Fellow Ecologists and Water Resource Professionals:

Welcome to the 2023 Annual Meeting of the Pacific Northwest Chapter of the Society for Freshwater Science (SFS PNW). The PNW Chapter began as the Northwest Biological Assessment Workgroup, a collaborative effort between State, Federal, Tribal, and academic bioassessment professionals in 1990. This year marks our 33rd annual gathering of regional scientists advancing the understanding and practice of freshwater science in the Pacific Northwest. Thank you for your continued support and contributions to our Chapter!

To increase accessibility, we are hosting a hybrid meeting with in-person and virtual access. Zoom links for each day will be provided. You can connect with us outside of the meeting via our website, Facebook, Instagram, Linked In, or Twitter Accounts. To facilitate participation in meetings by younger (student and early career), Black, Latino, Asian, Indigenous, and LGBTQ+ scientists, the chapter provides travel awards for student and early career colleagues to help offset attendance costs. To support future DEI scholarships, please consider bidding in our silent auction .

Our keynote speakers this year will be Sherri Johnson (USDA Forest Service, Oregon State University Fisheries, and president of the International Society for Freshwater Science) and Kristin Jaeger (Research Hydrologist, USGS Washington Water Science Center). Both are on the forefront of freshwater science research, science, education and policy and we know you will enjoy and learn from their talks. We are excited to offer a special session on the new invertebrate-based Biological Condition Gradient (BCG) bioassessment model, as well as a workshop on the many uses of R. We are confident our 2023 Annual Meeting will be exciting, informative, and enjoyable. We look forward to seeing you there, whether in person or on screen!

Sincerely,
Your 2023 Meeting Steering Committee At-Large: Zee Searles Mazzacano (President), Rob Plotnikoff (Past President), Jessie Doyle (Treasurer/Secretary), Bob Danehy, Dorene McCoy, Francine Mejia, Shannon Cleason, Chad Larson, Oliver Miler, David Wooster, Alex Bell, Barbara Hayford, and Mindy Allen

**Please note:** The Hood River-White Salmon Interstate bridge will be closed to all traffic from 12:01 a.m. Friday, November 3 through 11:59 p.m. Monday, November 6. When open, the Hood River Bridge toll is $3.50 each way. Alternate bridges to travel from the Washington side of the Columbia River to Oregon I-

84 are: Bridge of the Gods ($3.00 toll each way) in Cascade Locks ( west of Hood River) and The Dalles Bridge (no toll; east of Hood River).

ZOOM CONNECTION INFORMATION

[PUBLIC DATA DOES NOT INCLUDE ZOOM LINKS]

SPEAKER PRACTICE SESSION

Speakers are invited to connect to our Zoom meeting platform on 11/5/23 to practice working with moderators and using the meeting technology. Please let Jessie Doyle know if you are interested in participating in the practice session (jschnoyle@gmail.com). As a safeguard against unexpected bandwidth limitations, speakers should consider sending their final presentation to the steering committee (jschnoyle@gmail.com) by 5 pm Pacific time on 11/3/23 so moderators can advance the slides if needed.

SCHEDULE AT GLANCE

**Monday November 6th, 2023**

| TIME | TOPIC | SPEAKER |
|---|---|---|
| 8:30 am – 9:00 am | Check In at Registration | |
| 8:45 am - 9:00 am | Welcome and Opening Remarks | **Zee Searles Mazzacano** (SFS PNW President; CASM Environmental, LLC) |
| 9am - 10am | Plenary Talk - Improving mapping of perennial and non-perennial streams: models calibrated to simple flow/no flow observations | **Kristen Jaeger** (USGS) |
| 10:00 am - 10:30am | Break | |
| **SESSION** | | |
| 10:30 am - 10:45 am | Identifying the drivers of aquatic ecosystem vulnerability to wildfires in the Pacific Northwest | **David Roon** (Oregon State University), Kevin Bladon, (OSU), Rebecca Flitcroft, (USDA Forest Service), Jana Compton (USEPA), Joe Ebersole, (USEPA) |
| 10:50 am - 11:05 am | Stream chemistry responses to mixed-severity fire and increasing storm magnitudes at H.J. Andrews Experimental Forest | **Sherri L. Johnson** (U.S.D.A. Forest Service), Sidney A. Bush (Oregon State University), Pamela L. Sullivan (Oregon State University), Kevin D. Bladon (Oregon State University), Steven M. Wondzell (U.S.D.A. |

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| | | Forest Service, Pacific Northwest Research Station), Adam S. Ward (Oregon State University) |
| 11:10 am - 11:35 am | Reference conditions and ecological status classes for riverine lowland lakes | **Oliver Miler** (Northwest Intertribal Fisheries Commission), Magdalena Czarnecka & Mario Brauns |
| **LUNCH (12:00 pm – 1:00 pm)** | | |
| **SESSION** | | |
| 1:00 pm - 1:15 pm | Monitoring Freshwater Mussels in the Lower Boise River | **Colin Custer** (City of Boise) |
| 1:20 pm - 1:35 pm | Combining eDNA sampling with visual surveys to assess freshwater mussel distribution, abundance, and habitat associations in the Yamhill, Clackamas, and North Santiam River basins, Oregon | **Zee Searles Mazzacano** (CASM Environmental/ICF), Laura McMullen (ICF), and Travis Williams (Willamette Riverkeeper) |
| BREAK | | |
| **SESSION** | | |
| 2 pm - 2:15 pm | Geospatial Analysis and Modeling of Stream Temperature and Fish Habitat in the Clackamas River Basin Project | **David Bugni**, (Chair, Clackamas River Basin Council) |
| 2:20 pm - 2:35 pm | Some hopeful news: Stream macroinvertebrate communities are impacted less than expected by newer development | **Kate Macneale**, Beth Sosik, (King County Water and Land Resources Division) |
| 2:40 pm - 2:55 pm | The dark underside of floating solar panels: Iterative runs of CE-QUAL-W2 models as an assessment tool for understanding the effects of floating photovoltaic arrays on reservoir limnology. | **Evan Bredeweg** (Oregon State University), Ivan Arismendi (Oregon State University), Christina A. Murphy (U.S.G.S.), and Sarah Henkel (U.S.G.S.) |
| **BREAK** | | |
| 3:15 pm- 3:30 pm | Hyporheic macroinvertebrate assemblages in early successional streams on Mount St. Helens | **Shannon M. Claeson**, (Forest Service PNW Research Station) Debra S. Finn (Missouri State University), Carri J. LeRoy (The Evergreen State College) |
| 3:35 pm - 3:50 pm | Bioassessment of Ocean Shores' Freshwater Ecosystems Based on Chironomid Communities | **Barbara Hayford (**Coastal Interpretive Center, University of Montana), Marcella Jurotich (Coastal Interpretive Center), Rachel Davey (Coastal Interpretive Center) |

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| 3:55 pm - 4:25 pm | Holiday Farm Fire: impacts on stream temperature and the upstream extent of fish distribution on private timberlands | **Mark River,** Jason Walter, Peter James, Renata Tarosky, Travis Schill, Miranda Fix (Weyerhaeuser Co.) |

**November 7th, 2023**

| **TIME** | **TOPIC** | **SPEAKER** |
|---|---|---|
| 8:45 am – 9:00 am | Welcome and Logistics | |
| 9:00 am - 9:45 am | Keynote | Sherri Johnson (President, Society for Freshwater Science; OSU Fisheries; USDA Forest Service) |
| 9:45 am - 10:00 am | Break | |
| **SESSION - Update from State Agencies (10:00 am - 11:00 am), Pre- Lunch Business Meeting (11am - 11:45 am)** | | |
| **LUNCH (12:00 pm – 1 pm)** | | |
| **SESSION - Biological Condition Gradient Special Session** | | |
| **Time** | **Topic** | **Presenter** |
| 1:00 pm - 2:00 pm | introduction to BCG<br>Overview of new tools<br>● Maritime Northwest Biological Condition Gradient (BCG)<br>● Thermal preference metrics & fuzzy set temperature model<br>● Macroinvertebrate Temperature Tolerance index (MTTI) & Biological Sediment Tolerance Index (BSTI)<br>● BioDiversity index<br>● Integration into automated reports | Jen Stamp (TetraTech)/Susan Jackson (USEPA)/Shannon Hubler (OR DEQ) |
| 2:00 pm - 3:00 pm | R Shiny app demonstration htpps://tetratech-wtr-wne.shinyapps.io/BCGcalc/ | Jen Stamp (TetraTech) |
| 3:00 pm - 3:15 pm | Break | |
| 3:15 pm - 4:15 pm | How to use the assessment tools<br>● Assessment vs. stressor ID tools (MTTI, BSTI)<br>● How to integrate information & use tools<br>● Where to use the information<br>Group discussion | Shannon Hubler (OR DEQ), Chad Larson (Washington Department of Ecology), Kate Macneale, Rob Plotnikoff (Snohomish County Conservation and Natural Resources) |
| 4:15 pm - 5:00 pm | Status of Additional Tools & Support – Open Discussion | |
| | Regional Tools<br>● PNW Standard Taxonomic Effort | John Pfeiffer, Jen Stamp (TetraTech) |

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| | ● Attribute/Translator Table | |
| | Future Effort & Needs<br>● Expansion of BCG Model<br>○ Eastern OR/WA & ID<br>○ Rivers east of cascades<br>● Incorporate B-IBI & O/E into BCG Shiny App<br>● Puget Sound Stream Benthos (PSSB) 2.0 online app (upcoming revisions)<br>● Causal Assessment Screening Tool (CAST) model<br>● online access & frequency of tool updates<br>● workshop participant input & final thoughts | Susan Jackson (USEPA), Shannon Hubler (OR DEQ), Jen Stamp (TetraTech), Kate Macneale, Chad Larson (Washington department of Ecology) |
| 5:00 pm | Adjourn workshop, followed by informal gathering for continuing discussion | Rob Plotnikoff (Snohomish County Conservation and Natural Resources) |
| 6-8pm | **Evening Social and Poster Session** (one-on-one assistance with BCG shiny app as desired) | |

**November 8th, 2023**

| TIME | TOPIC | SPEAKER |
|---|---|---|
| 8:00 am - 8:15 am | Welcome and Logistics | |
| **Workshop: The many uses of R** | | |
| 8:30 am - 11:00am | Data manipulation | Oliver Miler (Northwest Intertribal Fisheries Commission) |
| 11:00 am - 11:15 pm | Break | |
| 11:15 am - 12:15 pm | Spatial analysis with R | Jessie Doyle (OR ODFW) |
| 12:15 pm - 12:30 pm | Closing Statements and Meeting Adjourns | Zee Searles Mazzacano (CASM Environmental) |

**FOR R WORKSHOP ATTENDEES:**

Please install R software before coming to the Wednesday workshop. Jessie Doyle and Oliver Miler are happy to troubleshoot R installation problems prior to the workshop.

**Presentation abstracts**

**Identifying the drivers of aquatic ecosystem vulnerability to wildfires in the Pacific Northwest, David Roon, Oregon State University, Corvallis, OR,** Kevin Bladon, Oregon State University, Corvallis, OR, Rebecca Flitcroft, USDA Forest Service, Corvallis, OR, Jana Compton, Environmental Protection Agency, Corvallis, OR, Joe Ebersole, Environmental Protection Agency, Corvallis, OR

Wildfires can have complex effects on aquatic ecosystems that vary widely depending on the characteristics of the fire and the ecological context of the watershed. This creates challenges for making predictions of fire effects on species of social and conservation interest, like salmonid fishes (*Oncorhynchus* spp.). As fire regimes shift, resource managers want to predict where on the landscape wildfires pose a risk to fish and aquatic habitats. However, before we can effectively predict where aquatic systems will be vulnerable, we first need to understand how and why fires influence aquatic ecosystems. As a result, new approaches are needed that can synthesize aquatic ecosystem responses to fire and identify the mechanisms driving those responses. To address this issue, we applied food web system-dynamics models to explore how wildfires influence aquatic ecosystems across multiple trophic levels via the physical and biological processes that support them. To illustrate these concepts, we ran model simulations to explore how variation in fire severity influenced aquatic ecosystem responses in headwater streams of western forests of the Pacific Northwest (USA) and the associated pathways driving those responses. Model simulations indicated that wildfires had diverse effects on aquatic ecosystems that varied extensively through time, with fire severity, and across trophic levels. Sensitivity analyses identified the individual pathways leading to collective behavior as predicted by the model. Stream temperature appeared to drive fish vulnerability to fire more than any other individual variable we considered in the model. Collectively, these simulations highlight the utility of whole system approaches, like food web modeling, to understand the mechanisms linking fire and fish. Such approaches can provide unique insights that can be applied to update our conceptual models of how fires can influence aquatic ecosystems, direct future empirical studies, and act as decision support tools for resource managers to help guide pre- and post-fire management actions on the landscape.

**Holiday Farm Fire: impacts on stream temperature and the upstream extent of fish distribution on private timberlands, Mark River**, Jason Walter, Peter James, Renata Tarosky, Travis Schill, Miranda Fix (Weyerhaeuser Co.)

In 2020, the Holiday Farm Fire burned approximately 173,000 acres in the Oregon Cascades. We will present pre- and post-fire stream temperature and fish distribution data for a series of watersheds on private timberlands in the Holiday Farm Fire footprint. Pre-fire stream temperature data was collected on 22 watersheds from 2010-2019, and the post-fire stream temperature data presented here is from 2021. These study watersheds range along a gradient from unburned to severely burned. As expected, stream temperatures increased most dramatically on severely burned sites. 2021 was a hot and dry year in the Cascades, so having control (unburned) watersheds is vital to be able to differentiate between the short-term effects of fire and fluctuating climatic conditions. In addition, comprehensive pre-fire data on the upstream extent of fish distribution had also been collected in a separate set of 24 watersheds within the fire footprint. Short-term impacts of the fire on fish distribution were assessed via backpack electrofishing surveys in spring of 2021 and 2022. Where the location of the uppermost

detected fish changed relative to the original survey, we measured the distance to the previous uppermost fish point and recorded stream habitat characteristics associated with the new point. These data suggest minimal short-term fire impacts on the upstream extent of fish distribution, with the location of the uppermost detected fish at the same point pre- versus post-fire in 11 of 24 streams. Where variability did exist, it was consistent with previous studies of variability in the upper extent of fish distribution in unburned watersheds. This study is ongoing, with annual fish distribution surveys and stream temperature monitoring efforts in place to better understand the potential longer-term impacts of the fire on these headwater systems.

**Monitoring Freshwater Mussels in the Lower Boise River, Colin Custer, City of Boise**

The City of Boise (City) monitors the occurrence of Western Pearlshell Mussels (*Margaritifera falcata*) within the Lower Boise River. In addition to species identification and measurement, other parameters are collected that include water quality, flow measurements, and eDNA sampling. Bioassessment data, that includes habitat and fish community monitoring, is also collected to measure the efficacy of future restoration projects. In addition, a mussel salvage opportunity occurred in an upstream side channel due to a planned bridge reconstruction project near one of the known mussel populations. The success of the mussel salvage effort required coordination and cooperation with multiple agencies, as well as the creation of a standardized protocol to relocate as many individuals as possible.

**Combining eDNA sampling with visual surveys to assess freshwater mussel distribution, abundance, and habitat associations in the Yamhill, Clackamas, and North Santiam River basins, Oregon, Zee Searles Mazzacano** (CASM Environmental/ICF), Laura McMullen (ICF), and Travis Williams (Willamette Riverkeeper)

Freshwater mussels improve water quality, stabilize substrate, and encourage healthy macroinvertebrate communities in the streams they inhabit, which enhances habitat for native salmonids and other wildlife. Detailed distribution information on native mussels is lacking in most Oregon watersheds, even though many populations are known to be declining. This lack of information regarding mussel distribution, abundance, and population status and needs limits the ability of natural resource organizations to make informed stream restoration and conservation decisions that will benefit these vulnerable animals. Current and historic records of freshwater mussels in Oregon are sparse or lacking in many streams, including the target basins, and comprehensive surveys have not been done. Because mussel aggregations are often small and/or patchy, complete surveys of continuous stream miles are prohibitive in terms of both effort and funding; access to the entirety of a stream length is also often limited by private land ownership. For this reason, using eDNA sampling to detect freshwater mussels can be a powerful and cost-effective tool that reduces impacts to habitat and increases detection efficacy. We are conducting a 2-year project to locate and study Western Ridge Mussel (*Gonidea angulata*), Western Pearlshell (*Margaritifera falcata*), and California/Winged Floater (*Anodonta californiensis/nuttalliana*) in anadromous fish-bearing reaches of the Yamhill, Clackamas, and North Santiam River basins. In 2023 (Y1), water samples were collected for eDNA analysis every 2-3 km

in target reaches to gain a broad understanding of population locations based on presence/absence data; rapid visual surveys and habitat data collection were also done at each eDNA sampling site. Existing eDNA samples collected by other organizations in the focal basins were analyzed for presence of target mussel species. In 2024 (Y2), we will ground-truth positive eDNA signals by conducting detailed snorkel/diving surveys in areas where mussel occurrence was indicated. Detailed studies will be done to characterize new mussel beds and stream habitat, to increase our understanding of habitat associations and mussel bed health. At least 10% of all sites with a negative eDNA signal will also be surveyed in Y2 to confirm mussel absence. Mussel occurrence data will be made available via an interactive, engaging story-style web map that will provide information on western mussels and their importance. We are also reaching out to local agencies and tribes to provide context and information on freshwater mussel conservation.

**The dark underside of floating solar panels: Iterative runs of CE-QUAL-W2 models as an assessment tool for understanding the effects of floating photovoltaic arrays on reservoir limnology, Evan Bredeweg (Oregon State University)**, Ivan Arismendi (Oregon State University), Christina A. Murphy (USGS Maine Cooperative Fish and Wildlife Research Unit), and Sarah Henkel(Oregon State University)

The development of renewable energy options is a pressing concern worldwide, and solutions that tie into existing power infrastructure and utilize previously disturbed environments are promising. Floating photovoltaic (FPV) arrays on hydroelectric reservoirs meet these criteria and have gained attention as an option that may be more efficient at capturing solar energy than traditional land-based installations. However, there has been limited research understanding of the effects these structures will have on limnological processes. Changes to incoming solar radiation and reduced interaction with surface wind can impact circulation dynamics, thermocline depth, and surface water temperature. In turn, these effects may impact algae growth, dissolved oxygen levels, and fish habitats. To estimate how some of these complex aspects of the reservoir may respond to the installation of such an array, we used the mechanistic modeling software CE-QUAL-W2 to assess how lake processes might change due to large scale FPV. We implemented a routine in R that runs repeated iterations of the same reservoir model with adjustments to shade and wind sheltering variables that relate to FPV arrays of different sizes. We extracted several response variables from each iteration to quantify how the modeled reservoir responds to different array sizes. This assessment was repeated across multiple selected reservoirs that represented a suite of climate conditions, bathymetry, and hydrologic inputs. Consistent decreases in surface water temperature occurred as responses to larger FPV installations across sites. We also observed shifts in stratification and water temperature in the reservoir outlets tied to season, but this pattern was inconsistent across reservoirs. While the results from this work need real-world validation, our models suggest that reservoirs' limnological processes will have unique and important responses to FPV arrays that may warrant further study in light of the growth of this renewable energy resource.

**Hyporheic macroinvertebrate assemblages in early successional streams on Mount St. Helens, Shannon M. Claeson, Forest Service PNW Research Station,** Debra S. Finn, Missouri State University, Carri J. LeRoy, The Evergreen State College

Opportunities are rare to study streams undergoing primary succession. The Pumice Plain at Mount St Helens, WA, was formed by a massive pyroclastic deposit during the eruption in 1980. Several streams developed on the sterile landscape shortly thereafter, and successional trajectories of instream benthic communities up to 35 years later varied substantially among streams. We asked whether hyporheic communities also varied among streams and if they were related to benthic communities. In 2019, we collected hydrological and geomorphological data across four Pumice Plain streams and sampled benthic and hyporheic invertebrates in one reach per stream during July and August. Hyporheic zones were not well developed in any of the streams by 2019, and hyporheic communities were depauperate (range 2-24 taxa per stream) compared to benthic communities (53-86 taxa), with hyporheic assemblages nested subsets of the benthos in each stream. However, streams with greatest abundance and diversity in the benthos had lowest abundance and diversity in the subsurface. Those streams occupied the western side of the Pumice Plain and had chemical and hydrological signals associated with crater springs in addition to strong upwelling throughout most of the sample reaches. Conversely, the eastern streams were likely sourced by glacier ice and snow outside of the crater, and the study reaches showed signs of both aggradation and stronger downwelling than the western streams. Interestingly, the easternmost stream dries seasonally but had the greatest hyporheic diversity (prior to losing surface flow in Sept). These contrasting hydrological and geomorphological settings across the Pumice Plain likely exert strong control on both benthic and hyporheic invertebrate communities at this still-early stage of primary succession.

**Geospatial Analysis and Modeling of Stream Temperature and Fish Habitat in the Clackamas River Basin Project, David Bugni, Clackamas River Basin Council**

A multi-phase, basin-wide, stream temperature data gathering, geospatial network analysis of stream temperatures incorporating 15 covariates with salmonid-related parameters map overlays (thermal tolerance, distribution and High Intrinsic Potential) project is currently underway within the Clackamas River basin. This project is being performed by a consortium of public and private entities, including Portland State University (PSU), the Oregon Department of Fish & Wildlife (ODFW) and the Clackamas River Basin Council (CRBC). The answers to two fundamental research questions are two of the goals of this study: 1) Which combination of variables best explains spatial variation in stream temperature across the basin and a what scales, and 2) Can spatial modeling provide insights into the watershed's thermal regimes and inform future monitoring and habitat restoration strategies? To answer these questions, PSU is analyzing data pertinent for present day representations of stream temperatures and will estimate future stream temperature conditions utilizing three representative IPCC-projected climate change scenarios (for 2050 and 2080). This project incorporates data acquisition efforts of stream temperatures within the 940 square mile basin (mainstem and tributaries) at currently over 100 selected sampling locations across rural and urban areas utilizing currently operating and historic data loggers between June and October of 2021, 2022, and 2023. Additional historic data from previous years is being incorporated into the PSU effort of geospatial statistical analysis and climate modeling activities.

The PSU data will also be utilized by ODFW to produce a series of multiparameter maps indicating thermal tolerances of salmonids, distribution of anadromy, and areas of High Intrinsic Potential. A

project of this magnitude and level of accuracy, while also capturing the June 2021 "heat dome" anomaly has never been undertaken within this basin, or arguably within Oregon. Results of this study will inform future fish habitat restoration and protection work by identifying areas of concern and where stream temperatures are adequate, coupled with the ODFW findings to identify locations where habitat restoration and protection is most likely to succeed in the long term; and thus, assist in providing the greatest benefit for the least cost to such future projects. Investigation of specific landscape variables, such as wetlands, and their relationship to downstream temperatures will allow meaningful stream temperature predictions. Further benefits of this study will pinpoint areas where drought-affected areas of the basin exist and where tree canopy improvements can be made to minimize rising stream temperatures and provide climate resiliency for the benefit of human, aquatic and wildlife species.

**Bioassessment of Ocean Shores' Freshwater Ecosystems Based on Chironomid Communities,** Barbara Hayford (Coastal Interpretive Center, 1033 Ocean Shores, WA; University of Montana, Division of Biological Sciences, Health Sciences), Marcella Jurotich (Coastal Interpretive Center), Rachel Davey (Coastal Interpretive Center)

Point Brown, a peninsula on Washington's Pacific Coast, was characterized historically by sand dune ecosystems including a large interdunal lake and Sitka spruce wetlands. Ocean Shores, located on the peninsula, was heavily modified in the early 1960s when developers converted the existing freshwater habitats into a large lake and several canals. These freshwater amenities were designed for recreation and water views for land owners. Increasing summer drought and significant declines in summer precipitation over a 20-year period have impacted Ocean Shores' freshwater ecosystems. Some of the canals are hypereutrophic during part of the year, and sediment inflow and wetland plant die-off have created increasingly shallow aquatic environments. The goal of this project was to use a ubiquitous freshwater invertebrate, non-biting midges (Diptera: Chironomidae), to establish baseline biodiversity estimates for the freshwater ecosystems of Ocean Shores. Sampling of the lake and canals in Ocean Shores as well as an unmodified wetland north of town was done during all seasons, 2022-2023. Samples of surface floating pupal exuviae (SFPE) were collected using a catch per unit effort method. Communities were dominated by typical wetland genera such as *Glyptotendipes*, *Chironomus*, *Procladius*, and *Tanytarsus*. The unmodified wetland north of town had far greater diversity than the other sites sampled indicating that it may serve as a reference site in comparison to the modified environments in Ocean Shores in future biomonitoring work. Little is known about Washington's Pacific coast lentic insect communities, so results from this study serve to increase documented biodiversity for this region.

**Some hopeful news: Stream macroinvertebrate communities are impacted less than expected by newer development**

**Kate Macneale and Beth Sosik, King County Water and Land Resources Division, Seattle, WA**
**kate.macneale@kingcounty.gov**

Scientists and managers have long recognized that clearing forests and building cities degrade streams and the macroinvertebrate communities they support. To prevent and mitigate these impacts, policy makers have passed regulations to and implemented policies that protect riparian areas, control stormwater runoff, and reduce sources of contaminants. Although these efforts have been ongoing,

with protections for streams increasing over time, it has been difficult to say if they have been effective. Using benthic index of biotic integrity (B-IBI) scores to track stream conditions over time, we found some surprising results that suggest some actions may be helping: 25% of the 120 sites that King County has been monitoring since 2002 have improved while only 3% have declined. These improvements have coincided with continued development, suggesting that recent development has impacted stream communities less than older development. Accordingly, we wondered whether the aquatic macroinvertebrate community response to development depends on when that development occurred. For this study, we characterized each basin by when it was developed, and examined whether that date of development could explain any of the variation in B-IBI scores. To quantify development, we used high resolution land cover and assessor data to estimate the impervious area and the date it first appeared for each parcel within each monitored basin. We found earlier-developed basins generally had worse B-IBI scores than basins with the same amount but more recent development. The extent of impervious area within a basin was still the best single predictor of B-IBI scores, but when that impervious area was built was also statistically significant. The effect was ecologically meaningful as well: on average, sites in basins with the oldest development scored 10 to 20 points lower (on a 0-100 scale) than sites in basins with the same amount but relatively newer development. This suggests aquatic communities are harmed less by more recent development than would be expected based on the historical relationship between urban development and B-IBI scores. There remains a strong, negative response of aquatic communities to urban development, but the magnitude of that response is less than in most previous studies using a space-for-time substitution. Although we cannot attribute this effect to a specific regulation or policy change, this is the first study to find a county-wide pattern that suggests the relationship between urban development and degraded stream communities has changed.

**Integration of BCG Work into Statewide Biological Assessments and Stressor Identification: Oregon and Washington**

Shannon Hubler, Chad Larson

Recent work in the PNW focusing on the Biological Condition Gradient (BCG) has yielded a variety of bioassessment tools that will improve stream monitoring throughout the region. Ensuring successful implementation of these tools will require strategic and thoughtful planning. Here, we discuss the differences between OR and WA in how bioassessment data are currently handled from a regulatory standpoint and lay out plans for how the tools developed by the BCG work, specifically the BCG and stressor specific indices (i.e., BSTI and MTTI), might be implemented into future bioassessments and stressor identification work. Successful utilization of these tools has the capacity for increasing the effectiveness of biomonitoring work and for determining the most likely stressor(s) impacting biologically impaired streams and rivers throughout the PNW region.

**Reference conditions and ecological status classes for riverine lowland lakes**

Oliver Miler (Northwest Indian Fisheries Commission), Magdalena Czarnecka 2 (Nicolaus Copernicus University Toruń, Poland); Mario Brauns (Helmholtz Centre for Environmental Research – UFZ, Brückstr)

Riverine lakes are found in many geographic regions shaped by glacial processes and are characterized by a lack of typical stratification, a short water residence time and high water discharge via a river that connects to the lake with an in- and outlet. Despite riverine lakes being widespread in the Central

European lowlands in Northeastern Germany and Northern Poland, an EU-wide applicable definition for riverine lakes does not exist so far and they are only distinguished as a separate lake type in biotic assessments in Germany. We compared the macroinvertebrate community composition between near-natural riverine lakes and three other types of near-natural lowland lakes to determine if riverine lake macroinvertebrate communities significantly differed from other lake types. Moreover, we quantified how macroinvertebrate communities from riverine lakes change along a degradation gradient as the basis for developing ecological status classes. Results showed that macroinvertebrate communities significantly differed (1) between riverine lakes and other lowland lake types and (2) between riverine lakes of different ecological status classes. Riverine lakes compared to other lake types were characterized by comparatively low maximum water depths and high % macrophyte and % xylal (tree roots and coarse woody debris) habitats. This corresponded well to the habitat requirements of some riverine lake indicator taxa, e.g., Hippeutis complanatus (Gastropoda) and Acroloxus lacustris (Gastropoda) which often occur as grazers in macrophyte-dominated habitats. Oulimnius tuberculatus (Coleoptera) and Nemoura sp. (Plecoptera) which are characteristic for lotic environments, were significant indicator taxa for riverine lakes. Highly degraded riverine lakes compared to less degraded and near-natural lakes in our study were characterized by the indicator taxa Unio pictorum ssp. (Bivalvia), Chelicorophium curvispinum (Crustacea) and Dreissena polymorpha (Bivalvia), with the latter two being invasive species originating from the Ponto-Caspian region. We could show the majority of indicator taxa to be indicative of near-natural lakes, followed by highly degraded lakes, whereas intermediate disturbance levels were less well represented by indicator taxa. To validate, if the ecological status classes identified based on environmental variables and supported by indicator taxa in this study actually and reliably correspond to the conditions of the macroinvertebrate communities, it is necessary to statistically analyze the relationships between macroinvertebrate metrics and environmental variables in riverine lakes displaying a degradation gradient. The EU WFD requires the use of typologies for assessments and our results clearly show the distinctness of riverine lakes with respect to littoral macroinvertebrates in an a-posteriori approach. We suggest to clearly assign the term riverine lakes to unstratified lakes with a short water residence time and to distinguish riverine lakes as a separate lake type in macroinvertebrate-based ecological assessments.

**POSTER ABSTRACTS**

**Wildfire burn severity differs between riparian buffers and whole stream catchments, Robert Brown (Oak Ridge Institute for Science and Education (ORISE), Corvallis, Oregon; USEPA US Forest Service)**, Joseph Ebersole (USEPA), Rebecca Flitcroft (US Forest Service) , Christine Hirsch (US Forest Service) , David Hockman-Wert (US Forest Service) , Marcía Snyder (US Forest Service) , and Sara Wall (Oak Ridge Institute for Science and Education (ORISE), Corvallis, Oregon; US Forest Service)

Wildfire is a characteristic disturbance process affecting Pacific Northwest (PNW) ecosystems, but fire regimes are variable across the region. Increasing wildfire frequency and severity can interact with other anthropogenic disturbances in the PNW to influence aquatic ecosystems already susceptible to climate changes. Quantifying aquatic ecosystem responses to fire requires assessment of burn severity for spatial extents at which wildfire-aquatic linkages are most directly connected. For example, wildfires in riparian buffers are expected to have less severe impacts on soil and vegetation compared to those in

upland areas, but proximity to streams likely results in stronger wildfire-aquatic linkages. Therefore, the relationship of burn severity with in-stream ecological responses and recovery trajectories likely varies with the spatial extent at which burn severity is quantified (i.e. riparian buffer vs. whole stream catchment). In this poster, we assess paired differences in burn severity between 100m riparian buffers and whole stream catchments for 85 long-term stream monitoring sites. Long-term ecological monitoring programs in fire prone regions provide valuable datasets with which to assess stream ecological responses to fire. The Aquatic and Riparian Effectiveness Monitoring Program (AREMP) was initiated in 2002 to evaluate Northwest Forest Plan management practices by collection of long-term, in-stream data at 1,411 study sites. Of these study sites, 376 (27%) have experienced fire within their 100m upstream riparian buffer since 1984 according to raster layers derived from the Monitoring Trends in Burn Severity
(MTBS) database. Because many of these sites are nested within drainage networks, we selected the most downstream sites (n = 85) and assessed paired median differences in burn severity between 100m riparian buffers and whole stream catchments in terms of (1) percent of total area burned; (2) percent area of moderate to high burn severity; and (3) percent area of low burn severity. Paired differences in burn severity extents showed total area burned was 2.4% lower and moderate to high severity burns were 5.0% lower in riparian buffers compared to whole stream catchments (both p < 0.001). Low severity burns appeared to be slightly higher in riparian buffers, but this result was less significant (p = 0.11). Ongoing research will use mixed effects models, including nested sites within drainage networks, to account for the influence of watershed size, elevation, slope, aspect, and precipitation on riparian vs. whole stream catchment burn severity differences. Our results support existing literature suggesting that riparian buffers are typically less severely burned than upslope areas. These differences highlight a need to consider wildfire impacts on streams at multiple spatial extents as burn severity and proximity likely influence in-stream biomonitoring responses and decisions around ecosystem management. The views expressed in this presentation are those of the authors and do not reflect those of ORISE, the USEPA or USFS.

**Natural disturbance regimes and community structure: Exploring community-level diversity in temporary and permanent ponds,** Courtney Hendrickson, Betsy Bancroft, Tiffany Garcia
Understanding how disturbance events impact community organization is crucial for management and conservation of aquatic species. Predictable natural disturbance regimes (NDR), such as the seasonal filling and drying of ponds, play a central role in shaping the evolutionary life histories of organisms. We posit that NDRs prime communities with resilience mechanisms such as species and trait diversity, to better respond to climate change disturbance. Heightened species richness increases the number of possible functional traits and asynchronous species responses available in a system, enhancing the chance of resistant species able to compensate for the loss of vulnerable species. Body size is an important trait regulating physiological and behavioral outcomes and can shift in response to environmental cues, producing feedback across ecological scales in both aquatic and terrestrial systems. Thus, body size provides an ecologically important metric for phenotypic flexibility that can be easily measured across taxa. To compare diversity mechanisms in temporary and permanent ponds, we measured species richness (species diversity) and body size (trait diversity) in fish, amphibians, and aquatic macroinvertebrates in ponds across the Willamette Valley, OR. We hypothesized that

communities in temporary ponds, experiencing more frequent NDRs, will be more species rich and exhibit higher body size variability compared to communities in permanent ponds. These observations will inform mesocosm experiments examining community-level climate change resiliency thresholds. Altogether, this in situ comparison of species richness and size structure, paired with future experimental exploration of resiliency thresholds will provide insight into community-level response to disturbance, with implications for the importance of phenotypic flexibility, species diversity, or the convergence of both mechanisms in resilience to climate change.

**Monitoring and conserving freshwater mussels in the Lower Boise River, Colin Custer** (City of Boise) and Dorene MacCoy (City of Boise).

The City of Boise (City) has begun monitoring several populations of Western Pearlshell Mussels (*Margaritifera falcata*) in the Lower Boise River. The City sampling and monitoring team (SAM) began searching for the presence of mussels to provide background information for Idaho negotiated rulemaking for ammonia aquatic life criteria. After confirming the presence of the mussels in the Lower Boise River, the City shifted to a conservatory role.

**Evaluation of wildfire impacts on surface soil moisture in the Pacific Northwest using remote sensing soil moisture data - Hyunwoo Kang (Oregon State University)**
Co-authors: Cameron E. Naficy (US Forest Service), Kevin D. Bladon (Oregon State University)

The Pacific Northwest (PNW) has experienced a surge in more extensive and increasingly severe wildfires over recent decades. These fires threaten hydrologic processes, water quantity, water quality, aquatic ecology, and downstream drinking water treatment. These potential threats have led to increased research on the impacts of wildfires on diverse aspects of hydrology, including streamflow, evapotranspiration (ET), stream nutrients and carbon, and components of aquatic ecosystems. However, research addressing wildfire impacts on post-fire soil water content, which has the potential to influence many other hydrologic components at scales beyond the hillslope or watershed level, has been rare. We studied soil water content response to the 2020 Labor Day fires in the Oregon Cascades, which burned more forest area than the cumulative total of the previous 36 years, predominantly at high severity. In our study, we used a 1-km resolution surface (5 cm depth) soil moisture dataset from the Soil Moisture Active Passive (SMAP) mission to investigate surface soil moisture in burned and unburned areas of the McKenzie and North Santiam sub-basins during pre- (2016–2020) and post-fire periods (2021–2022). During the rainy season (October to May), soil water content was greater in the burned areas. However, during the dry season (July to September), soil water content was slightly lower in burned areas because wildfires make the soil more vulnerable to moisture loss by removing litter and duff, which can store more moisture in the surface areas. The absence of vegetation in the burned regions led to increased net precipitation but decreased ET and interception, which contributed to elevated surface soil moisture during the rainy season. Despite prior research highlighting post-fire soil water repellency, which can

significantly reduce the infiltration rate, the effect of increased net precipitation in burned areas was more
pronounced. Besides, those increased soil moisture during the rainy season and decreased soil moisture during the dry season were predominant with higher burned severity. Our study offers a unique approach
to assessing post-fire soil moisture dynamics at a watershed scale, which may inform future watershed management decisions or facilitate an improved understanding of post-fire vegetation recovery and hydrologic responses.

**Hood River Restaurants.** *BIPoC - owned.

**Broder Øst**, 102 Oak St., #100, Hood River OR 97031: Savor a Scandinavian breakfast or lunch in the Historic Hood River Hotel. Open daily 8 am – 3 pm. 541-436-3444.

**Camp 1805**, 501 Portway Ave., Hood River OR 97031: Craft distillery and bar along the Columbia River. Open Sun 12-8 pm, M-F 3-930 pm, Sat 12-10 pm. 541-386-1805

**Doppio Coffee and Lounge**, 310 Oak St., Hood River OR 97031: Local, organic, sustainable, fair trade; breakfast and lunch menu. Open daily 7 am – 6 pm. 541-386-3000.

**Double Mountain Brewery and Taproom**, 8 Fourth St., Hood River OR 97031: Craft beers, pizza, and sandwiches. Open Su-Th 11;30 am – 9 pm, F-Sa 11:30 am – 10 pm. 541-387-0042.

**Egg River Café,** 1313 Oak St., Hood River OR 77031: Breakfast and lunch fare. Open daily 6 am – 2 pm. 541-386-1127

**Ferment Brewing Company**, 403 Portway Ave., Hood River OR 97031: Brewery using traditional farmhouse techniques overlooking the Columbia River. Open daily 11 am – 9 pm. 541-436-3499.

**Freshies Bagel and Juice**, 13 Oak St., Hood River OR 970312: House-made bagels for breakfast and lunch sandwiches. Open daily 630 am – 4 pm. 541-386-2123.owned

**Full Sail Brew Pub**, 506 Columbia St., Hood River OR 97031: Family-friendly pub with heated covered deck providing view of the river. Open daily 11 am – 9 pm. 541-386-2247.

***Grace Su's China Gorge Restaurant**, 2680 Old Columbia River Highway, Hood River OR 97031: Family-owned restaurant serving traditional Hunan and Szechuan recipes. Open Tu-Su 11 am – 8 pm. 541-386-5331.

***Hood River Taqueria and Mexican Restaurant**, 1210 13th St., Hood River OR 97031: Mexican food with a Jalisco flair. Open W-M 9 am – 9 pm. 541-387-3300.

**Kickstand Coffee and Kitchen**, 1235 State St., #100, Hood River OR 97031: Community-focused restaurant using local ingredients with a global twist. Open Su-Th 8 am – 9 pm, F-Sa 8 am -930 pm. 541-436-0016.

***Michoacan Grill**, 3405 Odell Highway, Hood River OR 97031: Made from scratch daily. Open W 10 am – 2 pm, Th 10 am – 4 pm, F & Sa 10 am – 730 pm, Su 8 am – 630 pm. 541-354-2900

**pFriem Family Brewers** 707 Portway Ave., suite 101, Hood River OR 97031: 15-barrel brewery and tasting room on the Hood River waterfront. Open daily 11 am – 9 pm. 541-321-0490

**Pine Street Bakery**, 1103 12th St., Hood River OR 97031: Bread, sandwiches, soups, pastry made fresh every day. Open M-Sa 7 am – 3 pm. 541-386-1719.

**River Daze Café**, 202 D Cascade Ave., Hood River OR 97031: local, organic, non-GMO artisanal fare. Open M-F 8 am – 3 pm, Sa-Su 8 am – 4 pm.

**Sixth Street Bistro and** Loft, 509 cascade St., Hood River OR 97031: Local sustainable food made from scratch. Open F-M 12-8 pm. 541-386-5737.

**Solstice Wood Fire Café and Bar**, 501 Portway Ave., Hood River OR 97031: waterfront café serving fresh, local, organic fare. Open W-F 11:30 am – 8 pm, Sa 11 am – 9 pm, Su 11 am – 8 pm. 541-436-0800.

**Sushi Okalani**, 109 1st St., Hood River OR 97031: Family-style Japanese and Pan-Pacific food. Open M-Th 5-9 pm, F 5-10 pm, Sa 5-9 pm.

***Taqueria Ayala**, 13th & Taylor St., Hood River OR: Food truck serving tacos, tamales, burritos, chili relleno, and more. Open daily 10 am – 4 pm. 541-490-2587.

**Three Rivers Grill**, 601 Oak St., Hood River OR 97031: PNW cuisine made with local ingredients. Open daily 11 am – 8:30 pm. 541-386-8883.