Fellow Ecologists and Water Resource Professionals:

This program agenda includes information about our keynote speakers and contributed presentations to our 2020 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 **30th** 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!

To accommodate travel restrictions, social distancing, and community health response to COVID we have elected to host a virtual meeting this year. Connections provided by an on-site meeting are important to all of us as is the health and well-being of our colleagues, presenters, and families. To maximize participation and support our community, registration fees were waived this year. We are optimistic that 2021 will provide the opportunity to reset and host an on-site meeting in Washington. In the spirit of keeping us connected during these unprecedented circumstances, **Jessie Doyle** has done an amazing job advancing our social media presence. Kudos to you Jessie, we are thankful for your energy, expertise, and professionalism. We encourage you to visit or subscribe to our: Website, Facebook, Instagram, Linked In, or Twitter sites.

Over the next year, we are looking forward to advancing diversity, inclusivity, and equity goals. Over the past year our steering committee has begun discussing approaches to improve participation by younger (student and early career), Black, Latino, Asian, Indigenous, and LGBTQ+ scientists. Thank you to **Celeste Searles Mazzacano**, **Francine Mejia**, **Rob Plotnikoff**, and **Judy Li** for your leadership, we are grateful for your efforts to better our Chapter.

The opening session begins on Wednesday, November 18th at 1:00 pm with our keynote speaker **Lorraine Loomis**. Lorraine is the fisheries manager of the Swinomish Tribe and the chair of the Northwest Indian Fisheries Commission. We are confident that our 2020 Annual Meeting will be an exciting and informative event that all will enjoy. We look forward to seeing you!

Sincerely,

Your 2020 Meeting Steering Committee At-Large
Bob, Chris, Rob, Chad, Jessie, Francine, Judy, Celeste, Oliver, Dorene, and Joe

CONNECTION INFORMATION

SPEAKER PRACTICE SESSION

Speakers are invited to connect to our Zoom meeting platform on November 17th, 2020 to practice working with our moderators and meeting technology. If you are interested in participating in our practice session, please click on the link below to register. As a safeguard to unexpected bandwidth limitations, speakers should consider sending their final presentation to the steering committee (via zell.christopher@epa.gov) by November 13th, 2020 5:00 pm PST so that moderators can advance the slides if needed.

Practice Session Link
When: Nov 17, 2020 09:00 AM Pacific Time (US and Canada)
https://zoom.us/meeting/register/tJYvduGsrjwoHtMxGMxANYusf_rPq2KrQPUB

Please Register for Our Virtual Meeting
Day 1: November 18th, 2020 1:00 PM Pacific Time (US and Canada)
Registration Link-> https://zoom.us/meeting/register/tJokc--srzovGtDI7eJ6Jdi27GstkwHxDRAM

Day 2: November 19th, 2020 9:00 AM Pacific Time (US and Canada)
Registration Link-> https://zoom.us/meeting/register/tJYode2pqzorGtSyFzPUFhKLw1tHNv9fMGId

MEETING GROUND RULES

Our 2020 meeting will be the first virtual event hosted by the Chapter. Please help our dialogue run smoothly by keeping your camera off and microphone muted unless you are presenting or asking a question. In addition, we encourage you to log off virtual networks to reduce interference and improve your connection experience. Each session will feature a facilitator, moderator, and of course our wonderful panel of speakers. Our facilitator will introduce and transition between speakers. Our moderator will post logistics and track question in the chat box. Questions, thoughts, and observations should be raised in the meeting chat box. At the conclusion of an individual talk or session, the moderator will call on attendees to share their question at which time the questioner may turn on their microphone (and camera if you choose) for the duration of the question. The moderator reserves the right to guide and take those actions necessary to facilitate a professional and collegial conversation.

SCHEDULE AT GLANCE

Wednesday, November 18, 2020

TIME	TOPIC	SPEAKER
1:00 pm – 1:15 pm	Welcome and Logistics	Bob Danehy
1:15 pm – 1:45 pm	TBD - Tribal Fishery Insights in the Pacific Northwest	Lorraine Loomis
	Pacific Northwest Fisheries and Applications	
1:45 pm – 2:00 pm	The USGS National Fisheries Program: Efforts Towards Reimaging a Modern Government Aquatic Science Research Program	Dave Hu
2:05 pm – 2:20 pm	Developing a Framework for Assessing Adaptive Capacity in Stream Networks Using Agent-Based Models for Redband Trout	Christopher C. Caudill and Travis Seaborn
2:25 pm – 2:40 pm	Update of the City of Boise 316(a) Demonstration Project for the Lander Street and West Boise Water Renewal Facilities, 2020	Dorene MacCoy
2:40 pm – 3:00 pm	Break	All
	Physical Habitat and Temperature	
3:00 pm – 3:15 pm	Development of Empirical Models to Estimate Channel Dimensions in the Contiguous US	Jessie Doyle, Ryan Hill, and Scott Leibowitz
3:20 pm – 3:35 pm	Spatial and Temporal Variation of Large Wood in a Coastal River	Kim Yazzie et al.
3:40 pm – 3:55 pm	Longitudinal, Lateral, Vertical, and Temporal Thermal Heterogeneity in a Large Impounded River: Implications for Cold-Water Refuges	Francine Mejia et al.
3:55 pm – 4:00 pm	Day 1 Wrap-Up and Comments	Bob Danehy
Thursday, November 19th, 2020		
	Hydrologic Analysis and Flow Considerations	
9:00 am – 9:10 am	Day 2 Welcome and Logistics	Bob Danehy
9:10 am – 9:25 am	Estimating Regional Patterns and Drivers of Flow Alteration in US Pacific Northwest Rivers and Streams Based on Channel Morphology from EPA's National Aquatic Resources Surveys	Phil Kaufmann
9:30 am – 9:45 am	Tools for Tackling the Question of Flow Permanence in Headwater Streams in the Pacific Northwest	Jason Dunham
9:50 am – 10:05 am	A Meta-Analysis of Surface Water Abstraction Impacts on Macroinvertebrates	David Wooster
10:10 am – 10:25 am	Assessing Hydrologic Change and Spatial Covariance Among Time Series of River Discharge Across Western North American	Lillian McGill and Gordon Holtgrieve
10:30 am – 10:45 am	Time Series Analysis of Hydrological Data of the Deschutes River in Washington State	Oliver Miler, Robert Conrad, and Erica Marbet
10:45 am – 11:00 am	Break	All
11:00 am – 11:45 am	State Roundtable – What's going on?	Agency Leads, All

Thursday, November 19th, 2020 (continued)

Benthic Communities and Management #1

TIME	TOPIC	SPEAKER
1:00 pm – 1:15 pm	Calibration of the Biological Condition Gradient (BCG) for Macroinvertebrate Assemblages in the Pacific Northwest Maritime Region of Oregon and Washington; Phase II Model Development	Rob Plotnikoff and BCG Workgroup
1:20 pm – 1:35 pm	Incorporating the Biological Condition Gradient Concept into the National Aquatic Resource Surveys: How do we (or can we) get there from here?	David Peck, Steven G. Paulsen, Alan T. Herlihy
1:40 pm – 1:55 pm	Stream Food Web Responses to Riparian Thinning in Second-Growth Redwood Forests	David Roon et al.
	Benthic Communities and Management #2	
2:15 pm -2:30 pm	Now You See Them, Now You Don't: Variations in *Margaritifera falcata* (Western Pearlshell) Habitat Across Different River Systems.	Celeste A. Searles Mazzacano, Travis Williams
2:35 pm – 2:50 pm	Can Active Recolonization of Bugs Help Restore Biodiversity in Urban Streams?	Kate Macneale
2:55 pm – 3:05 pm	Surprising Insights from Long-Term Monitoring: Improvements in Benthic Macroinvertebrate Integrity Scores and Sensitive Taxa Richness Despite Increased Development in King County, WA	Beth Sosik and Kate Macneale
3:10 – 3:45 pm	**Meeting Wrap-Up and 2021 Planning**	**Bob Danehy**

PRESENTATION ABSTRACTS PROVIDED BY AUTHORS

PLENARY: TBD - Tribal Fishery Insights in the Pacific Northwest
Lorraine Loomis, Chair of Northwest Indian Fisheries Commission

DEVELOPING A FRAMEWORK FOR ASSESSING ADAPTIVE CAPACITY IN STREAM NETWORKS USING AGENT-BASED MODELS FOR REDBAND TROUT

Christopher C Caudill, Associate Professor, University of Idaho
Travis Seaborn, University of Idaho

Adaptive capacity is an important emerging concept for predicting impacts of environmental change, but the factors of systems conferring adaptive capacity are poorly known. The Idaho EPSCoR GEM3 project is using a combination of landscape genomics to assess local adaptation, common garden experiments, physiological ecology, field studies, remote sensing and modeling to evaluate the impact of changing socio-ecological systems on populations of redband trout (*Oncorhynchus mykiss gairdneri*) in Idaho, with the goal to identify factors associated with population adaptive capacity. A key area of uncertainty is the role of 'plastic rescue' through the expression of phenotypic plasticity as populations encounter extreme and/or novel environmental conditions under rapid environmental change. We created a model of redband trout using CDMetaPOP in Jacks Creek in southern Idaho. The location was selected for initial model simulations because average August temperatures exceed those known to induce physiological stress in *O. mykiss gairdneri* (20 °C) in parts of the stream network, and local genetic adaptation to thermal stress has been demonstrated. The goal of the simulations is to understand how individual-level variation in genetics and plasticity affect the adaptive capacity of a species in stream environments at the landscape scale as the regional climate warms. We ran models using projected stream temperature data through 2099 under four broad scenarios: 1) historic environmental conditions; 2) warming climate 3) warming climate with adaptive loci ("genetic rescue"); and 4) including genetically-based phenotypic plastic traits for thermal tolerance and movement ("plastic rescue"). Inclusion of an adaptive allele prevented decline in population sizes regardless of climate in early simulations, although this effect was dependent on the amount of dispersal in model. Similarly, the rates of homozygosity and counts of the adaptive allele were heavily influenced by the amount of movement of individuals, highlighting the potential roles of movement behavior, connectivity, and habitat heterogeneity within the landscape. Future efforts will use refined parameter estimates obtained from the common garden and field experiments, and locations with differing thermal regimes. The ABM simulations will provide insight into the relative importance of genetic and phenotypically plastic traits and the spatial arrangement of habitat elements in dendritic networks in demogenetic population dynamics. More broadly, application of ABM simulations can be used to identify key components and metrics of adaptive capacity and to evaluate conservation and management options such as assisted migration and land use planning.

DEVELOPMENT OF EMPIRICAL MODELS TO ESTIMATE CHANNEL DIMENSIONS IN THE CONTIGUOUS US

Jessie Doyle, Ryan Hill, and Scott Leibowitz. US Environmental Protection Agency, Corvallis, OR.

Stream channel dimensions influence many critical features of stream ecosystems, such as temperature, habitat quantity, and water quality, and serve as key inputs for many ecohydrological and habitat models used for management. Although field measurements of channel dimensions are ideal to characterize habitat and parameterize management models, they are not always available, and obtaining parameter measurements can be costly and limit the spatial extent of modelling applications. Therefore, estimates of channel dimensions at unmeasured locations could facilitate the characterization of streams when measurements are unavailable for initial model parameterization, and help improve the management of these ecosystems.

We used empirical modeling to interpolate stream widths and depths to 1.1 million stream segments across the contiguous US. Specifically, we created four models: (1) wetted width, (2) thawleg depth, (3) bankfull width, and (4) bankfull depth. To do so, we used channel dimension measurements at 3,233 sites from the USEPA's 2008/09 and 2013/14 National Rivers and Streams Assessment. Stream dimensions were modeled with random forests and predictor
variables from the USEPA StreamCat dataset, which contains several hundred watershed metrics of land use, climate, geology and others. The wetted width, thawleg depth, and bankfull width models performed well with high r-squared values (≥79%) and median absolute errors within ±21.6% to ±25% of measured values across all stream orders. The bankfull depth model performed less well, explaining just 40% of the variation in measured values. We tested regional models of bankfull depth but found no improvement in model performance. A possible reason for poorer performance in the bankfull depth model could be the difficulty of identifying and measuring bankfull stage in the field and the sensitivity of depth measurements relative to bankfull width. Similar models in the literature were unavailable to compare with our models of wetted width, thalweg depth, and bankfull depth. However, we could compare the bankfull width model to another model from the literature. Through this comparison we observed that our model produced a similar, and sometimes better, spread of regional predictions, r-squared values, and root mean square errors. These results indicate that this modeling effort improved on previous models and point to the potential utility of our interpolations when measured channel dimensions are unavailable. Possible improvement will be explored for these models, such as log transformations of response variables. Upon publication of these models, we plan on making the interpolated values for 1.1 million stream segments publicly available through the StreamCat dataset, which will facilitate their use by aquatic resource managers and researchers.

TOOLS FOR TACKLING THE QUESTION OF FLOW PERMANENCE IN HEADWATER STREAMS IN THE PACIFIC NORTHWEST

Jason Dunham, U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center

Where are streams? What are their patterns of wetting and drying? How are these related to land cover, climate, and landform? These questions form the core of several ongoing studies conducted from local to regional extents in the Pacific Northwest. In this presentation I provide an overview of results from published work and new tools for quantifying flow permanence in this region. The PREDdiction Of Streamflow Permanence or PROSPER model has relied on vast troves of existing stream survey data to provide broad-scale predictions of the probability of perennial stream flow across years in the region. Within individual watersheds, Spatial Stream Network models have used more detailed time series information to predict seasonal patterns of drying across shorter time frames. To fuel future investigations, the "FLOwPER" (FLOw PERmanence) tool was also released this year, which can be downloaded to most mobile devices and used to easily collect data on flow permanence in streams. These efforts have involved collaboration across multiple USGS Centers, the Forest Service, Bureau of Land Management, and several other agencies and organizations. A more unified approach to updating hydrography and flow permanence promises to improve many aspects of land and water management and understanding of the processes driving the expansion and contraction of stream networks.

THE USGS NATIONAL FISHERIES PROGRAM: EFFORTS TOWARDS REIMAGING A MODERN GOVERNMENT AQUATIC SCIENCE RESEARCH PROGRAM

Dave Hu, US Geological Survey, Fisheries Program Manager

The USGS is modernizing our National Fisheries Program. We are working to create a more collective vision, update our business models, and develop new strategies to build upon over the near future. Our ability to do holistic and integrated or multi-disciplinary aquatic research encompassing species biology, habitats, as well as physical, chemical, and biological stressors and landscape drivers, represents the government value we offer and is something that the USGS excels at.

As such it is imperative that we are well coordinated and leveraging the wealth of expertise, capacities, and resources across USGS Science Centers, Regions, and Mission Areas, and with our partners. This presentation will present a brief overview of our rebranding process and the programmatic and organizational structure that we consider to be part of the USGS fish and aquatic species research portfolio.

ESTIMATING REGIONAL PATTERNS AND DRIVERS OF FLOW ALTERATION IN U.S. PACIFIC NORTHWEST RIVERS AND STREAMS BASED ON CHANNEL MORPHOLOGY FROM EPA'S NATIONAL AQUATIC RESOURCE SURVEYS

Philip R. Kaufmann, US Environmental Protection Agency, Corvallis, Oregon

As in many regions of the U.S., alterations in the flow of Pacific Northwest rivers and streams have great potential to adversely affect physical habitat, water quality, and biological assemblages in these waters. The magnitude, frequency and timing of stream flows can be altered by flood and low flow management, changes in drainage basin impervious area, extraction of surface and groundwater, and by natural or anthropogenic changes in precipitation or evaporation. In collaboration with EPA and USGS colleagues, I calculated several indicators of hydro-alteration using field measurements of channel morphology routinely collected at sites sampled by the USEPA's National Aquatic Resource Surveys (NARS). By truthing these estimates against USGS gauges and NARS snapshot discharge measurements, we were able to expand on the range of stream and river sizes where discharge measurements were available. This enabled us to estimate hydro-alteration in all the NARS sites, where comprehensive measures of biota, physical habitat, and chemistry are also made. Our predictions of low-flow discharge (Log-transformed) had regression RMSE=0.54 compared with actual low flow discharge measurements (m^3/s and $m^3/s\text{-}km^2$) ranging over six orders of magnitude at >300 closely matched USGS gauge locations in the U.S. At the same locations, we predicted bankfull floods (Log-transformed) that recur at intervals ranging between 1.3 and 2.5 yr, with regression RMSE=0.50. The primary drivers of discharge in Pacific Northwest river and stream sample sites were drainage area, precipitation, and temperature; but we demonstrated altered summer low and bankfull flows associated with the general level of anthropogenic activity. Diminished summer low and bankfull flows were primarily associated with agricultural land use, particularly when located in or near riparian areas, whereas urban land uses were associated with augmented summer and bankfull flows. Our approach offers promise for supporting the evaluation of the effects of hydrologic alteration on physical habitat and biota in rivers and streams.

UPDATE OF THE CITY OF BOISE 316(A) DEMONSTRATION PROJECT FOR LANDER STREET AND WEST BOISE WATER RENEWAL FACILITIES, 2020

Dorene MacCoy, City of Boise, ID

At the 2018 Society for Freshwater Science, Pacific Northwest chapter meeting in Ketchum, ID, the City of Boise (City) staff gave information on our proposed thermal variance for municipal discharge to the Boise River. This approach is available to dischargers and written in section 316(a) of the Clean Water Act. The City proposed this alternative in the discharge permit reapplications submitted through the Idaho Pollution Discharge and Elimination System (IPDES) for the Lander Street and West Boise Water Renewal Facilities (WRFs) that discharge to the Lower Boise River. Municipal wastewater is warmed during treatment processes by a variety of mechanisms, including solar radiation on open tanks and treatment used to support biological nutrient removal processes. Resultant discharges may contribute a thermal load to the receiving water. Due to the City's population growth and the increased demand for treated water, alternatives to reducing thermal load were evaluated. The temperature limits set by US Environmental Protection Agency (EPA) were based on a reasonable potential to exceed (RPE) evaluation, which are used to develop discharge limits for toxic pollutants such as metals and ammonia. The RPE method was not appropriate for setting thermal discharge limits. Additionally, the limits proposed were more stringent than necessary for the protection of the indigenous aquatic community in the discharge area. In cooperation with Idaho Department of Environmental Quality (IDEQ) a 316(a) evaluation was considered.

There are two demonstrations defined in the 316(a) guidance documents; 1) Prove that there was no appreciable harm of indigenous communities from facility thermal discharge (type 1); and 2) a predictive approach that proposes alternative thermal limits (ATELs) using existing data and literature that demonstrate protection of the health and reproduction of the balanced indigenous community (BIC) and the more sensitive representative important species (RIS; type 2). It was determined that there was not enough historic data to do a type 1 demonstration. Using continuous temperature, modeled temperature, macroinvertebrate and fish community data from the Boise River and other rivers in Idaho, the City completed a type 2 demonstration that proposed several thermal thresholds for RIS and provided protective ATELs. This presentation will give the audience a brief description of the 316(a) process and the progress the City has made. The proposed temperature management approach allows for habitat improvement projects which will benefit both environmental and economical long-term mitigation.

ASSESSING HYDROLOGIC CHANGE AND SPATIAL COVARIANCE AMONG TIME SERIES OF RIVER DISCHARGE ACROSS WESTERN NORTH AMERICA

Lillian McGill and Gordon Holtgrieve, University of Washington

In western North America, many rivers rely on winter precipitation and the resulting snowpack to sustain spring and summer streamflows. Climate models predict substantial winter warming, leading to increased precipitation falling as rain and decreased mountain snowpack. Subsequent changes to the timing, duration, and magnitude of streamflow over the course of the year are expected. To date, numerous studies have analyzed historical trends in streamflow to determine if climate induced changes are already present, but few have gone beyond simply checking for the presence of monotonic trends at individual stations. In this study, we utilize dynamic factor analysis (DFA) to characterize the dominant observed patterns of change among discharge time series, assess their spatial covariance, and examine relationships with global scale climatic processes. Specifically, we fit DFA models to time series of eight discharge metrics that capture ecologically relevant facets of streamflow across 183 climate reference rivers. We found support for grouping the time series according to 3 latent variables (trends) and including PDO and ENSO indices as covariates. Latent trend loadings were regionally coherent and varied strongly with latitude for all metrics. Results highlight the complexity of climate change impacts on river discharge and suggest that in the future we will see differing impacts across space. Future work will include spatial autocorrelation in DFA models to determine if river types (e.g. snow or rain dominant) behave similarly, regardless of geographic area.

CAN ACTIVE RECOLONIZATION OF BUGS HELP RESTORE BIODIVERSITY IN URBAN STREAMS?

Kate Macneale, King County Water and Land Resources, Seattle, WA

Can moving sensitive macroinvertebrate communities to isolated urban streams increase diversity and improve benthic index of biotic integrity (B-IBI) scores? We tested this idea in four streams in King County, WA. The recipient streams were selected because their B-IBI scores were lower than expected (given the surrounding land use), and they are far from sources of sensitive taxa. In the summer of 2018, we translocated approximately 46,000 individuals, including 40 or more unique taxa not found in the recipient streams, to each of the recipient streams. In the summer of 2019, we found several of those translocated taxa persisted, and in two of the four streams B-IBI scores improved. Continued monitoring is needed to demonstrate sustained establishment, and therefore long-term success, but initial results suggest active recolonization of macroinvertebrates may be an appropriate tool for jump starting recovery in isolated, under-performing urban streams.

LONGITUDINAL, LATERAL, VERTICAL, AND TEMPORAL THERMAL HETEROGENEITY IN A LARGE IMPOUNDED RIVER: IMPLICATIONS FOR COLD-WATER REFUGES

Francine H. Mejia and Christian E. Torgersen, U.S. Geological Survey
Eric K. Berntsen, Joseph R. Maroney, and Jason M. Connor, Kalispel Tribe of Indians Natural Resources Department
Aimee H. Fullerton, Fish Ecology Division, Northwest Fisheries Science Center
Joe Ebersole, US Environmental Protection Agency, Corvallis, OR
Mark S. Lorang, FreshwaterMap, Bigfork, MT

Dam operations can affect mixing of the water column, thereby influencing thermal heterogeneity spatially and temporally. This occurs by restricting or eliminating connectivity in longitudinal, lateral, vertical, and temporal dimensions. We examined thermal heterogeneity across space and time and identified potential cold-water refuges for salmonids in a large impounded river in inland northwestern USA. To describe these patterns, we used thermal infrared (TIR) imagery, in situ thermographs, and high-resolution, 3-D hydraulic mapping. We explained the median water temperature and probability of occurrence of cool-water areas using generalized additive models (GAMs) at reach and subcatchment scales, and we evaluated potential cold-water refuge occurrence in relation to these patterns. We demonstrated that (1) lateral contributions from tributaries dominated thermal heterogeneity, (2) thermal variability at confluences was approximately an order of magnitude greater than the main stem, (3) potential cold-water refuges were mostly found at confluences, and (4) the probability of occurrence of cool areas and median water temperature were associated with channel geomorphology and distance from dam. These findings highlight the importance of using multiple approaches to describe thermal heterogeneity in large, impounded rivers and the need to incorporate these types of rivers in the understanding of thermal riverscapes because of their limited representation in the literature.

TIME SERIES ANALYSIS OF HYDROLOGICAL DATA OF THE DESCHUTES RIVER IN WASHINGTON STATE

Oliver Miler and Robert Conrad, Northwest Indian Fisheries Commission
Erica Marbet, Squaxin Island Tribe, Shelton, WA 98584

Seasonal and spatial variability of discharge is an important characteristic of stream flow regimes and a determinant of in stream habitat quality and quantity for fish and invertebrates. Discharge patterns are affected among others by climate, local weather and water extraction. We analyzed a discharge data set from 1950 to 2016 of the Deschutes River in Washington State, U.S.A. Discharge was measured at two sampling stations, at Tumwater (lower reach) and at Rainier (middle reach). We also included precipitation data from the Olympia airport as a covariate in our analyses. Time series analyses of mean daily flow and daily precipitation showed strong linear correlations between the two variables. Time series residuals from these correlations did not show a significant temporal trend. When analyzing the residuals of the correlations between the minimum 5-day rolling sums of discharge and precipitation calculated for each month, seasonal differences became apparent. In the middle reach, discharge decreased over time in August, September and October. Seasonal differences were more pronounced in the lower reach: discharge decreased over time in July, August, September and October, but increased in November, January, March and April. In summary, discharge fluctuations in the Deschutes River have become more extreme from 1950 to 2016, with higher discharges in winter and early spring and lower discharges in summer and autumn. This will likely have negative implications for aquatic organisms, e.g. salmon. Discharge decreases in summer and autumn could impede the spawning migration and the survival of juvenile salmon through a lack of aquatic and riparian habitat and increased water temperatures. The observed changes in seasonal discharge patterns could be caused by climate change and exacerbated by water extraction of residential areas.

INCORPORATING THE BIOLOGICAL CONDITION GRADIENT CONCEPT INTO THE NATIONAL AQUATIC RESOURCE SURVEYS: HOW DO WE (OR CAN WE) GET THERE FROM HERE?

David V. Peck, Steven G. Paulsen, US Environmental Protection Agency, Corvallis, OR
Alan T. Herlihy, Dept. of Fisheries and Wildlife, Oregon State University, Corvallis, OR

A continuing challenge to interpreting bioassessments of streams and rivers across the US is that benchmarks are often based on "reference" sites that represent the lowest levels of human disturbance available in a state or region. These lowest levels, and the biological condition associated with them, vary substantially across the landscape. This variability constrains our ability to make comparisons of biological condition at larger scales. The Biological Condition Gradient (BCG) provides a conceptual framework that purports to provide a common scale of condition that can improve our ability to make comparisons at larger scales and help put least-disturbed conditions in different regions into context. To date, the BCG concept has been developed for individual states or relatively small regions. The EPA's National Rivers and Streams Assessment (NRSA) is a national-scale assessment of stream and rivers that acquires biological, stressor, and landscape-level data from a large number of sites using consistent field and laboratory methods, and allows inferences to be made from the set of sampled sites to a much larger target population. Given both the BCG concept and NRSA have matured over the past 10-20 years, it may be time has come to try to incorporate the BCG concept into NRSA to produce national estimates of condition based on the BCG. In this presentation, we will compare and contrast the BCG approach with the assessment approach used for NRSA (based on the more time-tested use of multimetric indices), describe areas where we think data from NRSA are appropriate for use in BCG development, and identify remaining questions and impediments to applying the BCG concept in NRSA. Our objective is to start constructive dialog and thinking about the process to make it happen.

CALIBRATION OF THE BIOLOGICAL CONDITION GRADIENT (BCG) FOR MACROINVERTEBRATE ASSEMBLAGES IN THE PACIFIC NORTHWEST MARITIME REGION OF OREGON AND WASHINGTON; PHASE II MODEL DEVELOPMENT

Rob Plotnikoff and the BCG Phase II Workgroup

The Biological Condition Gradient (BCG) model conceptually describes how ecological attributes change in response to increasing levels of human-caused stress. The BCG is typically divided into six levels of biological condition along a generalized stressor-response curve, ranging from observable biological conditions found at no or low levels of stressors (level 1) to those found at high levels of stressors (level 6). Following an expert-knowledge based approach to quantify the conceptual BCG, participants assigned sample data to BCG levels and documented their rationale for site assignments leading to development of narrative and then numeric decision rules.
In Phase 1, we calibrated a BCG model for macroinvertebrate assemblages in low and high gradient freshwater perennial streams in the Puget Lowland (PL) and Willamette Valley (WV) Omernik Level 3 ecoregions (Stamp and Gerritsen 2019). In Phase 2, we expanded the study area to include the full Maritime region of Washington and Oregon. The regional dataset included sites in six ecoregions: Coast Range, Puget Lowland, Willamette Valley, Cascades, North Cascades and Klamath Mountains/California High North Coast Range. We also expanded the taxa tolerance analyses to include data from 5787 sites and70 different organizations. The tolerance analyses were run on four anthropogenic disturbance variables from the EPA StreamCat dataset that have been shown to be associated with degraded key watershed functions: the Indices of Catchment and Watershed Integrity (ICI and IWI), percent urban and percent agricultural land cover. Through this process, we developed a master taxa list for the Maritime NW that conforms with the Pacific Northwest Standard Taxonomic Effort (STE) agreement, and refined the tolerance-based BCG taxa attribute assignments based on the expanded dataset BCG panelists assessed 110 samples in Phase 2, with samples broken into three preliminary classes (low gradient/lower elevation; high gradient/lower elevation; and high gradient/higher elevation). During Phase 3, we will complete BCG model development for the Maritime region. The BCG models are intended to supplement existing (independently developed) bioassessment tools, such as Benthic Index of Biological Integrity (B-IBI) and ODEQ's PREDictive Assessment Tool for Oregon (PREDATOR), and to help inform setting protection and restoration goals.

STREAM FOOD WEB RESPONSES TO RIPARIAN THINNING IN SECOND-GROWTH REDWOOD FORESTS

David Roon, Oregon State University, Corvallis, OR
Jason Dunham, US Geological Survey, Corvallis, OR
Ryan Bellmore and Dede Olson, US Forest Service
Bret Harvey, Forest Service Redwood Sciences Lab

Resource managers are actively thinning second-growth forests in the redwoods of coastal Northern California to accelerate the recovery of old-growth forests. These forest restoration practices have largely taken place in upland forests to date and now there is an interest in thinning second-growth forests in riparian zones. In this study we evaluated the effects of riparian forest thinning in a watershed-scale manipulative field experiment following a Before-After-Control-Impact design. We hypothesized that experimental thinning treatments would increase solar radiation and these increases in light would then increase the abundance of stream periphyton, which in turn would influence the seasonal and spatial dynamics of the food webs supporting stream fish and amphibians. To test these hypotheses we measured: stream periphyton abundance; macroinvertebrate communities in the diets of top predators - coastal giant salamanders and coastal cutthroat trout; and stable isotopes of carbon and nitrogen. In this presentation we share preliminary results on how stream food webs responded to thinning. Data from this study provide a whole-system, mechanistic understanding of how the food webs that link streams and riparian forests may shift in response to proposed forest restoration actions in second-growth riparian forests.

NOW YOU SEE THEM, NOW YOU DON'T: VARIATIONS IN MARGARITIFERA FALCATA (WESTERN PEARLSHELL) HABITAT ACROSS DIFFERENT RIVER SYSTEMS

Celeste A. Searles Mazzacano, CASM Environmental, LLC
Travis Williams, Willamette Riverkeeper

Margaritifera falcata (Western Pearlshell) is a broadly distributed Western endemic freshwater mussel. Extant populations vary greatly in density, and declines in population abundance and recruitment rates (i.e., presence of juveniles) have been documented in multiple states and watersheds. This species requires perennial flows and is considered to prefer stable cobble/ boulder substrates in cold, clear water at shallow to moderate depths (0.3-1.5 m) and lower velocities, and to be intolerant of sedimentation. Surveys over the last four years in the Willamette River basin in Oregon indicate that populations of *M. falcata* with multiple shell lengths (a proxy for mussel age), including juveniles (30-50 mm long), can be abundant in waters with a wide variety of flows and substrates. Dense populations have been found in fast, cold flows in cobble/boulder substrate in both shallows and at depths >1 m; in moderate flows in shallow (<15 cm) riffles and in channels in broad swathes of bedrock where sand and fine sediment collects; at the outer bends of fast cold river reaches in patches of sediment trapped in large rock rip-rap at depths >1.5 m; and in warm, shallow (<5 cm) pools at the sandy margins of cobble/gravel streams. Dense populations in both cobble and sand habitats have been also found with large proportions of live adult mussels (33-69%) completely buried in the substrate. Assessment of potential habitat where mussel records are scarce or lacking and prioritization of survey reaches within a single basin may thus need to be fine-tuned for flow and substrate characteristics of individual streams.

SURPRISING INSIGHTS FROM LONG-TERM MONITORING: IMPROVEMENTS IN BENTHIC MACROINVERTEBRATE INTEGRITY SCORES AND SENSITIVE TAXA RICHNESS DESPITE INCREASED DEVELOPMENT IN KING COUNTY, WA

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Stream conditions in King County, WA, are generally improving, according to improving benthic index of biotic integrity (B-IBI) scores. Of 125 randomly distributed sites sampled annually since 2002, B-IBI scores are significantly improving at 37 sites (30%) whereas no sites are significantly declining. These upward trends in B-IBI scores are surprising given there has been increased urbanization within many of the basins during this time frame. Although we do not yet know how conditions have changed over time, we explore which taxa and specific metric may be driving these trends in overall scores. Improvements in overall B-IBI scores appear to be driven by increases in stonefly and caddisfly richness, whereas generally mayfly richness has not increased over time. Increased taxa richness at individual sites and across the county are due to a variety of sensitive taxa that are now found more frequently and at higher abundance than in the past. In contrast, several tolerant taxa that are typically dominant are declining in abundance. We will present results from trends analyses of overall B-IBI scores, metric scores, and individual taxa at local, basin, and regional scales.

A META-ANALYSIS OF SURFACE WATER ABSTRACTION IMPACTS ON MACROINVERTEBRATES

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The abstraction of surface water for human use is one of our most prevalent impacts on river systems. Understanding how much water can be removed from a river for human use before detrimental effects on the river ecosystem emerge is a pressing need in developing sustainable water management. Studies that have examined the effects of surface water abstraction on macroinvertebrates have come to conflicting results; negative effects, no effects, and positive effects have all been reported. A variety of factors can influence this variability including the amount of water withdrawn, duration of abstraction, impact on water temperature, and study methodology. To address these factors and their effect on macroinvertebrates, I conducted a meta-analysis. Keyword searches in the Web of Science, Google Scholar, Agricola USDA/NAL, and Aquatic Sciences and Fisheries Abstracts as well as scanning the literature cited from relevant papers resulted in 220 manuscripts. Each manuscript was examined to determine if the study met the following criteria: 1) included macroinvertebrates, 2) sampled the same stream above and below the point of diversion and 3) reported no potentially confounding factors. Forty-five papers met the criteria. I used log-transformed response ratios to examine macroinvertebrate benthic density, benthic richness, EPT density, Diptera density, drift concentration, and drift flux. Across all studies, only EPT density and drift flux were influenced by water abstraction. I used mixed models to examine the effect of percent water abstracted (%abstracted) and duration of abstraction on macroinvertebrates. When %abstracted was the only independent variable in the model, only drift flux was related to %abstracted. When duration of abstraction was added into the models, a richer pattern in results emerged. Drift concentration was positively related to %abstraction when duration was taken into account, indicating that as %abstraction increases, drifting individuals crowd into smaller volumes of water and/or drift propensity increases. A significant interaction between %abstracted and duration was found for EPT density and drift flux. In both cases, the results indicate a switch-point or threshold in time, when the relationship between macroinvertebrate response and the %abstracted changes. EPT density was negatively related to %abstracted for relatively short durations of abstraction. However, longer durations resulted in negative effects of abstraction on EPT density regardless of the amount abstracted. In contrast, drift flux showed no relationship to %abstracted over short durations, but showed a negative response over longer durations. Increases in water temperature did not have an effect on response ratios. In addition, there was no difference in impact on macroinvertebrates in experimental studies (researchers directly manipulate abstraction) versus non-experimental studies (researches use existing points of diversion). The results of the meta-analysis indicate that benthic density and richness appear resistant to water abstraction.

However, benthic density of EPT taxa and drift dynamics were influenced by water abstraction. In addition, flow-ecology relationships were greatly influenced by duration of abstraction and this should be taken into account when developing flow-ecology relationships to inform sustainable water management practices.

SPATIAL AND TEMPORAL VARIATION OF LARGE WOOD IN A COASTAL RIVER

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Understanding of the processes controlling the spatial dynamics of large woody debris (LWD) is hampered by the lack of data at the watershed level and over ecologically relevant time periods. We aim to understand long-term physical and biological patterns in a coastal riverscape, particularly in the changing distribution of LWD which generates habitat for riverine fishes. Quantifying changes in habitat structure in a regionally important Pacific salmon stream with long-term ecological data can provide critical insight into forested aquatic ecosystems, which have typically been studied at relatively small spatial and temporal scales. Over a twelve-year period, eight years of data were used to assess patterns of instream habitat in the Elk River basin in coastal Oregon. Our preliminary results indicate that LWD in the main stem was more variable than in the six tributaries. A decrease in large wood occurred in 1997 in response to a 500-year flood event, presumably as wood was flushed from the ecosystem. Pronounced patterns of LWD emerged at finer spatial scales, providing further insight into scale-dependent patterns and processes in the stream ecosystem. This study highlights the importance of historical context for understanding the resilience of Pacific salmon to forest disturbance. These results provide a long-term perspective to inform decision-making and planning in the Northwest Forest Plan, which has far-reaching impacts on the socioeconomic fabric of the Pacific Northwest.