of four relatively low-elevation sites near the reservoir contained Yellowstone Cutthroat Trout in sympatry with early-generation hybrids and Rainbow Trout yet contained no physical barriers to admixture. A posteriori assignment tests suggested that migrants from a nearby headwater population in Ross Fork Creek and possibly recruitment by local-origin Yellowstone Cutthroat Trout with fluvial or adfluvial life histories drive persistence in these sites. In contrast, hybridization was rare or absent in headwater populations and was associated with complete or apparent physical isolation. We also compared genetic diversity of our samples with Yellowstone basin Yellowstone Cutthroat Trout and Bear River Bonneville Cutthroat Trout O. c. utah to examine possible historical gene flow resulting from hydrogeological connections during the Pleistocene. Multivariate analysis showed that most genetic variation among individuals was explained by divergence of Yellowstone basin Yellowstone Cutthroat Trout from our samples and Bear River Bonneville Cutthroat Trout, which supports recent mtDNA studies and a possible change in taxonomic nomenclature. Our results indicate that, due to relative isolation and downstream emigration, headwater populations are critical to the persistence of Yellowstone Cutthroat Trout and thus loss of such populations would likely threaten the subspecies throughout the region. Management actions to reduce threats from established, nonnative Rainbow Trout populations will likely have to be multifaceted and may include a combination of targeted removal of Rainbow Trout and hybrids and the use of physical barriers to prevent further dispersal.

Characteristics of a New Rainbow Trout Population in Spirit Lake, Mount Saint Helens Volcano, 2000-2019.

Tara Blackman
Mount Hood Environmental
tara.blackman@mthoodenvironmental.com
Coauthors: Charlie Crisafulli
Oral Presentation

Spirit Lake was grossly altered by the 1980 eruption of Mount St. Helens and all air-breathing life perished. A Rainbow Trout (Oncorhynchus mykiss) population was established circa 1991 and monitored from 2000 to 2019. During that time, the trout population increased, and individual fish size significantly decreased (both length and mass). Initially, fish diets were primarily composed of small prey items, mostly aquatic insects and aquatic snails, and piscivory was not observed. In 2019, diets shifted to piscivory. We surmise the relatively recent (2011) observation of juvenile fish occupying streams draining into Spirit Lake suggests an increased suitability of stream habitat for both spawning and rearing, which may account for changing age and size structure and diets of fish.

Communicating "Essential Understandings Regarding Oregon Indians" and Pacific lamprey in the context of K12 STEM

Lisa Blank
Oregon State University
lisa.blank@oregonstate.edu
Oral Presentation

In 2017 the Oregon Legislature enacted Senate Bill 13 -Tribal History/Shared History -that directed the Oregon Department of Education (ODE) to develop K-12 tribal curriculum for inclusion in Oregon public schools. Following this, the ODE - in partnership with the nine federally recognized tribes in Oregon - developed the Essential Understandings Regarding Oregon Indians. These essential understandings include: Since Time Immemorial, History, Identity, Language, Genocide, Federal Policy and Laws, Treaties with the US, Lifeways, Tribal Government, and Sovereignty. This session will share how the life cycle of the Pacific lamprey can be used as a place-based pedagogical strategy to communicate these essential understandings and advance students' knowledge of Pacific lamprey ecology and management challenges.

Freshwater Mussels of the Klamath River

Emilie Blevins
Xerces Society for Invertebrate Conservation
emilie.blevins@xerces.org
Oral Presentation

Freshwater mussels are important to aquatic ecosystems and to people for their benefits to water quality, habitat, other aquatic species. They are also culturally significant as a resource for food, tools,

and other items. Recent efforts have been undertaken to more fully document the current distribution of freshwater mussels in western North America, in part because mussel populations have declined from historic abundance and distribution. Freshwater mussels occur throughout multiple waterbodies in the Klamath Basin, including tributaries to Upper Klamath Lake, in the lake and the Klamath River downstream, and in tributaries to the river. Past mussel observations and surveys in the basin were supplemented in the summer of 2019 by detailed snorkel surveys conducted between Irongate Dam and the mouth of Cottonwood Creek. These surveys were conducted specifically to support measures intended to reduce impacts to mussels that could occur following removal of Irongate Dam. Surveys were also conducted at several locations upstream of Irongate Dam. Formal counts were conducted at 15 locations, while many other locations were superficially examined while boating. Mussels were detected at 5 of 8 sites where they had previously been documented, and 7 new sites were also documented. Mussels belonging to 3 genera (Gonidea, Anodonta, and Margaritifera) were observed, although western pearlshell (Margaritifera falcata) was observed at only a single site. At multiple sites, a large proportion of mussels was buried in the sediment and not observable during visual surveys. The data collected through this effort has improved understanding of the distribution and abundance of mussels in the river and provided valuable information on local habitat associations, which will be used to support conservation efforts in the basin.

The Prey Preferences of California Market Squid

Kate Bocskor
San Diego State University
kmb3xx@virginia.edu
Coauthors: Brian Hentschel
Poster Presentation

The California market squid, Doryteuthis opalescens, is an ecologically and economically important species throughout the California Current System. However, the early life history and the mechanisms controlling large inter-annual population variability of market squid are poorly understood. Variability in recruitment may be driven by the abundance of preferred prey species near paralarval hatching grounds during the critical feeding period of paralarvae. Although paralarvae have been reared on laboratory diets, the natural prey species of market squid paralarvae remain largely unknown. To determine which zooplankton taxa paralarvae can successfully capture and consume, single-taxon consumption trials were conducted with the 18 zooplankton taxa that were most abundant in plankton samples collected near hatching grounds. Paralarvae 15-30 days post hatching successfully consumed individuals of 14 zooplankton taxa. These taxa ranged in size from 150-585 µm in average total body length. Mixed-prey assemblage trials were conducted to determine if paralarvae demonstrate a preference for specific prey taxa when provided with a mixture of prey taxa. Paralarvae preferred trochophores, rotifers, and nauplii over copepods and other zooplankton taxa. Additionally, paralarvae reared on a diet of small nauplii for 15 days demonstrated better body condition with greater RNA:DNA ratios, mantle length, and body weight than paralarvae reared on diets of other zooplankton taxa. Soon after hatching, paralarvae are still developing successful prey capture techniques and their survival may be dependent on the availability of preferred prey that exhibit limited escape behavior.

Klamath River Reservoirs - Endangered Suckers and Fish Communities Before Dam Removal

Troy Brandt
River Design Group, Inc.
tbrandt@riverdesigngroup.net
Oral Presentation

Fish sampling in the Klamath River reservoirs is intended to assess the relative abundance, demographics, and genetics of Lost River Sucker (Deltistes luxatus) and Shortnose Sucker (Chasmistes brevirostris) inhabiting J.C. Boyle, Copco, and Iron Gate reservoirs, the three primary reservoirs in the Klamath River Hydroelectric Reach. Sampling data will be used for planning the sucker salvage effort that will be completed in advance of the Klamath River dam removals. The two lake-obligate sucker species inhabiting the Hydroelectric Reach reservoirs will be impacted as the lacustrine habitat is restored to a free-flowing river condition following the dam removal project. Lost River and Shortnose suckers are long-lived, lake-type suckers that are endemic to the Upper Klamath Basin and historically inhabited large shallow lakes in the Klamath and Lost River basins. Once extremely abundant, populations of both sucker species have experienced drastic declines due to habitat loss, water quality impairment, past overfishing, and disruptions in reproduction and gene flow. To better understand sucker demographics in the reservoirs, trammel net surveys were conducted in fall 2018 and spring and fall 2019. Shortnose Sucker were caught in all three reservoirs, but Lost River Sucker were only caught in J.C. Boyle Reservoir, similar to results from surveys conducted in the 1990s using similar gear types. Bycatch from sampled habitats yielded varying species and abundances across the three reservoirs. Sampling results will be used to inform the sucker salvage and the anticipated take of suckers and other species as a result of the dam removal project.

ORAFS Legislative Committee

Troy Brandt
River Design Group, Inc.
tbrandt@riverdesigngroup.net
Poster Presentation

The role of the Oregon Chapter American Fisheries Society's Legislative Committee is to inform the Oregon Chapter membership of pending legislation related to fish, fisheries, aquatic environments, the fishery profession, and guiding Chapter activities through the legislative process.

Fishing for Bull Trout: A statistical creel of the upper Imnaha River catch and release fishery

Kyle Bratcher
Oregon Department of Fish and Wildlife
kyle.w.bratcher@state.or.us
Coauthors: Jeff Yanke
Oral Presentation

Bull Trout (Salvelinus confluentus) life history traits make them particularly susceptible to overfishing. The Imnaha River population in Northeast Oregon is one of the few populations with an open catch and release fishery and therefore, may be sensitive to angler exploitation. Assessments of fishing mortality should include a baseline of angling effort and catch to understand impacts fisheries have on the Bull Trout populations. Therefore, from 2017 to 2018, the Oregon Department of Fish & Wildlife conducted an access point creel survey on the upper Imnaha River. In 2017, we estimated that anglers fished for 478 ± 268 hours and caught 122 ± 63 Bull Trout. In 2018, we estimated that anglers fished for 322 ± 282 hours and caught 56 ± 75 Bull Trout. Catch rates for Bull Trout in our study averaged 0.26 and .11 bull/hr in 2017 and 2018, respectively. Over both periods, anglers that were intentionally fishing for Bull Trout represented 40% of the parties interviewed and 27% of the total effort, but accounted for 91% of the Bull Trout catch. Angling parties that were fishing for other species never caught more than two Bull Trout per trip in 2017, and caught none in 2018. The results of our study indicate the upper Imnaha River is a low-pressure, specialized fishery for anglers pursuing Bull Trout and is unlikely to generate unsustainable impacts from angling. However, further evaluation of hooking mortality and impacts from salmon and steelhead fisheries are needed for a comprehensive understanding of impacts to the Imnaha River Bull Trout population.

Catch-and-Release "Best" Practices

Benjamin Briscoe
Mount Hood Environmental
benjamin.briscoe@mthoodenvironmental.com
Coauthors: Ian Courter, Thomas Buehrens, Forrest Carpenter, Ken Binder,
Oral Presentation

Many conservation organizations and sport angler groups advocate for practices aimed at reducing the impact of catch-and-release angling on wild salmon and steelhead. Similarly, fisheries managers enforce gear regulations as a way to reduce catch-and-release mortality rates. We developed a three-year mark-recapture study to examine the effect of catch-and-release angling methods on salmon and steelhead survival in the lower Cowlitz River, Washington. Over 1,300 hatchery-origin and 400 natural-origin salmon and steelhead were angled, and the effects of terminal tackle, landing net type, handling time, fight time, and angler experience were evaluated. Our findings show that some commonly accepted methods to reduce mortality have a positive effect, while others may not provide a high conservation benefit. This study provides a tool for refining catch-and-release practices aimed at conserving wild fish.

Integrating unmanned aerial vehicles into large-scale habitat monitoring in the Columbia River Basin

Lauren Burns
Columbia River Inter-Tribal Fish Commission
burl@critfc.org
Coauthors: Seth White, Casey Justice, Ben Staton
Oral Presentation

Advances in the development of high-resolution remote sensing technologies have substantially increased the ability to map riverine topography with high accuracy and precision. Unmanned aerial vehicles (UAVs) are one such rapidly evolving technology that may provide substantial savings in cost and time and yield standardized metrics with minimal observer bias. However, a critical uncertainty associated with this new technology - that has only been minimally tested at a few hand-picked sites with ideal conditions - is the ability to obtain accurate shallow water bathymetry using structure-from-motion (SfM). To evaluate the efficacy of using a UAV for these purposes, we conducted a study during the summer low flow period (late July -early October) in 2018 within the Grande Ronde Basin in Northeast Oregon. Thirteen river reaches were selected to represent a range of values in canopy density and valley constraint typical for spawning and rearing of Chinook Salmon in the sub-basin. We compared habitat metrics derived from UAV imagery relative to those collected using an intensive ground-based method based on the Columbia Habitat Monitoring Program Protocol. The density of the resulting SfM point cloud was affected largely by canopy overhanging the channel and whitewater, which resulted in consistent underestimations of UAV channel geometry metrics. Across all reaches, we found good agreement when comparing bed elevations between the two methods, but conversely variability increased when bed elevations were converted to summarized depth metrics (i.e., maximum depth) calculated using a modeled water surface. Capitalizing on lessons learned from this study, we hope to provide guidance for integrating remote sensing technologies into habitat monitoring protocols in the Columbia River Basin.

Evaluation of spring Chinook Salmon transportation in the Warm Springs River basin using sensor logging radio tags

Alex Bybel
Confederated Tribes of Warms Springs
alex.bybel@ctwsbnr.org
Coauthors: Amanda Ondrick
Oral Presentation

The Warm Springs River Chinook Salmon is the last remaining naturally producing spring salmon run in the Deschutes River basin. However, in recent years, these wild spring Chinook have experienced a drastic decline. Escapement in the Warm Springs River for 2019 was 205, which is 82% below the 40-year average. There is also a lack of spawning success for fish that do return. Fish red ratios have increased in the past 10 years from 4 to 13 fish per redd. Typically, returning adult Chinook pass through the Warm Springs National Fish Hatchery (WSNFH) ladder and hold in the warm springs canyon over summer before making a final run into the upper reaches to spawn. Previous radio

telemetry studies had shown a high prespawn mortality rate of fish holding in the canyon area. High summer water temperatures and diseases which are exacerbated by warm temperatures are thought to be contributing factors to this trend. In 2019, a portion of the wild Chinook that returned to the WSNFH were transported approximately 30 kilometers upstream into the colder waters of the historical spawning reaches of the Warm Springs River to increase prespawn survival. Prespawn mortality, holding temperature, and behavior of transported Chinook and a control group that was passed above the WSNFH were evaluated using sensor logging radio tags. During the first year of this multiyear study, Chinook that were transported upstream had an increased prespawn survival compared to those that migrated into the canyon, indicating transportation could be a useful management option for this depleted Chinook population.

An attempt to quantify mortality of juvenile salmonids and lampreys due to Northern Pikeminnow below John Day and The Dalles dams

Andrea Carpenter
Oregon Department of Fish and Wildlife
andrea.l.carpenter@state.or.us
Coauthors: Mac Barr, Eric Anderson
Oral Presentation

Consumption of regionally important species such as juvenile salmon and steelhead (Oncorhynchus spp.) has been an important topic in fisheries management for several decades in the Columbia and lower Snake rivers, leading to the creation of the Northern Pikeminnow Management Program (NPMP) in 1990. As a collaborator of the NPMP, the Oregon Department of Fish and Wildlife has collected stomach contents from Northern Pikeminnow (Ptychocheilus oregonensis) caught in the tailraces of The Dalles and John Day dams annually since 2006 and 2007, respectively. While analyses of stomach contents are primarily focused on consumption of juvenile salmon, there has been increasing interest in predation on lampreys (Petromyzontidae spp.). Historically, we have used the model developed by Ward et al. (1995) to estimate consumption index values and estimate weekly consumption of out-migrating juvenile salmon. Previous analyses determined that mean consumption data were correlated with their respective passage index data from the Fish Passage Center (fpc.org) at John Day Dam. In a novel approach, we attempt to use data on consumption of juvenile salmon and lampreys, Northern Pikeminnow removal data from Washington Department of Fish and Wildlife's hook-and-line dam angling fishery, and Fish Passage Center migration data at John Day and Bonneville dams to quantify mortality for these two prey groups due to piscivorous Northern Pikeminnow. A similar approach has been used to quantify avian predation of juvenile salmonids in the lower Columbia River. While this approach provides rough estimations of consumption, we compare the values for salmonid consumption to the estimates from our predation reduction model of the Sport Reward Fishery for context.

It's All in Your Head: the role of conceptual models in science communication

Janine Castro
US Fish and Wildlife Service
janine_m_castro@fws.gov

Oral Presentation

Models are used as thinking tools when scale, time, complexity, or danger overwhelm our ability to measure or observe things. They are also developed for repeatability -to allow different people or processes to achieve similar outcomes. Models are often associated with extremely complex numerical analyses, but mathematical models are just one specific type of wide array of models. We all use models in our everyday lives, from maps, which are simplified graphical representations of the landscape that help us navigate from one place to another, to recipes, which are written descriptions that help us cook a tasty meal. All models have assumptions (simplifications), and thus do not include every single detail, but generally provide enough information to achieve their desired outcome (perhaps a chocolate cake). In a world that is overflowing with information, some of which is valuable and much of it that is not, humans cope by developing mental models that help us organize our thoughts and identify patterns. As science communicators, we can tap into this natural tendency to organize information.

In natural resources, we are regularly exposed to conceptual models, such as the hydrological cycle or the salmon lifecycle. These models help us to both understand aquatic systems and to explain these concepts to others. This talk will explore a number of conceptual models that we regularly use in river restoration and stream ecology, and how we can more effectively use these models to improve science communication.

Investigation of Contemporary Population Structure of Pink Salmon from Prince William Sound, Alaska

Wei Cheng
Alaska Department of Fish and Game
wei.cheng@alaska.gov
Coauthors: Chris Habicht, William Templin, Zac Grauvogel, Anthony Gharrett
Oral Presentation

Pink salmon (Oncorhynchus gorbuscha) support a valuable commercial fishery in Prince William Sound (PWS). Private non-profit hatcheries in PWS contribute approximately 90% of the returning pink salmon and these fish are harvested at higher proportions than wild fish. Despite this high harvest level of hatchery-origin fish, hatchery proportions in wild streams range from 0.0% to 91.5% in wild drainages. The impact of hatchery fish on wild fish is of concern. These hatcheries used local fish as broodstock to seed the hatcheries in the late 1970's and early 1980's. An understanding of contemporary population structure of pink salmon is a first step in assessing the potential genetic interaction of hatchery fish spawning in the wild. In this study, we examined variation at 16 microsatellite loci from approximately 10,000 samples. Those samples were collected from 27 locations in the odd-year broodline (years of 2013 and 2015) and from 30 locations in the even-year broodline (year of 2014). Only natural-origin fish were examined from wild systems. The structure among populations at fine-and broad-spatial scales

and between early and late return timing was investigated. A fixation index, FST, in the odd-year broodline was 0.002, whereas it was 0.001 in the even-year broodline. Distinction between early and late return timing was observed within several, but not all, streams. Collections from the only hatchery in northeastern PWS, located at the head of a long fjord, were distinct from other collections from other PWS districts in both broodlines. Early returning fish from Snug Harbor Creek, a location close to one large hatchery and likely along the migration corridor for all other hatcheries in PWS, were the most divergent collections in both odd-year and even-year broodlines. This last finding was unexpected and we look forward to exploring hypotheses at the workshop.

Oregon Department of Fish and Wildlife's Conservation Plan for Lampreys

Benjamin Clemens
Oregon Department of Fish and Wildlife
Ben.Clemens@oregonstate.edu
Oral Presentation

The Coastal, Columbia, and Snake Conservation Plan for Lampreys in Oregon (Conservation Plan for Lampreys or CPL) covers four species: Pacific Lamprey (anadromous), Western River Lamprey (anadromous), Western Brook Lamprey (resident), and Pacific Brook Lamprey (resident). The purpose of the CPL is to identify, acknowledge, and support actions needed to conserve lampreys in the service of the mission of the Oregon Department of Fish and Wildlife (ODFW): "To protect and enhance Oregon's fish and wildlife and their habitats for use and enjoyment by present and future generations." The CPL identifies management strategies to address factors limiting lampreys, and research, monitoring, and evaluation (RME) needed to fill data gaps and inform future status assessments. These management strategies and RME are for ODFW to implement in coordination with other entities and landowners. Pacific Lamprey is the largest and most widespread lamprey in Oregon. The biology and distribution of the other three lampreys is less well known. Pacific Lamprey, Western River Lamprey, Western Brook Lamprey, and Pacific Brook Lamprey were ranked as "sensitive". The top five key limiting factors, in order of relative impact are: 1) access (passage), 2) water quantity, 3) water quality, 4) physical habitat, and 5) predation by other species. Three complex, large-scale threats exacerbate these limiting factors: 1) climate change, 2) estuary and ocean conditions, and 3) development relative to human population growth. These threats will have pervasive and interactive impacts to ecosystems used by lampreys. Eight management strategies were identified to address key limiting factors and threats. The CPL calls for an adaptive approach to implement new information and the best available science to improve these management strategies. Nine RME were identified to address key unknowns and management strategies for lampreys.

When do qualifying statements undermine your qualifications?

Benjamin Clemens
Oregon Department of Fish and Wildlife
Ben.Clemens@oregonstate.edu

Oral Presentation

Scientists have been trained to speak only to what they know, and to indicate when they don't know something. Scientists have further been trained to provide qualifications about the parameters under which they know something to be true. However, these attempts at accurate and precise communication have downsides. Saying "I don't know" and providing qualifying statements too many times in a conversation can result in non-scientist listeners tuning out or losing confidence in scientists themselves. To maintain engagement on scientific topics with non-scientists, it can be advantageous to replace qualifying statements with what one would expect (hypothesize) under specific scenarios. It can also be advantageous to admit the reasons why something is not known (e.g., "A specific study hasn't been done on that yet," etc.), and to concisely indicate what kind of study would be needed (e.g., "A study that examines X, Y, and Z is needed to answer that"). Questions for which scientists don't have clear answers may provide opportunities for educating the public about science, rather than allowing the public to discount science altogether.

Communicating Tribal history and knowledge through interagency consultation

Kelly Coates
Cow Creek Band of Umpqua Tribe of Indians
kcoates@cowcreek.com

Oral Presentation

The Cow Creek Band of Umpqua Tribe of Indians (The Tribe) is a sovereign government with its own natural resources department, regulatory oversight and management plans and authority as it relates to Tribal land. In the Tribe's Government-to-Government relationship with state and federal agencies, the Tribe utilizes consultation as a platform to communicate natural resources priorities and policies to federal, state and local agencies relating to the Tribe's Ancestral Territory. The integrated approach the Tribe uses for natural resource management interweaves the social/cultural, ecological, and economic values of the Tribe into all management decisions. This outlook serves as the foundation for interactions with partners when considering co-management opportunities. In order for agency partners to fully understand Tribal priorities and potential impacts to the Tribe from proposed projects, it is imperative that consultation happen early and often with clear communication at the various levels of Government and a recognition of the sovereign rights of the Tribe.

A closer look at two aquatic invaders and potential impacts to fish communities in the Willamette River basin

Matthew Collver
Oregon Department of Fish and Wildlife
matthew.collver@oregonstate.edu
Coauthors: Brian Bangs, Alex Harrison
Oral Presentation

Tag-Teaming Science Communication: How "Crowdsourcing" Talent Can Shape and Tell Our Stories

Sean Connolly
U.S. Fish and Wildlife Service
sean_connolly@comcast.net
Coauthors: Johnna Roy, Christina Wang, Leah Schrodt
Oral Presentation

Communication "the sending and receiving messages or transferring information from one part (the sender) to another (the receiver)[1]" is often depicted as a one- or two-way process. Mid-twentieth century communications models, designed to maximize the efficiency of telephone cables and radio waves, illustrated communications pathways that were linear, such as Sender-Message-Channel-Receiver-Destination,[2] or Communication Source-Encoder-Message-Channel-Decoder-Communication Receiver. [3]

Traditional science communication often mirrors these approaches: senders and receivers are usually field experts, and messages are delivered in a style syntactically, pragmatically, and semantically familiar to specialized audiences via channels such as peer-reviewed publications, lectures, or delivery of oral presentations at conferences (wink). And more often than not, the message is devised, encoded–put into spoken or written word, then relayed by a single sender.

But with the rapid ascent and application of multi- and social media over the past 20 years, is a person-to-person/people transmission paradigm still the best model? How do we, as scientists and natural resource managers with skillsets built around such approaches, adjust to communicating our science through multiple, different channels to multiple, different audiences/receivers?

The answer is simple: we expand the number of senders who help create, encode, and transmit the message(s). We assemble a team whose collective expertise and skills exponentially exceed those of even the best solo science communicator, and then deploy that team.

This talk will explore the power of 'crowdsourcing' individuals to co-develop, co-encode, and co-transmit science communication messages across multiple media. Using examples drawn from Facebook accounts, museum exhibits, pub talks (and more), it will also showcase the potency of presenting the ecological and cultural value of our science and programs to different audiences. It may also inspire you to think about assembling your own science communication 'dream team,' and how you can make your communication informative, entertaining, and most of all, impactful.

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Do you see what I see? Precision and Bias in Snorkel Surveys

Ron Constable
Oregon Department of Fish and Wildlife
ron.constable@oregonstate.edu
Coauthors: Alex Neerman, Scott Kirby
Oral Presentation

As part of the Oregon Plan for Salmon and Watersheds (OPSW), the Oregon Department of Fish and Wildlife uses snorkel surveys to monitor trends in the distribution and abundance of juvenile Coho Salmon and steelhead, which inform Endangered Species Act status reviews. Resurvey efforts have shown snorkel counts of these species to be precise and repeatable. While this is informative, little has been done to assess the bias of these counts since the early 1990s. Sources of bias in these counts can arise from (i) over or undercounting in pools, (ii) inter-annual variation in the abundance of these species in fastwater habitats, such as riffles and rapids, which are not snorkeled under OPSW protocols. To address these questions we used mark-recapture estimates in conjunction with snorkel surveys in selected stream segments over the past four years. Once a segment was selected, block nets were placed at the upstream and downstream ends and between each pool and fastwater habitat unit. Following OPSW survey protocols, pools were snorkeled. Mark-Recapture abundance estimates were then made in each pool and fastwater unit and for the entire stream segment. Snorkel counts of Coho Salmon in pools averaged 66.5% of mark-Recapture estimate. This result was similar to the assessment of bias in 1992. Snorkel counts of steelhead in pools averaged 55% of mark-recapture estimates. On average, 9% of the total Coho Salmon abundance, with a range of 4-19%, and 23% of the total steelhead abundance, with a range of 0-48% was in fastwater units. While these results are preliminary, early indications are that the proportion of total abundance from mark-recapture estimated by snorkelers is consistent for both species (though less so for steelhead) which translates into the ability to estimate abundance from snorkel counts in an accurate manner for trend monitoring.

A natural-origin steelhead population's response to exclusion of hatchery fish

Ian Courter
Mount Hood Environmental
ian.courter@mthoodenvironmental.com
Coauthors: Garth Wyatt
Oral Presentation

It is asserted that reduction or elimination of hatchery stocking will increase natural-origin salmon and steelhead production. We conducted an analysis of steelhead Oncorhynchus mykiss population census

data (1958-2017) to determine whether elimination of summer steelhead stocking in the upper Clackamas River in 1998 increased the productivity of natural-origin winter steelhead. A Bayesian state-space stock-recruitment model was fit to the adult steelhead dataset and productivity was estimated as a function of hatchery-origin spawner abundance, as well as other environmental factors. When used as a predictive variable in our model, the abundance of hatchery summer steelhead spawners (1972-2001) did not have a negative effect on winter steelhead recruitment. However, spill at North Fork Dam, the gateway to the upper Clackamas Basin, and Pacific Decadal Oscillation (an index of ocean conditions) were both negatively associated with winter steelhead recruitment. Moreover, winter steelhead abundance in the upper Clackamas Basin failed to rebound to abundances observed in years prior to the hatchery program, and fluctuations in winter steelhead abundance were correlated with other regional winter steelhead stocks. Our assessment underscores the need for studies that (1) directly quantify the effects of hatchery fish on the production of natural-origin salmon and steelhead, (2) empirically test published theories about mechanisms of hatchery fish impacts on natural-origin populations, and (3) document population responses to major changes in hatchery programs. (TAFS DOI: 10.1002/tafs.10140)

Advancements in stream production potential estimation techniques

Ian Courter
Mount Hood Environmental
ian.courter@mthoodenvironmental.com
Oral Presentation

There is a large need for analytical tools that can estimate salmonid production potential using stream habitat data. These tools are often used for mitigation and restoration planning, instream flow assessments, population viability analyses, and biological effects analyses. A variety of methods have been developed to meet the demand for these analyses including EDT, UCM, MesoHABSIM, Ripple, and many others. Because most analytical approaches rely on out-of-basin data or theoretical habitat-fish relationships, there is no way to characterize the level of uncertainty around production potential estimates. More recently, advances in computing and increased access to complex statistical approaches has made it possible to quickly parameterize fish production potential models with in-basin data, reducing the number of necessary assumptions. In this presentation, I will explore the past, present, and future of fish production potential estimation. I will also describe a technique that combines direct fish observations (e.g. snorkel surveys) and habitat survey data to estimate the relationships between fish density and small-scale habitat features. This approach makes it possible to quickly gather site-specific data for a subsample of stream channel units, quantify habitat-fish relationships, and characterize uncertainty when estimating fish production potential over large areas.

Was there a roadmap for this? Perspectives on an NGO career and AFS involvement
Daniel Dauwalter
Trout Unlimited / Western Division AFS
ddauwalter@tu.org
Oral Presentation

If you've talked to enough seasoned fisheries professionals, you'll quickly realize that careers within fisheries are as diverse as the fishes we work to manage and conserve. Agency positions represent the core career paths, but there are also jobs with consulting firms, non-governmental organizations (NGOs), and more. And while fisheries is the common thread among those different employers, the job skills preferred by them can vary considerably. Another common thread is AFS involvement, and administrators are often heard saying that their best employees are active in AFS. The benefits are many due to AFS's profile as the leading fisheries science organization in the world that produces high profile scientific journals, puts on meetings important for communicating fisheries science and providing networking opportunities, and is actively engaged in training the next generation of fisheries professionals. Here I profile my career path up to my present position as a scientist with Trout Unlimited (an NGO) while highlighting AFS my involvement along the way. In retrospect I can ask, was there a roadmap for this? Not really, but AFS provided some helpful landmarks along the way.

Feasibility of Stocking YY Males to Eradicate Brook Trout from an Isolated Washington Stream
Brian Davis
U.S. Fish and Wildlife Service
brian_davis@fws.gov
Coauthors: Jen Poirier, Doug Peterson
Oral Presentation

Stocking YY male brook trout (fish with two Y chromosomes) is a method of biological control that aims to skew the sex ratio of a population over time to all male. Abernathy Fish Technology Center (FTC), Columbia River Fish and Wildlife Conservation Office (FWCO), and Carson National Fish Hatchery (NFH) have initiated a proof-of-concept study to assess the feasibility of eradicating brook trout in Tyee Springs using the YY male approach. Tyee Springs is located in the Gifford Pinchot National Forrest and flows less than one kilometer before being screened and treated as the water source of Carson National Fish Hatchery. We conducted three mark-recapture events spanning a year in Tyee Springs to estimate abundance, age structure, growth and survival. These estimates inform a stochastic population model that evaluates the level and sensitivity of parameters required to eradicate the Tyee Springs brook trout population.

Managing Klamath River Water Quality Downstream of Iron Gate Reservoir Using a Barrier Curtain

Michael Deas
Watercourse
mike.deas@watercourseinc.com
Coauthors: Brooke Mejica, Demian Ebert
Oral Presentation

One element of improving water quality in the Klamath River downstream of Iron Gate dam involves managing cyanobacteria/blue-green algae (BGA) transported to the river from Iron Gate reservoir. Use of an intake barrier curtain (curtain) is one strategy PacifiCorp is employing to limit BGA releases from Iron Gate reservoir to the Klamath River. Seasonal BGA blooms in the reservoir typically occur in near-surface waters of the photic zone where light and nutrients are available. The penstock intake for Iron Gate powerhouse has an invert elevation that is approximately 10.7 meters (m) [35 feet (ft)] below normal water surface elevation. The intake tower is screened from the reservoir bottom to the surface of the reservoir, and entrains water from the full depth of the water column, including the photic zone, which can result in releases of BGA to the Klamath River downstream. The purpose of the curtain is to reduce releases of BGA to downstream river reaches by retaining near-surface waters with higher levels of BGA in the reservoir. Retaining near-surface waters in the reservoir takes advantage of several naturally occurring conditions. First, density differences associated with seasonal temperature stratification in the reservoir provide an opportunity to use an intake barrier curtain to isolate warmer, less dense near-surface waters. Second, these near-surface waters include the photic zone where light and nutrients are available. Finally, the buoyancy compensating capability of BGA generally keep the algae in the photic zone and near-surface waters. Thus, while a notable fraction of the BGA are retained in the reservoir, cooler, denser, and deeper waters are withdrawn from the reservoir for downstream Klamath River releases. Four years of monitoring have been completed to assess efficacy of the curtain. While the curtain is effective, other water quality conditions constrain the curtain to depths well less than the design depth, at times limiting the efficacy of retaining BGA in the reservoir.

The role of optimization in solving decision-support models for natural resource management

Adam Duarte
Oregon State University
adam.duarte@oregonstate.edu
Coauthors: James Peterson
Oral Presentation

Natural resource management involves the implementation of actions to achieve desired outcomes. The process requires objectives managers are trying to achieve, a set of potential management actions that can be taken in order to work towards the objectives, and an understanding of system dynamics to predict the expected outcome of alternative management actions. However, predicted outcomes are often complicated with uncertainty. Thus, the development and use of quantitative models to simulate ecological systems in the face of uncertainty has proven to be an invaluable tool in natural resource management. Indeed, such models allow for the explicit integration of hypotheses and data related to

system dynamics in order to forecast the expected outcome of alternative management actions. Furthermore, sensitivity analyses can be used to identify which uncertainties govern what management decisions are considered the best based on model results. Still, in practice model simulations are frequently limited to a select few scenarios that often ignore the fact that most decisions are state dependent. This approach is particularly limiting when management decisions are recurrent and the state of the system is dynamic, which is common in natural resource management. During this talk we will introduce optimization procedures that allow the model to choose the optimal actions and sequence of actions among a discrete set of user-defined management alternatives. We then apply this approach to two case studies: water allocation decisions in the Upper Deschutes River Basin, Oregon and habitat restoration actions in California's Central Valley. Overall, optimization procedures allow managers to make full use of decision-support models in order to better inform real-world management strategies.

Selective Fishing in the Lower Columbia River

Cameron Duff
Oregon Department of Fish and Wildlife
cameron.m.duff@state.or.us
Oral Presentation

Selective Fishing in the Lower Columbia River

Landscape models to predict fine-scale variation in temperature and drying of Great Basin streams

Jason Dunham
USGS
jdunham@usgs.gov
Oral Presentation

We evaluated seasonal changes in flow presence and water temperature during the low-runoff season in two arid watersheds within the Great Basin: Willow and Whitehorse Creeks in southeastern Oregon and Willow and Rock Creeks in northern Nevada. Response variables included May through August mean monthly water temperature and flow presence between May and August, which were calculated from a high-density network of water temperature measurement sites between 2015 and 2017. Covariates related to processes hypothesized to affect water temperature and the extent of wetted channels such as riparian vegetation, riparian evapotranspiration, spring snowpack, groundwater discharge, air temperature, and specific discharge were incorporated into a spatial stream network model. The predictive power of SSN models and the relative contribution of covariates to explain variance in water temperature and flow presence decreased from May through August. Collectively, these findings suggest that covariates introduced into the model better represent watershed processes influencing stream temperature earlier in the summer but become less adequate in representing localized processes that become more dominant in the late summer as the wetted stream network becomes progressively fragmented. In contrast, we were able to predict drying with a high degree of

precision. These findings have several implications for next steps to better resolve the hydrography and hydrologic status of streams in the region.

Arctic Salmon: Community-led initiatives bridge to an Arctic "beyond resilience"

Karen Dunmall
Fisheries and Oceans Canada
karen.dunmall@dfo-mpo.gc.ca
Coauthors: Darcy McNicholl, Zander Chila, Colin Garroway, Trevor Lantz, Jim Reist
Oral Presentation

Anthropogenically driven climate change is altering habitats, fish distributions, and ecosystem relationships in the Canadian Arctic at an unprecedented rate. Accordingly, adaptation to changes by developing responses that promote understanding and sustainability in the context of ongoing change is required. Monitoring, understanding, and adapting to these changes, however, is exceedingly difficult given the remote and harsh Arctic environment, the rates of change, the lack of basic information about aquatic species and their habitats at high latitudes, and absence of clear end points associated with the changes. Knowledge, informed responses, and delivery of responses by local communities is essential to effective adaptation by Arctic resource users. Here we present several examples of community-based and community-led initiatives developed to monitor changing fish biodiversity, key freshwater habitats, and coastal ecosystems in the Canadian Arctic, and which facilitate local adaptive responses. A Canadian Arctic-wide community-based monitoring project, called Arctic Salmon, is documenting increasing abundances and distributions of Pacific salmon, Atlantic salmon Salmo salar, and other "unusual fishes" in subsistence harvests, and is providing appropriate samples to understand biological and related ecosystem responses to climate change. We describe a novel framework to successfully apply citizen science to monitor rapidly shifting fish biodiversity in the Canadian Arctic. We also describe an approach, which can be community-led, to monitor key environmental parameters in critical freshwater habitats for native fishes, and to predict watersheds vulnerable to colonizations by salmon. We have also begun to document local and traditional knowledge about salmon and the changing aquatic environments to better understand factors influencing biodiversity shifts. Finally, we extend this approach to "Arctic Coast" to assess coastal ecosystems across trophic levels in a transferrable way to transition into a community-led, year-round initiative for the Canadian Arctic. By coordinating, sharing, and building upon local, traditional, and scientific knowledge in a rapidly changing environment, we can better adapt to changes, manage fishery development opportunities, and predict the conservation impacts in a future Arctic.

Resilience is Where You Find It
Joe Ebersole
USEPA
ebersole.joe@epa.gov
Oral Presentation

Many scientists in the fields of biology and ecology can trace the origin of their life's work to a common thread of biophilia -the love of life. With biophilia comes a desire to explore, uncover, connect with, and marvel at the secrets of organisms, communities, and the environmental systems in which they are embedded. This connection can provide a source of energy and purpose for the often-laborious scientific endeavor, and evoke inspiration for the creativity essential for novel work. But scientific careers come with a host of ancillary activities, constraints, and frustrations that can drain the creative energy of even the most optimistic scientist. In this presentation I will propose that the resilience of scientists in the face of soul-deadening stress can be nourished in a variety of ways that are independent of funding, political winds, and the crises of the moment.

Surviving Continual Change: 7 Resilience Lessons for the Fisheries Professional
Demian Ebert
PacifiCorp
demianebert@gmail.com
Coauthors: Shivonne Nesbit
Oral Presentation

Nothing is static. The climate is changing, communities and ecosystems are in continual flux, and your successful professional career will do the same. This talk focuses on several key messages that address how resilience relates to your professional development and long-term success. By taking over 40 years of professional experience and distilling it down into primary points, the authors will introduce seven key lessons in resilience for students and early career professionals. This list was developed based on experience, successes, failures, and lessons learned. Recognizing that everyone's perspective and experience will be different, the lessons discussed are intended to provide adaptable guidance useful at any stage of a career.

Enhancement of Coho Salmon in the Mid-Klamath River
Demian Ebert
PacifiCorp
demianebert@gmail.com
Oral Presentation

Recent spawning surveys and returns to Iron Gate Hatchery indicate that there are not many Coho Salmon in the mid-Klamath River, the area from Iron Gate Dam downstream of about Portuguese Creek. Since the inception of PacifiCorp's Coho Enhancement Fund in 2012, PacifiCorp has provided over $5 million dollars in funding to support a wide variety of projects benefiting Coho; partners in this effort

have brought in many million more in match funding. These projects have ranged from watershed scale restoration planning and prioritization, water transaction funding, and habitat restoration, off-channel pond construction, and gravel augmentation. This talk will provide an overview of these projects and background information to introduce the talks that follow.

Re-thinking survey life values for use in annual Chum salmon (Oncorhynchus keta) escapement calculations

Amy Edwards
Washington Dept. Fish and Wildlife
amy.edwards@dfw.wa.gov
Coauthors: Lea Ronne, Marisa Litz
Oral Presentation

Area-Under-the-Curve (AUC) calculations using live-counts of salmon is a common method used by fisheries managers to estimate escapement of spawning salmon species such as Chum (Oncorhynchus keta), Pink (O. gorbuscha), and Sockeye (O. nerka). Escapement is derived by dividing AUC abundance by a survey life value, which is the duration a spawner can be detected in a survey area. Throughout Washington, a standard survey life of 10 days is assumed for Chum salmon. However, survey life can vary within and between watersheds and from year-to-year. Ideally, unique survey life estimates should be calculated each year for varying stream sizes to determine if stream conditions are leading to shorter or longer residence times for spawning salmon. Over the three years of this study (2017-2019), we collected weekly live counts of Chum salmon in a range of stream reaches in Grays Harbor tributaries in Washington. Live chum were designated as either spawners or holders. A carcass mark-recapture effort was conducted and analyzed using a Jolly-Seber open population approach to determine unbiased abundance estimates of total chum spawners in a subset of the stream reaches. Unique survey life estimates delineated by stream size were derived using live-fish counts and mark-recapture abundances. Survey life estimates varied from as low as 7.5 days in a medium stream to as high as 13.4 days in a small stream. The survey life estimates were sensitive to the spawner vs. holder designation used for live fish, resulting in a difference of up to 3.9 days depending if survey life was calculated with spawner only or total live counts. Using spawner only counts resulted in shorter survey life values and higher abundance estimates than when using total live counts. We recommend using spawners only counts as it reduces the likelihood of double counting the same fish in multiple survey areas. In addition, using unique survey life values could result in more accurate spawning abundance estimates that account for differences in stream size, flow regimes, or other sources of interannual variation.

What shapes coastal visitors' ocean awareness?

Haley Epperly
ODFW Marine Resources Program
haleykepperly@gmail.com
Coauthors: Thomas Swearingen, Justin Dalaba
Oral Presentation

While humans depend on ocean systems for a variety of ecosystem services, our actions have resulted in detrimental consequences for ocean health. Understanding ocean systems and the issues they face is a necessary first step in developing pro-environmental behavior. However, currently public ocean knowledge is lacking. This knowledge gap may be explained by situation-specific variables (i.e., personal experiences and context) or trans-situational variables (i.e., socioeconomic status). Determining the relative influences of situation-specific and trans-situational variables on ocean knowledge is crucial for developing education initiatives and predicting support for or compliance with pro-environmental policies. The aim of this study was to determine the variables that predict perceived ocean knowledge, factual ocean knowledge, and perception of risks the ocean faces. We administered surveys to visitors along the Oregon coast from July-August 2016 and collected 273 complete surveys. Both factual ocean knowledge and perception of ocean risk were predicted by situation-specific variables. Factual ocean knowledge was predicted by how frequently a respondent had visited the Oregon coast while their perception of ocean risk was predicted by their connection to nature score. These results are promising as agencies are better able to close a knowledge gap resulting from situation-specific variables than trans-situational variables. However, respondents' level of perceived ocean knowledge was predicted by a combination of situation-specific (connection to nature) and trans-situational variables (gender). Our results highlight the discrepancies between respondents that perceive themselves as highly knowledgeable about ocean matters, those that possess factual ocean knowledge, and those that perceive Oregon's oceans as threatened.

Progressing towards a working landscape: fish screening in the upper Klamath basin

Charles Erdman
Trout Unlimited
cerdman@tu.org
Coauthors: Jason Wunschel, Todd Doughton, Rich Kilbane
Oral Presentation

Working landscapes are cohesive units of land that are economically, socially, and ecologically connected. Successful management requires careful consideration of both the economic importance derived from the natural resources across a landscape and the intrinsic value of healthy ecosystems within the landscape. In the upper Klamath basin, agriculture and ranching are essential to the local economy but also threaten the sustainability of aquatic ecosystems in the basin through several different pathways. Trout Unlimited and the Oregon Department of Fish and Wildlife are focusing on one of these pathways through the development of a collaborative partnership with private landowners focused on reducing entrainment of native fish in irrigation diversions in the Wood River Valley. Since 2016, six fish screens have been installed to reduce the threat of entrainment to Bull Trout, Redband

Trout, and lamprey in the watershed and allow for continued productive activity on the land. Installing fish screens at points of diversion will also benefit future anadromous salmonid reintroduction to the upper Klamath basin. This partnership is one example of the work that many organizations, agencies, and landowners are implementing across the upper Klamath basin to create a working landscape where both land and rivers are productive and healthy.

Factors affecting the suscetibility of juvenile salmoniods to avian predation

Allen Evans
Real Time Research
allen@realtimeresearch.com
Coauthors: Nathan Hostetter, Quinn Payton, Daniel Roby, Ken Collis,
Oral Presentation

Understanding environmental and biological factors that influence prey susceptibility to predation may help in the development of effective management plans for fish of conservation concern. We examined peer-reviewed publications, and reports from academic, governmental, and non-governmental agencies to identify commonalities and differences in susceptibility of juvenile salmonids to predation by colonial waterbirds across North America and Europe. We focused our review on factors hypothesized to influence juvenile salmonid susceptibility to avian predation. Factors were grouped into four major categories: (i) environmental factors, (ii) prey density, predator density, and migration timing, (iii) prey characteristics, and (iv) predator characteristics. Our synthesis focuses on predation by Caspian terns (terns), double-crested cormorants (cormorants), and a variety of gull species as these are the most well studied avian predators of salmonid populations. Where data are available, relationships with American white pelicans, heron species, and other avian predators were also described. Results of this literature review indicated that predator-prey interactions were highly dynamic and varied across salmonid populations and species of avian predator. Inferences across studies supported multiple hypotheses regarding predator-prey dynamics, including the influence of prey characteristics (e.g., fish size, condition), predator characteristics (e.g., foraging ecology, location of breeding colonies, colony size), environmental factors that primarily influence prey exposure to predators (e.g., river flows, turbidity), availability of alternative prey, and variation in predator and prey abundances. Studies of avian predation on fish populations have greatly improved our understanding of the factors affecting fish susceptibility to predation, the relative contributions of abiotic and biotic factors to predation susceptibility, and the extent to which avian predation affects fish survival and the viability of prey populations.

Science as Bayesian model averaging, with applications to density-dependence

Matt Falcy
Oregon Dept. Fish and Wildlife
matt.falcy@oregonstate.edu
Oral Presentation

The essence of science is the measurement of evidence for competing models of a given phenomenon. In this talk, I contemplate why model comparison is difficult yet neglected too frequently. I will also demonstrate a relatively simple way to measure evidence for competing models of density dependence by adopting Bayesian philosophy and technology.

Coho Salmon Restoration and Monitoring in McGarvey Creek, Tributary of the Lower Klamath River, California.

Jimmy Faukner
Yurok Tribal Fisheries Program
jfaukner@yuroktribe.nsn.us
Coauthors: Rocco Fiori, Sarah Beesley, Andrew Antonetti, Scott Silloway
Oral Presentation

McGarvey Creek is a small tributary to the Klamath River near the estuary. The watershed has been a focus of stream enhancement activities because it supports a natal population of Coho Salmon and is used extensively by non-natal juveniles originating from tributaries upstream. McGarvey Creek is also one of the few Klamath River tributaries where long term biological monitoring has occurred. The main objective of the presentation is to describe how monitoring has influenced restoration activities within the watershed. Stream enhancement within the watershed includes: over thirty constructed wood jams, four alcoves, and three beaver dam analogue sites. Primary methods used to measure Coho Salmon response to these enhancements are juvenile abundance estimates and the use of Passive Integrated Transponder technology to generate survival, winter emigration, and growth rates. Initial enhancement efforts focused on increasing overwinter habitat in the lower section of McGarvey Creek. Although the lower section of McGarvey Creek provides good rearing conditions during the winter it is prone to channel drying during the late summer and early fall. Since non-natal fish do not enter the watershed until fall and winter they avoid utilizing the lower reach during the channel drying period and can benefit from restoration efforts in this reach. However, natal fish rearing in the lower section during late summer and early fall experience poor survival, especially during drought years. Results of monitoring indicate natal Coho Salmon populations would likely benefit from enhancement activities in the upper reaches of McGarvey Creek that are not prone to channel drying. Therefore, the Yurok Tribal Fisheries Program is currently focused on implementing enhancement activities in the upper reaches of McGarvey Creek to assess the effectiveness of these measures on oversummer as well as overwinter survival.

Going where no salmon has gone before: evaluation of migratory passage of Coho Salmon over Lake Creek Falls

Reed Fischer
USGS
rfischer@usgs.gov
Coauthors: Emily Heaston, Nick Scheidt, Jason Dunham
Poster Presentation

Triangle Lake, located in the Siuslaw River basin, is one of the largest natural lakes in the Oregon Coast Range. It was formed by a massive block of tilted sandstone that slid into Lake Creek. This formation also formed three waterfalls that historically prevented Coho Salmon from accessing Triangle Lake and the upper Lake Creek watershed. In 1989, the Bureau of Land Management constructed three fish ladders to allow Coho Salmon to migrate upstream over the three waterfalls. Since that time, Coho Salmon have established a reproducing population upstream of the waterfalls. Given that the three fish ladders are now over 30 years old and not constructed to contemporary fish passage standards, there was interest to learn more about how they are currently passing adults during fall migration. To describe passage, we employed radio telemetry to track individual fish as they migrated upstream over each of the three fish ladders. We quantified several aspects of passage, including 1) proportion of tagged individuals that moved upstream through each fish ladder, 2) the time it took tagged fish to move upstream over each ladder, 3) timing of passage in relation to stream flows, 4) rates of fallback and mortality of fish within the study area. Results of this work will allow managers to identify future alternatives for managing passage at Lake Creek Falls and to prioritize the watershed as an opportunity for habitat restoration and recovery of Coho Salmon in the Siuslaw Basin.

Complex Particles: A potential tool for oral vaccine delivery

Henry Fleener
Oregon State University
fleenehe@oregonstate.edu
Coauthors: Matt Hawkyard
Poster Presentation

Disease continues to be a problem in finfish aquaculture. Current disease management strategies such as vaccination often involve immersion and injection delivery methods. Injections are effective but often costly and stressful on fish whereas immersions are generally less effective. Current options for an oral vaccine delivery route are limited. Vaccines cannot be added to commercial type feeds as the high temperature of production destroys bacterial-based vaccines. In this study, we investigate novel complex particles which utilize the entire particle volume for vaccine delivery and are produced with a cold production method. However, for these particles to be effective, the particles must be ingested and partially digested (once in the hindgut). For this study we investigated the rate of ingestion and level of digestion of complex particles fed to sablefish (Anoplopoma fimbria) and steelhead trout (Oncorhynchus mykiss).

We investigated the uptake of these particles by each species of finfish. We used a control complex particle that contained liposomes encapsulating a saline solution. For the experimental treatment, the

complex particles contained liposomes encapsulating an amino acid mix. A significantly higher portion of sablefish fed on the amino acid mix particles when compared to the saline treatment. Sablefish and steelhead that were offered the amino acid mix treatment had significantly more particles in their gut when compared to the saline treatment. We also investigated the digestion of complex particles and incorporated a third experimental treatment that included gelatin mixed within alginate. Particles containing the original alginate mix with no gelatin faced minimal digestion while particles that contained gelatin were highly digested.

Connected seasonal habitats are critical for survival of Coho Salmon in the Oregon Coast Range, USA

Rebecca Flitcroft
USDA Forest Service
rebecca.flitcroft@usda.gov
Coauthors: Brett Boisjolie, Mary Santelmann
Oral Presentation

Oregon Coastal Coho salmon (Oncorhynchus kisutch) have been listed as Threatened under the US Endangered Species Act since 2011. Habitat conservation, restoration, and recovery planning for Coho Salmon has been implemented by federal, state, and tribal agencies, non-profit organizations and individual stakeholders. A key management concern is how and where to preserve and protect habitat. Our results show that restoration planning targeting population-scale recovery of Coho Salmon may be most effective if the availability, connectivity, disturbance history, and protections of seasonally available habitats are considered jointly rather than in isolation. We have found that close proximity and connectivity among seasonally important habitats for Coho Salmon (ie. adult spawning habitat; juvenile summer rearing habitat; juvenile winter refuge habitat) has stronger explanatory power in understanding patterns of juvenile occupancy over time than does habitat quality alone. The geophysical template of the watershed and disturbance processes effect the relationship among habitats. In particular, deep-seated landslides modify stream reaches by altering gradient and delivering structural material that contribute to the development of seasonal habitats in close proximity. The needed connectivity among habitats for Coho salmon within the geophysical template of the watershed is further complicated by land use management. We found that riparian protections designed to preserve and protect Coho Salmon habitat are linked to land ownership rather than Coho salmon distribution or habitat configuration.

Comparative analysis of water quality standards for hatchery effluent affecting salmon under the Endangered Species Act and the Clean Water Act.

Megan Forte
National Oceanic and Atmospheric Administration
megan.forte@noaa.gov
Coauthors: Emi Melton, Natasha Preston
Poster Presentation

Water quality is an important environmental factor that is regulated by both the National Marine Fisheries Service (NMFS) and the Environmental Protection Agency (EPA). NMFS and EPA regulate water quality through the Endangered Species Act (ESA) and the Clean Water Act (CWA), respectively. These statutes are important to the survival of salmon species and can be applied to regulate the waste fish hatcheries discharge into rivers. This comparison outlines differences and similarities between salmon-specific water quality standards (WQS) for hatchery effluent under the ESA and CWA. There are differences between CWA and ESA processes that may lead to one statute implementing more stringent water quality regulations than the other, and vice versa. These differences include the CWA's use of mixing zones, designated uses, and technology-based effluent limitations, and the ESA's critical habitat analysis and considerations such as current species status and cumulative effects. Additionally, there is a crossover with the two statutes that ensures proper protection for salmon. The distinctions and connections between these statutes are important to consider moving forward with hatchery operations in order to address different environmental concerns. Having the two different, but overlapping, statutes ensures water quality for salmon is protected through various perspectives and considerations.

Influence of Soil Particle Size on Carbon Storage of Oregon Coastal Soils

Sage Fox
Oregon State University
foxcon@oregonstate.edu
Coauthors: J Boone Kauffman
Poster Presentation

As anthropogenic climate change grows in intensity and greenhouse gas outputs show no sign of slowing, understanding carbon sequestration patterns of different ecosystem types is an increasingly valuable tool in prioritizing areas for conservation. Certain ecosystem types, such as mangroves, tundra, and tropical forests, are well known to be carbon sinks, but the soil attributes that make these ecosystems better than others at sequestering carbon remains largely unknown. Particle size of the inorganic soil components likely influences the carbon storage capacity, since the particle size regulates the flow rate of water through the soil and the exchange of nutrients and gases. This should be especially true in habitats influenced by tidal water fluxes, such as coastal marshes and swamps, where moving water could carry away and release stored carbon. To better understand how Oregon's coastal soil attributes influence carbon storage capacity, we quantified the carbon content and particle size composition for coastal soils from California to Washington, covering habitats ranging from eelgrass to salt marshes. We hypothesized that in coastal systems, soils with smaller inorganic particle sizes, those with clay rather than sand for example, have higher capacity for carbon storage and are therefore more

valuable as carbon sinks. This project remains in the analysis phase, but preliminary results will be available by the time of this year's AFS conference.

Historical presence of salmon gill-maggots, including an undocumented species

William Gerth
Oregon State University
gerthw@oregonstate.edu
Coauthors: Christina Murphy, Kelci Pauk, Peter Konstantinidis, Ivan Arismendi
Oral Presentation

Salmincola californiensis is a lernaeopodid copepod parasitizing Pacific salmon and trout. This gill-maggot species is of increasing concern in both in native and introduced ranges because of its potential fish health impacts and extremely high infection prevalences and intensities in some habitats. In order to explore past disease metrics, we examined 1,241 preserved salmonid fish specimens from the Oregon State Ichthyology Collection collected between 1933 and 2014 from the Willamette River Basin, Oregon. We confirmed the historical presence and broad distribution of S. californiensis affecting Cutthroat Trout, Rainbow Trout, and Chinook Salmon. Cutthroat Trout and Rainbow Trout were the most affected species in the collection, with the highest infection prevalence and intensity. In addition, a previously undocumented Salmincola species was discovered on Mountain Whitefish. Revisiting collections is a valuable pursuit in understanding current fish infections and adding new fish specimens to collections over time will be important to ensure continuity for these analyses into the future.

Effects of Tide Gates on Juvenile Coho Salmon Passage and Estuarine Habitat Use

Guillermo Giannico
Oregon State University
giannico@oregonstate.edu
Coauthors: Arthur Bass
Oral Presentation

Tide gates are one-way doors integrated into dikes to prevent saltwater flooding and allow freshwater drainage into estuaries during low tides. These structures act as barriers to fish. We installed stationary passive integrated transponder (PIT) antennas in two streams: one with a top-hinged gate and one without gate; and monitored coho salmon, Oncorhynchus kisutch, smolt passage. Objectives were to: 1) describe smolt movements in ungated estuarine channel, 2) compare migration rate and behavior of smolts in ungated channel with those in channel with tide gate, and 3) identify tide gate conditions associated with smolt passage. We found that smolt travel time through upper estuary was negatively correlated with fork length, and in the ungated channel half of individuals returned upstream one or more times. Smolt downstream migration peaked at sunset and coincided with flood tides. In gated channel, smolt movement was predominantly towards estuary (only 4% passed upstream) and occurred at greater gate angles and earlier in the day. Top-hinged gates interfere with daily movements of coho salmon smolts in upper estuaries and alter their migration timing. This study is analyzed in the context of a recent systematic review of tide gate related project reports.

Satisfying anglers deprived of salmon: An opportunity to enhance warmwater fisheries in the Pacific Northwest

Sean Gibbs
Mount Hood Environmental
sean.gibbs@mthoodenvironmental.com
Coauthors: Ian Courter
Oral Presentation

With recent declines in salmon and steelhead populations, warmwater fisheries are becoming more popular among anglers in the Pacific Northwest. Although warmwater species provide angling opportunity, they may overlap in distribution with threatened and endangered pacific salmonids, and pose the risk of predation and competition for resources. For example, Smallmouth Bass (Micropterus dolomieu) have been identified as a significant predator to outmigrating juvenile salmon in the mainstem Columbia River and its tributaries. Therefore, managers are often faced with conflicting policy goals to enhance fishing opportunity while simultaneously limiting the adverse affects of non-native warmwater fish on native species. One option is to improve the warmwater fisheries present in many lakes and ponds throughout the Pacific Northwest, since they are often isolated from populations of salmon and steelhead. Unfortunately, most warmwater species are native to areas with environments that differ greatly from those in the Pacific Northwest, and habitat limitations are not well understood. Here, we explore the factors limiting populations of Largemouth Bass (M. salmoides) and evaluate enhancement actions that may improve warmwater pond and lake fisheries.

Seeking Input: Draft Guidelines for How to Minimize Impacts to Lampreys During In-water Work

Ann Gray
U.S. Fish and Wildlife Service
ann_e_gray@fws.gov
Coauthors: Jody Brostrom, Benjamin Clemens, Ralph Lampman, Zoltan Matica, Joseph Skalicky
Poster Presentation

Pacific Lamprey is an important native, anadromous fish species in decline. This fish is often overlooked when implementing in-water work, including stream restoration actions for other anadromous species. Efforts to protect and conserve Pacific Lamprey have increased over the past two decades. Many of these efforts are likely to benefit other species of lamprey. The first "Best Management Practices to Minimize Adverse Effects to Pacific Lamprey" was developed a decade ago (USFWS and USFS 2010). Members of the Lamprey Technical Workgroup have developed a draft "guidelines" document to update information on how to: 1) minimize impacts to native lampreys during in-water work, and 2) restore stream habitats to benefit these fishes. These guidelines cover lamprey biology and habitat use, design considerations for in-water work, salvage methods, and implementation of in-water work, including how to adopt a particular mindset for restoring habitats to benefit lampreys.

The purpose of this presentation is three-fold: (1) to raise awareness of the forthcoming, updated guidelines, 2) to provide an opportunity to a review these guidelines, and 3) to gather additional information, practical knowledge, techniques, and case studies from the broader fisheries community to improve this document prior to finalization.

Insights from a bad fisherman attempting good fish science: key considerations in detection probability modeling

Nick Hahlbeck
Oregon State University
nicholas.hahlbeck@oregonstate.edu
Oral Presentation

Across a wide variety of taxa, predators on the hunt exhibit variable success rates often far below 100%. We fisheries scientists are no different, "hunting" our research subjects with different degrees of success in different sampling situations. But when we draw quantitative inferences from our successes, how we account for our failures can affect the ecological conclusions we reach. Models incorporating variable detection probability can offer a solution, but like any other quantitative tool, also require thoughtful implementation to be effective. This concept talk will explore opportunities and challenges in applying detection probability modeling to fisheries ecology problems. With a focus on occupancy and N-mixture modeling frameworks, we will consider how these tools can be used (or misused) to address questions about species distributions, abundance assessment and habitat selection. Literature examples, mathematical simulations and raw field data will demonstrate patterns of advantage and disadvantage that transcend specific systems. Rather than exhaustively reviewing theory or techniques, this talk will contemplate practical problems residing in the mutual knowledge gap between statisticians and field biologists.

Just Rolled into the Shop: Building Bespoke Models for Idiosyncratic Data Generating Processes

Dalton Hance
USGS
dhance@usgs.gov
Oral Presentation

Applied statisticians in natural resources are often tasked with answering research questions from idiosyncratic datasets. The processes that generate ecological data, especially in fisheries, can present many challenges to analysis including missing or imperfectly observed data, inconsistent field operations, errors that change over time and scales, and other considerations. These challenges results in many decision points over the course of the analytical workflow and limit the applicability of relatively easy-to-use one-size-fits-all methods (e.g. linear regression, t-tests). Ultimately this means that the analyst must develop a unique model to capture all the wrinkles of unique data. In this talk, we present some examples of building bespoke models to extract meaningful information from messy datasets. Despite there being no one-size-fits-all analytical approach, we suggest that there are some general best practices for an analytical workflow that includes frequent use of simulation of check assumptions and to check model fit.

Evaluating swimming behavior during passage of migrating adult Pacific lamprey using accelerometer biotelemetry

Sarah Hanchett
University of Idaho
sahanchett@uidaho.edu
Coauthors: Chris Caudill, Breanna Graves, Timothy Blubaugh, Tami Clabough
Oral Presentation

Dams can impede connectivity for migratory fish species, and despite increasing attention towards the improvement of passage facilities, passage estimates still remain low for many non-target (i.e., non-salmonid) species that do not possess the burst swimming capabilities and strong homing drive present in salmonids, including Pacific lamprey (Entosphenus tridentatus). We used accelerometer biotelemetry to identify activity and behavioral responses of adult Pacific lamprey to local passage conditions at a previously identified passage bottleneck (the upper Washington-shore fishway of Bonneville Dam), with an emphasis on the serpentine weir section. Lamprey exhibited high intraspecific variability in duration and timing of attached and burst movements among sections of the fishway. Clear diel behavioral patterns were present, with longer durations of burst movement during the night hours. Within the serpentine weirs, lamprey that were successful at passing spent more time bursting compared to lamprey that did not pass. Unsuccessful fish spent a longer duration as attached and had higher turn-around rates, overall leading to longer residence times when attempting to pass. There was not clear evidence of gradual fatigue associated with non-passage, suggesting threshold changes in behavior or motivation. These results indicate that the serpentine weirs, as compared to the rest of the fishway, require extended periods of burst movements that indicate periods of high activity are required for passage of the serpentine weirs.

Fingerling Feast or Famine: How Stocking Fingerling Rainbow Trout May Benefit Wild Brown Trout in the Lower Owyhee River Oregon

Kirk Handley
Oregon Dept. of Fish and Wildlife
Kirk.a.handley@state.or.us
Coauthors: Dave Banks
Oral Presentation

The 13 miles of the Owyhee River downstream of Owyhee Reservoir has been a popular tailwater trout fishery since Brown Trout Salmo trutta were established in 1990. Recently, anglers have reported lower catch rates and expressed concern to Oregon Department of Fish and Wildlife (ODFW) that the fishery is not as productive as it once was. Brown Trout monitoring using spawning ground surveys and boat electrofishing has been done since their introduction. Declining redd counts and catch per unit effort from electrofishing suggest Brown Trout are not as numerous as they were from 2000 through 2010. The apparent decline in Brown Trout abundance coincides with a shift from stocking fingerling (76-102 mm) to legal sized (203-254 mm) Rainbow Trout Onchorynchus mykiss. We hypothesize the decline in Brown Trout is driven by conspecific piscivory on juveniles. Adult Brown Trout likely feed on the fingerling Rainbow Trout when they are stocked but shift to juvenile Brown Trout when fingerling

rainbow are not available. The human population in the adjacent Treasure Valley has more than doubled since this this fishery was established likely resulting in increased angling pressure. Increased angling pressure may also be contributing to the observed decline in Brown Trout abundance if some degree of catch and release mortality of brown trout is occurring. ODFW reverted to stocking fingerling Rainbow Trout in 2019 and will continue to monitor this fishery to determine how this change effects the Brown Trout fishery.

Performance of Injectable Juvenile Salmonid Acoustic Telemetry System (JSATS) Tags in the Yakima and Klickitat Rivers, Washington

Amy Hansen
USGS
achansen@usgs.gov
Coauthors: Tobias Kock
Oral Presentation

Representing the full run of an outmigrating salmon species historically has been challenging with active tags since tags have been too large and heavy to put in smaller fish. In 2017, an injectable Juvenile Salmonid Acoustic Telemetry System (JSATS) tag became commercially available. These tags are 15.0 mm long and 3.3 mm in diameter and weigh 0.210 g in air.

In 2018 and 2019, USGS tagged and released 887 fish with injectable JSATS tags. In May and June of 2018, 344 subyearling Chinook salmon were tagged and released into the lower Yakima River downstream of Yakima, Washington. In May of 2019, 150 juvenile coho salmon were tagged and released into the Klickitat River at Glenwood Hatchery. In addition, in May and of June 2019, we tagged and released 393 subyearling Chinook salmon in the lower Yakima River. We monitored these fish over 72 river kilometers (rkm) in the Klickitat River and over 187 rkm in the Yakima River. Performance of these tags in a laboratory setting and in the field will be presented.

Effects of dewatering on the behavior, distribution, and abundance of larval lamprey in an Oregon River

Julianne Harris
U.S. Fish and Wildlife Service
julianne_harris@fws.gov
Coauthors: Joseph Skalicky, Theresa Liedtke, Lisa Weiland, Benjamin Clemens, Ann Gray
Oral Presentation

Pacific Lamprey Entosphenus tridentatus is of cultural importance and conservation concern. Larval lamprey burrow in fluvial sediments and are vulnerable to stranding and mortality when their habitats are dewatered. We examined effects of dewatering on larval lamprey during a drawdown of Leaburg Reservoir (McKenzie River, OR). Study objectives were to: 1) examine emergence, distribution, and abundance of larvae due to the drawdown; and 2) compare field results with laboratory estimates of emergence and mortality during dewatering. We assessed changes in distribution and abundance by

deepwater electrofishing before the drawdown and after re-filling. We examined emergence by observation and excavation in 1 m^2 quadrats during the drawdown. Estimated numbers of larvae in the study area (1,142 m2) before the drawdown (~12,300; 95%: 10,893-14,011) and after re-filling (~2,600; 95%: 2,196-3,206) suggest a 79% decline in abundance. After re-filling, we generally collected larvae from sites dewatered for less time (average 16.3 hours) than before dewatering (average 38.9 hours). The observed proportion of burrowed larvae to emerge at Leaburg Reservoir was 0.45. Laboratory studies suggest the probability of larval emergence decreases with increasing fish length; the estimated probability of emergence for the average-sized larvae at Leaburg Reservoir (70 mm TL) was 0.47 (95%: 0.37-0.57). Laboratory results suggest the probability of mortality decreases with increasing larval length, increases with time dewatered, and is higher for emerged larvae than burrowed larvae. Dewatering time varied in Leaburg Reservoir; however, based on estimated dewatering times at sites of larval collection, laboratory results suggest 77% of larvae in the study area would perish, if they did not move to watered habitat, suggesting the observed decline in abundance in the study area is realistic. Studies to quantify movement out of dewatered areas and factors that might affect mortality could clarify population-level impacts of drawdowns.

Using Index Surveys to Monitor Winter Steelhead Spawning in the Upper Willamette River Basin

Sara Hart
ODFW
hart.sara.c@gmail.com
Coauthors: Luke Whitman, Elise Kelley, Alex Farrand, Collin McCandless
Poster Presentation

Winter steelhead are native to the upper Willamette river and have been listed under the endangered species act as threatened in the Willamette river basin since 1999. Index spawning surveys were conducting by ODFW and partners from 1985 to 2019 in most rivers with native. Short (0.5-1 miles) survey reaches were established to complete annually with limited effort. Index surveys were the most consistently surveyed sections of streams, with other areas being surveyed only sparingly. Redds were counted in each index and redds per mile was calculated, to estimate distribution among the spawning rivers. Out of 30 sites, 15 sites were surveyed for 18 of the last 35 years. Of those 15 regularly sampled sites, 13 had a decreased average number of redds per mile when averages were compared between the first 15 years of surveys (1985-2000) and the last 18 years (2001 -2019). These decreases in redds per mile could be due to habitat loss over time, or because of decreased run size in the upper Willamette basin due to losses in the lower river, estuary and ocean. Further research and expanded survey areas may be needed to determine the spawning success of winter steelhead in this system, or further analysis may help us better use these limited data.

Bridging The Gap Between Science And Art

Laura Hauck
PNW Research Station, U.S. Forest Service
lauralhauck@gmail.com
Oral Presentation

Are you analytical or creative? Does your imagination fill the sky with creatures or do you view the clouds only to see if it is about to rain? Classic neuro psychology research tells us that left brain individuals are analytical and right brained individuals are creative. Roger W. Sperry was a co-awardee for the Nobel Prize in Physiology/Medicine in 1981 for his discoveries concerning "the functional specialization of the cerebral hemispheres." The concept that left brain/right brain dominance shapes our personality and our perception of the world is slowly being debunked my modern research (Corballis, 2014 and Cherry, 2019) -but there are still traits that seem to coalesce together in human patterns of thinking: logic and analytics (science) versus emotion and creativity (art). Where do these two seemingly separate perceptions of our world form a seamless relationship with one another? Through Biological Illustrations, where a picture truly is worth a thousand words.

The Swampy Southeast Versus The Pacific Northwest -Exploring The Technological Challenges of Capturing Metagenomic Information From Drastically Different Ecosystems

Laura Hauck
PNW Research Station, U.S. Forest Service
lauralhauck@gmail.com
Coauthors: Richard Cronn, Brooke Penaluna, Kevin Weitemier, Jessica Homyack, Clay Mangum
Oral Presentation

Previously we developed a multi-species biodiversity assay for the Pacific Northwest that uses integrated fluidic circuits (IFCs) and massively parallel sequencing to identify 48 gene targets from a single eDNA sample. By combining taxon specific targets (e.g., cytochrome oxidase) and conserved metabarcoding targets (e.g., ribosomal DNA) we demonstrated the ability to reveal hundreds of organisms at a range of taxonomic ranks and abundances from aquatic communities in a Pacific Northwest stream (Hauck et al 2019). Here we will discuss the expansion of that platform to look at species of interest in the swampy low-lying Sipsey River located in west central Alabama. This shift was challenging on many levels, and involved evaluating new targets as well as modifying sample collection protocols due to the change in water sediment and organic load. We will discuss the strategy, development, pitfalls and preliminary results from a multiplexed metabarcoding study profiling the Sipsey River community.

FLOwPER (FLOw PERmanence): A mobile application for classifying streamflow permanence

Emily Heaston
USGS
eheaston@usgs.gov
Coauthors: Kristin Jaeger, Johnathan Burnett, Steve Wondzell, Sherri Johnson, Jason Dunham
Oral Presentation

As the prospect of drought increases across the globe, interest in quantifying changes in wet and drying patterns in non-perennial streams has grown. To effectively assess and track changes in the presence of surface flows (flow permanence) in streams, we developed an easily implemented application that is transferable across organizations. A collaboration between multiple agencies resulted in development and application of FLOwPER (referring to FLOw PERmanence). FLOwPER is a survey tool that focuses on the rapid collection of stream flow permanence observations across large spatial and temporal scales and functions across a wide range of mobile devices to facilitate crowd-sourcing data from different organizations and the crowd-sourcing of observations to a central database. The FLOwPER survey provides data to model the location of the transition from intermittent to perennial headwater streams within LiDAR-derived channel networks. Implementation of this protocol began in western Oregon and it quickly spread to other locations. Expansion of this survey tool to such a large geographic area includes planning for database management and application to a wide variety of people with diverse backgrounds. Efforts strive to include many different agencies and citizens to build community support and engagement in monitoring of valuable natural resources. Stream classification has implications for a host of natural resource and water use regulations. Data collected by FLOwPER will contribute to updating stream classifications that are outdated across the nation, increase an understanding of why streams dry, and update data on where streams exist.

Timing is everything…for comedians and adult steelhead

Jeremy Henderson
ODFW
jeremy.s.henderson@state.or.us
Coauthors: Logan Breshears, Ian Tattam, Jim Ruzycki
Oral Presentation

The return migration of a John Day River basin adult steelhead is a journey that begins in late summer, when individuals enter freshwater at the mouth of the Columbia River, and ends over eight-months later when fish arrive at the spawning grounds. These individuals will cross at least three dams on the mainstem Columbia, navigate 400 -800 km of river, and may make this journey much longer if they overshoot the mouth of the John Day River, as many of them do. Understanding the timing of this migration is useful to resource managers seeking to quantify the risks these fish are exposed to. We use detections of PIT tagged individuals to estimate the distribution of migration timing at various points along this journey, estimate travel time between these points, and examine differences in migration timing for different steelhead populations in the John Day River basin.

Assessing patterns and trends of entrained juvenile suckers in Reclamation's Fish Evaluation Station

Danielle Hereford
Bureau of Reclamation
dhereford@usbr.gov
Coauthors: Brock Phillips, Torrey Tyler, James Ross
Oral Presentation

Seasonal operation of the Fish Evaluation Station allows Reclamation to estimate take of endangered Lost River suckers and shortnose suckers, and is part of Reclamation's compliance with the Endangered Species Act to operate the Klamath Project. The Fish Evaluation Station is located at the A canal's headworks and is the largest screened diversion from Upper Klamath Lake. Suckers generally recruit to juvenile status by early July, and Reclamation begins sampling and quantifying suckers entrained at the A-canal pump station that sends fish through a bypass pump in front of the A-canal intake or through a secondary gravity bypass that releases fish below the Link River Dam from early July to as late as the end of September, depending on catches. A study conducted by Reclamation in 2010 found the majority of juvenile suckers attempt to exit Upper Klamath Lake via the A canal's forebay between 20:00 and 01:00. As such, Reclamation staff set a fyke net for 30 minutes once an hour, four days a week while catches of juvenile suckers are greater than 10 per night. Consistent sampling began in 2013 and Reclamation's dataset now extends from 2013 to 2019. We explore intra- and inter-annual trends in sucker catches and compare results from seasonal sampling at the Fish Evaluation Station to the end of the year salvage from the A-canal forebay.

Implementation Plan for the Reintroduction of Anadromous Fishes into the Oregon Portion of the Klamath Basin: An Update

Mark Hereford
Oregon Department of Fish and Wildlife
mark.e.hereford@state.or.us
Coauthors: Ted Wise, The Klamath Tribes
Oral Presentation

Anadromous fishes have been eliminated from over 400 miles of stream habitat in the Upper Klamath Basin since hydroelectric dam construction began on the Klamath River in 1912. Historical documents, evidence, and analyses have led to the conclusion that prior to construction of dams on the Klamath River, Chinook Salmon (spring and fall-runs), Coho Salmon, steelhead trout, and Pacific Lamprey occupied habitat in the upper basin. The four-mainstem hydroelectric dams on the Klamath River are scheduled to be removed in 2022. In preparation for this large-scale restoration, Oregon Department of Fish and Wildlife and The Klamath Tribes are writing an anadromous fishes reintroduction plan. The purpose of this plan is to recommend and guide efforts to reintroduce Chinook Salmon, Coho Salmon, steelhead trout, and Pacific Lamprey into the Oregon portion of the Klamath Basin. In this presentation we will present a summary of the historical fisheries of the upper basin and the current available habitat above the dams. We will also present an update to the species-specific reintroduction approaches we

plan to undertake, recommendations for monitoring efforts, and current pre-dam removal studies that are happening in the upper basin.

Duncan Creek Chum Salmon Reintroduction Program -Results and Lessons Learned

Todd Hillson
Washignton Department of Fish and Wildlife
Todd.Hillson@dfw.wa.gov
Coauthors: Brad Garner, Sean Toomey
Oral Presentation

After nearly 40 years of absence, the replacement of a failing private dam in the late 1990's and the construction of a spawning channel in 2001 provided a unique opportunity to evaluate three reintroduction strategies simultaneously: natural straying from nearby populations, direct adult releases into the spawning channel, and releases of hatchery-origin fed-fry.

Washington Department of Fish and Wildlife's Lower Columbia River Chum Salmon Viable Salmonid Paramter Monitoring Program

Todd Hillson
Washignton Department of Fish and Wildlife
Todd.Hillson@dfw.wa.gov
Coauthors: Brad Garner, Sean Toomey
Oral Presentation

In response to their listing under the ESA in 1999, WDFWs Southwest Region Fish Program developed and implemented a robust Viable Salmonid Parameter (VSP) monitoring program for Washington State populations of lower Columbia River chum salmon. VSP monitoring is essential to evaluating population viability status and tracking recovery progress. The program includes Fish-in/Fish-out monitoring in multiple primary recovery populations to estimate productivity. An expansive stream survey program was initiated to document temporal and spatial diversity. Whenever possible, mark/recapture tagging programs are incorporated with stream surveys to generate unbiased and precise estimates of abundance. Tissue samples are collected annually from all populations and hatchery programs to be used for current and future genetics analyses. All hatchery-origin chum salmon produced in the lower Columbia River are marked prior to release via either thermal marks on their otoliths or through parental based tagging. Origin determinations based on these marks, scale ages, and population estimates are combined for run-reconstruction, as well as annual estimates of pHOS and pNOS by population and estimates of pHOB and pNOB for the hatchery programs.

Washington Dept. Fish and Wildlife's Lower Columbia River Chum Salmon Recovery Strategy
Todd Hillson
Washignton Department of Fish and Wildlife
Todd.Hillson@dfw.wa.gov
Coauthors: Brad Garner, Sean Toomey
Oral Presentation

WDFWs recovery strategy focuses first on protecting existing populations by protecting and/or enhancing existing habitat with high incubation survival & hatchery production if needed. For extirpated populations, the first priority is restoration or creation of high quality off main-channel spawning and incubation habitat until natural process can create high-quality off-channel habitat. Promote natural recolonization and/or use hatchery releases from genetically appropriate donor stocks to jump start populations. Initiate monitoring programs (Viable Salmonid Parameters, habitat, and hatchery effectiveness) to track progress and adaptively manage.

How I spent my summer vacation, leading to 30 years with the Federal Government
Christine Hirsch
US Forest Service Pacific Northwest Region
christine.hirsch@usda.gov
Oral Presentation

Windows of opportunity open rather infrequently in the Federal Government. The late 1980's and early 1990's was one such window when the Forest Service did a lot of entry level recruiting of trainees into its Fisheries program. I was one of those bright-eyed and fishy tailed recruits back in 1990. The Forest Service sent recruiters across the country to universities looking for promising students for its Cooperative Education Program, especially women and minorities, as many science fields were almost exclusively white males. For me, this meant coming out to Prineville Oregon where I designed and implemented stream surveys in small mountain channels. Fast forward 30 years and I see a window opening up again for new employees to come into the Federal Government after years of downsizing and hiring freezes. This time not as undergraduate trainees, but as young professionals with a degree and a bit of field experience. Now I'm in a position to be able to give this experience to others.

How we got to Stage 0
Johan Hogervorst
Willamette National Forest
johan.hogervorst@usda.gov
Oral Presentation

Human alterations to our streams in depositional alluvial valleys of the Pacific Northwest have led to incision, loss of water table, increased stream power and coarsening of substrates. Subsequently, natural processes that created biological productivity have been lost, leaving these streams in a zombie state of arrested degradation with little hope of recovery. Three decades of stream restoration throughout the

U.S. focused on creating meandering, primarily single thread channels with constructed stable forms to create habitat has, in most cases, produced little uplift. More recently, a group of academics and practitioners have recognized that instead of form-based approaches that don't acknowledge the full extent of degradation and recovery potential, it's time to "bring da ruckus". Stage 0 (Cluer and Thorne, 2013) is a concept that recognizes the importance of the fundamental biological and physical processes that create and maintain depositional alluvial valleys and utilizes disturbance to bring these processes back. Stage 0 projects have utilized on-site fill materials from abandoned road beds, levees and natural sediment deposits to lift incised channels and reconnect the entire depositional valley floor, emulating a very large disturbance like a flood or landslide. In addition, coarse woody materials are added throughout the project, both wholly and partially buried, to distribute energy laterally. Results to date show immediate recovery of water table, support for wetland vegetation, and increased presence of native fish and wildlife. My talk will briefly share historical and geomorphic context for Stage 0 and how practitioners in Oregon transitioned to this approach. This will serve as an introduction to four presentations sharing preliminary monitoring results from three ecoregions of Oregon: East Cascades (Whychus Cr, Lauren Mork), West Cascades (Staley Creek, Audrey Squires and South Fork McKenzie River, Kate Meyer) and Oregon Coast Range (Fivemile and Bell Creeks, Chris Mayes).

Distribution of Ceratonova shasta in the lower Columbia River Basin and effects of exposure on the survival of juvenile Chum Salmon

Kris Homel
Oregon Department of Fish and Wildlife
kristen.m.homel@state.or.us
Coauthors: Julie Alexander
Oral Presentation

Chum Salmon populations in the Columbia River basin were listed as threatened under the Endangered Species Act and are the target of recovery efforts in Oregon and Washington. Despite those efforts, marine survival rates have remained depressed; marine survival averages 0.34%, as compared to the average of 1.8% observed in Chum Salmon populations from the remainder of the range. It is thought that the majority of mortality contributing to those rates occurs during the 2-3 month period of time beginning when fry leave the natal stream and extending through the first 1-2 weeks in the ocean. One potential mortality source for juvenile Chum Salmon is the parasite Ceratonova shasta. This parasite is endemic to the Pacific Northwest and has caused sometimes fatal infections in juvenile Chum Salmon outside of the Columbia Basin. The goal of this study was to assess the potential of C. shasta to limit the survival of juvenile Chum Salmon by identifying: (1) the spatiotemporal distribution and density of C. shasta, (2) the susceptibility of Chum Salmon fry to ambient levels of C. shasta in the Columbia River and tributaries, and (3) susceptibility to low and moderate levels of C. shasta under controlled conditions. In 2018 and 2019, we collected water samples from throughout the Columbia River and tributaries during the outmigration of juvenile Chum Salmon and used genetic-techniques to determine if the parasite was present. In 2019, we used sentinel exposures at three locations where C. shasta is present to determine infection rates across ambient spore densities. Lastly, we conducted lab experiments to determine infection and mortality rates under different exposure durations and spore densities of C. shasta. Results from these studies demonstrated spatio-temporal overlap between C.

shasta and juvenile Chum Salmon and high susceptibility of Chum Salmon to infection (and death) from C. shasta.

Four decades of change in the Oregon nearshore flatfish fishery through the eyes of science and industry

Rebecca Howard
Oregon State University CEOAS
howardre@oregonstate.edu
Coauthors: Lorenzo Ciannelli, Waldo Wakefield, Melanie Fewings
Poster Presentation

Commercial fishing has long been a significant industry for the Oregon Coast and fishery research efforts were primarily established in the 1970s. The target species for the non-whiting groundfish fishery are primarily flatfishes, sablefish, lingcod, and rockfishes, though landings of each have fluctuated dramatically over time. Recent work has shown that in the past two decades fishing efforts have shifted offshore, largely caused by the implementation of strict gear regulations, Rockfish Conservation Areas, and lower catch limits following the fishery's collapse in 2000. Although federal fisheries-independent surveys have been conducted across most of the depth range, the data is limited by years and seasons surveyed as well as absence of data in the very shallowest waters (<50m). Fishery-dependent data covers those shallow waters and broader temporal range but at coarse scale. Limitations in data coverage combined with a historical focus on deeper water groundfishes has led to a gap in understanding dynamics of the nearshore fishery, particularly regarding the influence of environmental factors on abundance and distribution. Here we assess changes in the spatiotemporal dynamics of the Oregon nearshore non-whiting groundfish trawl fishery over the past four decades. Statistical modeling is used to assess distribution shifts in species and temporal changes in community composition. This analysis has revealed that species utilizing both slope and shelf habitat have shifted northward and offshore, while shallower water species do not display such a shift. Visualizing both fishery-independent and -dependent data allows us to qualitatively compare data coverage as well as assess differences in species distribution when mapping each dataset. These analyses illuminate where knowledge gaps lie in both data types and how they complement one another.

Considering new pathways to resiliency through diverse coho life histories.

Edward Hughes
Coos Watershed Association
ehughes@cooswatershed.org

Oral Presentation

Considering the extent and magnitude of modifications to the tidal zone of the Oregon Coast can tidal habitat restoration provide population level resiliency through life history diversity that also boosts population abundance? Although the estuarine ecology of coho is not well understood, tidal sloughs have been shown to be productive juvenile habitat. In reference to previous population level genetic

analyses and local long term tidal Life Cycle Monitoring data, additional pathways to resiliency may exist through migratory life histories of both adult and juvenile coho. Although the current OC coho population condition significantly confounds recent tidal restoration effectiveness monitoring, multiple sampling methodologies including juvenile seining, trapping, PIT mark-recapture and eDNA, can be leveraged to quantify categorical behaviors assumed to promote productivity. Spatio-temporal modeling of tidal habitat utilization and migrations based on tidal water levels and salinity will complement and build on other previous and current regional efforts to assess tidal restoration potential. Genotypic patterns of population dependence suggest regional strategies for tidal restoration may be effective at strengthening genetic linkages across dependent and independent OC coho populations and potentially provide a shared increase in resiliency and abundance.

Fraser River pink salmon: comparing run size estimates based on two different methods.

Erica Jenkins
Employer
jenkins@psc.org
Coauthors: Merran Hague, Cory Legasse, Yunbo Xie
Oral Presentation

Fisheries targeting pink salmon (Oncorhynchus gorbuscha) returning to the Fraser River in British Columbia are managed bi-laterally by Canada and the United States under the Pacific Salmon Treaty. Making decisions regarding fishing opportunities for pink salmon can be challenging because pink salmon returns are highly variable from year to year, and occur in a relatively short time period. The Pacific Salmon Commission (PSC) is responsible for providing both countries with in-season estimates of the Fraser River pink salmon daily abundances in marine areas and in the lower river, as well as updates for the expected total run size and timing of the run. Two methods are used to produce these estimates: a test-fishing-based method and a hydroacoustics-based method. Catch-per-unit-effort data from marine test fisheries provide an early prediction of the pink salmon return, but assessments are uncertain due to low catchability and highly variable estimates of historical catchability. A hydroacoustics program in the lower Fraser River provides higher precision estimates of daily escapement and is used to produce marine reconstructions of the pink salmon run, but this information is often not timely enough to inform fisheries management decisions for marine areas. We compare several years of Fraser River pink salmon run size estimates using test-fishing-based and hydroacoustics-based methods. We discuss strategies to overcome challenges in producing timely, accurate, and precise in-season pink salmon run size estimates, as well as what can be learned from comparing these two methods.

What can creel data tell us about angling behavior in a recreational salmon fishery?
Alexander Jensen
Oregon State University
alexander.jensen@oregonstate.edu
Coauthors: James Peterson
Oral Presentation

Effective fisheries management often boils down to understanding and accounting for angler behaviors. Anglers typically have numerous choices; two of the most common choices are when and where to fish. In recreational fisheries, two sources of data for informing angling behavior are directed social surveys and creel surveys from traditional assessments. For a high-effort recreational fishery on fall-run Chinook salmon in the lower Columbia River, we propose using daily creel data from eight annual fishery seasons to quantify trends in fishing participation and site choice. We integrate analysis of total effort and effort allocation using a regression model with both a Poisson distribution for participation and multinomial distribution for site choice. We examine the influence of pre-season decision-making, tradition, weather, and fishing quality on total effort, and explore the role of site-specific fishing quality on site choice. Finally, we discuss extensions of this work to improve understanding of angling motivations, and specifically how they may relate to on-water decisions like catch-and-release.

How redband roll: ontogenetic shifts, seasonal migration, and what it means for conservation
Armstrong Jonathan
Oregon State University
jonathan.armstrong@oregonstate.edu
Coauthors: Nick Hahlbeck, William Tinniswood, Matthew Sloat, Mark Hereford, Benji Ramirez
Oral Presentation

The Upper Klamath Basin is one of the most hydrologically diverse watersheds in Oregon, expressing a mosaic of contrasting thermal and flow regimes. Much of the watershed, such as Upper Klamath Lake and the Sprague River, oscillate between freezing in winter and upwards of 25° C in summer. However, the basin is also scattered with more stable groundwater habitats ranging in size from tiny seeps to substantial rivers, as well as mountain tributaries dominated by snowmelt. A key challenge in the Klamath Basin and beyond is to understand how fish integrate across hydrological diversity to inform restoration and climate change adaptation. In this talk, I will summarize four years of research on redband rainbow trout, characterizing what we have learned, what we still don't know, and what it all means for dam removal, restoration, and climate adaptation.

Examining the false promise of perfect data taken from an uncertain world (Concept Talk)
Michelle Jones
ODFW
Michelle.k.jones@state.or.us
Oral Presentation

Integrating traditional monitoring procedures with technological advances in data collection presents many opportunities to extract more precise estimates at reduced costs. Consequently, several long-standing monitoring projects traditionally conducted by human surveyors are being replaced by new devices. But exactly how much more precise are these estimates? The false promise of perfect data collected by electronics can lead to unrealistic expectations. Inherent variability in natural systems and new sources of uncertainty unique to data-capturing devices will continue to surround estimates. Moreover, in many cases new technologies require calibration, demanding analysts to develop new quantitative methods that rely on untested assumptions. This concept talk will focus on tempering our expectations about the precision and accuracy of estimating parameters from data collected at the interface of traditional methods and new technology. Specifically, it will focus on the quantitative methods being used to combine time-lapse photography with traditional creel surveys to estimate fishing effort. While taking advantage of new technologies undoubtedly improves estimates and enables government agencies to accomplish increasingly ambitious projects, communicating and understanding uncertainty remains paramount to providing realistic projections of what can be achieved. This is a non-traditional concept talk offering a contemplative presentation with minimal direct ties to empirical data.

Y or Y not: sorting out the maze of olfactory imprinting odors in Chinook salmon
Maryam Kamran
Oregon State University
maryam.kamran@yahoo.com
Coauthors: Amanda Pollock, Andrew Dittman, David Noakes
Oral Presentation

Anadromous salmonid homing behavior has been studied extensively for its significant spatial scale and for the role of olfactory cues in returning to the natal streams. Olfactory imprinting occurs to odors in natal streams at critical early developmental stages. Salmonids can readily detect compounds ranging from amino acids to prostaglandins at low levels but the definitive imprinting odorants are still unknown. Here we identify ideal candidate odorants as appropriate olfactory cues for olfactory imprinting that can be used by hatchery managers to enhance homing in hatchery reared Fall Chinook salmon. We monitor behavior of juvenile Elk River hatchery Chinook in response to selected odorants in y-maze experiments. We analyze the feasibility of using behavioral choice assays to choose candidate odorants. Improving olfactory imprinting and thereby reducing straying of hatchery fish, we can reduce interactions between hatchery and wild salmon.

Network-scale spatial patterns of juvenile Chinook salmon size, growth rates, and density in two NE Oregon tributaries

Matthew Kaylor
Oregon State University
matthew.kaylor@oregonstate.edu
Coauthors: Casey Justice, Seth White, Edwin Sedell, Lauren Burns, Joshua Dowdy
Oral Presentation

Juvenile salmonid size is recognized as a key factor influencing rearing and emigration survival. However, it is unclear how juvenile Chinook salmon size, and the factors driving size (e.g. growth), vary within stream networks. In the summer of 2019, we quantified juvenile Chinook cohort growth rates at 53 sites and estimated juvenile Chinook densities and habitat at 59 sites spread between two sub-basins. We first used habitat data collected continuously throughout these networks combined with spatial autocorrelation in densities among sites to predict juvenile Chinook density at the network scale. We then modeled growth rates across each network using Chinook density, biophyscial metrics, and spatial autocorrelation among sites. Modeled growth rates and modeled densities were combined to predict summertime juvenile Chinook production throughout these networks. The combined components of this project will help identify areas where physical and biological conditions promote enhanced Chinook growth rates, size, and productivity, with implications for survival and restoration planning.

Stream metabolism monitoring on Staley Creek following Stage 0 restoration: dramatic increases in gross primary productivity and respiration may suggest stream-ecosystem regime shift

Dylan Keel
Willamette National Forest/Middle Fork Willamette Watershed Council
dylanjonkeel@gmail.com
Coauthors: Audrey Squires, Johan Hogervorst
Oral Presentation

Valley-bottom scale restoration requires novel techniques and unprecedented levels of targeted disturbance to remove anthropogenic degradation and reconnect valley surfaces. The goal of these projects is to restore geomorphic, hydrologic, and biologic processes that grow wetland-forests and maintain complex habitat-mosaics for native species. Because the emergence of stage 0 restoration projects is recent on the landscape, and human-caused disturbance events of this scale have historically been met with concern, restoration practitioners and researchers need powerful effectiveness monitoring tools. Whole Stream Metabolism is a novel method of floodplain restoration monitoring and can be used to quantify the autochthonous and allochthonous productivity of stream foodwebs. Intended complexity of reconnected valley bottom habitats impedes the effectiveness of traditional habitat and species population monitoring methods, and illustrates the practicality and pertinence of evaluating primary drivers of in stream productivity. Within a stage 0 reach and an immediately upstream reference reach of Staley Creek, in the Western Cascades of Oregon, we used diel dissolved oxygen and temperature curves, and BAyesian Single-station Estimation (BASE) (as in Grace et al. 2015), to model stream metabolism in the late Summer and Fall of 2019. We observed consistently and

radically elevated levels of gross primary productivity and ecosystem respiration per wetted-square meter of the restored reach, and net ecosystem production (GPP/ER ratio) of the restored reach more similar to that of wetland environments than other Cascadian streams. Passively collected dissolved oxygen and temperature data can be easily and affordably collected and BASE allows for rapid estimation of whole stream metabolism in a variety of aquatic habitats across the region. This monitoring approach may prove to be a cost effective and inferential method for comparing restoration effectiveness across project implementation variations, sub-regions/stream ecosystem types, and may provide justification for the use of valley-scale disturbance techniques to restore stream ecosystems.

A Primer for Reviewing Socioeconomic Analyses in Environmental Impact Assessments (EIS)

Camilla Kennedy
ODFW
camilla.m.kennedy@state.or.us
Coauthors: Allen C. Molina
Oral Presentation

The purpose of this presentation is to summarize key points from a primer document developed to help Environmental Impact Assessment (EIS) reviewers digest socioeconomic analyses, understand economic analysis framework, and provide effective feedback. The primer was developed with natural resource and environmental state agency EIS reviewers as the intended audience. These reviewers may have a background in natural sciences rather than social sciences and are tasked with reviewing EIS sections containing socioeconomic analyses for proposed actions, alternatives, and mitigation efforts. The primer lays out many of the best practices for economic impact analyses as well as some applicable foundational economics concepts, including: inflation adjusted values, discount rates, type of economic contribution impact (direct, indirect, induced), total economic value (TEV), nonmarket valuation, applying estimated resource values from previous studies (benefits transfer). Understanding these best practices and key principles can provide a context to help determine whether the National Environmental Policy Act (NEPA) EIS criteria has been met and support reviewers' efforts to draft substantive comments on EIS analyses.

Ecological differences of juvenile steelhead produced by natural origin and local hatchery origin adult steelhead spawning in the wild

Ben Kennedy
USFWS-Abernathy Fish Tech Center
benjamen_kennedy@fws.gov
Coauthors: Matt Smith, Doug Peterson, Roger Root
Oral Presentation

Recent data suggest that steelhead produced from local hatchery origin (HOR) steelhead spawning in the wild have lower fitness than their natural origin (NOR) counterparts. Despite this pattern, the mechanisms behind this phenomenon remain poorly understood. To increase our understanding of this pattern we investigated possible differences in important life history traits related to fitness between

juvenile steelhead produced by local HOR and NOR steelhead spawning in the wild. By integrating genetic parentage assignment and ecological data, we looked for differences in fish length, weight, condition, spatial distribution, and migration timing among each parent type. Adult steelhead were collected and sampled via an electric weir and released upstream to spawn naturally. Juveniles were collected and sampled via electrofishing and a rotary screw trap. Additionally juvenile steelhead were PIT tagged and migration behavior was measured via instream PIT tag antenna arrays. Results from this study are currently being analyzed and they will be presented during the presentation.

Gyotaku, the Japanese Art of Fish Printing as a Bridge for Community Engagement

Bruce Koike
Little Pond Nature Prints
koike.bruce@gmail.com

Oral Presentation

Though the "true" origin of Gyotaku is lost, this art form is enjoying an increasing number of practitioners, broad geographic exposure, and an established organization that promotes "Nature Printing".

Gyotaku has evolved from solely documenting the fish catch to a sophisticated art form that can give a hands-on experience to participants at community outreach events.

This presentation will highlight the basic techniques as well as discuss the range of topics that can be encompassed by a fish printing activity. The presenter-artist has exhibited at such venues as American Fisheries Society annual conferences, Joint Meeting of Ichthyologists and Herpetologists, Pacific Estuarine Research Society meetings, International Symposium of Aquatic Animal Health and The Partnership in Interdisciplinary Studies of Coastal Oceans.

A Review of Community Support Measures Included in Alaskan Fisheries and a Roadmap for their Use in Sustaining and Rebuilding Small Fishing Communities

Alexander Kotlarov
University of Alaska Fairbanks
akotlarov@Alaska.edu
Oral Presentation

How Alaskan commercial fisheries have evolved and how this has affected small coastal communities. Alaska's commercial fisheries policies and regulations have maintained the biological integrity of the ecosystem, but they have also, intentionally or inadvertently shaped the economies of fishery-dependent communities along the Alaskan coastline. When the MSA expanded U.S. fishing boundaries from 12 miles to 200 miles offshore of the United States coast. This encouraged the expansion of U.S. fishing fleets. This expansion was particularly dramatic in the U.S. EEZ off Alaska, where groundfish stocks had been exploited, almost exclusively, by foreign-flagged fishing fleets. MSA provisions that promoted the Americanization of fisheries in the U.S. EEZ led to a rapid evolution in the fisheries off

Alaska. Between 1976 and 1990, the groundfish fisheries off Alaska went from largely foreign catching and processing to joint ventures between U.S.-flagged catcher boats and foreign-owned processors and then to a fully Americanized fishery. By the early 1990s, many of these American fisheries had fleets that could quickly harvest the total annual catch, and the competition among the vessels participating in these fisheries continued to increase . The resulting race-for-fish reduced the value of the landed catch, increased the risk of overharvest, increased risk-taking by fishermen, and reduced the economic viability of fishing. Consequently, the NPFMC began to adopt fishery policies to restrict access to the fisheries. These include the Community Development Quotas (CDQs) for 7.5% of the pollock, Individual Fishing Quotas (IFQs) were implemented in the halibut and sablefish fisheries in 1995. Coop allocations were implemented in the pollock fishery in 1999. The scallop fishery was closed to new entrants in 2000. IFQs and Individual Processor Quotas (IPQs) were implemented in the Bering Sea and Aleutian Island (BSAI) crab fisheries in 2005. And, coop allocations were introduced in the Gulf of Alaska (GOA) rockfish fishery in 2007, in the BSAI groundfish trawl fishery in 2008, and in the BSAI groundfish longline fishery in 2010. Faced with similar challenges, the State of Alaska began in 1973 to limit entry to salmon, herring, and other oversubscribed state-managed fisheries. While restricted access management helped to make the fisheries more manageable and addressed some economic and social concerns, it changed the economic and social dynamics among fishermen, crew, processors, and their Alaskan communities. This chapter explores the attributes, successes, and failures of management measures intended to avoid or mitigate unintended community impacts of restricted access management in state and federal fisheries off Alaska. Implementing a catch share program is challenging and frequently controversial even though catch share programs are widely recognized as a practical approach to end overfishing

Salmon Research at the Oregon Hatchery Research Center

Jen Krajcik
Oregon Department of Fish and Wildlife
jennifer.a.krajcik@state.or.us
Coauthors: David Lawson
Oral Presentation

The Oregon Hatchery Research Center is a unique research facility, owned by the Oregon Department of Fish and Wildlife and operated jointly with the Fisheries and Wildlife Department of Oregon State University. We have living space for visiting researchers, wet and dry labs, incubation and rearing facilities, multiple sizes of tanks both indoors and in an outdoor tank farm, and four simulated streams. The OHRC professional staff work with researchers on a wide range of projects with wild and hatchery salmon and steelhead. Our Mission is to study the mechanisms creating differences between wild and hatchery fish, and to develop ways to manage these differences while meeting fishery and conservation goals. Operational research is directed to practical questions from hatchery rearing, including the production of sterile triploids, the effects of rearing structures on fish growth and health and the use of different fish brood stocks for hatchery production. Strategic research ranges from molecular genetics to landscape ecology, including studies of olfactory imprinting and homing, geomagnetic ocean navigation, effects of rearing temperature on sexual development, life history consequences of egg size and mating success of individual males and females. We have access to wild Chinook, coho, cutthroat and steelhead, as well as hatchery Chinook and steelhead. We are actively engaged in education and

outreach at all levels from pre-school students to senior citizens. We encourage those interested in research collaborations to contact us to develop productive projects that take advantage of our unique facilities.

Darwin Was Right: A Scientist Needs a Heart of Stone

Robert Lackey
Oregon State University
Robert.Lackey@oregonstate.edu
Oral Presentation

In 1857 Charles Darwin offered a blunt admonition to scientists: "A scientific man ought to have no wishes, no affections, - a mere heart of stone." His advice was strict, uncompromising, and unequivocal, but spot-on for scientists, then and now. These days, regrettably, many scientists seamlessly substitute "normative" science (i.e., information that superficially appears to be science, but contains an embedded policy preference) for "policy neutral" science when communicating with policy makers, natural resource managers, and the public. Not only is such behavior a misuse of science, it is insidious because the consumer of normative science is often unaware of the hidden policy preference contained in the information being offered (i.e., "stealth policy advocacy"). The practice of science, as with all human enterprises, is not free of bias, but it should be as policy neutral as possible. Confidence that scientific information is technically accurate, policy relevant, and politically unbiased is fundamental to informed resolution of fisheries policy and management issues, but in a YouGov national poll, 34% of the respondents believed that scientists "often" let political ideology influence their science. Another 44% felt that the influence of political ideology "sometimes" occurred. In a Washington Post/ABC national poll, 40% of the respondents said that they place little or no trust in what scientists have to say about the environment. Scientific information communicated by scientists to managers, policy makers, and the public should be the relevant, unvarnished facts, including probabilities, uncertainties, and caveats - information that only scientists can credibly provide, but will only be trusted if the providers are perceived to be even-handed and policy-neutral. Science should be a cornerstone of fisheries policy and management, but I offer cautionary guidance to scientists: play an active, engaged, and responsive role, but be ever vigilant to play the proper role - the one recommended by Darwin 163 years ago.

The effect of variation in water chemistry on stress physiology and survival of endangered Idaho Sockeye and Chinook salmon

Don Larsen
NOAA Fisheries
don.larsen@noaa.gov
Coauthors: Jesse Trushenski, Mollie Middleton, Lytle Denny, Keats Conley, Jonathan Ebel
Oral Presentation

Springfield Fish Hatchery in south east Idaho, completed in 2013, is the primary facility for rearing endangered Snake River Sockeye Salmon. The first two brood years of Springfield reared Sockeye Salmon experienced extensive acute mortality upon release into Redfish Lake Creek in the upper

Salmon River. In 2017, co-managers determined that difference in hardness and alkalinity between the rearing and release water was the primary source of stress and mortality, but 1-2 week acclimation in intermediate hardness water mitigated these effects. In 2008, the Shoshone-Bannock Tribes (SBT) initiated the development of the Crystal Springs Hatchery to aid in recovery of Chinook salmon in the Yankee Fork (YF) of the upper Salmon River, ID. The site is proximate to IDFG's Springfield Fish Hatchery (FH) in southeast ID, and would use the same ground water source. This raised concerns regarding rearing of YF Chinook salmon on water from the same source and releasing them in the YF. To answer this question, 100,000 Chinook Salmon were reared at each of two hatcheries - Sawtooth FH (control group; water hardness = 40-80 mg CaCO3/L) and Springfield FH (treatment group; water hardness = 250-270 mg CaCO3/L) - for release into the YF. We evaluated stress and survival between groups at the parr and smolt life stages. In parr, we observed low acute mortality in control and treatment groups, but downstream survival was an order of magnitude lower in the treatment group. In smolts, the treatment group showed extreme physiological stress (high plasma cortisol and glucose, high blood lactate and hematocrit and impaired blood ion balance), ~50% acute mortality, and very low downstream survival. The control group showed little stress, no acute mortality, and high downstream survival. These results demonstrate the challenges associated with rapid transfer of salmonids from very hard to soft water, provide evidence of inter- and intraspecific differences in tolerance and present a cautionary note to the efficacy of out of basin transfers for hatchery supplementation efforts.

The Non-Market Economic Benefits from Recovering Oregon Coast Coho Salmon

David Lewis
Oregon State University
lewisda@oregonstate.edu
Coauthors: Steven Dundas, David Kling, Daniel Lew, Sally Hacker,
Oral Presentation

The economic benefits from recovering threatened species arise outside of conventional markets and can include non-use values. This study measures the public non-market benefits i) from recovering threatened Oregon Coast Coho salmon (Oncorhynchus kisutch), ii) from partial gains in salmon abundance that fall short of official recovery, and iii) from achieving gains in salmon abundance that occur earlier in time. We report on a stated preference choice experiment survey that was sent to 5,000 randomly selected households in the Pacific Northwest and use econometric methods to quantify the non-market benefits for alternative conservation scenarios aimed at improving salmon abundance. Our results show that full implantation of the State of Oregon's Oregon Coast Coho salmon conservation plan would generate up to $1.4 billion/y in non-market benefits. Our results also indicate that a program aimed at increasing numbers of returning salmon can generate sizable benefits of up to $518 million/y for an extra 100,000 annually returning fish, even if the species is not officially declared recovered. Moreover, while conservation investment strategies expected to achieve relatively rapid results are likely to have higher up-front costs, our results show that the public attaches substantial additional value of up to $277 million/y for achieving conservation goals quickly. Our results and approach provide evidence on the magnitude of the broader public's benefits from programs to recover threatened salmon.

Chinook Life cycle modeling in the Columbia River: data, knowledge, assumptions and goals

Martin Liermann
NOAA Fisheries / Northwest Fisheries Science Center
martin.liermann@noaa.gov
Oral Presentation

Salmon life cycle modeling provides a useful tool for describing hypotheses relating habitat restoration actions to population dynamics. While a large body of research linking habitat to fish metrics can guide the development of these models, there is typically still a great deal of uncertainty when quantifying effects. Here we explore the interplay between management questions, model complexity, data and assumptions using different Columbia River Chinook life cycle models. We contrast different approaches to accounting for uncertainty based on ease of communication, speed of model development, and model validation. Sources of uncertainty are broken down into three components, a) the relationship between the management action and habitat conditions, b) the relationship between habitat conditions and fish demographic parameters (like capacity), and c) the population dynamics of the current population.

Competition between Pink and Chum Salmon is mediated by environmental variability in natural populations from Washington

Marisa Litz
Washington Department of Fish and Wildlife
marisa.litz@dfw.wa.gov
Coauthors: Mickey Agha, Aaron Dufault, Andrew Claiborne
Oral Presentation

Natural populations of Pink (Oncorhynchus gorbuscha) and Chum (O. keta) Salmon make up the highest abundances of Pacific salmon in Washington, USA and in many cases spawn in the same watersheds. Pink Salmon predominantly return in odd years, and for Chum Salmon, stocks interacting with Pink Salmon exhibit strong even- and odd-year variations in size, age-at-maturity, and productivity. In this study, we investigated the effects of competition between natural populations of Washington Pink and Chum Salmon during all life history phases over five decades. Chum run sizes were <50% lower in pink years compared to non-pink years and productivity was more likely to be negative in odd (pink) brood years, even along the coast, where there are no Pink Salmon populations, suggesting that competition during the overlapping marine period may be most critical for establishing the distinct even- and odd-year patterns. We used dynamic factor analysis to evaluate long-term observable and hidden trends in Pink and Chum productivity. We also evaluated the influence of marine survival indicators such as sea surface temperature, Pacific Decadal Oscillation (PDO), and North Pacific Gyre Oscillation (NPGO) on productivity trends and whether Pink exerted competitive control over Chum productivity through time. Our results indicate that Chum may be showing a long-term multi-decadal decline in productivity starting in the mid- to late 1990s, while Pink are showing a more recent decline in productivity occurring over the past decade. These trends were strongly associated with PDO in both salmonids, however, NPGO and Pink abundance may be playing a weaker role, suggesting that

productivity patterns, and hence marine survival, are likely determined by a suite of temporally varying oceanographic and ecological processes that occur during the first few years of growth.

Fisheries Battlegrounds and Identity Loyalty: Reconciling Professional & Personal Perspectives in 2020

Erica Maltz
Upper Snake River Tribes Foundation
erica.m.maltz@gmail.com
Oral Presentation

Our identities, interests, morals, spirituality and political beliefs may shape our motivations in pursuing a career in natural resources. Whether you are a researcher or policy advisor, the business of fisheries routinely requires us to acknowledge our personal biases and set aside the opinions that arise from our personal motivations. As natural resource management increasingly offers political and philosophical battlegrounds, how do we as fisheries professionals best serve societal decision-making without compromising ourselves? Using the concepts of credibility, integrity and neutrality, I will present strategies for reconciling our personal motivations and identities with our professional responsibilities, and offer practical considerations for early- and mid-career professionals. I will draw from current issues and events as well as perspectives from my own non-traditional career path as a nonnative, religious, millennial woman working in rural natural resources issues on behalf of tribal governments.

Application of Emergency Management Concepts In Assessing The Risk of Hybridization Between Native and Introduced Salmonids

Michael Manning
Oregon State University
michael.manning@oregonstate.edu
Coauthors: Ivan Arismendi, Guillermo Giannico
Oral Presentation

The overall goals of emergency management planning are to prevent or minimize the impacts of catastrophic events and improve the resiliency of those systems that are impacted. This is accomplished through an integrated approach with a system-wide perspective. Emergency planning is a cyclical process that begins with the analysis of hazards and risks that can involve multiple systems, identifies actions to minimize hazard impact, evaluates the effectiveness of those actions, and then starts the process over again with updated information. These same concepts can be applied to the management of threatened or endangered species that face numerous risks. When assessing the risk of hybridization between native and introduced salmonid species temporal and spatial use of spawning habitat, combined with the spatial distribution of habitat types associated with different salmonid life stages, and species distributions can be used to categorize hybridization risk. Risk can be further defined by understanding how other ecosystem components may influence the occurrence of hybridization. Our approach uses geospatial analysis of current species distribution data, habitat use based on species life history, and physical stream characteristics to model hybridization risk between a threatened native

species, Bull Trout (Salvelinus confluentus) and an introduced species, Brook Trout (S. fontinalus) in the state of Oregon. This paper presents the preliminary modeling results of the analysis of hybridization risk based on the distribution of native Bull Trout and introduced Brook Trout, combined with life-stage specific habitat use by native Bull Trout. Long-range project goals include the development of tools that can be used to aid integrated management efforts focused on improving the resiliency of native populations facing threats from introduced species.

Effects of temperature on the survival and growth of Lost River Suckers naturally infected with Ichthyobodo spp.

Barbara Martin
USGS
barbara_ann_martin@usgs.gov
Coauthors: Summer Burdick, Maureen Purcell, Rachel Powers
Oral Presentation

The primary, short-term threat to the persistence of Lost River suckers (Deltistes luxatus) in Upper Klamath Lake, is a prolonged lack of substantial recruitment of new individuals into the spawning populations. Mortality within the first two summers of life, rather than reproductive failure or lack of access to spawning habitat, appears to be the primary cause of recruitment failure. To compensate for low natural survival, the U.S. Fish and Wildlife Service and the Klamath Tribes have initiated captive rearing efforts. Ichthyobodo spp., a common parasite that attacks fish skin and gills, is found in Upper Klamath Lake and both the federal and tribal fish rearing facilities. Given that this parasite is established in these facilities, it is prudent to account for Ichthyobodo spp. in any assessment of best rearing practices. Furthermore, it is important to understand how environmental factors, such as water temperature, may aggravate the effects of Ichthyobodo spp. on wild suckers. We conducted laboratory experiments to determine the optimum temperature for survival and growth of juvenile Lost River suckers naturally infected with Ichthyobodo spp. All fish held at mean temperatures of 16.3 and 18.8°C survived the entire 65-day experiment, whereas median time to death was 27 days at 22.0°C, 8 days at 23.9°C, and 7 days at 25.7°C. Ichthyobodo spp. infection rates were significantly greater for fish held at mean temperatures of about 22°C or warmer compared to fish held at about 19°C or cooler. All fish grew very slowly and growth rates did not differ between fish held at mean temperatures of 16.3, 18.8 or 22.0°C.

Fivemile Bell Restoration Project: Groundwater and Stream Temperature Monitoring in a Stage 0 Restoration Project

Chris Mayes
USDA Forest Service
christopher.mayes@usda.gov
Coauthors: Paul Burns, James Pettett
Oral Presentation

Fivemile Creek is the largest tributary to Tahkenitch Lake on the Central Oregon Coast. These coastal lake systems contain some of the most productive coho salmon (Oncorhynchus kisutch) spawning and rearing habitat in the Pacific Northwest. This high production occurs even though streams such as Fivemile Creek underwent significant anthropogenic manipulation, including channel straightening, diversion, and incision.

The Fivemile Bell Project is a decade-long restoration effort conducted in five phases that began in 2012. The project utilizes the Stage 0 concept of recognizing the importance of restoring historic biological and physical processes in a low-gradient valley floor stream. To date, four of the five phases have been implemented, with Phase 5 planned for implementation in summer 2020.

As Stage 0 projects have increased in popularity across Oregon, questions arise regarding their effects on physical and biological stream attributes over time. The Siuslaw National Forest and partners have conducted several years' worth of groundwater elevation and stream temperature monitoring throughout the Fivemile Bell project area as part of efforts to further inform restoration practitioners and stakeholders on the effects of Stage 0 restoration on these attributes.

Monitoring results showed a rapid increase in groundwater elevation compared to pre-project conditions. Groundwater elevations also remained sustained for longer periods of time through the dry summer season. Stream temperatures were observed to increase in areas immediately following Stage 0 treatment, with significant cooling of stream temperatures downstream of recently-treated areas down to or below pre-project conditions.

Monitoring data collected pre-project and over the last four phases of the Fivemile Bell Project provide restoration practitioners insight into the effects of Stage 0 treatments on water tables and stream temperatures. Ongoing and future monitoring will be invaluable in the identification, design and implementation of future Stage 0 projects.

Effects of Catch-and-Release Mortality on an Idaho Steelhead Population

Joshua McCormick
Idaho Department of Fish and Game
josh.mccormick@idfg.idaho.gov
Coauthors: Marika Dobos, Brett Bowersox, Tim Copeland
Oral Presentation

Low numbers of returning adult hatchery- and wild-origin steelhead Oncorhynchus mykiss to the upper Snake River basin in Idaho has led to the closure of several popular fisheries in recent years. Fishery

closures were a result of concerns about achieving hatchery broodstock needs, but also to minimize effects on wild steelhead due to catch-and-release mortality. Although several studies have provided estimates of catch-and-release mortality on individual steelhead, little to no literature has been published on the population-level effects of catch-and-release fisheries. The objective of this study was to evaluate the effect of catch-and-release mortality on the long-term abundance and sustainability of a steelhead population in Idaho. An integrated population model was built using juvenile and adult abundance data collected for more than 20 years from a rotary screw trap and an adult weir in the Fish Creek watershed. The effect of the catch-and-release fishery was relatively small on projected adult, and smolt abundance, as well as measures of population viability, even in the presence of relatively high catch probabilities. Results from the model will be used to manage fisheries in future years if low returns of steelhead persist.

Recovering Oregon Coast Coho Salmon -How Badly Do We Want It? Exploring some Hurdles to Stream Restoration in Oregon

Jeff McEnroe
Bureau of Land Management
jmcenroe@blm.gov
Oral Presentation

Oregon Coast coho salmon (Oncorhynchus kisutch) are protected under the Endangered Species Act. Coho are listed as "threatened" and thus a Recovery Plan was developed by the National Marine Fisheries Service and numerous stakeholders in December of 2016. One of the primary limiting factors in the Plan is "reduced amount and complexity of habitat". Stream and watershed restoration were identified as the primary strategies to address degraded habitat. In recent years, a number of timing "hurdles" have developed in completing stream restoration projects on both private and federal lands. These hurdles include wildlife restrictions, fire seasons, and in-water work windows. These "hurdles" can be managed individually, but when combined severely restrict the window in which stream restoration projects can be implemented. The restricted restoration season also makes it difficult to find willing contractors to implement restoration projects. Each hurdle will be discussed along with possible solutions to allow restoration practitioners more flexibility to recover Oregon Coast Coho Salmon.

Detection patterns, abundance, and survival of translocated juvenile Bull Trout in the Odell Lake drainage

Michael Meeuwig
Oregon Department of Fish and Wildlife
michael.h.meeuwig@state.or.us
Coauthors: Elizabeth Bailey
Poster Presentation

Abundance of Bull Trout in the Odell Lake drainage is critically low. For example, Bull Trout redd counts in the primary spawning stream in this drainage varied from 4-8 redds during the last 4 years. Some streams within the Odell Lake drainage may not be suitable for rearing Bull Trout due to high water

temperatures during portions of the year. However, cold-water streams may act as refuge or preferred habitat. During 2018 and 2019, we collected and PIT (passive integrated transponder) tagged 1,948 juvenile Bull Trout from the Metolius River drainage and we translocated them to the Odell Lake drainage. We used translocated fish due to the low abundance of local Bull Trout. We monitored PIT tagged Bull Trout with PIT arrays that were located in 1) Odell Creek downstream from Odell Lake (four arrays), 2) an unnamed, cold-water tributary to Odell Creek (one array), 3) Crystal Creek (one array), and 4) Trapper Creek (one array); Crystal Creek and Trapper Creek are cold-water tributaries to Odell Lake. We also conducting mobile surveys in the cold-water tributaries three times per year. Bull Trout were detected at PIT arrays during all times that arrays were operational, but PIT detections were most consistently observed associated with the unnamed, cold-water tributary to Odell Creek. Abundance of PIT tagged Bull Trout was relatively consistent among time periods within years for all three of the cold-water tributaries. Survival of Bull Trout was relatively low immediately following translocation, but increased thereafter. For example, estimated survival of fish translocated in 2018 was 45% from June-August 2018 (a 2-month period), but was 55% from August 2018-July 2019 (an 11-month period). These data show that overall stream conditions are suitable for rearing Bull Trout in the Odell Lake drainage; however, access to cold water refuge may facilitate survival.

A review of radio telemetry studies to assess fish movement, behavior and survival through Pelton Round Butte Hydroelectric Project in the Deschutes Basin.

Gonzalo Mendez
Portland General Electric
gonzalo.mendez@pgn.com
Coauthors: Rebekah Burchell
Oral Presentation

Following relicensing of the Pelton Round Butte Hydroelectric Project in 2005 and construction of an innovative downstream passage facility in 2009, Co-licensees Confederated Tribes of Warm Springs and Portland General Electric have conducted a series of studies focused on fish passage reconnecting the Deschutes Basin. These investigations support a long-term reintroduction program of summer steelhead, spring Chinook and sockeye salmon to the Upper Deschutes Basin. We have used radio telemetry complemented with PIT tag technology to assess juvenile and adult fish movement, behavior and timing through our facilities in multiple configurations and applications. We highlight four studies conducted from 2012 to 2018 with varying degrees of complexity and success. 1) We used radio telemetry to monitor arrival timing, approach behavior and passage efficiency of Chinook and steelhead smolts at the Selective Water Withdrawal (SWW) floating collector. The data collected provided useful information but lacked the fine scale precision we hoped to collect. 2) We found that monitoring downstream movement and survival of Chinook, steelhead and sockeye smolts in the Deschutes River was successful and provided valuable insight to largescale migration patterns and release strategies. 3) We found that monitoring upstream migrating spring Chinook collected at the Pelton Adult Trap was technically successful but because of unanticipated fish behavior we could not collect enough evidence to confirm hypothesis of no delay through the Adult Trap. 4) Lastly, because of the lack of returning steelhead, spring Chinook and sockeye adults we have had difficulty identifying spawning abundance, inter-and intraspecific competition and survival to spawning. We found radio telemetry in conjunction

with PIT tag detections at interrogations sites was a useful tool to track movement of individual fish in several different configurations. However, we found careful considerations need to be taken when considering tracking studies, emphasis should be taken on equipment reliability, study design and array testing.

Short-term Physical and Biological Responses Following Stage 0 Restoration of the South Fork McKenzie River Valley

Kate Meyer
USDA Forest Service
kate.meyer@usda.gov
Oral Presentation

The lower three miles of the South Fork McKenzie River lies within a broad alluvial valley about one mile wide. Historically, this was a low gradient depositional reach with a dynamic wetland-river complex that was very biologically productive. The construction of Cougar Dam (1963), widespread placement of levees and berms, harvest of valley bottom forests, and removal of in-stream wood collectively resulted in impaired fluvial processes and transformed the South Fork into an incised, single-thread, transport channel with limited habitat for ESA-Threatened spring Chinook salmon and bull trout, Pacific lamprey, and other native species. A Stage 0 restoration approach (Cluer and Thorne 2013; Powers et. al. 2018) is being used to restore the lower 600 acres of valley bottom back to a complex, depositional reach with maximum connectivity.

In 2018 and 2019, two phases of the large-scale project were implemented on 200 acres of the South Fork. About 118,000 cubic yards of alluvium from berms and natural sediment deposits within the valley was used to fill and raise the streambed elevation (up to 14 feet) to create an anastomosing system with very high connectivity, even at base flow. Over 4,200 pieces of large wood were placed throughout the valley bottom to create hydraulic complexity and dissipate energy wherever channels may migrate. This approach does not dictate channel form or construct channels. Rather, it simply "resets" valley bottom connectivity and allows natural processes to create dynamic wetland-river complexes. Preliminary monitoring results show: increased wetted area at all flows; increased base flow depth; decreased velocities; decreased substrate size and increased size class diversity. These immediate physical changes are already having dramatic effects on the biological community, including: more diverse macroinvertebrate assemblages; increased fish density; increased suitable spawning and rearing habitat for native fishes; and increased spring Chinook salmon redd abundance (>500%).

Prevalence and diversity of parasites in rainbow trout, in lakes and reservoirs of eastern and central Oregon

Zachary Mize
Oregon State University, Cascades
zacharymize@gmail.com
Coauthors: Dave Banks, Stacy Strickland, Bruce Seal, Heather Broughton
Poster Presentation

Rainbow trout are an iconic sports fish throughout the western United States of America and considered by many sportsmen as the most important game fish. As a result, the importance of rainbow trout in the sport fishing community and the role that rainbow trout have on economics in the United States is substantial. The U.S. Fish and Wildlife Service's fisheries program, state run programs, tribal programs, and programs run by different non-governmental organizations contribute $3.6 billion annually to the U.S economy. If these programs were all combined into one company, that company would rank in the top 50 on the Fortune 500. The overall health of American fisheries is dependent on numerous factors, including habitat degradation from a wide range of human-influenced activities. Another of the factors influencing the health of fisheries and is the focus of this study is the prevalence and diversity of parasites hosted by rainbow trout in central and eastern Oregon. A parasite is an organism that lives in, on, or with another organism and obtains some form of benefit; this benefit generally results in injury/injuries or death to the host. In this study we sampled seven sites, that were decided to be important fisheries for their own districts. Using gill nets, fish were sampled at each location, then transported to the laboratory for inspection. Upon completion it was found that the overall prevalence of parasites was low, with a pattern of more trematodes in eastern Oregon and only copepods in central Oregon. Also, all the fisheries appeared in good overall health.

Jordan Cove Energy Project

Christine Moffitt
Retired Academic - Living in Coos Bay
cmoffitt@uidaho.edu
Oral Presentation

The Jordan Cove Energy Project stands to seriously jeopardize critical habitat for Oregon's stream and coastal fisheries and take Oregon in the wrong direction to mitigate the climate crisis related to greenhouse gas emissions from fossil fuels. Oregon has long been a leader in efforts to protect and preserve natural resources that provide a sustainable future for its citizens. Additional concerns are based from the current political climate and sense of urgency because of recent federal roll-backs of environmental statutes that had been put in place over the past 50 years and promulgated to protect our land, water and air quality. Indian Tribes, the National Marine Fisheries Service (NMFS), and the State of Oregon have worked hard to restore salmon populations along the south coast. The State has invested significant amounts of Oregon taxpayer money to improve water quality and salmon habitat in all six of the sub-basins that would be affected by the JCEP-the Coos, Coquille, South Umpqua, Upper Rogue, Upper Klamath, and Lost River sub-basins. The proposed extensive area of excavation for ship berthing, the associated channel modifications to the entrance and the existing Federal Navigation

Channel to transport the LNG will result in removal of more than 4.3 million cubic yards of wet sediments. I summarize major areas of concern regarding the project. They are: 1.Greenhouse gas emissions, ocean acidification and climate change; 2.Disruption of tributary watersheds and forest ecosystems; 3.Effects of habitat alterations on water quality and listed fish species; 4.Effects of habitat alterations on the Coos Bay estuary; 5.Interference with existing recreational and commercial fishing; and 6.Risks of explosion, accidental discharge and grounding of vessels. I urge our fisheries scientists and AFS to support the agencies to maintain the strong regulatory standards that have been in place since the early 1970s, and stop this project that will jeopardize the aquatic resources of the region now and into the future.

Short-term Geomorphic and Biological Outcomes on a Stage Zero Restoration Project at Whychus Canyon Preserve, Central Oregon

Lauren Mork
Upper Deschutes Watershed Council
lmork@restorethedeschutes.org
Coauthors: Mathias Perle
Oral Presentation

Whychus Creek is the focus of a multi-year collaborative restoration effort intended to support fisheries restoration, improve stream habitat and restore stream processes. In 2016 project partners implemented one mile of a six-mile restoration project along Whychus Creek at Whychus Canyon Preserve owned by Deschutes Land Trust. Project proponents employed established ecological restoration and process-based stream restoration principles (Beechie et al. 2010, McDonald et al 2016), including addressing root causes of degradation by restoring valley-wide physical and biological processes including depositional environments, multiple dynamic and evolving flow paths, and valley-wide riparian cover to create, maintain and support resilient habitat and water quality for all life stages of native fish and wildlife species over time (Beechie et al. 2013). Project design and implementation sought to explore the degree to which some of the most ecologically productive stream conditions, described in the Cluer and Thorne Stream Evolution Model as Stage 0, can be achieved through accelerating stream evolution and recovery across the valley bottom given existing site characteristics (Cluer and Thorne, 2013). Monitoring goals include understanding how this restoration technique is performing to inform future phases of Stage 0 restoration. Project monitoring, ongoing since 2014, includes evaluating physical and biological metrics for parameters such as groundwater, geomorphology, fish habitat, macroinvertebrates, fish usage and the valley bottom plant community. We present monitoring data from 2019 to update 2017 and 2018 results. Monitoring shows an increase in instream habitat quantity and complexity, a shallow water table, and a channel network with numerous channels bracketing Geomorphic Grade Line target elevations (Powers et al 2018). Preliminary macroinvertebrate data show community recovery achieving the best conditions observed at the site to date by the second year post-project, following an initial decline one year post-project. 2019 radio detections of adult Chinook salmon returning to Whychus Creek show use concentrated in the project reach.

Optimizing 3D positioning capabilities of acoustic telemetry arrays

Joshua Murauskas
Four Peaks Environmental
jmurauskas@fourpeaksenv.com
Coauthors: Mark Weiland, Kevin McCraney
Oral Presentation

Acoustic telemetry is a continually evolving tool that is used to address complex questions in fisheries management. Accurate three-dimensional (3D) positions of study fish can be used to evaluate physical or operational changes aimed at increasing survival in highly-modified systems. Despite impressive capabilities-such as 210 mg tags that transmit for over 10 weeks-3D positioning is a challenge. Time of arrival uncertainties between receivers, acoustic reflections that result in multipath or signal corruption, clock drift, and excessive ambient noise all compromise data and therefore interpretation of detection and position estimates. We present a heuristic optimization-based approach for determining optimal array configuration under uncertain data conditions and site-specific constraints. Lastly, we present innovative data management and 3D visualization tools to demonstrate how acoustic telemetry can be used to accurately assess juvenile fish behavior in challenging environments.

Salmon gill-maggots: Why are they a headache in reservoirs?

Christina Murphy
Oregon State University
christina.murphy@oregonstate.edu
Coauthors: William Gerth, Travis Neal, Ivan Arismendi
Oral Presentation

Salmincola californiensis is a Lernaeopodid copepod parasitizing Pacific salmon and trout. S. californiensis is of increasing concern in both in native and introduced ranges because of its potential fish health impacts and extremely high infection prevalences and intensities in some habitats. Improving our understanding of S. californiensis life history, in particular, is especially important for infections occurring outside of controlled settings. In this case, it appears that revisiting old assumptions is a necessary step to improving our knowledge of the life history and development critical to disease management. We describe a previously undocumented lifestage, the extreme thermal dependence of egg development and copepodid survival, and our new methods to capture the infectious copepodid stage in reservoir habitats. We are working to expand existing models on juvenile Chinook Salmon in reservoirs that could provide avenues for disease management.

Experimental infection of the parasitic copepod on juvenile Chinook salmon

Travis Neal
Fisheries and Wildlife, Oregon State University
nealw@oregonstate.edu
Coauthors: Michael L. Kent, Justin Sanders, Carl B. Schreck, James Peterson,
Oral Presentation

Anadromous salmonids rearing in in Upper Willamette Valley Reservoirs reportedly experience greater growth rates and have better body condition relative to conspecifics rearing in riverine environments. The larger size and better condition of these fish is believed to confer an advantage to these fish during migration to and entering the ocean. However, reservoir rearing fish are known to experience severe infections by a native, freshwater parasitic copepod, Salmincola californiensis. The effects of this parasite on juvenile salmonids are not fully understood. Thus, we developed an experimental protocol for infecting juvenile salmonids. We found that infection rate and intensity was positively related to water temperature and the density of the infective stages of S. californiensis. Infection rates were greater than 85% and infection intensity averaged 5.6 copepods per fish, with 80% attached to fish gills. We also found parasite related morbidity in experimental fish that was positively related to parasite burdens. Preliminary results suggest that gill damage caused by the parasite affects the performance of infected fish and can lead to mortality in the wild.

Warm and Wormy: The Climate Change Forecast Fish Fear!

Kathleen Neely
NMFS
kathleen.neely@noaa.gov
Coauthors: Kris Homel, Julie Alexander
Poster Presentation

As fisheries professionals, we tend to apply the techniques we are most familiar with to the problems we see, and then look for relationships. This approach can be improved upon by traveling outside of our lanes and examining other forces that affect ecosystems. Climate change is here and is changing the paradigm. One such shift is the balance between parasites and hosts. For example, ongoing studies have shown that Ceratomyxa shasta has expanded its range in the Columbia River Basin and that it is affecting salmonids negatively (Miller et al., 2014). This poster will outline life cycles of several parasites in a warming Pacific Northwest climate, and address the overarching questions on how these organisms may affect the success of host species, and how these changing dynamics may affect fisheries, recovery, and restoration planning. The focus will be on, but not limited to, investigations with salmonids and C. shasta in the Fraser River System and in the Puget Sound Region.

Future Scientists -Conversations with Children

David Noakes
Oregon State University
david.noakes@oregonstate.edu

Oral Presentation

There is a common misconception that science is something special and that scientists are a select group of truly remarkable people. My perspective is quite the opposite. I will illustrate by personal example and experience. Mere observation will confirm that from the start young people operate as scientists. Experience, particularly conventional education tends to channel young people in ways that present increasing opportunities for us to communicate science. We need to teach our children well. Public understanding of science is clearly a major issue that requires our attention. I will offer some thoughts in that regard.

Non-insect abundance and their contributions to salmonid parasites in the Deschutes River, Oregon

Wesley Noone
Water Quality Coordinator Deschutes River Alliance
wes@deschutesriveralliance.org
Coauthors: Rick Hafele, Greg McMillan

Poster Presentation

In 2015 and 2016 the Deschutes River Alliance performed benthic sampling at two sites on the lower Deschutes River to determine the abundance of non-insects. We characterized the macroinvertebrate community using a Multi-Metric Index (MMI). Nine of the ten calculated MMI scores fell into the "poor" stream category while one scored in the "fair" condition category. The macroinvertebrate results observed in this study are consistent with changes in water quality toward eutrophic conditions. Benthic sampling followed methods developed by the Oregon Department of Environmental Quality and Multi-Metric Index scores were calculated following methods developed by the U.S. Environmental Protection Agency for the 2008-2009 National Rivers and Streams Assessment. The results showed that non-insects accounted for >50% of the total abundance at both sites. Non-insects in high abundance included a polychaete worm Manayunkia speciosa and the snails Vorticifex effusa and Fluminicola spp.. The dominant taxon at the most upstream site (Dizney Riffle) was M. speciosa, while at the downstream site (Kaskela) snails were dominant in 60% of sample events. M. speciosa is host to Ceratonova (syn.: Ceratomyxa) shasta a deadly salmonid parasite and snails can host a worm-like fluke that causes undesired black spots on fish.

Continued Service
Dylan O'Keefe
Oregon Department of Fish and Wildlife
dylan.j.okeefe@state.or.us
Coauthors: Shannon Richardson
Oral Presentation

A growing number of prior military service members and active service National Guard/Reserve members are seeking to join the ranks of Fisheries and Wildlife professionals. They share a passion to conserve our nation's natural resources and beauty, and possess valuable skills and experiences gained in national service. However, these contributions often don't translate well or are misunderstood in a civilian workforce. The challenges these folks face in the transitionary period coming from Active Military service are unique and difficult to navigate. What strengths do they carry with them into the civilian work force and how can you best incorporate these into your natural resources team? How do these interactions help the service member in their career path and in transitions into a civilian life? Points of discussion will focus on transition, effective communication, 'ecotherapy' in regards to PTSD, and general skills that service members bring forward. This talk will help spark a conversation around effective team building and ways to maximize the effectiveness of existing and future natural resources projects.

Beaver Dam Analogues and Juvenile Coho Fish Passage
Chris O'Keefe
Humboldt State University
cokeefe@humboldt.edu
Coauthors: Darren Ward
Poster Presentation

Beaver dam analogues (BDAs) are well-documented to increase suitable rearing habitat for juvenile salmonids. Concerns loom that BDAs might limit juvenile salmonid movement. We assessed early season passage of sub-taggable juvenile Coho (<65mm) on Miners Creek BDAs. We found that juvenile Coho Salmon were able to pass beaver dam analogues with jump heights of up to 365mm during early summer conditions.

Conceptual decision making model for artificial rearing of fish intended for use in passage studies

Hakanson Olivia
Oregon State University
olivia.hakanson@oregonstate.edu
Coauthors: Karen Cogliati, Carl B. Schreck, David Noakes
Oral Presentation

Oregon State University and Oregon Hatchery Research Center have provided researchers with Chinook salmon Oncorhynchus tshawytscha and Steelhead Oncorhynchus mykiss for migration studies to evaluate passage efficiency and survival of these E.S.A. listed fish through Upper Willamette River reservoirs and high head dams. We have created a conceptual framework of tactics used to achieve movement timing, an important component we are targeting to produce fish that demonstrate behaviors and phenotypes similar to that of their wild origin counterpart. These hatchery reared fish are used as surrogates for the protected E.S.A. listed fish in these passage studies. Our decision-making is based on evidence and results from numerous studies we have conducted to define the components of early life history, and specific environmental variables that influence movement timing. We will give examples of experimental tactics we are currently using and the rationale behind selecting those particular tactics. In addition we will discuss key unknowns and the research we are conducting directed at answering these questions.

Juvenile Redband Trout Distribution and Habitat Use in the Sprague River

Jordan Ortega
Oregon State University
ortegjor@oregonstate.edu
Coauthors: Nick Hahlbeck, William Tinniswood, Benji Ramirez, Jonathan Armstrong
Oral Presentation

Redband trout of the Upper Klamath Basin express multiple life histories, including an adfluvial form that migrates extensive distances for growth and reproduction. The Sprague River contains the farthest migrating adfluvial population, with some fish spawning 150 km from their adult foraging habitats in the lake. What these fish do in between their spawning and adult foraging sites remains largely unknown. To address this knowledge gap, we studied riverscape level patterns of juvenile fish habitat use across an 80 km extent of the Sprague River. We used a generalized random tessellation stratified sampling design to select 40 sites (400-m long reaches) along the mainstem. We sampled sites once in spring (April-May) and once in summer (July-September) using boat and backpack electrofishing. During spring, the highest densities of age-0 redband trout were found in Beatty gap, the segment of river that has the most groundwater springs and the highest densities of spawning. In summer, the distribution of fish expanded to form a second, spatially distinct peak in abundance. Juveniles remained at high densities in Beatty gap, but similar densities of juveniles were also found 50 km downstream in Chiloquin Canyon, which is characterized by highly turbulent riffles and rapids. This downstream site is among the warmest in the river during summer but is likely fully saturated in dissolved oxygen due to turbulence. We hypothesize that dissolved oxygen mediates the extent to which high temperatures

constrain the distribution of redband trout during summer, and we are planning new research to test this hypothesis. Our results can help guide ongoing restoration efforts on the Sprague River and may predict how anadromous salmonids will use habitat on the Sprague River after the removal of four dams on the mainstem Klamath River.

Adopting a Climate and Ocean Change Policy for the Oregon Department of Fish and Wildlife.
Davia Palmeri
Oregon Department of Fish and Wildlife
davia.m.palmeri@state.or.us
Coauthors: Shaun Clements
Oral Presentation

The Earth's climate and oceans are changing because of activities that emit greenhouse gases into the atmosphere. Oregon is already experiencing changes such as increased average air and water temperatures, disrupted precipitation patterns, and an acidifying ocean. These changing conditions are undermining the ability of our lands and waters to support Oregon's native fish and wildlife, and the cultural and economic benefits they provide. This is hindering the Department of Fish and Wildlife's ability to achieve its mission and meet its statutory mandates to manage the public trust resources in its care. To respond to these challenges, the Oregon Fish and Wildlife Commission is considering a draft Climate and Ocean Change Policy to provide internal guidance to the Department. This talk will describe the rationale for this policy, share the policy's key principles, and describe the process by which it could be adopted by the Fish and Wildlife Commission. We also hope to discuss opportunities for a coordinated, collective effort in Oregon to gather the most relevant data to help track and respond to the impacts of climate and ocean change.

Revealing patch attractiveness to straying hatchery chum salmon in Southeast Alaska
Molly Payne
University of Alaska Fairbanks
mpayne19@alaska.edu
Coauthors: Peter Westley
Oral Presentation

The straying of hatchery salmon produced in harvest enhancement programs results in lost yield to fishermen and mediates interactions between strays and wild fish on the spawning grounds. Previous work has revealed a strong influence of distance between release locations and sites where hatchery fish ultimately stray, but other evidence suggests additional features of recipient sites may similarly attract hatchery strays. In this talk, I review what is known and not known about site-specific attractiveness to hatchery salmon and describe a new project seeking to further elucidate patterns of dispersal within Southeast Alaska chum salmon metapopulations. I describe a modeling approach that considers collective movement ecology as well as site specific streamflow models while accounting for hydrological distances among sites. Understanding and identifying the biotic and abiotic factors shaping site specific attractiveness to strays with this model will allow for more accurate accounting of

wild fish escapement and facilitate planning of release locations to avoid locations of highly attractive streams. Taken as a whole, this project seeks to support Alaska's intention to avoid interactions of hatchery and wild fish on the spawning grounds because of the well-known detrimental ecological and evolutionary impacts on wild fish.

Streamflow response to lithology and physiography in rain-dominated, coastal watersheds

Rosemary Pazdral
Oregon State University
pazdralr@oregonstate.edu
Coauthors: Rebecca Flitcroft, Mary Santelmann
Poster Presentation

Lithology is an important consideration in the analysis of streamflow regimes and seasonal water availability in rain-dominated watersheds. By definition, rain-dominated watersheds in seasonal climates rely on old water sources, or water draining into the stream from the critical zone, during the dry portion of the year. In the Oregon Coast Range, there are two predominant lithologies: sedimentary (sandstone) and volcanic (basalt). It has been demonstrated that these lithologies store, transport, and release water by different processes. However, the degree to which streamflow regimes and seasonal runoff timing are influenced by lithology in rain-dominated, coastal watersheds is unknown. Increased understanding of rainfall-runoff processes in these systems is important because it may be an indicator of aquatic systems that are likely to become warmer and drier under changing precipitation conditions. The timing and quantity of streamflow is particularly relevant in this region to Pacific salmon, who rely on specific aquatic conditions during both dry and wet seasons for juvenile survival and adult spawning. We use stable isotopes, electrical conductivity, watershed physiography, and long-term streamflow records to investigate the relationship between predominant streamflow source (old or new water) and streamflow quantity and timing across six headwater watersheds in the Oregon Coast Range.

Will a Changing Climate Exacerbate or Facilitate Control of an Aquatic Invasive Species?

James Pearson
OSU - USFWS
pearsjam@oregonstate.edu
Coauthors: Ryan Bellmore, Jason Dunham
Oral Presentation

Nonnative Common Carp (Cyprinus carpio; hereafter referred to as carp) have been implicated in the decline of aquatic health in Malheur Lake, a large-shallow-endorheic lake in Southeastern Oregon. Management plans for lake restoration call for reducing biomass of carp in the system to below 50kg/ha. Currently, control efforts have been focused on removal of adult carp, but it is also likely that lake level fluctuations influence potential outcomes. To investigate how these factors interact we employed a modified version of an age-based population model (CarpMOD) to investigate how past and future hydrologic variability influences the dynamics and efficacy of control. We simulated three control scenarios targeting adult carp: 1) no carp removal, 2) carp removal during low water years, and

3) carp removal every year, in which adult carp removal rates were inversely related to lake area. Preliminary results of these simulations suggested that no individual control scenario consistently reduced carp biomass below the targeted threshold. Simulations further demonstrated that increasing the removal effort from carp removal during low water years to carp removal every year lead to only a minimal reduction in the overall carp biomass. These model results are due to a combination of two factors: 1) density dependent interactions within the carp population and 2) decreased removal efficiencies during high water years. Ultimately, simulation demonstrate that the carp population in Malheur Lake is more affected by the interactions within the population brought on by environmental fluctuations than by our ability to impose mortality rates via removal efforts.

Spring Chinook Salmon Survival and Movement in Response to Altered Flows and Temperatures in the Willamette River, Oregon

Jessica Pease
Oregon State University
jessica.pease@oregonstate.edu
Coauthors: Luke Whitman, Kirk Schroeder, James Peterson
Oral Presentation

Spring Chinook Salmon Oncorhynchus tshawytscha have been listed as threatened in the Willamette River, Oregon since 1999. All life history stages of anadromous fish species, such as spring Chinook Salmon, have been negatively impacted by altered flow regulation, impoundments, and human land development. Extensive work has been done to better understand the demographic processes of anadromous adult salmonids. However, very little is understood about the growth, survival, and movement of juvenile anadromous salmonids, particularly those with diverse life history strategies. The Oregon Department of Fish and Wildlife has pit tagged juvenile Chinook Salmon in the Willamette Basin for the past 20 years. Individuals are later resighted at PIT-tag interrogation stations, recaptured during seining efforts, or recovered in the estuary. Using a multi-state recapture-resight-recovery model, we estimated annual juvenile Chinook Salmon growth, survival, and movement in response to changes in abiotic or biotic factors. Preliminary modeling results suggest that Chinook Salmon survival and movement is related to temperature, flow and fish body size. Gaining a better understanding of the growth, movement, and survival of juvenile Chinook Salmon will facilitate better management of these threatened anadromous salmonids at all life history stages.

Drawn to Nature: The Artwork of Anthony Pedro

Anthony Pedro
Oregon Department of Fish and Wildlife
anthonyrpedro@gmail.com
Oral Presentation

Throughout the prehistoric world of Western and Eastern Europe animals were often depicted with mortal wounds inflicted by the spears of hunters. Archaeologists suspect these paintings may have been a form of magic. By bringing these awe-inspiring creatures into their dwellings, perhaps the

strength of the animals could be somehow transferred from the cave walls to its human inhabitants. The capability to produce art was an evolutionary breakthrough for early (Homo sapiens). These first artworks demonstrated self-awareness, an understanding of their surroundings and the ability to communicate figuratively. As members of the same species, our brains are anatomically similar. Perhaps then, not unlike modern humans, they were simply hoping to make sense of the perilous world around them through art, as they struggled to survive. Thousands of years later, I make pictures for many of the same reasons my ancestors did. I intend to discuss in detail, my methods, influences, and motivations for depicting animal life, as well as how my career and experiences as a Fisheries Professional continues to inspire my painting and vice versa.

Investigating fine-scale population genetic structure of inland and coastal Rainbow Trout in the Klamath Basin prior to one of the largest dam removal projects in history

Stan Piotrowski
Oregon State University
stanley.piotrowski@oregonstate.edu
Coauthors: Kathleen O'Malley, Mark Hereford, Devon Pearse, Armstrong Jonathan,
Oral Presentation

The completion of Copco 1 Dam in 1918 blocked anadromous fish passage to more than 600km (400 miles) of spawning and rearing habitat in the Upper Klamath Basin. Removal of Copco 1, Copco 2, Iron Gate, and J.C. Boyle Dams along the Upper Klamath River will begin in 2022, marking the start of one of the largest dam removal projects in world history. However, our ability to monitor how dam removal may impact fishes that have been isolated by the dams for more than a century will be limited by our understanding of conditions prior to their removal. Currently, a robust recreational fishery for Redband Trout (Oncorhynchus mykiss newberii) exists in Upper Klamath Lake and its associated tributaries. Previous work revealed significant genetic divergence between Coastal Rainbow Trout (O. mykiss irideus), and Upper Klamath Lake and inland lake Redband Trout lineages. However, fine-scale population structure of various life history phenotypes among tributaries of Upper Klamath Lake remains poorly understood. To this end, we are using a panel of 392 single nucleotide polymorphisms (SNPs) to investigate fine-scale population genetic structure among groups of Redband Trout in the Upper Klamath Basin and Coastal Rainbow Trout populations below the current dam sites. To date, tissue samples have been collected from 4,454 individuals from 104 sites across the Klamath Basin. Additional samples from three sites in the neighboring Great Basin, a tributary of the McCloud River, and two domesticated hatchery strains will be included to refine our understanding of phylogeographic relationships and effects of hatchery stocking. I will present preliminary results of our genetic analyses and discuss how these results may prove useful in the adaptive management and conservation of native O. mykiss phenotypes of economic, evolutionary, and cultural importance post-dam removal.

Assessing the genetic origin of Redband Trout (Oncorhynchus mykiss gairdneri) occupying Tumalo Creek and Bridge Creek in Central Oregon

Matthew Piteo
US Fish and Wildlife Service
matthew_piteo@fws.gov
Coauthors: Justin Bohling
Oral Presentation

We investigated the genetic ancestry of isolated populations of Redband Trout within the Tumalo Creek Basin of central Oregon: one above Tumalo Falls and another within Bridge Creek. Both populations are separated from other wild Redband Trout in Tumalo Creek by either a large waterfall (Tumalo Falls) or an artificial barrier (Bridge Creek). This raises questions as to the origin of these populations and whether they are related to nearby Redband Trout populations or descendants of out-of-basin stocking. We genotyped these populations at 379 Single Nucleotide Polymorphisms (SNPs) and compared them to Redband Trout from Tumalo Creek, the Deschutes River Basin, and out-of-basin hatchery strains that have been historically stocked in the area. Our analyses revealed that the Redband Trout occupying Tumalo Creek above Tumalo Falls and Bridge Creek are genetically most similar to downstream populations in Tumalo Creek. We found no evidence in either population of common ancestry or introgression with the hatchery strains we tested. Our dataset cannot be used to determine when these Redband Trout colonized these respective areas of Tumalo Creek, but it is clear they originated from nearby populations.

Non-lethal effects of predation risk on sub-yearling Chinook salmon in Lake Wenatchee, Washington

Carlos Polivka
Wenatchee Forestry Sciences Lab
carlos.polivka@usda.gov
Coauthors: Rachel Hosman
Oral Presentation

Non-lethal effects of predators affect the behavior of prey species, resulting in an “ecology of fear” where habitat use, vigilance, and foraging are all modulated by predators with potential effects on life history traits of individuals of the prey species that may be correlated with future fitness. Foraging behavior can further be driven by predation risk according to an individual’s current condition. One possible response is “asset protection” in which individuals in poorer condition take greater risk and sometimes, but not always, succumb to predation. Individuals in good condition have more to lose when body condition is correlated with future fitness and forgo foraging for vigilance. Asset protection results in many individuals remaining near the mean value of condition; thus, measured variation may be lower relative to that among individuals exposed to fewer predators. Non-lethal effects of predation on Chinook salmon by piscivorous fish are not well understood, particularly in areas with recovering populations. In the Wenatchee River (WA), sub-yearling Chinook rear in the Little Wenatchee and White Rivers, but encounter predation risk from bull trout during movements into Lake Wenatchee and/or outmigration of smolts. Recent observations in the tributaries and lake indicated patterns consistent

with asset protection: 1) individuals that remained and were recaptured in tributary pools that offer protection from predators varied less in condition than those that emigrated to the lake. 2) growth variation among individuals was lower in the lake relative to tributaries, and 3) size and condition variation among individuals decreased with increasing time in the lake. These observations suggest that further experimental study of the energetic cost of predation may inform how non-lethal effects of predators affect the population status of Chinook in this sub-basin.

What's My Story? Challenges Modeling Individual Time-varying Covariates in Space-for-time Mark Recapture Studies with Missing Data

Adam Pope
USGS
apope@usgs.gov
Oral Presentation

Mark-recapture studies are a familiar tool for estimating demographic rates such as population survival. Modeling these parameters as a function of both time-invariant and time-varying covariates has long been a staple of these analyses. When sampling events occur at known times, time-varying environmental covariates (e.g. temperature) can be assigned even to undetected individuals. However, in a space-for-time mark-recapture framework, individuals passing a stationary detection location undetected do so at an unknown time, imposing serious challenges to modeling the effect of these covariates. Recent advances in mark-recapture analysis techniques have provided researchers tools to overcome these challenges, although the methods are generally not without drawbacks. As an example, the use of complete data likelihoods within a Bayesian modeling approach can allow for imputation of missing event times and thus, the use of time-varying covariates in space-for-time mark-recapture analyses. This talk will focus on aspects of the theoretical development of several of these techniques, highlighting strengths, weaknesses, and potential applications and extensions for each.

Accounting for population dynamics improves the use of no-take marine reserves for fishery management

Victoria Quennessen
Oregon State University
victoria.quennessen@oregonstate.edu
Coauthors: J. Wilson White
Oral Presentation

Today, fisheries are managed using information obtained through periodic stock assessments which provide reference points, such as how depleted the fishery is compared to its unfished state, to inform catches and prevent over-fishing. However, these stock assessments typically need historical data, or long time series of catch and abundance data, to accurately assess depletion -this amount of data may be difficult to obtain for smaller or mainly recreational fisheries. Populations that are in no-take marine reserves, and are therefore unfished, may help serve as a reference point to determine depletion. One method that was developed in the past decade uses the ratio of density of fish outside and inside the

reserve to serve as a proxy reference point from which to determine catch based on control rules. The density ratio is especially useful because it does not require a long time series of data, and can be applied at a local spatial scale with observable fluctuations in annual recruitment. Two limitations to the original method include not accounting for different population dynamics immediately following marine reserve implementation that are distinct from unfished population dynamic, or accounting for inaccurate estimates of natural mortality. Using spatial, age-structured population dynamics modeling of Black Rockfish (*Sebastes melanops*) and Cabezon (*Scorpaenichthys marmoratus*) populations, I show how these factors can be accounted for to help determine consistent, sustainable catches by using information from no-take marine reserves, illustrating their ability to aid in management as well as conservation.

Recolonization Potential for Coho Salmon in Tributaries to the Klamath River Above Iron Gate Dam

Max Ramos
Humboldt State University
mmr37@humboldt.edu
Coauthors: Darren Ward
Oral Presentation

Four major dams on the Klamath River are slated for removal in 2021, restoring access to hundreds of miles of potential habitat for anadromous fishes. The coho salmon (Oncorhynchus kisutch) in the Klamath River are classified under the Southern Oregon/Northern California Coast evolutionarily significant unit as a threatened species. Low-flows and elevated water temperatures during the summer months in the mainstem Klamath River are expected to be limiting for juvenile coho salmon rearing potential. We are using physical habitat and biological features of major tributaries to the Klamath River above the dams to assess available habitat and its fundamental capacity to support coho salmon post dam removal. Nearby watershed abundance data was used to estimate the potential distribution and abundance of juvenile coho salmon at the sites. Results from this analysis can be used to make management decisions for habitat restoration efforts and future coho salmon population goals.

Patterns of occurrence of hatchery-origin pink salmon in five streams in western Prince William Sound, Alaska

Pete Rand
Prince William Sound Science Center
prand@pwssc.org
Oral Presentation

Since 2013, a collaborative field project in western Prince William Sound, Alaska, has focused on sampling the origin of adult pink salmon in five small spawning streams. Here we report on patterns in P(H) (probability of occurrence of hatchery-origin pink salmon on the spawning grounds) observed during 2013-2017. Result of analysis of 57,626 otoliths over 5 years will be presented. We analyzed the probability of occurrence of hatchery-origin fish using a generalized linear model with the following

covariates: year of sampling, day of sampling, and distance upstream of the low tide line. A stream on southern Knight Island near Montague Entrance was found to have the highest overall P(H) (mean=0.5), whereas the other 4 streams exhibited lower occurrence probabilities (<0.25). The year 2014 was marked with the highest occurrence of hatchery-origin fish (mean=0.78), and there appears to be a trend of lower P(H) in more recent years in the time series. Hatchery-origin pink salmon tended to arrive later in the season, and were found disproportionately present in upstream, freshwater habitat (as opposed to intertidal habitat), which likely has consequences for reproductive fitness. Recent years have been marked by pre-spawning mortality resulting from drought conditions. I will emphasize the important of this study and how it might affect the management of wild and hatchery pink salmon in Prince William Sound and elsewhere.

Exploring Thermal Conditions Occupied by Lampreys in their Southern Range

Stewart Reid
Western Fishes
westernfishes@opendoor.com
Coauthors: Damon Goodman
Oral Presentation

Western North America is home to a diverse lamprey fauna that historically occupied streams throughout as far south as northern Baja California. We explore the summer stream temperatures of locations occupied by lampreys in California and southern Oregon, representing the southern and often warmest portion of their range. First we compiled a database of 1,166 lamprey collections from California and the Oregon portion of the Klamath River drainage, primarily composed of the authors' collections (1998-2018). The resulting database included records of all nine described lamprey species within the study area, including two genera (Entosphenus and Lampetra). Lamprey collections were then associated with NorWest modeled average August stream temperatures from the time period of 1993 to 2011. Miller Lake Lamprey collected in Evening Creek at 1,718 m in the Upper Klamath Drainage were associated with the lowest stream temperatures (8° C). Pacific Lamprey were the most widely distributed species in the study and were found in the warmest stream temperatures (Santa Clara River) as well as the widest range of stream temperatures (11° to 24° C). These results are discussed in the context of the range of habitats suitable for lampreys and an evaluation of the thermal suitability of historical habitats not currently occupied by lampreys.

A Deterministic Life Cycle Model for Flow Effects on Partially Anadromous Steelhead Populations

Mark Roes
Mount Hood Environmental
mark.roes@mthoodenvironmental.com
Coauthors: Tara Blackman, Ian Courter
Oral Presentation

Clear evidence has demonstrated interdependence between sympatric populations of resident and anadromous Rainbow Trout (Oncorhynchus mykiss). Rainbow Trout and steelhead frequently

interbreed, and otolith microchemistry and breeding experiments have shown that any mating pair can produce offspring that adopt a variety of life-history strategies. This life history plasticity within O. mykiss populations has impaired efforts to accurately analyze effects of management actions on protected steelhead stocks. To address this problem, we constructed a deterministic life cycle model for a partially anadromous population of resident Rainbow Trout and steelhead in the upper Yakima Basin to quantify flow and temperature effects on anadromous steelhead production and viability. Previous modeling efforts in the upper Yakima were used as a framework, and updated with results from recent observational and experiential research. The model simulated the full life cycle of resident and anadromous O. mykiss, including mating pairings and an individual's probability of anadromy. Model accuracy was evaluated by comparing estimated steelhead returns to dam counts from 1981-2007. Use of the model to evaluate water operations scenarios revealed that flow management, while capable of increasing steelhead abundance, would likely need to be combined with other restoration actions to achieve steelhead recovery goals in the upper Yakima Basin. Our approach provides a foundation to evaluate the effects of a variety of restoration alternatives on partially migratory fish populations.

Food web responses to riparian thinning in redwood headwater streams

David Roon
Oregon State University
david.roon@oregonstate.edu
Coauthors: Jason Dunham, Ryan Bellmore
Oral Presentation

Resource managers are actively thinning second-growth forests in the redwoods of coastal Northern California to accelerate the recovery of old-growth redwood forests. These forest restoration practices have largely taken place in upland forests to date, but now there is interest in thinning riparian forests. In order to understand how stream ecosystems respond to these more subtle changes in riparian forest conditions, we evaluated riparian thinning in a watershed scale Before-After-Control-Impact field experiment. Riparian thinning treatments decreased riparian shade by 21(±5)% and increased light to streams by 23(±7)%. We hypothesize that these reductions in shade and increases in light associated with thinning will increase the abundance of stream periphyton, which will shift the seasonal and spatial dynamics of these food webs. To test this hypothesis we are measuring: stream periphyton abundance; macroinvertebrate communities in the diets of the top predators, coastal giant salamanders and coastal cutthroat trout, to determine if the abundance and composition of prey resources are shifting; and using stable isotopes to determine the extent to which any increase in periphyton may be assimilated in the food web. In this presentation we share preliminary results on how stream ecosystems responded to these changes in riparian shade and light. Our data will provide a mechanistic understanding of how the food webs that link streams and riparian forests may shift in response to riparian thinning.

Influence of oceanographic conditions and food web quality on Black Rockfish body condition

Claire Rosemond
Department of Fisheries and Wildlife, OSU
claire.rosemond@oregonstate.edu
Coauthors: Kevin Martin, Scarlett Arbuckle, Scott Heppell
Poster Presentation

Oceanography in the California Current Ecosystem is highly variable, being driven by annual-to-decadal climate oscillations, such as the El Nino-Southern Oscillation and the Pacific Decadal Oscillation, and is affected by a changing climate. Extreme anomalous events, such as marine heat waves, are predicted to occur more often and with increasing intensity. Our study investigates how these ocean processes impact body condition of Black Rockfish (Sebastes melanops), a commercially- and recreationally-important fish species in the northeast Pacific. Prey quality and availability may also impact the overall energy storage of Black Rockfish. Using proximate analysis, we quantified the seasonal and interannual variability of body condition of male and female Black Rockfish over five years (2015-2019) to investigate how ocean processes, food web quality, and life stage characteristics (e.g., sex and age) influence body condition. Quantifying annual patterns of lipid storage as well as variation in these patterns is important as changes in body condition may influence reproductive potential and overall productivity.

A Researcher's Guide to the Endangered Species Act Permitting Process

Rachel Sanchez-Ruffra
University of Houston
rachel.sanchez.ruffra@gmail.com
Poster Presentation

The Endangered Species Act of 1973 (ESA) was enacted to give protection to endangered or threatened species, including their essential habitat, and to mandate that all federal agencies utilize their authorities in consideration of these protections. The ESA prohibits all take of species listed on the endangered species list and defines "take" as "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct." Research conducted on endangered or threatened species is regulated by Section (10)(a)(1)(A) and Section 4(d) of the ESA. The goal of my research project with the National Marine Fisheries Service (NMFS) was to create a visual aid by which researchers can interpret the ESA and navigate the NOAA Fisheries permit process to perform scientific research to evaluate the status, or condition, of an endangered or threatened species. Through background research, informational interviews, and field site visits, I developed two research questions; first, if take is prohibited under the ESA, what are the mechanisms by which we determine the status of a species? And secondly, how do researchers maneuver through the research permitting process in order to do essential scientific research concerning listed species?

Exploring relationships between stream characteristics and the relative abundance of trout and salamanders in forested headwaters of western Oregon

Ashley Sanders
National Council for Air and Stream Improvement
a.sanders333@gmail.com
Coauthors: Ashley Coble, Dana Warren
Oral Presentation

Coded Wire Tag: Where's your head at?

Sarah Sapienza
ODFW-Columbia River Management
abbotts08@rocketmail.com
Oral Presentation

The Coded Wire Tag (CWT) Lab in Clackamas processes all steelhead and salmonid heads in the State of Oregon and Columbia River (OR-WA combined) for a yearly total of about 40,000. Due to significant improvements in the processing, fisheries biologists are able to get their data for in season management in real time. This talk will discuss the various advances in the processing of CWT's, the insertion method and how the data is processed.

Implementing a video monitoring system for estimating recreational fishing effort

Natalie Scheibel
Oregon Department of Fish and Wildlife
natalie.c.scheibel@state.or.us
Oral Presentation

The Buoy 10 fishery in the Columbia River estuary depends on accurate effort and catch estimates to provide valuable fishing opportunities while limiting impacts on ESA-listed stocks of salmonids. Traditional instantaneous trailer and mooring basin counts have been the primary method to estimate fishing effort. Instantaneous counts are effective but can falter if the counts occur outside of peak fishing times. Mooring basins also present a challenge, as the number of boats moored at any given time changes unpredictably over the course of a fishing season. Video cameras present an alternative or additive method to estimating fishing effort. In order to transition from the instantaneous counts to the video boat counts (VBC) a comparison study was done to develop relationships between the traditional counts and VBC. Video cameras were installed at five access points throughout the estuary and recorded outgoing and incoming boats. Video was analyzed via security software by technicians on a daily basis. VBC were adjusted with on-site creel surveys to exclude incomplete trips and break out other trip types. VBC were consistently higher than traditional counts. Video cameras can provide a cost-effective way to monitor fishing effort 24 hours a day, which helps managers improve the accuracy of fishing effort counts and better understand angler behavior.

Mapping lamprey distributions along Oregon's south coast using eDNA and citizen science
Shon Schooler
South Slough Reserve
shon.schooler@state.or.us
Coauthors: Deborah Rudd, Jenni Schmitt, Rebecca Flitcroft
Oral Presentation

Lamprey are important components of many aquatic ecosystems in Oregon. However, determining basic spatial distributions of different species of lamprey has been difficult due to: 1) nocturnal behavior that impedes direct observation, 2) differentiation among species (i.e. ammocetes or adults) is problematic, even for experts, and 3) common methods of sampling, such as electro-fishing, are gear and labor intensive. Identifying organisms using environmental DNA (eDNA) from water samples is an increasingly common field survey and monitoring method. In addition, collecting water samples does not require advanced technical skills, making this sampling method accessible for trained citizen scientists, which may reduce staff time. In this project, we examine the use of eDNA analysis for mapping spatial distributions of two lamprey species (western brook and Pacific) in streams and rivers along the southern Oregon coast. In 2019, we sampled 71 sites across five coastal watersheds, some of which were previously sampled using electro-fishing methods. In this presentation we: 1) compare eDNA results with electro-fishing results, 2) report on trends we observed between the species and compare with a lamprey habitat suitability model, and 3) discuss the use of citizen scientist volunteers in the collection of eDNA water samples.

Be innovatively simple by simply being innovative
Carl Schreck
Oregon State University
carl.schreck@oregonstaste.edu
Oral Presentation

Effective communication of science across different domains depends on a number of factors, but what they all have in common is that the message to be communicated needs to be made in the simplest way possible. Accomplishing this depends on the domain involved (paper, oral, poster, etc., and constraints such as page limits time), the audience, and the message. In the context of the domain and the audience, the presentation should be developed to focus on the message.

Making in-stream tributary data findable, accessible, interoperable, and reusable (FAIR).
Rebecca Scully
USGS/PNAMP
rscully@usgs.gov
Oral Presentation

To accelerate research and decision-making, data needs to be findable, accessible, interoperable, and reusable (FAIR). Four federal programs collect in-stream habitat data for project-specific objectives:

BLM's Assessment, Inventory, and Monitoring (AIM), EPA's National Rivers and Streams Assessment (NARS), and US Forest Service's Pac-fish/In-fish Biological Opinion (PIBO) Effectiveness Monitoring and Aquatic Riparian Effectiveness Monitoring Program (AREMP). These programs have long-term spatially overlapping data and calculate a sub-set of metrics with comparable field and analysis methodology, yet there is no easy process to find, access, and integrate the data from all four programs, making data reuse difficult. Producing FAIR in-stream habitat data from these four programs would allow mangers and monitoring professionals to reuse over 15 years of data and design new data collection efforts to integrate with the existing data collection. We kicked off a working group to tackle the factors confounding data integration: differences in response design and survey design. And we documented the initial technical steps to the exploration and analytical process of combining information. We are in the early stages of this effort, but we have found that a key component of making data FAIR is strong metadata documentation and a data dictionary to crosswalk information between programs.

Calculating trap efficiency rates for adult spring Chinook salmon using radio telemetry in the Hood River, Oregon

Megan Shearer
Confederated Tribes of Warm Springs
megan.mckim@ctwsbnr.org
Oral Presentation

After Powerdale Dam's removal in 2010 a new trapping facility to manage the Hood River spring Chinook salmon program was established at a partial barrier, known as Moving Falls, on the West Fork Hood River. In order to assess the effectiveness of the new trapping facility a radio telemetry project was initiated in run year 2014 to document adult spring Chinook distribution and behavior related to the Moving Falls facility, and estimate proportion of fish captured at the trap versus those that bypassed the trap via the falls. For the study, returning adult Chinook were collected via hook-and-line angling methods near Punchbowl Falls, located 4.3rkm downstream of the Moving Falls trap site, implanted with both radio tags and PIT tags, and released directly at the capture site. Tagged fish were then tracked throughout the remainder of the spawning migration using a combination of mobile and fixed site radio telemetry, as well as PIT detections at traps and PIT interrogation sites located throughout the watershed. To date, we have monitored 184 fish over 5 run years. We found that of the fish that navigated the Moving Falls structure, 88% were captured at the trap, suggesting a low proportion of fish were jumping the falls and bypassing the trap. However, we also observed that only a minority of the of the total radio tagged fish (36%) actually migrated upstream of the Moving Falls site, which could have significant implications for broodstock collection and fisheries management in the Hood River.

Relative fitness of hatchery and natural Pink Salmon in Prince William Sound: Part I, Methods

Kyle Shedd
Alaska Department of Fish and Game
kyle.shedd@alaska.gov
Coauthors: Emily Lescak, Heather Hoyt, Tyler Dann, Chris Habicht
Oral Presentation

Private non-profit hatcheries practice extensive ocean-ranching aquaculture of Pacific salmon in Alaska. Most of the 1.8B juvenile salmon released annually by hatcheries are Pink Salmon (Oncorhynchus gorbuscha) in Prince William Sound (PWS) and Chum Salmon (O. keta) in Southeast Alaska. While policies exist to reduce risk to natural stocks, the scale of these hatchery programs and documented hatchery straying into streams has raised concerns regarding the long-term impact of hatchery-origin fish on the productivity and sustainability of natural stocks. We used genetic parentage analysis to estimate the relative reproductive success (RRS) of stray hatchery-origin versus natural-origin Pink Salmon for the first time in two streams in PWS for one generation in both odd- and even-year lineages. We reconstructed pedigrees for brood years 2013 and 2014 for Hogan Bay and Stockdale Creek by combining origin information from thermal otolith marks with parentage information from genetic data analyses of > 17,000 fish for 298 single nucleotide polymorphism amplicons. This research is part of the larger Alaska Hatchery Research Program that seeks to better understand hatchery and natural-origin interactions and inform resource management decisions regarding future hatchery production in Alaska.

Relative fitness of hatchery and natural Pink Salmon in Prince William Sound: Part II, Results

Kyle Shedd
Alaska Department of Fish and Game
kyle.shedd@alaska.gov
Coauthors: Emily Lescak, Heather Hoyt, Tyler Dann, Chris Habicht
Oral Presentation

We present the first study to directly measure the relative reproductive success (RRS) of hatchery- and natural-origin Pink Salmon (Oncorhynchus gorbuscha). We examined both odd- and even-year lineages for two streams in Prince William Sound, Alaska (PWS) to provide pseudo-replicate measures of RRS. Reproductive success, measured as adult progeny that return and die in the stream, was significantly lower for hatchery-origin versus natural-origin parents from both lineages. However, while reproductive success was significantly lower for hatchery females in both streams and lineages, the reductions in male reproductive success were not always statistically significant. Generalized linear modeling indicated that reproductive success was lower in hatchery-origin fish after accounting for covariates such as sample date (run timing), sample location within the stream, and fish length. These are the first in a series of RRS analyses under the Alaska Hatchery Research Program (AHRP), which will ultimately include replicate analyses in other streams that will provide more power to investigate cross-type effects (matings between natural- and hatchery-origin fish, and the potential to explore inter-generational effects generations to determine whether decreased reproductive success is ephemeral (effects a single generation) or long-term (effects multiple generations). If reductions in fitness are

replicated, important questions will remain regarding the mechanisms driving the effect and its persistence into future generations. Identifying driving mechanisms behind reductions in fitness and the potential for persistent effects across generations will be important to inform policy makers on how best to balance the economic value of hatchery programs with the potential for risk to wild stocks.

Twenty seven years and counting, Salmon and steelhead monitoring in Tenmile and Cummins Creek, Oregon

Wesley Shum
Oregon Dept. Fish and Wildife
wesley.a.shum@state.or.us
Coauthors: Michael Lance, Erik Suring, Chris Lorion
Poster Presentation

The addition of large woody debris to streams is a common method employed to improve freshwater rearing habitat for anadromous salmonids. However, long term monitoring of the efficacy of LWD additions is necessary to understand if restoration efforts result in transient or semi-permanent improvements in the abundance of target species. In 1991, the Oregon Department of Fish and Wildlife, US Forest Service, and local stakeholders began an intensive research study at Tenmile Creek on the central Oregon coast to evaluate the effects of large woody debris placement on juvenile salmonid populations with a before-after-control-impact study design. Nearby Cummins Creek served as an unaltered reference site for the study. We monitored juvenile salmonid outmigrants on Cummins Creek from 1992-2012 and from 1992-present on Tenmile Creek. In 1996 logs were added to Tenmile Creek to increase stream complexity and improve habitat for juvenile salmonids. Rotary screw traps were used to collect outmigrating juvenile salmonids from March through June. Capture efficiency of each trap was estimated by marking a subset of captured fish with a small fin clip, releasing them upstream of the trap site, and enumerating the number that were recaptured. Annual estimates of the abundance of outmigrating juvenile salmonids was calculated from the total catch and number of recaptures using Bayesian Time-Stratified Population Analysis (BTSPAS). Wood placement in Tenmile creek showed the greatest benefit to winter Steelhead Trout Oncorhynchus mykiss smolt abundance. Coho Salmon O. kisutch smolt abundance did not respond as rapidly to treatment as steelhead did, but their abundance has steadily increased over the study period. Our study highlights the efficacy of large wood placement to improve habitat for juvenile anadromous salmonids, but the influence of large wood placement can vary among different species in the same watershed.

The Upper Klamath Basin Watershed Action Plan

Megan Skinner
U.S. Fish & Wildlife Service
megan_skinner@fws.gov
Oral Presentation

The Upper Klamath Basin (UKB) is home to numerous native fish species of conservation, cultural, and economic importance. A number of factors related to land use practices and a changing climate have

led to a decline in water quality, and fish populations and habitat in the UKB. Several past efforts, including the UKB Comprehensive Agreement, Total Maximum Daily Load documents and associated water quality management plans, and Endangered Species Act recovery plans, have identified the need for a coordinated plan or strategy to prioritize and implement restoration actions to support fisheries recovery, water quality improvements, and restoration of riparian and riverine process and function in the UKB. The UKB Watershed Action Plan (WAP) provides science-based guidance regarding types of restoration projects necessary to address specific impairments to riverine and riparian process and function, and development of monitoring regimes tied to quantifiable restoration objectives at multiple scales; a reach-scale watershed condition assessment that prioritizes reaches, based on degree of impairment, for landowner recruitment and subsequent implementation of restoration activities; and detailed guidelines for implementation of specific restoration activities, such as riparian fencing and riparian grazing management. Additionally, the WAP outlines a process of adaptive management to refine condition assessments, recommended restoration actions, and monitoring approaches as new information becomes available. The WAP is being developed by a team of local restoration professionals including U.S. Fish and Wildlife Service, The Klamath Tribes, Trout Unlimited, Oregon Department of Environmental Quality, Klamath Watershed Partnership, The Nature Conservancy, and the North Coast Regional Water Quality Control Board.

Chum SNP baseline development and implementation

Maureen Small
Washington Department of Fish and Wildlife
Maureen.Small@dfw.wa.gov
Coauthors: Todd Hillson, Josh Weinheimer, Mark Downen, Mike McHenry, Randy Johnson
Oral Presentation

Population genetic baselines provide a foundation for fisheries research and management. Employing new advances in genome science, the WDFW Chum Salmon baseline now characterizes 73 populations throughout the northeastern Pacific with 350 single nucleotide polymorphisms (SNPs). With the high resolution of this baseline, researchers explore production and out-migration timing of different run groups in the same rivers in Hood Canal and Strait of Juan de Fuca, identify parents of returning spawners in the Columbia River to assess recovery strategies, and estimate components of mixed stock fisheries in Puget Sound to inform harvest allocation, especially for populations of conservation concern, and to improve run reconstruction. We are currently collaborating with Department of Fish and Oceans, Canada to expand the Chum SNP baseline to resolve mixed stock fisheries in the Southern Boundary region. The expanding SNP baseline for Chum Salmon is useful to multiple agencies managing Chum Salmon throughout the northeastern Pacific.

Tough places and safe spaces: can refuges save salmon from a warming climate?

Marcia Snyder
US Environmental Protection Agency
snyder.marcia@epa.gov
Coauthors: Nathan Schumaker, Joe Ebersole, Matthew Keefer, Jason Dunham
Oral Presentation

In freshwater systems in the western US, there is evidence that warmer water temperatures along migration corridors have increased energetic costs of migration, decreased reproductive fitness, and increased premature mortality in anadromous salmonids. Behavioral thermoregulation has been observed across all life stages of anadromous salmonids and thought to be a beneficial strategy that can help mitigate costs to fish fitness of water temperature increases. In spite of the hypothesized importance of cold water refuge use to mitigate increasing water temperatures, directly linking thermal exposure of adult salmonids to survival and fitness outcomes during upstream migration has been challenging. We use a hybrid probabilistic-mechanistic simulation model to evaluate the buffering potential of cold water refuge use for anadromous salmon and trout migrating upstream in the Columbia River from Bonneville dam to the Snake River confluence. The simulation model, developed within HexSim, is built around a mechanistic behavioral decision tree that drives individual interactions with their spatially explicit simulated environment. To evaluate the advantages and disadvantages of behavioral thermoregulation on fitness at individual and population scales, we use emergent model properties, including observed passage times, energy use, cumulative exposure, and survival rates.

Applications of a Disease Model for Listed Coho Salmon to Evaluate Flow Regimes

Nicholas Som
U.S. Fish and Wildlife Service
nicholas_som@fws.gov
Coauthors: Russell Perry, Julie Alexander, Nicholas Hetrick
Oral Presentation

The myxosporean parasite Ceratonova shasta is known to have increased mortality rates for outmigrating populations of Klamath River juvenile salmonids for several decades. In order to evaluate how mortality risk varies according to in situ riverine characteristics, a series of fish-exposure experiments were conducted. The experimental design targeted broad ranges of water temperatures and waterborne concentrations of the parasite, which are each known to impact mortality risk, and the exposure duration to these variables, which has been hypothesized to correlate with mortality risk. These experimental exposures were conducted separately for Chinook and Coho salmon owing to observed historical variation in mortality rates among the species. In this talk, we first summarize the details and benefits of applying mixture-cure models for Coho Salmon to predict both the probability of mortality, and given susceptibility, the time to death of individuals. We then focus on an application of this model to evaluate a restoration flow regime designed to reduce C. shasta risk. More specifically, the flow regime restores scouring events, timed to be consistent with the natural flow regime, that are intended to reduce the abundance of Manayunkia speciosa, a polychaete worm known to be the intermediate host in the C. shasta lifecycle.

Middle Klamath River Coho Salmon Ecology and Utilization of Constructed Off-Channel Habitats

Toz Soto
Karuk Tribe
tsoto@karuk.us
Coauthors: Charles Wickman
Oral Presentation

The Karuk Tribal Fisheries Program (KTFP) is leading efforts to study Coho Salmon ecology within the Middle Klamath River corridor and partnering with the Middle Klamath Watershed Council (MKWC) to implement habitat enhancement projects designed to address specific habitat limitations found during these studies. The KTFP has conducted Coho Salmon ecology studies since 2007 and began constructing off channel floodplain habitats in partnership with MKWC beginning in 2010. The Middle Klamath River is surrounded by high inland mountains where stream channels are typically steep and characterized by extreme seasonal shifts in habitat conditions due to cold wet winters and hot dry summers. Enhancement of winter and summer juvenile Coho rearing habitat was identified as high priority for Middle Klamath River restoration actions. We found that building off channel floodplain ponds with a strong groundwater influence to be the most effective restoration method for addressing these habitat limitations. Groundwater fed off channel ponds provide a stable year round rearing environment for Coho Salmon buffering the seasonal extremes found between winter and summer conditions. A large part of our work is attempting to measure juvenile Coho Salmon performance within these newly constructed habitats with the goal of learning from both failures and successes in order to refine enhancement methods. Our studies found diverse utilization patterns among Middle Klamath River juvenile Coho Salmon characterized by long distance migrations of age 0+ fish and by constructing preferred habitats in the path of these migrating fish has proven a successful means of increasing their survival.

Coho Salmon Response to Restoration Produced Ecosystem Heterogeneity

Betsy Stapleton
Scott River Watershed Council
betsy@scottriverwatershedcouncil.com
Coauthors: Michael Pollock, Erich Yokel, Charnna Gilmore
Oral Presentation

Abstract: French Creek, a tributary to the Scott River, has long been considered a key stream for maintaining one of the Klamath Basin's core, functionally independent, hatchery influence free populations of Southern Oregon Northern California Coho (SONCC) salmon. Even so, the stream has suffered from the typical anthropogenic insults of beaver removal, channelization, agricultural water extraction, road building and headwater logging. The resulting stream simplification offers limited habitat options for Coho, and places stressors on all life stages. Recent Scott River Watershed Council restoration efforts have created a variety of habitats, and preliminary monitoring results suggest how Coho are utilizing them. This session will share those insights.

Back in Clack: The status of reintroduced Bull Trout in the Clackamas River Basin

Steven Starcevich
ODFW
steve.starcevich@oregonstate.edu
Coauthors: Chris Allen
Oral Presentation

Over 50 years after the extirpation of Bull Trout from the Clackamas River Basin, a multi-agency effort is underway to reintroduce the species, with the goal of establishing a self-sustaining population of 300-500 adults. Annual translocations from 2011 through 2016 resulted in the transfer of 2,837 PIT-tagged fish from the Metolius River Basin to the Clackamas. The donor cohort was composed mainly of age-1 (40%) and age-2 (30%) fish. The multi-agency team has used a variety of methods to monitor population status. During census spawning surveys, redds have been observed in three translocation patches; with relatively low redd counts in the upper Clackamas River, the first observation of spawning in Berry Creek in 2019, and most of the spawning concentrated in Pinhead Creek. Using video and PIT tag monitoring and weir trapping, large annual increases in spawning abundance were observed in Pinhead Creek from 2013 through 2017, and a slower increase was observed in 2018, when abundance peaked at an estimated 104 adults. Preliminary results suggest abundance declined in 2019. PIT tag data show that fish translocated at age-1 have contributed only 2% of all adults detected in Pinhead Creek (2011-2018) while those released at age-2 account for 17%. Hydraulic sampling of a few redds confirmed the presence and apparent normal development of alevins. However, locally-born offspring have not been observed during annual juvenile fish surveys (2015-2019) and their recruitment into adulthood has not yet been confirmed at the weir. Bull Trout reach maturity in the donor stock at age-5 and 6 so it is still relatively early in the reintroduction effort. Survival of translocated juveniles to maturity demonstrates the capacity of this basin to support Bull Trout. Until locally-born juveniles and adults are observed, the self-sustaining nature of this population remains uncertain.

A hierarchical approach to joint estimation of juvenile salmonid abundance and snorkel survey detection efficiency

Ben Staton
Columbia River Inter-Tribal Fish Commission
bstaton@critfc.org
Coauthors: Casey Justice, Seth White, Edwin Sedell, Lauren Burns, Matthew Kaylor
Oral Presentation

Snorkel surveys are a widely used method of assessing salmonid abundance in small streams throughout the Pacific Northwest, however, they are imperfect in the sense that observers rarely count all fish present at a site. These counts are generally calibrated to an independent measure of fish abundance (e.g., mark-recapture) to correct for this imperfect detection, but it is often ignored that this independent measure may also be an imprecise or inaccurate estimate of the true abundance. Our objective was to develop and apply an analytical approach that accommodates uncertainty in both sources of information when estimating the detection efficiency of snorkel surveys. The model assumed that snorkel counts have binomial sampling variability in which the true abundance (a latent, free

parameter) was treated as the binomial sample size and the success parameter was a logit-linear function of local covariates. Simultaneously, latent abundance was informed by an additional observation model explaining variability in paired mark-recapture data. We used Bayesian methods to fit the model to a data set in which 70 paired snorkel and mark-recapture surveys were conducted in the Grande Ronde Basin in northeastern Oregon. The selected covariates that best explained variability in snorkel detection efficiency included stream width (negative effect), maximum depth (positive effect), large wood density (negative effect), and a snorkeler-determined visibility metric, though a non-negligible amount of variability was explained by a site-level random effect. Covariates that received little support included stream gradient, unit classification (fast vs. slow water), and stream temperature. Estimated snorkel efficiency ranged from 0.05 to 0.71 between surveys. This model represents an improvement over previous snorkel calibration methods by applying a more rigorous statistical treatment of the sources of variability in the data while explicitly describing the mechanistic link between local stream conditions and efficiency of snorkel surveys.

Lord, I was born a ramblin' Sturgeon: Behavior and Movement of mature White sturgeon in the John Day Reservoir.

Peter Stevens
ODFW
peter.m.stevens@state.or.us
Oral Presentation

Spawning behavior and seasonal movement of sexually-mature White sturgeon (Acipenser transmontanus) within the John Day Reservoir represent a key knowledge gap in assessing recent trends in poor recruitment. Starting in 2018, ODFW initiated a multi-year study to tag and track mature White sturgeon. Over two year we captured 30 male and 19 female White sturgeon on the spawning grounds in the McNary Dam tailrace and implanted them with 69 kHz acoustic tags. We deployed acoustic telemetry receivers in a dense array between the US-395/I-84 Bridge and McNary Dam (i.e. - the "tailrace") to capture fine scale movement, habitat usage and possible direct interaction of tagged fish on their suspected spawning ground. In addition, acoustic "gates" made up of paired or tripled receivers were deployed at Irrigon, Boardman, Crow Butte, Arlington and the John Day River to assess large-scale seasonal movements. We used both multi-state mark-recapture and graph theory/social network analysis to assess mature White Sturgeon habitat usage particularly at the fine-scale in the McNary tailrace. Analysis revealed interesting fine-scale and regional-scale movement patterns throughout the John Day Reservoir. Also, fish gender seemed to be a driver of some of these patterns. These differences in behavior and movement patterns while biologically interesting also have potential implications for White sturgeon management within John Day Reservoir.

Uncharted Water: Implementing New Methods and Technology for Habitat Sampling in Non-Wadeable Rivers

Matt Strickland
Oregon Department of Fish and Wildlife
matt.strickland@oregonstate.edu
Coauthors: Eric Bailey
Oral Presentation

Habitat programs have spent extensive time and resources developing methods to sample wadeable stream habitats to assess status, trends and associations with fish use and assemblage. Numerous peer reviewed protocols exist giving agencies and individuals alike a plethora of sampling options depending on their particular interest. In contrast, large river habitats (often non-wadeable) have been largely understudied due to a number of factors including the highly altered or anthropogenic influenced nature of the habitat, lack of resources, personnel or time, and/or the absence of an applicable and flexible protocol. However, large river systems across the Pacific Northwest may offer the highest species richness potential, an understanding of life history diversity or lack thereof, and the potential for restoration across a watershed. While these opportunities are clear, developing a protocol to assess both the general health and key elements of the aquatic habitat for multiple species across multiple life histories has many inherent challenges that inhibit development and implementation of widely used habitat and juvenile fish monitoring techniques. We explore these challenges from the perspective of a multi-faceted monitoring program with deeply rooted habitat sampling methodologies looking to develop a non-wadeable sampling protocol utilizing side scan sonar technology throughout Oregon.

Detecting spawning of threatened Chum Salmon over a large spatial extent using eDNA: implications for monitoring recovery

Erik Suring
Oregon Department of Fish and Wildlife
Erik.Suring@oregonstate.edu
Coauthors: Kris Homel
Oral Presentation

Chum Salmon were historically abundant in the Columbia River with estimated returns exceeding 1 million adults. Following rapid declines in the 1940s, Columbia River Chum Salmon were listed as threatened in 1999. Oregon and Washington developed recovery strategies aimed at increasing the viability of the species throughout their historical range in the Columbia River. Above Bonneville Dam, dam counts provide spawner abundance data but little is known about where spawning occurs. Spawning ground surveys may underestimate distribution and abundance, particularly for rare species, as they often have a limited spatial and temporal scope are hampered by survey conditions. Trapping is costly and spatially constrained. In contrast, environmental DNA (eDNA) allows for the collection of samples across a broad spatial extent in a short period of time, is cost effective and accurate, which makes it well-suited for identifying the presence of a rare species. In this study, we used eDNA to identify the spawning distribution of Chum in tributaries between Bonneville Dam and The Dalles. We successfully detected Chum Salmon DNA in four streams and in our positive control. We also conducted

a pilot study examining potential contamination by surveyors. We walked in a small stream with contaminated waders and collected water samples before and after contamination. Chum Salmon DNA was detected up to 11 days after contamination. These results demonstrate that eDNA is a useful tool to improve our understanding of spawning distribution across a broad spatial extent. However, the potential for contamination from surveyors or anglers must be explicitly incorporated in the sample design. With these constraints, eDNA is useful for rapidly understanding distribution at a fraction of the cost that would be required with surveyors or trapping methods, and may serve as a companion to those techniques by refining the extent where surveyors could focus their efforts.

Can Subjective Well-being Be Used to Assess Public Responses to Marine Policy?

Thomas Swearingen
ODFW Marine Resources Program
Thomas.c.swearingen@state.or.us
Coauthors: Kreg Lindberg
Oral Presentation

Natural resource management often focuses on ecosystem services as a framework for understanding the benefits humans receive from nature. Recently, assessment of subjective well-being has been promoted as a method to investigate the impacts of public policy decisions. This presentation is a review of a study designed to integrate these two topics. A choice experiment and contingent subjective well-being methods were used in a survey to understand public responses to changes in Oregon marine reserves policy. Both methods produced similar heterogeneous results among respondent groups classified by environmental worldview, prior recreation use of reserves, and commercial fisheries employment. Methodologically, these results indicate that responses to both types of survey task are closely related. However, there were also differences in responses between the tasks. Such differences could potentially be more pronounced in other studies, such as between-subject research designs. Further investigation of contingent SWB is an important objective of considerable relevance to natural resource policy. Designs for additional methodological research will be discussed.

Population Structure and Homing of John Day River Steelhead: Comparison of Genetic Analysis and PIT Tag Monitoring

Ian Tattam
ODFW
Ian.A.Tattam@state.or.us
Coauthors: Ewann Berntson, Deb Eddy, Jim Ruzycki
Oral Presentation

The John Day River in Northeast Oregon supports five putative populations of summer steelhead. Genetic sampling in 2011 found little evidence, however, to support the current five population designations. These results contrast with the tracking of individual John Day steelhead through their entire life cycle, which has found few steelhead detected in non-natal tributaries within the John Day River basin. We hypothesized that a substantial abundance of Snake River strays spawning in the John

Day River basin until the late-2000s obscured population structure. The abundance of strays declined dramatically following 2011, hence we re-sampled the same sites for genetic analysis in 2017 to define population structure with a reduced level of straying. We will compare and contrast the genetic population structure at two points in time with the evidence accumulating from individual tagging studies.

Does temporal variation in smolt estuary entry influence adult returns of Imnaha River Chinook Salmon and steelhead trout?

Lora Tennant
Nez Perce Tribe
lorat@nezperce.org
Coauthors: James Harbeck
Poster Presentation

The Nez Perce people have historically harvested fish throughout the Snake River basin and the mainstem Columbia River. The once abundant salmon runs were vital to supporting the Nez Perce way of life and served as a powerful cultural and social icon for the Nez Perce people. Due largely to hydroelectric power developments, habitat degradation, water quality impairments, over-harvesting, and poor ocean conditions the once robust salmon and steelhead trout runs have declined significantly. As a co-manager of salmon and steelhead trout, the Nez Perce Tribe has operated a rotary screw trap on the lower Imnaha River (~7 rkm from the Snake River confluence) from 1992 -present. Juvenile Chinook Salmon and steelhead trout are captured and PIT (passive integrated transponder) tagged at the Imnaha River rotary screw trap. Once released, the majority of fish continue emigrating down river and are detected when passing near operating PIT tag antennas, such as those installed at hydroelectric dams on the Snake and Columbia rivers and at the upper Columbia River estuary. Recent studies suggest that climate change might drive phenological mismatches between juvenile salmonids and their prey. We used generalized linear models to investigate how juvenile time of entry into the estuary, ocean conditions, and rearing type (i.e., hatchery or wild) relates to successful adult return to Lower Granite Dam. Preliminary results suggest that the proportion of adult steelhead trout returning to Lower Granite Dam is not related to ocean condition at the time of juvenile emigration, timing of estuary entry, or rearing type. However, the proportion of adult Chinook Salmon returning to Lower Granite Dam is related to ocean condition at the time of juvenile emigration, but not timing of estuary entry or rearing type.

The Most Incredible Poster about the ODFW Marine Resources Program Fish Aging Project You'll Ever Read

Mark Terwilliger
Oregon Department of Fish and Wildlife
mark.r.terwilliger@state.or.us
Coauthors: Leif Rasmuson
Poster Presentation

The Oregon Department of Fish and Wildlife's mission is to "protect and enhance Oregon's fish and wildlife and their habitats for use and enjoyment by present and future generations." The Marine Resources Program (MRP), a program unit within ODFW's Fish Division, focuses on marine resources, habitat, and fisheries. To that end, MRP's fish aging project conducts specialized age reading, data management, and analyses all which are used for age-structured stock assessments and other specialized studies of nearshore and shelf groundfishes off Oregon. This poster describes MRP's production aging project, including species of interest, its current age structure library, and past, current, and future research projects.

Effects of Ration Size on Growth Responses and Sexual Maturation in YY Brook Trout

Ronald Twibell
Abernathy Fish Technology Center
ronald_twibell@fws.gov
Coauthors: John Holmes, Nicole Hams, Doug Peterson
Oral Presentation

A population of invasive Brook Trout (Salvelinus fontinalis) resides in Tyee Springs, which is the water source for Carson National Fish Hatchery (CNFH) in southcentral Washington. There are concerns that these Brook Trout could enter CNFH and be stocked into streams along with spring Chinook salmon (Oncorhynchus tshawytscha) produced at the hatchery. As physical removal has failed to eliminate the Brook Trout population from Tyee Springs and use of piscicides is unfeasible due to proximity to the hatchery, alternative means of population control are needed. One possible method is to reduce long term viability of the population by stocking YY Brook Trout into Tyee Springs to mate with wild female Brook Trout. As YY Brook Trout possess two Y chromosomes (YY), rather than the normal X and Y chromosomes (XY), mating of stocked YY males with wild females (XX) would produce only male (XY) progeny. Thus, if such matings occur over successive generations, sex ratio of Tyee Springs Brook Trout would skew toward males and thereby reduce population viability.

As part of the effort to eradicate Brook Trout from Tyee Springs, Abernathy Fish Technology Center (AFTC) is rearing YY Brook Trout that were provided as eyed eggs by Idaho Department of Fish and Game. To examine the effects of ration size on hatchery growth and sexual maturation of a portion of the YY Brook Trout at AFTC we fed rations equaling 1.5, 2.5, 3.0 or 3.5% of body weight to quadruplicate groups of 300 fish reared in circular tanks. The effects of ration size on weight gain, gonadosomatic index, availability of milt and level of plasma 11-ketotestoerone will be discussed. Results of this study may inform decisions concerning size and number of YY Brook Trout that should be released into Tyee Springs as well as timing of those releases.

Chum on the Margins
Erick Van Dyke
Oregon Department of Fish and Wildlife
erick.s.vandyke@state.or.us
Oral Presentation

Species decline has long been linked with socioeconomic re-purposing of natural systems. Shifting nature's processes to serve authorized societal advances generally have been accompanied by reassurance that mitigation would be attainable. Yet, mitigation proposals often lack post hoc empirical evidence of their likelihood to protect ecological function. This talk will discuss mitigation action for lower Columbia River Chum salmon in the Ives Island complex - brought about by decades of re-purposing the Columbia River Ecoregion. Particular attention will be paid to the early motivations for change with concepts and purpose for chum mitigation. The discussion will assess realistic perspectives and lessons learned after decades of implementation.

Salmonberry River Steelhead: A unique subpopulation of the Nehalem River basin.
Jesus Vargas
Oregon Department of Fish and Wildlife
jvargas1603@gmail.com
Poster Presentation

The Salmonberry River, a large tributary of the Nehalem River watershed in Northwest Oregon, has a strong native winter steelhead run. However, hatchery influence has become an increasing concern for this historically wild dominated stream. We investigated this particular run of steelhead to determine if there is evidence it might be a separate subpopulation. The South Fork Salmonberry River is recognized as an anchor habitat for multiple species of salmonids, but little research has been done to evaluate whether the steelhead that return to this stream are unique from others in the same watershed. We analyzed redd densities and spawn timing of returning adults in the Nehalem watershed and compared those to that of the Salmonberry subbasin. Our results show that the winter steelhead that return to the Salmonberry River are unique and highlight the need for further research and conservation efforts within the subbasin.

Saltwater Marking Otoliths
Mike Wachter
Kodiak Regional Aquaculture Association
kitoi@gci.net
Oral Presentation

Kodiak Regional Aquaculture Association's (KRAA) Kitoi Bay Hatchery (KBH) is a large and diverse Pacific salmon production facility (215 million pink, 36 million chum, 2.3 million coho and 850,000 sockeye salmon eggs) located on Afognak Island, AK. Like many hatcheries in the Pacific Northwest, KBH marks

hatchery reared salmon by utilizing different otolith marking techniques. Thermal marking on chum salmon is done with stratified lake water during the summer, and dry marking is used on sockeye and coho salmon in the winter. Prior to 2017, pink salmon at KBH were not thermally marked because the infrastructure for heating water was not in place and the decreasing lake temperatures in October no longer allowed for marking with stratified lake water. Dry marking pink salmon otoliths was not possible due to incubator type and eyed egg loading densities. In 2017, trials were run to test the efficacy of saltwater as a way of marking otoliths. That year KBH marked 18 million pink salmon by alternating back and forth between freshwater and saltwater using combinations of 12 hour, 6 hour, and 4 hour intervals. The marks were a success and in 2018 more trials were to done to 31 million pink salmon using 8 hours of saltwater and 16 hours of freshwater intervals. In 2019 the entire inventory of 191 million pink salmon were marked with this saltwater technique. By using saltwater marking instead of thermal marking KRAA was able to reduce capital and long-term operational costs, as well as reduce its carbon footprint by avoiding the need to heat large volumes of water. KRAA's endeavor to mark all of its pink salmon will enable the creation of an evaluation program which will help the State better understand salmon migration and allow for the best practices in fisheries management. Otolith marking pink salmon also fulfills the requirements for Kodiak to maintain Marine Stewardship Council (MSC) and Alaska Responsible Fisheries Management (RFM) certifications.

Predicting the freshwater range of occurrence for chum salmon to guide restoration efforts in the Chehalis River basin, WA

Eric Walther
Washington Department of Fish and Wildlife
ejwalther@alaska.edu
Coauthors: Peter Westley, Mara Zimmerman
Oral Presentation

Understanding the factors influencing the distribution of species in time and space is a fundamental goal of ecology and a crucial component for effectively managing and recovering populations. The fragmentation of habitat restricts the ability of local populations to exploit heterogeneous patches of habitat that shift in suitability over time and space, and is an on-going threat to the persistence of freshwater fishes. A large-scale restoration effort of salmonid habitats in the heavily altered Chehalis River basin in southwest Washington requires science-based guidance to maximize restoration effectiveness. The current study will provide a robust model of freshwater distribution, allowing habitat gains from restoration actions to be more accurately represented in the planning process. Freshwater fish distribution can be described by identifying the upper limit of occurrence, whereas all habitat downstream is potentially exploited during different life history stages. The objectives of this study are to (i) document to upper limit of occurrence of adult Chum Salmon (Oncorhynchus keta), (ii) identify the relationship between landscape characteristics and the range of occurrence, and (iii) estimate the potential freshwater range of occurrence of adult Chum Salmon in the Chehalis River basin based on observed distributions rather than relying on professional opinion. To do so, we fit a GIS-based logistic regression model parameterized with available landscape and environmental spatial data along with fish occurrence data collected from terminal streams in three sub-basins in 2017 and 2018 (n=59). In this talk, I will discuss preliminary model results, which identify elevation and drainage area as important

covariates for predicting chum range of occurrence (PCC = 0.88±0.01; AUC = 0.95±0.01). Our model estimates 3,221.4 km of potential habitat in the absence of anthropogenic obstructions. These results will inform discussions on the prioritization of restoration efforts by providing a quantitative description of chum habitat suitability.

Response of fish and salamanders to experimental canopy gaps in the riparian forest

Dana Warren
Oregon State University
dana.warren@oregonstate.edu
Coauthors: Allison Swartz
Oral Presentation

The mid-succession riparian forests that currently dominate much of the western Oregon landscape tend to have uniform closed-canopies; and therefore, the streams that run through these forests often have very low light, limiting growth and abundance of benthic autotrophs. Given the high degree of shading over these streams, we hypothesized that patches of light created by riparian canopy gaps create local productivity hotspots that could enhance the growth and abundance of cutthroat trout at the larger reach scale. We created experimental gaps in five replicate study streams. We applied a Before-After Control-Impact (BACI) study design to determine gap influences on trout and salamanders in sections with gaps relative to closed-canopy reference reaches at each site. We quantified abundance and biomass of fish and salamanders in reference and treatment sites in summer 2016 or 2017 -before gap treatments were applied. In fall 2017/winter 2018, we cut riparian canopy gaps that were designed to resemble the canopy gaps that commonly occur along headwater streams in old-growth forests in western Oregon (between 20 and 60 linear meters of stream). In summer of 2018 and of 2019, we re-surveyed the sites to quantify responses. Preliminary analysis indicate a moderate increase in average adult fish and total vertebrate biomasses (g/m-2) in the gap reaches relative to the reference reaches. We also evaluated stream temperature responses to the gap treatments as it is a key regulatory metric and an important covariant to consider in any biological response. We found a small overall response (+0.21°C) in the mean of the 7-day moving average maximum temperature across the six streams.

Pink and chum salmon on the high seas: new insight from a winter expedition to the Gulf of Alaska

Laurie Weitkamp
NOAA Fisheries/NWFSC
laurie.weitkamp@noaa.gov
Oral Presentation

Pacific salmon spend the majority of their life in the ocean, but many details are poorly understood. For example, we only have a vague sense of where they go, what they eat, or how fast they grow during the 1-5 years that salmon typically spend in marine waters. We know the least about winter, when there may be so little to eat that fish risk starving to death.
To begin to understand this winter period, the International Gulf of Alaska Expedition spent a month in

late winter 2019 in the Gulf of Alaska studying salmon on board the Russian Research Vessel Professor Kaganovskiy. This expedition was a signature event for the International Year of the Salmon (yearofthesalmon.org/). Laurie was fortunate to serve as one of 21 scientists representing U.S., Canada, Russia, Japan, and South Korea on the expedition. This talk will describe the initial findings from the expedition (with many more to come once 1,000s of collected samples are analyzed), with an emphasis on the winter ecology of pink and chum salmon.

What factors make sites attractive to hatchery strays?

Peter Westley
University of Alaska Fairbanks
pwestley@alaska.edu
Oral Presentation

Notwithstanding the well-known ability for salmon to return with high fidelity to natal sites for reproduction, the straying of individuals to non-natal sites is a fundamental aspect of salmon ecology, evolution, and conservation. Although the rates of straying have been well described and are known to vary in response to a host of drivers, comparatively little is known about what makes a site attractive or unattractive to strays. In this talk, I explore factors that may underpin the observation that some sites appear to be more attractive than others to hatchery strays. To do so, I analyze mark and recapture data from 19 populations of hatchery-produced spring Chinook salmon (Oncorhynchus tshawytscha) across 17 years in the Columbia River Basin, USA, to estimate rates of emigration (donor stray rates) and immigration (recipient stray rates). Using published rates of straying we categorized 280 paired comparisons of donor and recipient straying into four categories: i) 'imprintably attractive' (characterized as low rates of donor and recipient straying), ii) 'inherently unattractive' (high rates of donor straying and low rates of recipient straying), iii) 'inherently attractive' (low rates of donor straying and high rates of recipient straying), or iv) 'ecological traps' (high rates of donor straying and high rates of recipient straying). Landscape and riverscape factors such as sub-basin size, distance to donor sources, migration distance, and water temperature were used in multinomial regression and model selection was used to identify models with greatest weight of evidence. Taken as a whole, results suggest a leading role of water temperature in site attractiveness. This finding is consistent with previous studies focused on donor rates of straying and suggests a role of climate warming in shaping source sink dynamics of freshwater systems.

A Day in the Life: In-season management of Columbia River non-treaty fisheries

Jeff Whisler
Oregon Department of Fish and Wildlife
geoffrey.s.whisler@state.or.us
Oral Presentation

An inside look at managing Columbia River fisheries in-season, using one day during the 2019 fall season as an example.

Complex management in a complex system: Columbia River fisheries regulation

Jeff Whisler
Oregon Department of Fish and Wildlife
geoffrey.s.whisler@state.or.us
Oral Presentation

The Columbia River is known for its regulatory, biological, and social complexity. The states and tribal sovereigns have authority to independently enact regulations for recreational, commercial, and ceremonial/subsistence fisheries. However, management of mixed-stock salmonid fisheries in the mainstem Columbia River requires multiple parties working collaboratively to ensure meaningful harvest opportunity while adhering to the tenets of established case law, legislation, and policy. Fishery management agreements enacted under the auspice of the U.S. vs Oregon court case, federal authorization of fisheries impacting populations afforded protection by the Endangered Species Act (ESA), and policies adopted by the fish and wildlife commissions of Oregon and Washington provide much of the framework for management of these fisheries. The Columbia River Compact, ratified by Congress in 1918, is the agreement between the states of Oregon and Washington to adopt or modify regulations pertaining to the management of fisheries in the Columbia River, where it forms their common boundary, only with the mutual consent of both states. Today, regulations are considered, negotiated, and agreed to via procedures that have developed out of practical application of this Compact.

Management of Columbia River salmonid fisheries entails an annual three-part process of pre-season planning, in-season monitoring of fishery performance and fish abundance, and post-season assessment. Input from the public is solicited and considered during the pre-season and in-season regulation-setting processes. Species-, stock-, or run-specific abundance forecasts are developed pre-season by a technical committee established by the U.S. vs Oregon Management Agreement or, in some instances, by state or tribal staff. Initial season structure is developed based harvestable surpluses, ESA limitations, allocation policies, and user-group priorities. Monitoring programs provide harvest and abundance information in-season. This allows fishery managers to make modifications to the regulations in response to up-to-date information. During critical periods, in-season assessments of fishery performance and salmonid abundance are often done weekly. Post-season estimates of harvest and abundance are used to assess fisheries performance and compliance with ESA-take limitations and harvest agreements and policies.

Food for thought (and salmon): Incorporating prey availability into habitat monitoring for Columbia River basin salmonids

Seth White
Columbia River Inter-Tribal Fish Commission
whis@critfc.org
Coauthors: Sean Sullivan, Casey Justice, Lauren Burns, Edwin Sedell, Benjamin Staton
Oral Presentation

Salmon habitat monitoring programs typically evaluate physical stream conditions such as geomorphology, substrate composition, riparian condition, wood recruitment, water temperature, and

streamflow. Biological conditions such as food webs and other ecosystem processes are often relegated to research studies, which tend to occur on shorter time frames and therefore are less able to track long-term trends over large spatial scales. Some programs additionally collect benthic macroinvertebrates (BMIs), but generally limit metrics to those representing water quality such as indices of biotic integrity. We describe the development of alternative BMI metrics tied more closely to the feeding ecology of juvenile salmon using data collected in the upper Grande Ronde River, Catherine Creek, and Minam River of NE Oregon from 2011-2017. We tested whether these new metrics or standard BMI indicators were more strongly correlated with climate conditions, intrinsic watershed factors, land use, and salmonid distribution. In all cases, standard BMI metrics were most strongly associated with these factors when only bivariate relationships were considered. We then evaluated whether reach-scale distribution of Chinook Salmon summer parr was associated with habitat quality, prey availability, and water temperature using a zero-inflated count model. For reaches within their historical range and where physical barriers did not prevent their occurrence, juvenile Chinook had an approximately 70% chance of having a non-zero expected abundance when pool frequencies were below threshold historical values for public lands (5 large pools per kilometer) which increased to 97% when pool frequencies exceeded this threshold value. After accounting for pool habitat, prey availability and water temperature explained a portion of juvenile Chinook abundance. Because of their relevance to fish and because they are readily calculated from existing data, we recommend food availability and food web integrity metrics-along with standard BMI indicators-be considered in routine habitat monitoring programs.

Making New Fish: Integrating Twelve Years of Coho Ecology Studies into Habitat Restoration on the Mid Klamath

Charles Wickman
Mid Klamath Watershed Council
charles@mkwc.org
Oral Presentation

Since 2009 the Mid Klamath Watershed Council has worked with the Karuk Tribe and other partners to design and construct Coho habitat restoration projects within the Middle Klamath Subbasin. Guided by twelve years of Coho ecology studies from the Karuk and Yurok tribes, we have collectively designed and constructed dozens of projects to address the somewhat unique needs of our mid Klamath fish. Focusing on the limiting factors of winter rearing habitat and thermal refuge, we have constructed, and learned from, 21 mainstem and tributary off-channel rearing habitat features, and this presentation will focus on the concepts, methods, results, and lessons learned along the way.

A phased sampling approach to monitor recolonization and inform management of anadromous fish in the Klamath River following dam removal

Thomas Williams
NMFS Southwest Fisheries Science Center
tommy.williams@noaa.gov
Oral Presentation

We are developing a conceptual framework for a phased sampling approach to monitor recolonization and inform management of anadromous fish in the Klamath River following the removal of four dams scheduled to occur in 2022. This science-based adaptive framework will allow for the development of goals that define project success and monitor project implementation and responses, serving as a guide to inform fisheries management and conservation efforts during and following dam removal. This adaptive management approach builds upon the monitoring programs developed for other dam removal projects and is based on monitoring several categories of performance indicators, each containing associated 'trigger' values which, when met, inform fisheries management and restoration activities through successive restoration phases. Performance indicators proposed in this framework are based upon Viable Salmon Population (VSP) metrics, including abundance, productivity, distribution, and diversity. Restoration of habitat (e.g., floodplains, reservoir areas, riparian communities) and ecological processes (e.g., benthic producers and consumers, nutrients and organic matter, and microbial communities and processes) are contingent on more than just time since dam removal, and therefore appropriate consideration needs to be given to sequencing expectations of fish response given the evolving habitat conditions and processes. The biologically-based phases focus on outcomes associated with rebuilding fish populations, but considers event-based sequencing of expectations given the uncertainty of flow, storm, drought events, for example.

Intertidal influences on winter stream temperatures and duration of incubation for Pink and Chum Salmon eggs in coastal Alaska

Steve Wondzell
USFS Pacific Northwest Research Station
steve.wondzell@usda.gov
Coauthors: Luca Adelfio, Nathan Mantua, Gordon Reeves
Oral Presentation

Projections of climate change impacts on Pink and Chum Salmon should consider changes in the thermal regimes of both freshwater streams as well as the near-shore ocean environment. Freshwater spawning habitat in the steep-walled fiords of Alaska's Prince William Sound (PWS) is limited because, within short distances from the ocean, streams become steep and the bed sediment becomes too coarse for spawning. Previous research has shown that, in some PWS streams, more than half of the Pink Salmon spawn in the intertidal zone, even when freshwater spawning habitat is accessible and uncrowded.

Water temperature monitoring in streams throughout PWS showed that temperatures in non-glacial, freshwater streams closely followed air temperatures, but in both the surface and subsurface of intertidal reaches, temperature periodically spiked during winter high tides -often rising from near 0 °C

to 4 °C. Surface ocean temperatures do not follow air temperatures because of deep mixing of ocean waters. Thus, PWS functions as a large thermal reservoir and maintains ocean surface temperatures close to 4 °C. When ocean water floods intertidal reaches, relatively warm ocean water intrudes into the streambed sediment, displacing colder freshwater. The height of a redd above the low tide line determines the duration of tidal inundation and the salinity, temperature, and dissolved oxygen concentration of water in the redd.

We modeled incubation of Pink and Chum Salmon eggs from daily temperature data, comparing intertidal reaches with adjacent freshwater reaches. We found periodic warming from ocean water intrusion increased the over-winter accumulation of thermal units leading to shorter incubation duration and earlier emergence. The tidal interactions between surface ocean water and freshwater create steep environmental gradients over a few 100's of meters of stream. Over the long-term, selection for freshwater versus intertidal spawning locations will lead to very different pressures from climate change.

Biological Response Following Habitat and Flow Restoration in a Previously Dewatered Reach

Garth Wyatt
PGE
Garth.Wyatt@pgn.com
Coauthors: Nick Ackerman, Margaret David, Dan Cramer, Tim Shibahara
Oral Presentation

Portland General Electric (PGE) operates the Oak Grove powerhouse in the Clackamas River Basin. The powerhouse is supplied from an inter-basin water transfer from the Oak Grove Fork to the Clackamas River resulting in an altered hydrograph for a 7.2-km reach and the extirpation of spring Chinook since 1924. During the relicensing process it was identified that the Oak Grove hydroelectric complex caused a suite of dam-induced geomorphic and biological changes. In response PGE implemented a fish habitat enhancement plan and minimum flow requirements starting in 2012. The goal was to improve geomorphic processes and increase habitat for ESA listed coho, spring Chinook, and winter steelhead. The plan identified six sites for large wood habitat structures, measures to provide 35,000 square feet of side-channel habitat, a minimum flow release schedule, and a gravel augmentation program. To document the physical and biological response to flow and habitat restoration a monitoring plan was developed. Preliminary results are the basis of the presentation and suggest:

1.Rapid and dispersive spring Chinook recolonization; 2.Expression of multiple life-histories of spring Chinook outmigrants in a single generation; 3.Increased upstream distribution of juvenile coho; 4.Differential growth across flow regimes and species; 5.Observed gravel transport; and 6.Side-channel persistence

Biodiversity of Cottus in western North America: a molecular perspective on the sculpins of the intermountain West

Michael Young
Rocky Mountain Research Station
michael.k.young@usda.gov
Coauthors: Rebecca Smith, Kristy Pilgrim, Daniel Isaak, Michael Schwartz,
Oral Presentation

The taxonomy of sculpins (Cottus, Cottidae) remains one of the last major unresolved puzzles in the systematics of North American freshwater fishes. Therefore, we began an effort to clarify the evolutionary history and taxonomy of sculpins from across western North America using molecular tools. First, we crowd-sourced collection of specimens (n = 8,191 and counting) via outreach to biologists in the western U.S. and Canada, and compiled the results of those collections on a webpage (https://www.fs.fed.us/rm/boise/AWAE/projects/fish_tissue_collection.html). Second, we sequenced two mitochondrial and two nuclear genes of specimens from most basins in the West, and applied standard phylogenetic techniques to assess patterns of diversity. Those analyses revealed five discrete species complexes of sculpins, each composed of an array of lineages of which only some were accorded taxonomic recognition despite relatively deep phylogenetic divergence among most or all groups. In the intermountain West, lineages of Paiute (C. beldingii), shorthead (C. confusus), and Columbia (C. hubbsi) sculpin exhibited discordant phylogeographic patterns, indicating profound differences in life histories, divergence times, or generation times, although each group concealed extensive cryptic diversity indicative of the need for comprehensive taxonomic revision of these fishes. Next-generation sequencing is underway to support that effort.

Art and Science: A Graduate Student's Story

Lauren Zatkos
Oregon State University
lauren.zatkos@oregonstate.edu
Oral Presentation

This presentation will focus on drawings of fish and macroinvertebrates and address the combination of science and art from a graduate student's perspective. While completing a Master's program is very time-intensive, it is important for students to carve out moments for creativity, fun, and decompression. Advantages and disadvantages of illustrating your study subjects will be covered. I'll discuss my most important sources of inspiration and drive, including work at the H.J. Andrews Experimental Forest and time spent outdoors with friends and fellow graduate students. Suggestions for how to incorporate art into a busy life will be made and vital sources of encouragement for a student artist will be discussed.

Music To My Career

Jeff Ziller
Oregon Dept of Fish and Wildlife
jeffrey.s.ziller@state.or.us

Oral Presentation

Growing up as a performing artist (garage band member) can provide great training for some aspects of fish management, especially pertaining to event preparation and learning to be comfortable in front of audiences. In addition, music has been an important social thread woven through my 40+ years of work with ODFW and association with the Oregon Chapter AFS. Although my professional music career was cut short when I entered college, I was not able to shake the compulsion to perform at various gatherings with friends especially around the campfire. The level of play was quite low given a small allotment of practice time, a hectic work schedule and an active personal schedule. As time moved on, I realized that playing music felt like an antidote to being wedded to working as a fish manager. It was liberating. Subsequently, the repertoire of songs became larger, the campfire concerts lasted deeper into the night and my association of music, fish and rivers became stronger. Today it is difficult to float a river or attend an AFS event without bringing along a guitar and a songbook.