

2019 ANNUAL MEETING

NOVEMBER 6 – 8, 2019

AGATE BEACH INN
NEWPORT, OREGON



PACIFIC NORTHWEST CHAPTER



Society *for* Freshwater Science

PROGRAM AGENDA



Fellow Ecologists and Water Resource Professionals:

This program agenda includes information about our keynote speakers, sponsors, and contributed presentations to our 2019 Annual Meeting of the Pacific Northwest (PNW) Chapter of the Society for Freshwater Science. The PNW Chapter began as the Northwest Biological Assessment Workgroup, a collaborative effort between State, Federal, Tribal agency, and academic bioassessment professionals in 1990. Our meeting this year is the 29th annual gathering of regional scientists to advance the understanding and practice of freshwater science in the Pacific Northwest. Thanks to each of you for your continued support and contribution to our Chapter!

As mentioned in an e-mail distribution earlier this year, we initiated a small registration fee for our annual meeting to address growing venue costs and advance student participation. Please click ([Register for 2019 Meeting](#)) to register if you have not already done so. The registration service we selected was the most cost-effective for a group of our size and will allow us to better serve the needs of our membership. Feedback on this change has been positive but we look forward to other feedback you can provide. Another change you may have noticed is our increased activity on Facebook ([PNW SFS Facebook](#)) thanks to our Social Media Advisor, **Hannah Harris**.

For this year's meeting, a block of rooms has been reserved at the Agate Beach Inn overlooking the ocean. Interested parties may book rooms online ([Group Z34ZL9C9](#)) or contact the front desk agents at (541) 265-9411. Rooms are available on a first come, first serve basis for a group rate through November 10th. Due to positive feedback we have received from our membership, we will continue rotating our annual meeting between Idaho, Oregon, and Washington. Our 2020 meeting will be held in Washington. Please come to this year's meeting with ideas for a 2020 location.

The opening session begins on Wednesday November 6th at 1:00 pm with two keynote speakers, **Dr. Judith Li** and **Dr. Amy Rosemond**. Dr. Li is highly recognized for her work in riparian processes and has received many research, service, conservation, and education awards. We are fortunate to have Dr. Rosemond, the Society for Freshwater Science president, joining us remotely from Georgia to share national updates and parent society perspectives with us. Thank you to **Rob Plotnikoff, long time chapter member**, for working closely with Dr. Rosemond and venue staff to bring remote presentation technology to our meeting.

We confident that our 2019 Annual Meeting will be an exciting and informative event that all will enjoy. We look forward to seeing you!

Sincerely,

Your 2019 Meeting Steering Committee At-Large
(Bob, Chris, Rob, Dorene, Hannah, and Francine)





About the Society for Freshwater Science
[Please Visit SFS Website](#)

The Society for Freshwater Science (SFS) is an international scientific organization whose purpose is to promote further understanding of freshwater ecosystems (rivers, streams, lakes, reservoirs, and estuaries) and ecosystems at the interface between aquatic and terrestrial habitats (wetlands, bogs, fens, riparian forests, and grasslands). The Society was founded as the Midwest Benthological Society by 13 charter members at Havana, Illinois, in the spring of 1953. The first annual meetings attracted the Midwest's best benthic scientists, which led to rapid increases in membership and a diversification within the society. Later renamed the North American Benthological Society (NABS), and most recently the Society for Freshwater Science, the society has expanded from our early and ongoing specialization in stream insect ecology to include a range of disciplinary interests from genes to landscapes. SFS has also expanded from its core focus on lotic freshwater ecosystems to benthic habitats in wetlands, estuaries, and oceans, and to the riparian and shorelands.

About the Pacific Northwest Chapter
[Please Visit PNW SFS Website](#)

The purpose of the Pacific Northwest Chapter (Chapter) is to promote better understanding of the biotic communities in freshwater aquatic ecosystems of the Pacific Northwest. The Chapter encourages and facilitates the use of benthic macroinvertebrates and fish assemblages and other biota in the assessment of the condition of freshwater aquatic resources and other environmental and natural resource management decision-making. The Chapter is a transition from the Northwest Biological Assessment Workgroup which was a collaborative effort between State, Federal, Tribal agency, and academic groups founded in 1990. Membership is open to anyone who is interested in freshwater biotic communities and their role in aquatic ecosystems in the Pacific Northwest (generally, but not limited to: British Columbia, Idaho, Western Montana, Oregon, Washington, and Northern California).





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Gary has been a long-term sponsor for our Chapter. Thank you to EcoAnalysts for their support and belief in our organization.

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Welcome our Keynote Speakers



Dr. Judith Li

As a retired Associate Professor in the Department of Fisheries and Wildlife at Oregon State University, Judy Li's research continues in western Oregon exploring forested ecosystems with interest in riparian food webs. Her previous studies included work with her graduate students in streams of eastern Oregon, the Willamette Valley, and the Coast Range. She has been an active member of SFS since 1985, serving on numerous committees, including the Executive Committee for many years, and is presently an emeritus member.

To encourage the understanding of science by lay audiences Judy edited a volume on cultural ecology entitled *To Harvest, To Hunt*, and co-edited a collection of stories by aquatic entomologists, *Wading for Bugs*. Teaching has always been an important part of her life, for years at the university and more recently with elementary children. For mid-elementary kids she has written the "Ellie and Ricky series" illustrated by M. L. Herring and published by the OSU Press. These stories, based on her experiences as an ecologist studying streams and invertebrates, follow two 11-year-olds learning to be scientists in natural settings (the Cascades, central Oregon, the coast) and the urban environment of Portland. "Ellie's Log" received a special honorable mention from the John Burroughs Association, "Ricky's Atlas" was the winner of the AAAS Excellence in Science award for Hands-On Science, and "Ellie's Strand" received the Runner-up Award for Green Earth Children's Fiction from Nature Generation.

Dr. Amy Rosemond

President, Society for Freshwater Science

Amy is Professor of Ecology in the Odum School of Ecology at UGA, a Fellow of the Ecological Society of America, recipient of UGA's Creative Research Medal in Science and Engineering in 2018, and President of the Society for Freshwater Science. She teaches Freshwater and Ecosystems courses at the University of Georgia, has served as major advisor to over 20 graduate students, and has graduated 7 doctoral students and 6 master's students. She, her collaborators, and students have over 80 peer-reviewed publications on a broad range of topics from stream urbanization to carbon cycling with funding made possible by the National Science Foundation, US EPA, US Department of Defense, Georgia Water Resource Institute, and other agencies.



Amy's research interests are rooted in benthology. She earned BS and MA degrees from the University of North Carolina at Chapel Hill with Dr. Seth Reice, and worked with Dr. Dave Penrose, and Dr. Dave Lenat of NC DNR. Her dissertation work was influenced by researchers in food web ecology, phycology, and watershed ecology, working at Vanderbilt University and Oak Ridge National Laboratory (ORNL). Work at ORNL with Dr. Pat Mulholland developed her perspectives on the integrative nature of watersheds and ecosystem ecology. The strong aquatic ecosystem science group attracted her to the University of Georgia. Her research program has been motivated by society's need for healthy, resilient freshwater ecosystems and the goods and services they provide. Current studies are focused on how elevated temperature and nutrient pollution affect carbon processing and stream organisms. The most important thing to her is that young people from all walks of life feel empowered, motivated, and supported to be working in the field of aquatic science.





PROGRAM AGENDA

WEDNESDAY NOVEMBER 6TH

- 1:00 - 1:15 **Welcome, Logistics, and Introductions etc.**
Bob Danehy - Catchment Aquatic Ecology
- 1:15 - 1:45 **Keynote**
Getting It Right; Interpreting and Delivering Messages That Matter
Judith Li, Associate Professor, Retired - Oregon State University
- 1:45 - 2:15 **Keynote**
National Trends and Updates
Amy Rosemond, SFS President - University of Georgia
- 2:15 - 2:35 **Selective Water Withdrawal from Dams May Restructure
Downstream Macroinvertebrate Communities**
Christina A. Murphy, Sherri L. Johnson, Gregory Taylor, Todd Pierce, William Gerth – Oregon State University
- 2:35 - 2:55 **Valuing Water: Learning from the Past to Add Resilience to Our
Future**
Kami Ellingson - Siuslaw National Forest

Special Session

Ecosystem Responses to Riparian Forest Management along Small Streams

Moderator: Dede Olson - US Forest Service (moderator)

- 2:55 - 3:00 Session Introduction (Dede Olson)
- 3:00 - 3:20 *Food Web Responses to Riparian Thinning in Redwood Headwater Streams*
David Roon - Oregon State University
Jason Dunham, USGS, FRESC, Corvallis, OR
- 3:20 - 3:40 *Response of Stream-Associated Amphibians to Timber Harvest with Alternative
Riparian Buffer Configurations*
Marc P. Hayes, Aimee McIntyre, Reed A. Ojala-Barbour, and Timothy Quinn
Washington Department of Fish and Wildlife
Jay E. Jones and Andrew Kroll - Weyerhaeuser
- 3:40 - 4:00 {Networking Break, Refreshments Provided}





- 4:00 – 4:20 *Density Management and Riparian Buffer Study of Western Oregon: Lessons Learned after 25 years, 1994-2019*
Deanna H. Olson - US Forest Service
- 4:20 – 4:40 *Modifying Canopy Shading in the Riparian Zone during Timber Harvest: Results from Salmonid (*Oncorhynchus* spp.) and Coastal Giant Salamander (*Dicamptodon tenebrosus*) monitoring in Northwestern California*
Matt Kluber and Matthew House - Green Diamond Resource Company
- 4:40 – 5:00 *Responses of Aquatic Vertebrates and Stream Temperature to Experimental Riparian Forest Canopy Gaps*
Allison Swartz and Dana Warren - Oregon State University
- 5:00 – 5:20 *Did Distributions of Summer Stream Temperature Shift Following Forest Harvest in the Trask River Watershed?*
Sherri Johnson - US Forest Service
Maryanne Reiter, Jessica Homyack, and Jay Jones – Weyerhaeuser
- 5:20 – 5:30 Closing Comments and Session Wrap-Up

THURSDAY NOVEMBER 7TH

- 8:30 – 8:50 **Diatom Community Composition Supports the Dissolved Oxygen (Delta DO) Threshold for Impairment Classification in Plains Streams, Montana, USA.**
Sean P. Sullivan - Rhithron Associates, Inc.
Mike W. Suplee and Rosie Sada - Montana Department of Environmental Quality
- 8:50 – 9:10 **Testing a New Method for Early Detection of Harmful Algal Blooms in Oregon Lakes and Reservoirs**
Daniel J. Sobota - Oregon Department of Environmental Quality
Victoria Avalos - Portland State University
Steve Hanson, Brian Fulfroost, Smita Mehta, Sam Doak – Oregon Department of Environmental Quality
Lara Jansen - Portland State University





- 9:10 - 9:30 **Downstream Dynamics of Reservoir-Born Cyanobacterial Blooms in the Klamath River, CA**
Laurel Genzoli - University of Montana
Jacob Kann - Aquatic Ecosystem Sciences
Susan Fricke - Karuk Department of Natural Resources
Matt Hanington - Yurok Tribe Environmental Program
Crystal Robinson - Quartz Valley Indian Reservation Environmental Program
- 9:30 – 9:50 **Chironomidae of the Pacific Northwest: Taxonomic Needs and New Records**
Barbara Hayford – Rhithron Associates, Inc. and University of Montana
Rebecca Spring and Andrew Fasbender – Rhithron Associates, Inc.
- 9:50 – 10:10 {Networking Break, Refreshments Provided}
- 10:10 – 10:30 **Update to the Standard Taxonomic Effort and Links to the Biological Condition Gradient Model**
Robert Wisseman - Aquatic Biology Associates, Inc.
- 10:30 - 10:50 **Freshwater Mussels in the Pacific Northwest: A Review of the State of Knowledge and Future Research and Conservation Opportunities**
Emilie Blevins - The Xerces Society for Invertebrate Conservation
- 10:50 - 11:10 **The Search for Freshwater Mussels in the Lower Boise River, Boise, Idaho**
Dorene MacCoy - City of Boise, Idaho
Matt Laramie – US Geological Survey
- 11:10 – 1:00 {Extended Networking Lunch}
- 1:00 - 1:20 **Relative Controls on Stream Temperature from Shade, Land Use, and Water Management in Basins of the Pacific Northwest, USA**
Matthew Fuller - U.S. Environmental Protection Agency, ORISE Fellow

Special Session

Temperature Metric Development for Landscape Bioassessment Applications

Anne Timm - US Forest Service (moderator)

- 1:20 – 1:25 Session Introduction (Anne Timm)





- 1:25 – 1:45 *Water Temperature Bioassessment Tools - What is Available Now and What We Will Need in the Future*
Anne Timm – US Forest Service
- 1:45 – 2:05 *Thermal Responses to Riparian Thinning in Redwood Headwater Streams at Multiple Spatial Scales*
David Roon - Oregon State University
- 2:05 – 2:25 *Spatial Analysis of Thermal Sensitivity in Western US Mountain Streams*
Junjie Chen - Portland State University
- 2:25 – 2:45 *Challenges and Opportunities for Linking Riverscape Thermal Regimes to Fish Populations*
Joe Ebersole - U.S. Environmental Protection Agency
- 2:45 – 3:05 *Linking Temperature and Discharge to Expressed Behavior of Fishes; Implications for Climate Change*
Rebecca Flitcroft, Brooke Penaluna, Ivan Arismendi, Mary Santelmann, Sarah Lewis, Muhammad Safeeq, and Jeffrey Snyder - US Forest Service and Oregon State University
- 3:05 – 3:35 *Modeling and Mapping Freshwater Thermal Regimes in Oregon*
Kara Anlauf-Dunn – Oregon State University
- 3:35 – 3:45 Closing Comments and Session Wrap-Up
- 3:45 – 4:00 {Networking Break, Refreshments Provided}
- 4:00 – 4:20 **Evaluating the Impacts of Climate Change on the Future Distribution of Stream Macroinvertebrates, Fish and Amphibians in Washington using Species Distribution Models**
Jennifer Elliot – Washington Department of Ecology Research Scientist
Chad Larson, Glenn Merritt, and Stacy Polkowske – Washington Department of Ecology
- 4:20 – 4:40 **Aquatic Community Assembly in Early Successional Streams at Mount St. Helens**
Shannon Claeson - US Forest Service
- 4:40 – 5:15 **Agency Highlights and Updates**
Round Robin





5:15 – 6:00 {Poster Viewing, Networking Social}

Wet Pond, Dry Pond: Temporal shifts in invertebrate community structure across seasonal ponds in the Willamette Valley

Christi Kruse, Dave Lytle, Hannah Beverage, and Megan Griffiths – Oregon State University

Looking into the Life History and Ecology of the Mysterious Coleoptera Halipilidae Apteraliplus Parvulus

Megan Griffiths – Oregon State University

FRIDAY NOVEMBER 8TH

8:30 – 8:50 **Linking Variables Across Different Scales in River Macrosystems Research: A Graph-Based Theoretical Approach**

Barbara Hayford - Rhithron Associates, Inc.

Sally Clark - University of Alabama

Marcella Jurotich - Carleton College

Jon Gelhaus - Drexel University

8:50 – 9:10 **Developing a Spatial Modeling Approach to Estimate Invertebrate O/E in Streams and Lakes in the Conterminous US**

Jessie Doyle, Ryan Hill, Scott Leibowitz, and Paul Ringold - US Environmental Protection Agency

9:10 – 9:30 **Management of Chinook salmon (*Oncorhynchus tshawytscha*) stocks in Washington State using the Fishery Regulation Assessment Model (FRAM)**

Oliver Miler - Northwest Indian Fisheries Commission

9:30 – 9:50 **NARS: In Case You Ever Wondered How We Got Here**

Dave Peck - US Environmental Protection Agency

9:50 – 10:10 **Characterizing Methylmercury Bioaccumulation in Larval Dragonflies**

Cailin Mackenzie, Tiffany Garcia, and Collin Eagles-Smith - Oregon State University

10:10 – 10:30 {Networking Break, Refreshments Provided}

10:30 – 10:45 **Social Media Updates**





10:45 – 11:15 **Feedback and Suggestions for Next Year**

11:15 – 12:00 **PNW SFS Chapter Business**

Submitted Abstracts

WEDNESDAY NOVEMBER 6TH

2:15 – 2:35 **Selective Water Withdrawal from Dams May Restructure
Downstream Macroinvertebrate Communities**

Christina A. Murphy, Sherri L. Johnson, Gregory Taylor, Todd Pierce, William Gerth – Oregon State University

Regulated rivers downstream of dams often experience highly modified thermal regimes, in addition to modified hydrologic regimes. River temperatures are out of sync with unimpacted streams and can be seasonally much warmer or cooler. Temperatures are critically important to the growth and survival of downstream organisms and can structure the timing of critical life history events. At Cougar Dam on the McKenzie River in Oregon, such outflows following reservoir construction resulted in downstream waters which were colder during the summer and warmer during the fall. To minimize temperature related dam impacts a selective water withdrawal ‘temperature control tower’ (92 meter wet well) was constructed and began operations during May 2005.

We examined benthic macroinvertebrate responses before and after the implementation of this selective water withdrawal, expecting to see shifts in the benthic macroinvertebrate community over time to more closely resemble upstream, undammed reaches. In contrast, we found that the benthic macroinvertebrate community became more dissimilar in species composition and traits after selective water withdrawal compared to thermally similar flow-through conditions. These changes included an increase in non-insect taxa and taxa known to feed on plankton. The most likely explanation for this transition is that the selective water withdrawal is resulting in increased export of zooplankton subsidies to downstream reaches during the spring and summer, when the reservoir is stratified and zooplankton are abundant in the epilimnion. Our findings highlight the interconnected nature of water quality parameters in dammed systems and the need to consider water source when anticipating management outcomes from actions such as thermal restoration via selective water withdrawal.

2:35 – 2:55 **Valuing Water: Learning from the Past to Add Resilience to Our Future**
Kami Ellingson - Siuslaw National Forest

Degradation of low gradient streams, rivers and wetlands occurred incrementally over centuries. To understand, it is necessary to revisit the foundational history of the science of Hydrology, based primarily on field assessment and study post 1950's. Comparison of pre 1950 versus post 1950 stream conditions would provide a different basis of our understanding of “reference” conditions (Suzanne Fouty, 2016). This is 50 years after beavers were removed from the landscape across Europe and the United States. Pre-1950 there were millions of beavers across the United States.





Trapping counts confirm that millions of beavers were killed. Beavers in England were trapped to extinction and when the United States was settled, beavers were the currency that gave rise to the United States (Goldfarb, 2019). Based on reports from early explorers, complex wetlands were everywhere, making navigation difficult.

Beavers construct sequences of dams in a stream system that result in large wetland complexes. Fifty years without consistent beaver activity to maintain dams would result in the unraveling of wide spread beaver dams and subsequent wetlands. This alteration would have occurred with relative speed. When beaver dams fail, the large wetland complexes are drained, water levels drop carrying large amounts of sediments that would have otherwise been captured and accumulated behind beaver dams year after year. When dams fail, stream velocities increase, resulting in more erosion. This vicious cycle of stream channel incision, more scouring, deepening of the stream itself, disconnects the stream from its floodplain and lowers the water table. This results in a self-perpetuating flood and drought cycle exacerbating each condition year after year.

3:00 – 3:20 Food Web Responses to Riparian Thinning in Redwood Headwater Streams

David Roon - Oregon State University

Jason Dunham, USGS, FRESC, Corvallis, OR

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 and now there is an 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 the stream 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 composition and structure of prey resources are shifting; and 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.

3:20 – 3:40 Response of Stream-Associated Amphibians to Timber Harvest with Alternative Riparian Buffer Configurations

Marc P. Hayes, Aimee McIntyre, Reed A. Ojala-Barbour, and Timothy Quinn

Washington Department of Fish and Wildlife

Jay E. Jones and Andrew Kroll – Weyerhaeuser





Headwater streams comprise the majority of stream miles in forests of the Pacific Northwest, providing important habitat for many stream-associated amphibians. A large proportion of those headwater streams are owned and managed by private timber companies, who retain riparian buffers during clearcut harvest to protect amphibians and other important ecosystem functions. We monitored stream-breeding amphibian density in a replicated Before-After Control-Impact (BACI) experiment with alternative riparian buffer configurations (continuous buffer, patchy buffer distribution, and clearcut throughout the riparian area) and unharvested reference basins.

We estimated amphibian density using count data adjusted for variation in detection and estimated the relative change in density for each buffer configuration between pre- and post-harvest periods after controlling for temporal changes in the reference. Eight years post-harvest, we observed a consistent and substantial decline in larval coastal tailed frog (*Ascaphus truei*) density in all buffer configurations, regardless of the amount or arrangement of leave trees remaining in the riparian area. The greatest change in mean tailed frog density was -93% (95% credible interval (CI): 98%, 73%) in basins with a patchy distribution of buffers. However, we saw no discernable difference in the change in mean larval density among buffer configurations. In basins with continuous and patchy distribution of buffers, we observed a -71% (CI: -82%, -52%) and -97% (CI: 99%, 86%) change in post-metamorphic tailed frog densities, respectively. We observed a -64% (CI: -86%, -10%) change in torrent salamander (*Rhyacotriton* spp.) density in basins with a patchy buffer distribution. Finally, we did not observe a difference in the change in giant salamander (*Dicamptodon* spp.) density among basins. Continued monitoring is needed to validate whether our findings reflect longer-term trends.

4:00 – 4:20 **Density Management and Riparian Buffer Study of Western Oregon:
Lessons Learned after 25 years, 1994-2019**
Deanna H. Olson - US Forest Service

The Density Management and Riparian Buffer Study of western Oregon was initiated in 1994 to examine upland thinning treatments to accelerate development of late-successional forest conditions, and alternative riparian buffer widths to address headwater species and habitat values. Ten years after the initial thinning treatments, canopies were closing and a second thinning was conducted. Field surveys in 2020-2021 will mark ten years after the second thinning. Lessons learned over 25 years of study implementation include the value of long-term partnerships, how logistics of large-scale experimental study implementation matter, and continuation of key research findings. This study has relied on long-term collaborations of US Bureau of Land Management, US Forest Service Pacific Northwest Research Station (PNW), and Oregon State University (OSU) personnel. Logistically for the riparian buffer study component, we started with >100 stream reaches across 13 study sites and we continue to monitor 59 reaches at 8 sites.

Implementation and site condition variances led to reduction of sites and reaches in our sample. Our complex design permitted numerous on-site resource values to be addressed during implementation, and numerous case studies to be conducted. Research findings of three main component studies continue to emerge: 1) vegetation response, led by Dr. Klaus Puettmann, OSU; 2) microclimates and microhabitats of riparian and adjacent upland areas, led by Dr. Paul Anderson, PNW; and 3) aquatic habitats and vertebrate diversity, which I have led.





Recent findings show the value of the one-site potential tree height riparian buffer treatment (~70 m) for stream fauna five years after two harvests, and that past headwater streamflow patterns were tied to climate metrics and basin area but not buffer treatments, with future streamflow losses projected to potentially affect hundreds to thousands of km of stream length.

4:20 – 4:40 **Modifying Canopy Shading in the Riparian Zone during Timber Harvest: Results from Salmonid (*Oncorhynchus* spp.) and Coastal Giant Salamander (*Dicamptodon tenebrosus*) monitoring in Northwestern California**
Matt Kluber and Matthew House - Green Diamond Resource Company

Timber management approaches establishing continuous dense mature riparian buffers along watercourses with the intent of providing cold water temperatures, high levels of large wood, and sediment filtration may overlook the importance of overall productivity in aquatic ecosystems. Here we provide our findings from a pilot project in northwestern California evaluating the response of local instream productivity to riparian canopy thinning using a mark-recapture study of salmonids and aquatic larval salamanders. Growth and movement of anadromous salmonids (*Oncorhynchus* spp.) and larval Coastal Giant Salamanders (*Dicamptodon tenebrosus*) were monitored bi-monthly within a 600 m reach of continuous stream habitat starting August 2014 and concluding in February 2018. Mark-recapture sampling was conducted utilizing PIT tags and visible implant elastomer to examine the effects of the changes in the riparian structure on salmonid and salamander growth and movement.

Overall, an average of 429 *Oncorhynchus* spp. and 293 larval *D. tenebrosus* were captured per survey; however, 40% of marked fish and only 15% of marked salamanders were recaptured at least once. Throughout the study, the majority of recaptured animals demonstrated high fidelity to within site location, although downstream movements within the study area as great as 495 m for salmonids and 554 meters for salamanders were documented. Examination of the effects of the riparian treatment on growth and movement showed equivalent or higher growth rates in the treatment reach for both salmonids and larval salamanders. Further results on growth and movement will be presented surrounding this study as well in the context of general *Oncorhynchus* spp. and *D. tenebrosus* ecology.

4:40 – 5:00 **Responses of Aquatic Vertebrates and Stream Temperature to Experimental Riparian Forest Canopy Gaps**
Allison Swartz and Dana Warren - Oregon State University

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 placed thermistors throughout each reach to monitor stream temperature and found a small overall average response ($+0.210\text{C}$) in the maximum of the 7-day moving average maximum temperature across the six streams.

5:00 – 5:20 **Did Distributions of Summer Stream Temperature Shift Following Forest Harvest in the Trask River Watershed?**

Sherri Johnson - US Forest Service

Maryanne Reiter, Jessica Homyack, and Jay Jones – Weyerhaeuser

Stream temperatures are influenced by numerous processes; changes in incoming radiation have been shown to be a major driver of increased stream temperatures. Maximum daily temperature is a commonly used metric for evaluating stream temperature responses to changes in land use. However, single metrics are not able to fully represent the magnitude and duration of temperatures experienced by instream biota. Analyses that make use of all the data more accurately characterize shifts in summer stream temperature regimes, quantify potential exposure to critical and non-critical temperatures, and help researchers and managers to better understand stream temperature responses to manipulation of streamside and watershed vegetation.

Here we examine the distributions of summer stream temperatures before and after forest harvest in the Trask River Watershed Study, in northwestern Oregon. We studied 15 small streams for 10 years; half of the sites had their catchments clearcut harvested in 2012. Four sites had no buffers, with some leave trees, and three sites had 12 m buffers on both sides. Even though these streams are generally cold, we observed high spatial and temporal variation among sites and years, with some sites having normally distributed temperatures, while others showed skewed distributions and long tails. Forest cover, aspect or elevation were not good predictors of temperature distributions pre-harvest. After harvest, sites without buffers showed the greatest shift in distributions of temperatures and widest temperature ranges, while sites with narrow buffers showed little change. We examined the implications of shifts in temperature distributions before and after harvest against the known thermal tolerances for the dominant resident species (*Ascaphus truei*; tailed frog tadpoles) in these headwater streams. With these analyses, we are quantifying chronic exposure, which could subsequently result in shifts in phenology or community structure.





THURSDAY NOVEMBER 7TH

8:30 – 8:50 **Diatom Community Composition Supports the Dissolved Oxygen (Delta DO) Threshold for Impairment Classification in Plains Streams, Montana, USA.**

Sean P. Sullivan - Rhithron Associates, Inc.

Mike W. Suplee and Rosie Sada - Montana Department of Environmental Quality

Nutrient levels in streams and rivers can indirectly alter the dissolved oxygen concentrations and have negative impacts on the native aquatic communities. Primary producers, such as diatoms and other algae, are typically the first affected by eutrophication and have historically been used as bioindicators of water quality. Montana has a long history of using multiple lines of evidence to determine impairments and potential causes of impairment in State waters. In 2016 Montana adopted a dissolved oxygen threshold (Delta DO (5.3mg/L)) for use support determination and nutrient impairment in prairie streams. Here we use diatom community data as part of the State's efforts to assess dissolved oxygen impacts on aquatic communities in order to add an additional data source helping to validate the state's threshold of 5.3mg/L Delta DO. We performed a Threshold Indicator Taxa Analysis (TITAN) using the observed Delta DO gradient and diatom community (n=204) to determine if the diatom community showed a similar threshold of change for the parameter Delta DO. In addition to supporting the existing threshold, we modeled the decreaser taxa from the TITAN analysis to develop a novel community metric and suggest a biological threshold that corresponds to the chemically derived Delta DO threshold currently in place.

8:50 – 9:10 **Testing a New Method for Early Detection of Harmful Algal Blooms in Oregon Lakes and Reservoirs**

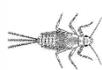
Daniel J. Sobota - Oregon Department of Environmental Quality

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Steve Hanson, Brian Fulfroost, Smita Mehta, Sam Doak – Oregon Department of Environmental Quality

Lara Jansen - Portland State University

Increasing public concern has prompted increased research on how to improve detection, management, and reduction of harmful algal blooms in Oregon lakes and reservoirs. A promising approach is early warning signal detection, which may help mitigate effects of blooms and provide insight on factors responsible for triggering blooms. Here we adapt a statistical approach that uses a moving window of autocorrelation and standard deviation of time series data to provide early warning signals for the onset of harmful algal blooms in lakes and apply the method to Odell Lake in central Oregon. Time series data used for the analysis included in situ monitoring water quality data (dissolved oxygen, chlorophyll a, and phycocyanin concentrations) and cyanobacteria cell counts derived from satellite imagery from June through September 2019. Odell Lake is ideal to test this method because the lake frequently experiences at least one harmful algal bloom during summer months. As a control, we also collected water quality and satellite data from Crescent Lake, which is near Odell Lake but does not experience harmful algal blooms. Odell Lake experienced a harmful algal bloom for a two-week period in late July/early August 2019. Both in situ sensors and satellite imagery captured early warning signals two weeks before the onset of the bloom in Odell Lake.





The same data collected on Crescent Lake showed no signals of an algal bloom. These results suggest that increasing in situ monitoring in systems susceptible to harmful algal blooms may help identify when blooms are beginning to form several weeks in advance. Expanding the use of time series of satellite imagery may further help identify new systems vulnerable to harmful algal blooms.

9:10 - 9:30 **Downstream Dynamics of Reservoir-Born Cyanobacterial Blooms in the Klamath River, CA**

Laurel Genzoli - University of Montana

Jacob Kann - Aquatic Ecosystem Sciences

Susan Fricke - Karuk Department of Natural Resources

Matt Hanington - Yurok Tribe Environmental Program

Crystal Robinson - Quartz Valley Indian Reservation Environmental Program

Cyanobacterial blooms are often associated with lentic systems but cyanobacteria cells and cyanotoxins exported from upstream lakes or reservoirs can enter high-gradient rivers affecting ecosystem function and public health. The Klamath River experiences annual blooms dominated by toxigenic *Microcystis aeruginosa* that originate in warm, nutrient-rich hydroelectric reservoirs with epilimnetic outflows and persist in the river for over 300 km to the estuary.

We explored longitudinal and temporal trends of *M. aeruginosa* cell densities, microcystin toxin, and phycocyanin fluorescence in the Klamath River from 2007 to 2017. Blooms occurred every year of the study and peaked in the river in August and September. Cell density and toxin concentration decreased longitudinally below the source reservoir due to both tributary dilution and cell loss. Cell density and toxin concentrations were often highly variable between regular weekly sampling events and within a single day. We developed relationships between the probability of toxin concentrations exceeding public health thresholds and real-time phycocyanin data that can be used to indicate changing bloom conditions in real-time. Understanding cyanobacterial dynamics in receiving waters is important for predicting the effect of source blooms on riverine ecosystem processes and public health.

9:30 – 9:50 **Chironomidae of the Pacific Northwest: Taxonomic Needs and New Records**

Barbara Hayford – Rhithron Associates, Inc. and University of Montana

Rebecca Spring and Andrew Fasbender – Rhithron Associates, Inc.

Documented declines in aquatic macroinvertebrate diversity necessitate the publication of taxon databases for use in biodiversity, ecological, and environmental research. An exhaustive search through the journal database, Web of Science, indicated a lack of published diversity data and species lists for non-biting midges (Diptera: Chironomidae) in the Pacific Northwest. To meet this need, we compiled a geo-referenced database of chironomids identified to genus and species for Washington, USA. Taxa were identified by Rhithron Associates from samples collected over a ten year period from over 3000 stream sites.





A total of 181 unique chironomid taxa were identified from streams located in every EPA level III ecoregion and most EPA level IV ecoregions in Washington State. Ten new state records are presented including a newly described genus and species, *Oropuella pallida* Fasbender, several undescribed genera, and the poorly known Eretmoptera, whose larvae have been previously described only from the sub-Antarctic *E. murphyi*. Our research finds that species level identification is currently impossible for many genera, highlighting the need for targeted taxonomic work to associate life stages for established genera and more sampling to work out the geographic range and taxonomy of the numerous undescribed species. One notable example is the ubiquitous *Eukiefferiella*, which currently has more species groups recorded from the region than described species. Based on the results of this study we suggest that increased taxon-specific research will inform ecological and environmental studies and lead to a better understanding of biodiversity in the Pacific Northwest.

10:10 – 10:30 **Update to the Standard Taxonomic Effort and Links to the Biological Condition Gradient Model**

Robert Wisseman - Aquatic Biology Associates, Inc.
#N/A

10:30 - 10:50 **Freshwater Mussels in the Pacific Northwest: A Review of the State of Knowledge and Future Research and Conservation Opportunities**

Emilie Blevins - The Xerces Society for Invertebrate Conservation

The Pacific Northwest is home to multiple species of freshwater mussel (Order: Unionida), which are important components of our aquatic ecosystems. Freshwater mussels remain generally understudied in the western U.S., yet the body of research on species in the eastern U.S. suggests that an increased research focus on these species could provide valuable insight into the function and health of western freshwater habitats. This research would also benefit aquatic biologists by developing a better basic understanding of western freshwater mussels, as well as help guide conservation and management activities. The Xerces Society has developed a robust freshwater mussel conservation program, which has included research into extinction risk status, taxonomy, distribution, and health. This presentation will provide a brief overview of this and other western freshwater mussel research and potential future directions.

10:50 - 11:10 **The Search for Freshwater Mussels in the Lower Boise River, Boise, Idaho**

Dorene MacCoy– City of Boise, Idaho
Matt Laramie – US Geological Survey, Forest and Rangeland Ecosystem Science Center, Boise, Idaho

The City of Boise is investigating the presence of native freshwater mussels in the lower Boise River to provide background information for future Idaho negotiated rulemaking for ammonia aquatic life criteria. Idaho's current ammonia water quality standards are based on the 1999 Environmental Protection Agency (EPA) recommended criteria for the protection of early life stages of salmonids. In 2013, the EPA updated the freshwater ammonia aquatic life ambient water quality criteria to incorporate additional scientific studies. Several of the new studies looked at the toxicity of ammonia to life stages of freshwater mussels in the family Unionidae and found them to be more sensitive than salmonids. Many states, including Idaho, have several implementation options to adopt EPA recommended criteria.





These limits will be incorporated into Idaho Pollutant Discharge Elimination System (IPDES) discharge permits. Lower ammonia limits may require costly water renewal facility upgrades for municipalities. Identifying the presence of freshwater mussels is critical in identifying ammonia discharge permit limits for IPDES and for future municipal utility operations.

There are three unionid species found in the Snake River and tributaries; these are *Anodonta* sp. (Floaters), *Margaritifera falcata* (Western Pearlshell), and *Gonidea angulate* (Western Ridged). Although there have been several macroinvertebrate sampling events in the mainstem lower Boise River since the early 1990's, no freshwater mussels have been documented. The City of Boise is using several strategies to search for freshwater mussels that included an intensive search for mollusks in a dewatered section of the lower Boise River in 2018, a geographical information system (GIS) based analysis of potential mussel habitat, and a focused survey using visual assessments and environmental DNA (eDNA) sampling techniques. This presentation will discuss each of these monitoring strategies and present any available results.

1:00 - 1:20 **Relative Controls on Stream Temperature from Shade, Land Use, and Water Management in Basins of the Pacific Northwest, USA**
Matthew Fuller - U.S. Environmental Protection Agency, ORISE Fellow

Stream temperature is controlled by many factors including a landscape's geology, climate, and human alterations. Our study compares the relative importance of these factors in controlling stream temperature using a statistical modelling framework for three study catchments in the Pacific Northwest, USA. We tested dozens of competing and alternate covariates which include representations of landscape geology, climate, and land use, as well as covariates with potential management implications to see which were significant in predicting observed stream temperatures.

To do this, spatial stream network models were fit with these covariate combinations and a modified best subsets analysis selected among different models (using Akaike Information Criterion – AIC – as a model diagnostic statistic) to find a suite of best models. Using this suite of best models, model-averaging methods predicted stream temperatures under a variety of management plan scenarios. These predictions demonstrate how much water temperatures might shift under different restoration scenarios (e.g., channel width restoration, reduced agricultural water use, or riparian shade restoration). The results of this research provide information on the alternate mechanisms potentially controlling stream temperature and could help advise decisions for future temperature management plans.

1:25 – 1:45 **Water Temperature Bioassessment Tools - What is Available Now and What We Will Need in the Future**
Anne Timm – US Forest Service

The terms thermal regime and thermal landscape are both used to describe stream temperature characteristics and heterogeneity at different spatial and temporal scales. Factors that influence the thermal landscape may include land cover, groundwater connectivity, and stream network configuration. Maintaining heterogeneity and resilience of thermal regimes is considered one approach to counteract potential impacts from thermal pollution. Another way to reduce impacts of thermal pollution in streams is to maintain thermal refugia that aquatic species can access via dispersal during periods of thermal stress.





Various water temperature metrics, decision support tools, remote sensing applications, and thermal imaging approaches can be applied to quantify water temperature variability and to identify locations within stream networks that are potential thermal refugia locations. Using these tools and metrics most effectively requires applying the right tool or metric at the most appropriate spatial and temporal scale. For example, metrics that are based on mean daily water temperature values may not adequately quantify diel, seasonal, and annual variability that drives behaviors such as fish spawning migrations or triggers aquatic species early life stage development. In addition, spatial stream-network models (SSNMs) are useful for quantifying spatial distributions of stream temperature, but certain facets of the thermal regime can vary temporally. Therefore, focusing on spatial variability of a specific aspect of the aquatic food-web considered a priority for management for a specified time series may be more predictive or relevant. Another ongoing and future challenge for thermal landscape management is development of specific tools to quantify stream temperature dynamics for urban land cover dominant watersheds, where spatial configuration and interactions with human infrastructure are drivers of variation. Examples of using stream temperature metrics at appropriate scales, applying SSNMs to specific facets of thermal regimes, and challenges for quantifying stream temperature in urban watersheds will be demonstrated and discussed.

1:45 – 2:05 **Thermal Responses to Riparian Thinning in Redwood Headwater Streams at Multiple Spatial Scales**

David Roon - Oregon State University

Jason Dunham, USGS, FRESC, Corvallis, OR

Resource managers are actively thinning second-growth forests in the redwoods of coastal northern California to accelerate the recovery of old-growth redwood forests and are now interested in applying these thinning treatments to second-growth riparian forests. In this study, we evaluated the effects of riparian thinning in a watershed-scale field experiment following a BACI design on riparian shade and light conditions and the influences on stream temperature in three redwood headwater stream networks. Preliminary results indicate that experimental riparian thinning treatments decreased riparian shade by a mean of 21%, increased solar radiation by a mean of 23%, and increased stream temperature as 7-day-moving-maximum by a mean of 2.5°C. Local increases in temperature extended further downstream between 100-700m and were evident at multiple spatial scales. These initial data suggest that more subtle changes in shade and light associated with riparian thinning treatments can affect thermal conditions of these headwater streams both locally and further downstream. However, the magnitude of these thermal responses and their spatial extent vary with the amount of shade lost. These data provide important information for managers considering riparian management activities in the redwoods.

2:05 – 2:25 **Spatial Analysis of Thermal Sensitivity in Western US Mountain Streams**

Junjie Chen - Portland State University

The Aquatic and Riparian Effectiveness Monitoring Plan (AREMP) program of the Northwest Forest Plan (NWFP) has collected massive watershed data on in-stream and riparian conditions. It's crucial to understand various factors that influence stream temperature during summer, which are essential in thermal pollution and water quality assessments.





Our team investigates the relationship between stream temperature and air temperature by examining thermal sensitivity for each study site for the past 18 years using gridded estimate of surface meteorological conditions and stream temperature measurements. Due to the messy nature of our dataset, we categorized monitoring sites by warm, average, and cool climate years based on maximum daily temperature in August. Furthermore, we also tested riparian vegetation (GNN model) and topography effects on thermal sensitivity under average climate years using spatial analysis in GIS. Principle Component Analysis (PCA) was conducted to observe the largest variance among climate variables. We expect our results to show strong correlation between thermal sensitivity and riparian canopy cover. Outcomes of this research will inform us about relative importance of study site location vs climatic year, which will enable us to further investigate other thermal drivers such as geology, precipitation (rain vs snow), and flow. Management implications include identifying critical areas with high thermal sensitivity and examine monitoring and restoration efforts. Preliminary conclusions can also be drawn for monitoring sites with multiple years of stream temperature on whether landform or climate has a more significant impact on stream thermal sensitivity.

2:25 – 2:45 **Challenges and Opportunities for Linking Riverscape Thermal Regimes to Fish Populations**

Joe Ebersole - U.S. Environmental Protection Agency

Assessing the potential effects of altered regimes on fish populations is complicated by variation in fish movement and behavior, and environmental heterogeneity. Quantifying the value of both small and large scale thermal features to fish populations has been challenging due to the difficulty of mapping thermal regimes at biologically relevant spatial and temporal resolutions, and integrating thermal regimes into population models. We attempt to address these challenges by using newly-available datasets and modeling approaches to link thermal regimes to fish populations across scales. We discuss the challenges and opportunities to simulating fish behaviors and linking thermal exposures to migratory and reproductive fitness. We describe two approaches: an individual-based modeling approach useful for tracking implications of behavioral decision-making by fish, and a population modeling approach that incorporates species interactions, habitat effects, and movement.

2:45 – 3:05 **Linking Temperature and Discharge to Expressed Behavior of Fishes; Implications for Climate Change**

Rebecca Flitcroft, Brooke Penaluna, Ivan Arismendi, Mary Santelmann, Sarah Lewis, Muhammad Safeeq, and Jeffrey Snyder - US Forest Service and Oregon State University

Globally, river systems have been extensively modified through alterations in riverscapes and flow regimes. These changes reduce the capacity of river floodplains and to absorb geophysical and environmental changes and directly affect life history adaptations that have developed over the millennia for native species. In western North America and elsewhere, changes in upslope processes (i.e. fire regimes, forest harvest and associated practices) work in concert with alterations in natural flow regimes through dams, levees, and floodplain development to change recovery trajectories of river systems. However, existing phenotypic adaptation by native fishes to environmental conditions may not be compatible with alterations to flow regimes. Climate change may compound this issue by further reducing variability in environmental conditions thereby inhibiting the full expression of life history diversity present in current populations.





We explored expressed behavioral variability in upriver migration and passage for Coho salmon (*Oncorhynchus kisutch*), an endangered salmonid in Washington and Oregon, USA. We combined long-term records of discharge, water temperature, and upstream fish passage in a single visualization, providing strong empirical foundations for understanding upstream behavioral movement and tolerances of this native salmon. We focus on Coho salmon movement timing in recent decades with respect to temperature and discharge and compare this with scenarios representing possible future hydrologic conditions associated with a changing climate. Our approach provides a framework for the study of future hydrologic alterations in other locations, and can inform local and regional conservation planning particularly in view of water management policy. We discuss management implications and recommendations for action that may expand the capacity of riverscapes to absorb perturbations, thereby allowing for enhanced resilience of native fish populations.

3:05 – 3:35 **Modeling and Mapping Freshwater Thermal Regimes in Oregon**
Kara Anlauf-Dunn – Oregon State University

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) and would enable and improve a myriad of 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. The physiological response of fish to a changing climate provides a mechanistic explanation for population responses such as altered phenology, range shifts, and biotic interactions. 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.

4:00 – 4:20 **Evaluating the Impacts of Climate Change on the Future Distribution of Stream Macroinvertebrates, Fish and Amphibians in Washington using Species Distribution Models**
Jennifer Elliot – Washington Department of Ecology Research Scientist
Chad Larson, Glenn Merritt, and Stacy Polkowske – Washington Department of Ecology
#N/A





4:20 – 4:40 **Aquatic Community Assembly in Early Successional Streams at Mount St. Helens**
Shannon Claeson - US Forest Service

The eruption of Mount St. Helens in 1980 obliterated forests and buried streams on the mountain's north flank by over 100m of sterile pumice. Following the eruption, springs and snowmelt created four new watersheds flowing into Spirit Lake. Community recovery was predicted to take many decades to centuries, but surveys 36 years post-eruption found significant aquatic community development. Reach-scale surveys in the four watersheds reveal large ranges in many physio-chemical characteristics including water temperature, discharge, conductivity, organic carbon, nitrate, and canopy cover. Communities of periphyton, macroinvertebrates, and riparian plants differ significantly among streams suggesting different developmental trajectories for primary succession. In one watershed, only low-profile and firmly attached soft-algae taxa were observed, along with fewer riparian plants and benthic invertebrates. We suspect that continual disturbances by floods and sediment transport are keeping the aquatic and riparian communities in earlier successional states of development. The other streams are warmer with lower discharge and sediment transport, and tend support more diverse and/or abundant taxa and canopy cover. The large differences in habitat across the four watersheds provide a unique opportunity to explore in-stream community development and early stream succession.

FRIDAY NOVEMBER 8TH

8:30 – 8:50 **Linking Variables Across Different Scales in River Macrosystems Research: A Graph-Based Theoretical Approach**
Barbara Hayford - Rhithron Associates, Inc.
Sally Clark - University of Alabama
Marcella Jurotich - Carleton College
Jon Gelhaus - Drexel University

Macroecosystems research is used to ask questions about stream ecosystem function across large spatial and temporal scales, scales that are useful for natural resource management given the complex features of watersheds and downstream impacts of upstream land uses. However, cross-scale linkages are difficult to establish and visualize. Herein, we explore the use a graph-based theoretical approach in linking environmental variables at different scales to functional trait diversity. Data from the US EPA National River and Stream Assessment for western North American watersheds were retrieved for analysis. Sites designated as undisturbed to relatively undisturbed were selected for study if they were accompanied by a full suite of microhabitat, reach, landscape, and regional data. Unique macroinvertebrate taxa were assigned functional traits and functional diversity was calculated for each site. The results of multiple regression indicate that variables at three different scales predicted variation in functional diversity ($R^2 = 0.59$, $P < 0.01$): Microhabitat, substrate; reach, riparian condition; landscape, stream order and latitude; and biogeographic region. We selected sets of cross-scale variables from the multiple regression analysis and linked them using Signal Flow Graph Theory. The models are effective in visualizing the interaction of variables at different scales in watersheds. We discuss the use of these models in watershed management.





8:50 – 9:10 **Developing a Spatial Modeling Approach to Estimate Invertebrate O/E in Streams and Lakes in the Conterminous US**
Jessie Doyle, Ryan Hill, Scott Leibowitz, and Paul Ringold - US Environmental Protection Agency

The USEPA has estimated macroinvertebrate observed-to-expected (O/E) taxonomic richness for several thousand rivers, streams and lakes throughout the continental United States as part of the National Aquatic Resource Surveys (NARS). However, predicting O/E in unsampled rivers/streams and lakes could help local, state, and federal agencies prioritize areas for conservation or restoration. In addition, this measure of aquatic condition is of great interest to economists as it is readily understood by participants in willingness-to-pay-studies. Our main objective is to produce spatial interpolations of macroinvertebrate O/E across the conterminous US that can be used in an economic analysis to estimate the willingness of individuals to pay for incremental improvements in biological condition near them. However, this work raises several methodological questions that have not been addressed at this scale, such as: How best can we develop and apply models to both streams and lakes? How do we communicate the accuracy and precision achieved in the ecological models to support economic analyses? How will the use of regional reference sites in the development of O/E indices affect interpolations at regional boundaries and are there ways to mitigate these differences for economic analyses? In this presentation, we will review the need for such information, review past approaches, and discuss our proposed approach to model O/E for streams and lakes as well as several challenges we expect to encounter.

9:10 – 9:30 **Management of Chinook salmon (*Oncorhynchus tshawytscha*) stocks in Washington State using the Fishery Regulation Assessment Model (FRAM)**
Oliver Miler - Northwest Indian Fisheries Commission

Salmon-bearing streams in Washington State are the spawning grounds for several salmonid species, such as Chinook (*Oncorhynchus tshawytscha*), coho (*Oncorhynchus kisutch*), sockeye (*Oncorhynchus nerka*), pink (*Oncorhynchus gorbuscha*) and chum (*Oncorhynchus keta*) salmon. These species cross vast marine areas and often national and state boundaries on their way to the watersheds where they spawn in. Pacific salmon, especially Chinook, are highly valued for human consumption and commercial as well as recreational fisheries have severely depleted many stocks. Puget Sound Chinook constitute an evolutionary significant unit (ESU) with the status 'threatened' according to the U.S. Endangered Species Act (ESA). The Fishery Regulation Assessment Model (FRAM) is currently used to facilitate the sustainable management of Chinook in Washington State. Escapement numbers, i.e. the number of fish that 'escape' fisheries and return to the river to spawn, and exploitation rates (the ratio of fisheries mortality divided by the sum of fisheries mortality and escapement) are used as minimum goals to allow for sustainable wild Chinook populations.

FRAM uses a complex set of fisheries inputs, Chinook forecasts, age distributions, natural and incidental mortality rates and maturation rates to calculate the projected impacts of planned fisheries. Using FRAM, rates and quotas for commercial, recreational and ceremonial & subsistence fisheries are negotiated between tribal governments and the Washington State Department of Fish and Wildlife in such a way that restricts the combined fisheries impacts on each stock so that previously defined escapement and exploitation rate goals are achieved.





The inputs into FRAM as well as its Visual Basic code are frequently updated to reflect recent fisheries research outcomes, improvements in available data inputs and changes in fishery regimes and forecasts. Degradation of spawning and juvenile rearing stream habitats as well as disadvantageous changes in ocean foraging conditions ('Warm Blob') have resulted in low Chinook spawning returns and severe fisheries restrictions in the last years. This results in the urgent need to strongly and continuously improve the precision of forecasts, FRAM fishery mortality and escapement estimates as well as to strictly control and enforce the negotiated fishery terms.

9:30 – 9:50 **NARS: In Case You Ever Wondered How We Got Here**
Dave Peck - US Environmental Protection Agency

EPA's National Aquatic Resource Surveys (NARS) provide information on the status and extent of biological and stressor condition in lakes and reservoirs, streams and rivers, coastal waters, and wetlands of the US. The tools (e.g., survey designs, methods, indicators) needed to implement NARS, and the resulting data and assessments produced from NARS are intended to help EPA and partners better meet the reporting requirements of the Clean Water Act. The NARS assessments are the pinnacle of a series of large-scale aquatic surveys conducted or coordinated by EPA and the methods used are built on the lessons learned from over 30 years of probabilistic monitoring of the nation's aquatic resources. I will attempt to trace the evolution of the research efforts to support the implementation of NARS, beginning in the mid-1980s with the National Surface Water Surveys (NSWS), to the Environmental Monitoring and Assessment Program (EMAP), to the NARS assessments. I hope this perspective will give potential users of NARS data a better understanding and appreciation of the hows and whys of "NARS monitoring." I also hope that those who have been participants in NARS activities will appreciate the magnitude and importance of their collective efforts to the current and future success of the program.

9:50 – 10:10 **Characterizing Methylmercury Bioaccumulation in Larval Dragonflies**
Cailin Mackenzie, Tiffany Garcia, and Collin Eagles-Smith - Oregon State University

Monitoring aquatic organisms is a critical tool for informed management of mercury within food webs and across landscapes. Predatory invertebrates are increasingly being used to gauge biotic cycling of mercury, given their import as both prey and predator as well as their site fidelity, widespread distribution, and biphasic linkage of aquatic and terrestrial habitats. Quantitative understanding of mercury bioaccumulation, biomagnification, and toxicity to predatory invertebrates remains limited, requiring further research to quantify mechanisms underlying mercury accumulation and adverse effects in order to estimate population and community level impacts. This study will quantify dietary methylmercury accumulation over 8 weeks in dragonfly larvae fed ad libitum prey at three different methylmercury concentrations. We will sample dragonfly larvae from each treatment weekly for total and methyl-mercury as well as growth and body condition. The resulting trophic transfer rates will inform how different levels of methylmercury contamination influence assimilation to secondary consumers, and how this accumulation changes over time. Additionally, these findings will provide context for the United States National Park Service's Dragonfly Mercury Project's database of larval dragonfly mercury concentrations from habitats impacted by atmospheric deposition of mercury. Future experiments will quantify mercuric impacts to life history parameters including development timing, immune response, and prey capture and predator avoidance behaviors.

