Pacific Northwest Society of Environmental Toxicology & Chemistry

Meeting Program

35th Annual Meeting

The Enzian Inn, Leavenworth, WA

April 15–17, 2026

Table of Contents

Meeting Sponsorship

Orca Level Sponsors

U.S. Tire Manufacturers Association

The U.S. Tire Manufacturers Association is the national trade association for tire manufacturers that produce tires in the United States. USTMA members operate 57 facilities in 17 states, are responsible for more than 291,000 jobs and have an annual economic footprint of $170.6 billion. Our mission is to strengthen the competitiveness, societal impact and reputation of the U.S. tire manufacturing industry. Our vision is to be the premier advocate, trusted voice, and thought leader for the U.S. tire manufacturing industry. Advancing safe, sustainable mobility for the future.

Chinook Level Sponsors

GSI Environmental Inc.

GSI Environmental Inc. (GSI) is an engineering and environmental science consulting firm committed to investigating, analyzing, and solving complex environmental problems around the globe. Our work ranges from site remediation and management of chemical hazards, sustainable development of natural resources, and practical solutions for environmental compliance. Our staff combines practical know-how with leading-edge research to deliver timely, innovative, and focused solutions to your environmental challenges

Chinook Level Sponsors (Continued)

WSP

WSP is one of the world's leading professional services firms, uniting its engineering, advisory and science-based expertise to shape communities to advance humanity. From local beginnings to a globe-spanning presence today, WSP operates in over 50 countries and employs approximately 73,000 professionals, known as Visioneers. Together they pioneer solutions and deliver innovative projects in the transportation, infrastructure, environment, building, energy, water, and mining and metals sectors. WSP is publicly listed on the Toronto Stock Exchange (TSX:WSP).

Anchor QEA, Inc.

Anchor QEA is a nationally recognized environmental science and engineering consulting firm specializing in aquatic, shoreline, remediation, and water resource projects, including coastal and flood resiliency. With more than 500 employees in 26 offices across the United States, Anchor QEA works with public and private sector clients to address environmental issues at some of the most challenging sites in the nation by providing planning and strategy development, scientific investigation, engineering design, and construction management. Learn more at anchorqea.com

Chinook Level Sponsors (Continued)

Eurofins

Eurofins Environment Testing operates out of more than 50 laboratories and over 40 service centers across the US. The network can provide full-service Environment Testing capabilities in all US states, either via direct local laboratory participation, or via the extensive logistics network. Through our sustained investment in people, technology, instrumentation, and infrastructure, Eurofins Environment Testing laboratories are positioned to support public and private sectors, DoD, DOE and Municipalities. Services include but are not limited to testing of the following matrices, compound/elemental/wet chemistry suites: Air & Vapor, Drinking/Potable Water, Dioxins/Furans and PCB Congeners, SVOC, VOC and Hydrocarbon, Groundwater, Surface & Non-Potable Water, Metals and Metal Speciation, PFAS, Radiochemistry, Sediment & Tissue, Treatability & Aquatic Toxicology, Soil & Hazardous Waste, Nutrients, Inorganic Non-Metallics, Oil, Fuel & Grease.

ALS

As a global leader in laboratory testing services, ALS supports industries and governments across the USA and Canada with reliable scientific solutions. ALS's environmental testing capabilities include robust assessment of water, air, soil, and biological media to support environmental protection, sustainability initiatives, and public health objectives. Through advanced instrumentation, standardized quality systems, and experienced technical staff working from more than 30 locations across the USA and 34 across Canada, ALS delivers dependable data that informs responsible environmental management for our Clients.

Heron Level Sponsors

Spheros Environmental

Spheros Environmental brings together proven teams with deep expertise across air, water, ecology, climate, environmental data, digital solutions, and permitting. As a single, integrated partner, we provide the insight and practical judgment clients rely on to make decisions that hold up where it matters most.

That integration is built on a deliberate foundation of experience – shaped by science- and mission-driven work with long-standing reputations across disciplines. Today, that experience is fully integrated within Spheros Environmental, bringing clarity, confidence, and durable outcomes as environmental challenges continue to evolve.

Kingfisher Level Sponsors

Oregon State University Department of Environmental and Molecular Toxicology

Floyd Snider

PNW SETAC Annual Conference Leavenworth, WA

Agenda as of 3/31/2026

Conference Dates: April 15-17 2026

Alpine, Danube, and Continental Rooms at The Enzian Inn: 590 US Hwy 2, Leavenworth, WA 98826 Tel: +18002238511

Tuesday 4/14/2026 - *Optional* Social/dinner meet up with the PNWSETAC board: Icicle Brewing Company (935 Front St.) https://iciclebrewing.com/ ~ 6:30 pm to ~ 9:00 pm; drop-in anytime

Wednesday April 15, 2026

*student is being evaluated for presentation award

Time Start	Time End	Room/Location	Session Title	Title of Presentation	Speakers/Affiliation
9:00 AM	9:45 AM	Alpine	Conference Opens, Check-in, and Networking - **Coffee refreshments**		
9:45 AM	10:00 AM	Alpine	Welcome Address by Chapter Vice President		Kara Hitchko, Floyd | Snider
10:00 AM	**11:00 AM**	**Alpine**	**Plenary: Safer products, chemicals, and practices: science communication and advocacy for policy solutions**		**Ryan Babadi, Toxic-Free Future**
11:00 AM	**11:30 AM**	**BREAK/NETWORKING**			
11:30 AM	**12:00 PM**	**Session 1: Killer Start to the Conference- Moderator: Mark Surette (WSP)**			
11:30 AM	11:45 AM	Alpine	Analysis of Chiral Polychlorinated Biphenyls (PCBs): Chemical Tracers of Ecotype Differentiation and Metabolic Divergence in Southern Resident and Transient Killer Whales (Orcinus orca)		Jonelle Gates, NOAA
11:45 AM	12:00 PM	Alpine	Metabolic and Immune Disruption by Persistent Organic Pollutants in Bigg's Killer Whale Skin Cells		John Hansen, USGS Western Fisheries Research Center
12:00 PM	**1:50 PM**	**Continental**	**Lunch provided at The Enzian Inn, followed by optional yet encouraged activity:** *Outdoor social excursion #1: 12:45 to 1:50 Stroll downtown for icecream (Whistlepunk Ice Cream Co) and back, meet at the entryway of the Continental room*		
2:00 PM	**3:30 PM**	**Session 2: Toward Indigenous-Led Chemical Risk Management and First Foods Restoration- Moderator: Tanya Williams, Washington State Department of Ecology**			
2:00 PM	2:20 PM	Alpine	Áwtni Tkʷátat (First Foods) as Climate Resilience: Tribal Stewardship, Cultural Resources Protection, and Sovereignty		Wenix N. Red Elk, Confederated Tribes of the Umatilla Indian Reservation, Department of Natural Resources
2:20 PM	2:40 PM	Alpine	Indigenous Knowledge Systems and Assessing Chemical Risk		Dr. Niiyokamigaabaw Deondre Smiles Ph.D., Leech Lake Band of Ojibwe, The University of British Columbia
2:40 PM	3:00 PM	Alpine	Tribal Influence in the Remedial Investigation/Feasibility Study Process at the Upper Columbia River Superfund Site		Cindy Marchand, Colville Tribe business council
3:00 PM	3:30 PM	Alpine	Workshop/roundtable		Tanya Williams, WA State Department of Ecology
3:30 PM	**3:50 PM**	**BREAK/NETWORKING**			
3:50 PM	**4:20 PM**	**Session 3: Contaminants in Aquatic Foodwebs - Moderators: Michelle Knowlen (Spheros Environmental) & Brian Weir (PSU)**			
3:50 PM	4:05 PM	Alpine	Oil Spill Contaminants in our Seafood: How much do we know?		Morgan Powers, Fjord & Fish Sciences
4:05 PM	4:20 PM	Alpine	Modeling the bioconcentration of per- and polyfluoroalkyl substances (PFAS) in rainbow trout (Oncorhynchus mykiss) using a chemical activity-based approach		*Samantha Maika, Simon Fraser University
4:20 PM	**4:30 PM**	**BREAK/NETWORKING - Poster Setup in Danube room**			
4:30 PM	***5:30 PM***	***Alpine***	***Short Course Part 1: Integrity and Transparency in Scientific Communication: Pull Back the Curtain***		***Allison Geiselbrecht, Floyd | Snider***
5:30 PM	**7:30 PM**	**Danube**	**POSTER SESSION I:** hor d'oeuvres and refreshments		
7:45 PM	**10:00 PM**	**Icicle Village Resort**	**PNW SETAC Mini-Gold Tournament with Prizes!** *Wander down to Icicle Village Resort after the Poster Session or dinner to play a round of putt-putt on us before 10pm. The winning team will share the goodies of a gift basket!*		

Thursday April 16, 2026					
Time Start	**Time End**	**Room/Location**	**Session Title**	**Title of Presentation**	**Speakers**
8:30 AM	08:55 AM	Alpine	Conference Opens, Check-in, and Networking - **Coffee refreshments**		
9:00 AM	**10:00 AM**	**Session 4: Science and Partnerships in the PNW- Moderators: Julie Layshock (Oregon DEQ) & Kervelle Baird (PSU)**			
9:00 AM	9:15 AM	Alpine		Ethical modeling of native plants: mapping rare and endemic plants of Cascadia	*Grace Galles, Oregon State University
9:15 AM	9:30 AM	Alpine		How effectively do filters reduce the release of microplastics in stormwater along the Oregon coast?	*Kervelle Baird, Portland State University
9:30 AM	9:45 AM	Alpine		Bridging Science to Action: CEC Strategic Planning at King County	Analise Lindborg, King County
9:45 AM	10:00 AM	Alpine		Partnering with Citizen Scientists to Advance 6PPD & 6PPD-Quinone Monitoring: Regulatory Readiness, Field Insights, and Emerging Sediment Methods	Louis Wagner, ALS Environmental
10:00 AM	10:15 AM	Alpine		Perceptions and Attitudes of Residents Living Near Superfund Sites in Oregon	*Francesca Germano, Oregon State University
10:15 AM	**10:35 AM**	**BREAK/NETWORKING**			
10:35 AM	**11:50 AM**	**Session 5: Strategic Monitoring - Moderators: Claire Detering (WSP) & Brianna Benner (WWU)**			
10:35 AM	10:50 AM	Alpine		Advancing our understanding of environmentally driven selenium speciation and bioaccumulation through a coal mine monitoring program	Claire Detering, WSP
10:50 AM	11:05 AM	Alpine		Evaluating Iron Nanogeochemistry Within the Nooksack River	*Brianna Benner, Western Washington University
11:05 AM	11:20 AM	Alpine		PBDEs in the Snohomish Watershed: from exploratory data to unique regulatory solutions	Alex Gipe, Washington Dept. of Ecology
11:20 AM	11:35 AM	Alpine		Advancing passive sampling for 6PPD-Quinone monitoring in western Washington watersheds	Andrew Spanjer, U.S. Geological Survey
11:35 AM	11:50 AM	Alpine		Employing passive samplers for monitoring urban stream health and informing management of 6PPDQ	Chelsea Mitchell, King County
11:50 AM	**12:00 PM**	**Sponsor Spotlight and Network Time (we mean you, students!)**			
12:00 PM	**2:00 PM**	**Continental**	**Lunch provided at The Enzian Inn, followed by Chapter Business Meeting**		
				PNW SETAC Chapter Business Meeting: President's Address	Mark Surette, WSP
				PNW SETAC Chapter Business Meeting: Treasurer's Report	Sara Hutton, GSI Environmental Inc.
1:00 PM	2:00 PM	Alpine		PNW SETAC Chapter Business Meeting: SETAC NA	Ruth Sofield, Western Washington University
				PNW SETAC Chapter Business Meeting: Board Nominations and Bylaws Updates	
				PNW SETAC Chapter Business Meeting: Feedback from Members	
2:00 PM	**3:15 PM**	**Session 6: Assessing Toxicity in a Changing Environment - Moderators: Kaley Major (Oregon DEQ) & Amirah Casey (UW)**			
2:00 PM	2:15 PM	Alpine		REU Interrupted: An Undergraduate's Lessons from a Zooplankton Ecotoxicology Project Halted by Bacteria	*Brian John Weir, Portland State University
2:15 PM	2:30 PM	Alpine		Investigation and Analysis of Acute Toxicity from Copper and other Toxicants in Samples of Cyanide-Treated Wastewater from the Emergency Response Leach Solution Treatment Facility at Eagle Mine	Josh Baker, Rise Over Run Enviornmental/ BQE Water
2:30 PM	2:45 PM	Alpine		Early-Life Chronic Exposure to 6PPD-Quinone Alters Acute Sensitivity in Coho Salmon (Oncorhynchus kisutch)	*Anastasia McConachie, Washington State University Puyallup Research and Extension Center
2:45 PM	3:00 PM	Alpine		How will increasing temperatures affect the uptake and toxicity of 6PPD-Q in juvenile coho salmon (Oncorhynchus kisutch)?	*Amirah Casey, Univeristy of Washington
3:00 PM	3:15 PM	Alpine		Development of a Web-Based Risk Screening Tool for Indigenous Shellfish Consumption	*MacKenzie Allison, Oregon State University
3:15 PM	**3:30 PM**	**BREAK/NETWORKING**			
3:30 PM	***4:30 PM***	***Alpine***	***Short Course Part 2: When Fish Speak English***		***Hiedi Siegelbaum, Washington State University***
4:30 PM	**5:30 PM**	**Social excursion #2: Stroll downtown Leavenworth**			
5:30 PM	**7:30 PM**	**Danube**	**POSTER SESSION II:** hor d'oeuvres and refreshments		
7:30 PM	**-**	**off site**	**Student Mixer - all students welcome to drop-in at the Blind Tigress (https://www.theblindtigress.com/)**		

Friday April 17, 2026					
Time Start	**Time End**	**Room/Location**	**Session Title**	**Title of Presentation**	**Speakers**
8:30 AM	08:55 AM	Alpine	Coffee, Refreshments, and Networking		
9:00 AM	**10:15 AM**	**Session 7: Assessing Toxicity in a Changing Environment - Moderators: Sara Hutton (GSI) & Samantha Maika (Simon Fraser U)**			
9:00 AM	9:15 AM	Alpine	River Restoration Along Urbanization Gradients: A Salmon Metapopulation Perspective on Stormwater in Restored Habitats		Julann Spromberg, Northwest Fisheries Science Center NOAA
9:15 AM	9:30 AM	Alpine	Evaluating the Effects of Anticoagulant Rodenticides in Coho Salmon (Oncorhynchus kisutch) through Dietary Exposure.		Melissa Driessnack, Washington State University
9:30 AM	9:45 AM	Alpine	Updates on the toxicokinetic behavior of 6PPD-Q in tolerant vs sensitive salmonid species		Denis da Silva, NOAA
9:45 AM	10:00 AM	Alpine	Photosynthesis can increase pH, which can act as a toxicant and eliminate effective grazers		Frieda B. Taub, University of Washington
10:00 AM	10:15 AM	Alpine	Evaluating target tissues and cell types of 6PPD-quinone induced toxicity in coho salmon (Oncorhynchus kisutch)		Justin Greer, U.S. Geological Survey
10:15 AM	**10:40 AM**	**BREAK/NETWORKING**			
10:40 AM	**12:00 PM**	**Session 8: Risk in Reality- Moderators: Gunnar Guddal (Anchor QEA) & Anastasia McConachie (WSU)**			
10:40 AM	10:55 AM	Alpine	Cleaning Sediments and Restoring Ecosystems – Evolving Towards an Adaptive Risk Assessment and Management Framework		Bob Johnston
10:55 AM	11:10 AM	Alpine	Same Element, Different Risk? The Importance of Modern Speciation Methods for Environmental Risk Assessments		Ben Wozniak, Brooks Applied Labs
11:10 AM	11:25 AM	Alpine	Are the EPA Aquatic Life Benchmarks for Pesticides Protective for Aquatic Invertebrates		John D. Stark, Washington State University
11:25 AM	11:40 AM	Alpine	A framework and basic rules for the use of quantitative methods for the estimation of probabilistic ecological assessment and management within the diverse landscapes of the Pacific Northwest		Wayne G. Landis, Western Washington University
11:40 AM	**11:50 AM**	Alpine	**Student Awards**		Julie Layshock, Oregon DEQ
11:50 AM	**12:00 PM**	Alpine	**Closing Remarks**		Mark Surette, WSP

Poster Galas and Presidents' Receptions Wednesday and Thursday 4/15/2026- 4/16/2026 (Danube Room)					*student is being evaluated for presentation award
Time Start	**Time End**	**Poster number**	**Session Title**	**Title of presentation**	**Speakers**
5:30 PM	7:30 PM	**2**	Poster Session I (Wednesday); Even #'s present	Optimizing bioinspired TAML (tetra-amido macrocyclic ligand) catalysts for preventing CEC toxicity in wastewater effluent	Claire O'Connor, Washington State University
5:30 PM	7:30 PM	**4**	Poster Session I (Wednesday); Even #'s present	Treads to Treatment: Converting Tire Waste into Bioretention Media for Removing Toxic Tire Chemicals	*Koral Griffith, Washington State University
5:30 PM	7:30 PM	**6**	Poster Session I (Wednesday); Even #'s present	Investigating the potential impacts of Upper Columbia River sediments to early life stage Chinook Salmon (Oncorhynchus tshawytscha)	Melissa Driessnack, Washington State University
5:30 PM	7:30 PM	**8**	Poster Session I (Wednesday); Even #'s present	Developing an automated behavioral test system for evoked startle response in Danio rerio	*Katie Allen, Western Washington University
5:30 PM	7:30 PM	**10**	Poster Session I (Wednesday); Even #'s present	Development of an automated behavior assay assessing thigmotaxis, scototaxis and photomotor behavior in adult zebrafish (Danio rerio)	*Luke Fincher, Western Washington University
5:30 PM	7:30 PM	**14**	Poster Session I (Wednesday); Even #'s present	A Validated Method for Accurate Isotopic Analysis of Total Mercury, Methylmercury and Inorganic Mercury in Environmental Samples.	Ben Wozniak, Brooks Applied Labs
5:30 PM	7:30 PM	**16**	Poster Session I (Wednesday); Even #'s present	Holistic source assessment of PCBs and PBDEs to the Hylebos waterway	Maya Faber, University of Washington Tacoma
5:30 PM	7:30 PM	**18**	Poster Session I (Wednesday); Even #'s present	Persistent Organic Pollutants in a Keystone Forage Fish: Comparisons in Pacific herring contaminants in Pacific Northwest waters.	Robert J Fisk, WA Dept. of Fish & Wildlife
5:30 PM	7:30 PM	**20**	Poster Session I (Wednesday); Even #'s present	1H-NMR Metabolomics Reveals Functional Group–Specific Toxicity of Trisiloxane Surfactants in Honey Bees	Kelsey Bouse, Oregon State University
7:30 PM	9:30 PM	**1**	**Poster Session II (Thursday), Odd #'s present**	Toxicity of binary mixtures of 6PPDQ with Zinc or Copper in coastal cutthroat trout	Prarthana Shankar, USGS Western Fisheries Research Center
5:30 PM	7:30 PM	**3**	**Poster Session II (Thursday), Odd #'s present**	Comparing in vitro Metabolism of 6PPD-Q by Coho Salmon and Steelhead Fishes	Gunnar Goetz, NOAA Fisheries
5:30 PM	7:30 PM	**5**	**Poster Session II (Thursday), Odd #'s present**	Model risk: What it is and why we should consider it.	Julann Spromberg, Northwest Fisheries Science Center, NOAA Fisheries
5:30 PM	7:30 PM	**7**	**Poster Session II (Thursday), Odd #'s present**	Improving cell culture conditions for proliferation of Botryllus schlosseri epithelial cells	Alison Gardell, University of Washington Tacoma
5:30 PM	7:30 PM	**9**	**Poster Session II (Thursday), Odd #'s present**	Microplastics in Western Washington Drinking Water: A Preliminary Assessment	Ben Wozniak, Brooks Applied Labs
5:30 PM	7:30 PM	**11**	**Poster Session II (Thursday), Odd #'s present**	Elemental Imaging of Plant Leaves Using Laser Ablation-Inductively Plasma-Mass Spectrometry (LA-ICP-MS)	Ben Wozniak, Brooks Applied Labs
5:30 PM	7:30 PM	**13**	**Poster Session II (Thursday), Odd #'s present**	Assessing PFAS accumulation in transplanted native bay mussels from Puget Sound nearshore waters (2023-2024)	Michelle (Shell) Stowell, Washington Department of Fish & Wildlife
5:30 PM	7:30 PM	**15**	**Poster Session II (Thursday), Odd #'s present**	Characterizing contamination of the Puget Sound benthic environment and the effects on English sole	Dwight Causey, Toxics Biological Observation System, Washington Department of Fish & Wildlife
~~5:30 PM~~	~~7:30 PM~~	~~**17**~~	~~**Poster Session II (Thursday), Odd #'s present**~~	~~Polychlorinated Biphenyls (PCBs) Concentrations in Bivalves Linked to Biological Effects.~~	~~Samantha Dahlke, Washington Department of Fish and Wildlife - Toxics Biological Observation Systems~~
5:30 PM	7:30 PM	**19**	**Poster Session II (Thursday), Odd #'s present**	A Spatial and Temporal Assessment of Metal Accumulation in Ulvoid Seaweeds	Ruth Sofield, Western Washington University
5:30 PM	7:30 PM	**21**	**Poster Session II (Thursday), Odd #'s present**	Measuring Per- and Polyfluoroalkyl Substance Concentrations in the Lower Columbia River Using Passive Sampling Techniques	Chris Schmokel, Oregon State University

Wednesday Plenary Speaker

Safer products, chemicals, and practices: science communication and advocacy for policy solutions

Presented by Dr. Ryan Babadi, Toxic-Free Future

Dr. Ryan Babadi is an environmental health scientist with experience across academia, government, and the nonprofit sector. He is the Science Director for Toxic-Free Future, a national leader in environmental health research and advocacy. His research experience involves epidemiological studies examining the links between environmental exposures and health outcomes. Before joining Toxic-Free Future, Ryan completed postdoctoral research fellowships at the Centers for Disease Control and Prevention and the Harvard T.H. Chan School of Public Health, and he holds a PhD in environmental toxicology from the University of Washington, an MPH from UCLA, and undergraduate degrees in biological sciences and history from UC Irvine.

Everyone deserves a toxic-free environment, and consumers should be able to assume products for sale are free from hazardous substances. These ideals do not reflect reality; we are constantly exposed to complex mixtures of toxic chemicals from products, packaging, and pollution. Consumer choices alone cannot solve this problem – we need strong government and corporate policies that eliminate classes of toxics in favor of safer solutions. This need is especially critical as research funding and environmental protections are increasingly threatened. Thus, effective science communication and advocacy have never been more important to environmental health policy. This presentation will showcase a series of research studies and market-based initiatives that fueled policy wins in the environmental health arena, led by Toxic-Free Future, a national non-profit organization focused on environmental health research and advocacy. Studies will be discussed on testing of environmental media, consumer products, and biomarkers of exposure, in tandem with efforts to transform the marketplace and protect consumers from harmful chemicals. Relevant challenges and opportunities will be highlighted to promote dialogue and collaboration.

Wednesday Platform Presentation Abstracts

‡ Presenting Author

Session 1: Killer Start to the Conference

Analysis of Chiral Polychlorinated Biphenyls (PCBs): Chemical Tracers of Ecotype Differentiation and Metabolic Divergence in Southern Resident and Transient Killer Whales (Orcinus orca)

Jonelle Gates‡, Irvin Schultz, Li-Jung Kuo, Jennie Bolton, and Kia Hayes. NOAA.

Polychlorinated biphenyls (PCBs) are a group of persistent organic pollutants (POPs) that are ubiquitous aquatic contaminants known to bioaccumulate in diverse groups of marine organisms. These compounds can undergo various degradative pathways, including biotransformation into hydroxylated (OH-) derivatives. Interestingly, several PCB congeners exist as atropisomers, a form of chirality, and were originally manufactured at racemic levels. It has previously demonstrated that the formation of OH-PCBs can occur in a stereoselective manner. This process may result in a measurable shift away from racemic levels for both the parent chiral PCB and its metabolite. Analysis of chiral PCBs in marine mammals, such as killer whales, may be useful in identifying potential differences between fish-eating resident and marine mammal-eating transient whales. In this study, we measured the enantiomer fractions (EFs) of chiral PCB congeners (PCB 84, 95, 136, and 149) in blubber extracts of Southern Resident and transient killer whales. The EFs were calculated as the area ratio of the first-eluting atropisomer (E1) divided by the sum of both atropisomers (E1 and E2). Tissue extracts previously analyzed for a variety of legacy contaminants were analyzed for chiral PCBs. This analysis was conducted using gas chromatography and mass spectrometry (GC/MS), with the GC equipped with a Chirasil-Dex column to facilitate the separation of individual atropisomers. While the analysis of archived samples of several Aroclor products confirmed that these PCBs were formed at racemic levels, the blubber extracts show specific enantiomerically enriched congeners. The mean EFs for PCB 84, 95, 136 and 149 in resident killer whales were consistent between K pod (0.75, 0.39, 0.54, 0.43) and L pod (0.75, 0.39, 0.49, 0.43) individuals. However, J pod signatures (0.72, 0.48, 0.56, 0.54) showed distinct shifts that aligned more closely with mean EFs observed in transient killer whales (0.72, 0.56, 0.53, 0.59). These results suggest PCB metabolism may differ not just between residents and transients but also among the various resident pods. This study indicates chiral PCB analysis has potential to be a helpful tool for distinguishing between ecotypes and assessing the metabolic differences of killer whale populations.

Metabolic and Immune Disruption by Persistent Organic Pollutants in Bigg's Killer Whale Skin Cells

John Hansen[1]‡, Andrea J. Roth-Monzón[1], Paxton T. Bachand[1], Justin B. Greer[1], and Mark Jankowski[2]. [1]U.S. Geological Survey, Western Fisheries Research Center, Seattle, WA, USA, [2]U.S. Environmental Protection Agency, Region 10 Laboratory Services and Applied Science Division, Seattle, WA, USA.

Skin health in cetaceans reflects overall physiological status and may signal environmental stressors. Recent photographic monitoring has revealed increasing skin lesions among endangered Southern Resident Killer Whales (Orcinus orca, SRKW) inhabiting the Salish Sea, where chronic exposure to persistent organic pollutants (POPs) is a concern. Cetacean skin is metabolically active, integrating lipid handling, signaling, and immune functions that interact with pollutant responses. Among POPs, 4-Nonylphenol (4-NP), an endocrine disruptor, can penetrate the cetacean skin barrier and potentially impair these processes. Building on our earlier work that utilized Bigg's killer whale fibroblast cell lines as an in vitro model to examine POP-induced effects on antiviral immunity through a targeted qRT-PCR approach, we now broaden this framework to capture a more comprehensive picture. In this study, we employ genome-wide transcriptome profiling to explore how 4-Nonylphenol (4-NP) influences both innate immune signaling—specifically Toll-like receptor (TLR)-mediated responses—and metabolic pathways in killer whale dermal fibroblasts challenged with viral and bacterial mimics (Poly(I:C) and lipopolysaccharide, respectively). Genome-wide transcriptome profiling across multiple time points revealed alterations in antimicrobial signaling and metabolic regulation. These findings illuminate on how contaminants and infection independently and jointly affect orca skin health, offering guidance to inform management and conservation strategies for these vulnerable populations.

Session 2: Toward Indigenous-Led Chemical Risk Management and First Foods Restoration

Session Summary: Chemical pollution threatens Treaty-protected resources and culturally grounded lifeways across the Pacific Northwest, while existing chemical risk management frameworks often fail to reflect Tribal governance systems, Tribally relevant exposure pathways, or Indigenous definitions of environmental health. This session will share how Tribal Nations are responding through innovative, sovereignty-driven approaches that center responsibilities to land, water, and future generations. This session also invites scientists, regulators, Tribal leaders, and community partners to engage in dialogue that respects Indigenous knowledge as lived law, recognizes Tribal governance as foundational, and advances more accountable, place-responsive approaches to chemical risk management.

Session Abstract: Chemical pollution is increasingly recognized—alongside climate change and biodiversity loss—as one of the most pressing drivers of environmental change. Yet, chemical risks are not distant problems acting on the world from afar; they are inherent to the conditions we live within, including the air we breathe, the water we drink, the foods that sustain us, and the bodies of future generations. Addressing these risks requires approaches to environmental decision-making that move beyond fragmented regulatory and scientific frameworks that are increasingly insufficient for identifying how toxic contaminants persist, interact, and accumulate across landscapes and time. In the Pacific Northwest, Tribes of the Columbia Basin and Salish Sea are confronting these limitations through sovereignty-driven approaches that prioritize First Foods and Treaty-protected relationships to land and water. These approaches demonstrate that Indigenous knowledge systems are well oriented to identify gaps in conventional chemical risk frameworks because they center exposure routes defined by the highest levels of human-landscape connectivity, integrate ecological and cultural dimensions of health, treat biodiversity protection as responsibility embedded in sovereignty rather than an external endpoint, and require accountability to future generations. Tribal work in toxics management and cleanup provides critical lessons for rethinking how chemical risk, toxics monitoring, and restoration are conceived and implemented.

Presentations: The session will open with a presentation of the First Foods mission of the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) as a formalized system for natural resource management based on the lived understanding of the Umatilla, Walla Walla, and Cayuse Tribes. Additional speakers will highlight success stories and ongoing challenges faced by Tribes in the Columbia Basin and Salish Sea, including areas where chemical risk management approaches have not been effective, particularly in supporting co-management, addressing cumulative impacts, or fully honoring Indigenous knowledge systems.

Áwtni Tkʷátat (First Foods) as Climate Resilience: Tribal Stewardship, Cultural Resources Protection, and Sovereignty

Wenix N. Red Elk, Confederated Tribes of the Umatilla Indian Reservation, Department of Natural Resources

Wenix N. Red Elk serves as the Public Outreach and Education Specialist for the Cultural Resources Protection Program within the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) Department of Natural Resources. Her work supports the CTUIR First Foods Mission, which guides the protection, restoration, and management of water, salmon, deer, roots, and berries—resources essential to Tribal culture, health, and Treaty-reserved rights. She leads outreach and education initiatives that help connect Tribal members, partner agencies, and the broader community to CTUIR natural resource management efforts. Her work strengthens understanding of First Foods management, cultural resources protection, and the environmental conditions necessary to sustain these resources for future generations. She collaborates with multiple CTUIR natural resource programs, including Fisheries, Wildlife, Water Resources, Energy and Environmental Sciences, and First Foods Policy, to support stewardship, cultural continuity, and informed environmental management. An enrolled member of CTUIR, Wenix brings more than 24 years of experience in cultural and natural resources protection. Her work bridges Indigenous knowledge and natural resource management through education, outreach, and partnership development, supporting Tribal sovereignty and the long-term protection of First Foods and cultural landscapes.

The Confederated Tribes of the Umatilla Indian Reservation (CTUIR) protect First Foods—including water, salmon, deer, roots, and berries—as part of their Treaty of 1855 rights and their responsibility to sustain Tribal culture, health, and lifeways. These First Foods represent an interconnected system that guides Tribal stewardship, environmental protection, and climate resilience. The CTUIR Department of Natural Resources First Foods Mission integrates traditional ecological knowledge and science to protect, restore, and enhance these resources and the cultural landscapes that support them. Cultural resources protection, outreach, and education help reconnect Tribal members to traditional gathering areas, strengthen cultural continuity, and support the exercise of Treaty Rights. This presentation will share how the First Foods framework guides environmental stewardship, strengthens partnerships, and supports Tribal sovereignty by ensuring First Foods remain protected, accessible, and sustained for future generations.

Indigenous Knowledge Systems and Assessing Chemical Risk

Dr. Niiyokamigaabaw Deondre Smiles Ph.D., Leech Lake Band of Ojibwe, The University of British Columbia.

Dr. Niiyokamigaabaw Deondre Smiles (Leech Lake Band of Ojibwe) is a postdoctoral research fellow at the University of Toronto's Technoscience Research Unit, and adjunct faculty in the Institute for Resources, Environment, and Sustainability at the University of British Columbia. Their work focuses on Indigenous land relations and the role of on-the-land learning in cultural and political revitalization. Dr. Smiles holds a doctorate in Geography from The Ohio State University, and currently lives in Victoria, BC, Canada with their spouse, their cat, several fish, and multiple spiders.

Governmental institutions in nations that have adopted the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) are working to create appropriate institutional structures to support the implementation of the declaration. This opens a window of opportunity to learn from and engage with Indigenous Knowledge Systems (IKS) and promote transformational change if communication challenges are overcome. Canada recently elevated the inclusion of Indigenous Knowledge into existing practices as a top priority, following the revision of the Canadian Environmental Protection Act (CEPA) and the adoption of the UNDRIP Act. We advocate that there is an urgent need to make the colonial legacies of chemicals management visible, to enable government staff to find concrete and effective ways to bring this legacy to light. We also advocate the need for governmental participants in conversational and consultation processes to enhance their understanding of the ways in which the inconspicuousness of mechanistic worldviews contributes to challenges in meaningful consultation and communication.

Tribal Influence in the Remedial Investigation/Feasibility Study Process at the Upper Columbia River Superfund Site

Cindy Marchand, Confederated Tribes of the Colville Reservation.

Cindy Marchand is a member of the Confederated Tribes of the Colville Reservation (Sinixt/Lakes Band). She is currently serving her second term on the Colville Business Council as Secretary of the Executive Committee having chaired the Culture Committee, Elections Committee and currently chairs the Fisheries Committee, and vice-chair of the Natural Resource Committee. She works extensively on environmental issues in the United States and Canada. Ms. Marchand serves as the Eastern Representative of the Environmental Protection Agency's Regional Tribal Operations Committee and Commissioner for the Upper Columbia United Tribes. Before Council, Ms. Marchand worked for the Colville Tribes' Environmental Trust Department for 15 years working on complex tribal boundary water issues of the Okanogan and Columbia Rivers both on and off the reservation in the US and in Canada. She worked on a wide range of environmental issues related to on-going projects dealing with international waters and the reduction of cross boundary contaminants affecting tribal resources along with protection and management of important tribal rights, natural resource protection and human health associated risks. Ms. Marchand holds a B.A. of Interdisciplinary Studies with minors in Business Administration, Economics, and Anthropology from Eastern Washington University. She is currently in her final term to receive a Masters of Business Administration from Western Governors University.

The Confederated Tribes of the Colville Reservation (CCT) people have lived along the Columbia River in the United States and Canada since time immemorial using the resources along and in river for subsistence and traditional uses. In 1998, the Colville Tribes petitioned EPA to address historical contamination of heavy metals and liquid affluent from one of the largest lead-zinc smelters in the world based in Trail, BC which is approximately 14 miles from the US/Canadian border and former North Half of the Colville Indian Reservation. This petition resulted in the 2006 Settlement Agreement between the United States Environmental Protection Agency and the Canadian smelter. This agreement included a "superfund-like process' on the Upper Columbia River (UCR) which included an Ecological Risk Assessment and a Human Health Risk Assessment. The CCT acknowledged that the traditional Human Health Risk Assessment did not address exposure pathways that were specific to tribal uses such as subsistence use (i.e., hunting, fishing, gathering of roots, berries, and medicinal plants, etc…) and traditional tribal activities (i.e., weaving, construction of shelters and sweat lodge, medicinal, spiritual, food preparation and preservation, etc.). The Tribal Consumption and Resource Use Survey (aka Tribal Survey) was developed with Tribal environmental professionals and elders, toxicologists, and risk managers to develop specific tribal exposure pathways on the UCR Superfund Site to heavy metals and other contaminants. This presentation will describe how tribal specific data was collected and analyzed to protect CCT population while they continue to engage in subsistence and Traditional use of their resources on the UCR Superfund Site.

Workshop

Facilitators:

- Negonnekodoqua "Negonne" Blair, Confederated Tribes of the Umatilla Indian Reservation, Department of Natural Resources
- Dianne Barton, Columbia River Inter-Tribal Fish Commission
- Tanya Williams, WA State Department of Ecology

Workshop: The session will conclude with a facilitated, interactive workshop (approximately 30 minutes). Participants will engage in small-group discussions to identify gaps in current toxics monitoring and risk assessment, explore opportunities to co-develop Indigenous-led tools and indicators, and outline next steps to advance collaborative, Tribal sovereignty-based chemical risk management. Facilitators will synthesize speaker contributions and participant input to translate lessons from Tribal leadership in the Pacific Northwest into actionable strategies and partnerships.

Breakout Session Objectives This session invites scientists, regulators, Tribal practitioners, and community members to learn from regional Tribal leadership while collectively building pathways toward more effective, just, and culturally grounded approaches to chemical pollution and ecosystem restoration.

Goals: The goal of the breakout session is to discuss the following objectives:

1. Identify key gaps in conventional toxics monitoring and chemical risk assessment when evaluated through a First Foods and Tribal sovereignty lens, including limitations related to exposure pathways, contaminant prioritization, and ecological indicators.

2. Articulate how Indigenous knowledge systems and First Foods frameworks can function as governance and analytical tools, guiding chemical risk management, monitoring priorities, and restoration decision-making in ways that differ from, and strengthen, existing regulatory approaches.

3. Evaluate opportunities for co-developing tools, indicators, and monitoring strategies that meaningfully support Tribal Treaty Rights, Tribal data sovereignty, co-management, and Indigenous-led research, including clear governance over data ownership, interpretation, and use, and alignment with analytical laboratories and regulatory agencies.

4. Prioritize concrete next steps for advancing Indigenous-led and community-centered chemical risk management beyond the conference, including durable capacity building, partnership building, resourcing and staffing needs, data governance structures, and pathways for translating Indigenous-defined risk into regulatory, policy, and restoration actions.

5. Identify Tribal-defined conditions for equitable collaboration, including requirements related to data sovereignty, decision-making authority, protection of sensitive knowledge, and mechanisms to ensure that Indigenous participation results in meaningful regulatory and management outcomes

.

Session 3: Contaminants in Aquatic Food Webs

Oil Spill Contaminants in our Seafood: How much do we know?

Morgan Powers‡[1] and Will Samuel[2]. [1]Fjord & Fish Sciences, [2]Tributary Research Consulting.

The marine subsistence resources Alaskans rely on face risks from hydrocarbon contamination due to marine oil spills—from disasters like the 1989 Exxon Valdez, 2004 Selendang AYU, and 2022 Tug Western Mariner oil spills. Oil contaminants can build up in marine organisms, where they can affect growth and reproduction, even survival. When these species are harvested and eaten, the contaminants in these organisms may impact the people who consume them. Understanding where, when, and how much oil contaminants are found in marine subsistence species is a critical part of protecting both environmental and community health. This project pulled together existing hydrocarbon tissue data from over 2,300 samples collected between 2000 and 2024, representing 22 different studies. The focus was on Alaska's coastal and marine species that are harvested for subsistence—like mussels, clams, salmon, flatfish, cod, seals, and whales. We looked at where the samples came from, what species were tested, and what PAH levels were found in their tissues with the goal of creating a clear picture of what data already exists and identifying where there are important gaps in our knowledge. We found that intertidal mussels are the most frequently tested species, making up 45% of the samples. Mussels are often used to monitor pollution because they stay in one place and reflect local contamination. Other key species, like seaweed, salmon, seabirds, and seals, have very little data, even though they bioaccumulate PAHs, are widely eaten, and are culturally important. Sampling has decreased over time, and many regions with heavy subsistence harvests—like the Bering Strait, Northwest Arctic, Bristol Bay, and Prince of Wales Island—have almost no recent data. This study reveals a major mismatch between where people are harvesting and where scientists are monitoring. If another spill were to happen, it would be hard to determine whether it caused contamination, as background data is missing or outdated. This report gives scientists, communities, and decision-makers a strong starting point for future studies. To better protect marine food resources, we recommend updating monitoring programs to include recent data and focusing efforts in high-harvest, high-pollution risk regions that currently have little or no data. With this approach, Alaska's communities will be more prepared for future environmental changes and have stronger tools to protect the health of their subsistence culture and ecosystems.

Modeling the bioconcentration of per- and polyfluoroalkyl substances (PFAS) in rainbow trout (Oncorhynchus mykiss) using a chemical activity-based approach

Samantha Maika‡, Allison McCloy, Samuel Pina Hodges, Barry Kelly, and Frank Gobas. Simon Fraser University.

The widespread presence of per- and polyfluoroalkyl substances (PFAS) in the United States, and around the world is a major concern due to the potential harm of PFAS to both wildlife and humans. However, the lack of understanding and considerable uncertainty about how different types of PFAS accumulate in various species makes it challenging to determine risks and interpret ambient concentrations to create risk management guidelines. Some difficulties are related to the high degree of ionization of PFAS in the environment, their high affinity for proteins and polar lipids, and the differing metrics in which exposure and toxicity data are presented, which complicates or prevents accurate risk characterization. To improve risk assessment of PFAS, this study aims to develop and test a model that can be used to assess the bioaccumulation and environmental risks of PFAS at contaminated sites and in the general environment. To do this, we measured organism-water partitioning factors for selected PFAS; determined the lipid and protein composition of various tissues; and performed a 57-day bioconcentration study in Rainbow trout (Oncorhynchus mykiss). PFAS concentrations in individual tissues and water samples from the bioconcentration study were measured using Solid Phase Extraction (SPE). To measure the organism-water partitioning properties of PFAS, equilibration of soluble proteins and phospholipids with a known PFAS concentration, and ethyl vinyl acetate (EVA) films coated onto vials was performed. Following incubation, the films were extracted and the concentrations of PFAS were determined using the LC-MS-MS. Measured concentrations are then expressed in terms of chemical activities using a chemical activity-EVA concentration calibration curve. The total lipid content of the tissue was determined using gravimetric determination, the phospholipid content using a phospholipid assay kit, and the protein content using the Bradford assay method. The model predicted and measured concentrations were compared and used to test the model. The modeling framework is aimed at facilitating the comparison of exposure concentrations to toxicological relevant concentrations to assess ecological risks. This opens the door to the use of in-vitro toxicity tests for risk assessment, in response to efforts to reduce animal testing.

Science Communication Short Course Part 1: Integrity and Transparency in Scientific Communication: Pull Back the Curtain

Presented by Alison Geiselbrecht, PhD, Floyd|Snider

The Science Communication Short Course will feature two complementary sessions. The first session, “Integrity and Transparency in Scientific Communication: Pull Back the Curtain,” will focus on the foundations, processes and outcomes necessary to ensure scientific credibility and data integrity while acknowledging the realities of different work environments.

Attendees will come away with guideposts, resources and partake in conversation that will add to the richness of the discussion and experiences from the audience.

Poster Session I Abstracts (Wednesday)

‡ Presenting Author

Poster #2: Optimizing bioinspired TAML (tetra-amido macrocyclic ligand) catalysts for preventing CEC toxicity in wastewater effluent

Claire O'Connor‡[1], Terrence Collins[2], Andy James[3], James Meador[4], and Jen McIntyre[1]. [1]Washington State University, [2]Carnegie Mellon University, [3]University of Washington, [4]Maritox Consulting.

Wastewater effluent is an important source of contaminants of emerging concern (CECs) that can impact the health of aquatic animals in receiving waters. Including hormones, pharmaceuticals, and industrial chemicals, these CECs contribute to the impairment of Chinook salmon that rear and/or migrate through Puget Sound. Additional removal of CECs from wastewater is needed, but municipal wastewater treatment facilities that convey the highest volumes of effluent to Puget Sound do not have the technology to reduce these CECs to non-toxic levels. TAMLs (tetra-amido macrocyclic ligands) are bio-inspired catalysts that efficiently metabolize environmental contaminants in wastewater through oxidation. Prior to testing the ability of TAML to reduce CECs and resulting toxicity to juvenile Chinook salmon, we will optimize treatment conditions by varying the concentration of TAML (10, 50, 100 nM) with a standard chlorine disinfection procedure for King County's South Plant facility (2.5 ppm NaClO for 60 min) and an alternative oxidation protocol without chlorination (5 ppm H2O2 with 100 nM TAML). We will screen for treatment success with analytical chemistry and toxicology assays. High resolution mass spectrometry will assess changes in the presence and abundance of various CECs and LC-MS/MS will be used to quantify 12 targeted analytes before and after treatment. Zebrafish bioassays will assess changes in effluent hazard, including morphometric, behavior, and targeted molecular endpoints.

Poster #4: Treads to Treatment: Converting Tire Waste into Bioretention Media for Removing Toxic Tire Chemicals

Koral Griffith‡[1], Alanna Hildebrandt[2], Jessica Ray[2], and Jenifer McIntyre[1]. [1]Washington State University, [2]University of Washington.

Urban stormwater runoff is a major source of toxic contaminants entering freshwater ecosystems, including tire-derived 6PPD-quinone which is acutely lethal to coho salmon. Green stormwater infrastructure (GSI), particularly bioretention systems, can effectively reduce contaminant loads, yet the compost-based media predominantly used in Washington State remain inconsistent in performance – leaching nutrients/metals or failing to eliminate sublethal toxicity. Biochar is a promising amendment capable of high contaminant sorption that could reduce the use of compost in bioretention systems. We are investigating whether char made from waste tires is both biologically safe and effective at mitigating tire-related contaminants in stormwater. Optimization work by UW collaborators will assess whether 6PPD-quinone and other tire-derived compounds leach from tire char, as well as the sorption potential of tire char for these compounds. Toxicological performance of tire char will be assessed using zebrafish bioassays including morphometric, behavioral, and transcriptomic analysis. Finally, we will test treatment performance in bioretention columns receiving synthetic stormwater over a simulated 20 water years. In this presentation we will discuss development of the synthetic stormwater that will be used in the bioretention study. To best represent real-world roadway runoff, the synthetic stormwater is based on vehicle-derived sources of contaminants to roadway runoff, with proportions determined by high resolution mass spectrometry. Appropriateness of the runoff 'recipe' will be validated by comparing zebrafish bioassay responses to those from collected roadway runoff.

Poster #6: Investigating the potential impacts of Upper Columbia River sediments to early life stage Chinook Salmon (Oncorhynchus tshawytscha)

Melissa Driessnack‡ and Jenifer McIntyre. Washington State University.

Efforts to develop fish passage systems at Chief Joseph and Grand Coulee Dams on the mainstem Columbia River (Washington, USA) are underway to facilitate the reintroduction of Chinook salmon (Oncorhynchus tshawytscha) to habitats upstream of these impoundments. Habitat assessments have identified several potential Chinook spawning areas in the Upper Columbia River (UCR) (Bellgraph et al. 2020). During spawning, salmon construct redds by creating depressions in which eggs are deposited and subsequently covered with surrounding substrate. Following hatch, alevins remain within their redds for several weeks until yolk sac absorption is largely complete, resulting in prolonged and intimate contact with sediment and porewater during this sensitive early life stage. Sediments in the UCR contain deposits of slag, a smelting byproduct composed primarily of iron, silica, and lime with elevated concentrations of metals including zinc, lead, copper, and cadmium. In addition to slag deposition, historical liquid effluents from a smelter located upstream of the U.S.–Canada border were discharged into the river, with associated metals subsequently sorbing to river sediments. As a result, concentrations of several metals in UCR sediments and porewaters have been documented to exceed ambient water and sediment quality criteria, raising concerns regarding potential risks to Chinook reintroduction efforts if toxicity occurs from slag exposure in early life stages. To evaluate these risks, eyed Chinook salmon embryos obtained from the Entiat National Hatchery in partnership with the Confederated Tribes of the Colville Reservation were reared to swim-up in direct contact with sediments collected from three candidate spawning sites in the UCR. Embryos and alevins were monitored daily for mortality and morphometrics assessed at three developmental time points. This study provides critical early-life-stage toxicity data to inform habitat suitability and risk assessment for Chinook salmon reintroduction efforts in the Upper Columbia River.

Poster #8: Developing an automated behavioral test system for evoked startle response in Danio rerio

Katie Allen‡, Luke Fincher, Katie Knaub, Ruth Sofield, and Ian Moran. Western Washington University.

This project aims to develop an automated and cost-effective system to measure evoked startle responses in fish. We used single board computers (Raspberry Pi) to create a behavioral test system that integrates visual stimuli and video capture to evoke and record predator avoidance behaviors in zebrafish (Danio rerio). To simulate the visual stimulus of a predator strike, a 3D-printed servo arm swings a model over the test tank. This replicates the "looming" effect (increasing in apparent size as it moves), mimicking a bird strike to evoke a natural escape response. Using computer vision software (Noldus EthoVision XT), the organism's movement can be tracked and quantified to determine the proportion of test subjects that exhibit avoidance behaviors. Trials will vary the intervals between stimuli to identify the threshold where zebrafish desensitization (habituation) occurs. Automation using microelectronics platforms results in more consistent and reproducible behavioral responses. Anticipated results will characterize the baseline startle response and the optimal recovery time needed between trials to maintain high sensitivity. A compromised startle response in the laboratory demonstrates the potential for increased predation risk and decreased survival in the field. By utilizing cost-accessible electronics and 3D-printed components, this open-source approach to behavioral testing systems furthers accessibility of standardized research methods. In the future, this system will serve as the foundation for experiments evaluating how specific chemical stressors impair predator-avoidance behaviors.

Poster #10: Development of an automated behavior assay assessing thigmotaxis, scototaxis and photomotor behavior in adult zebrafish (Danio rerio)

Luke Fincher‡, Katie Allen, Katie Knaub, Ruth Sofield, and Ian Moran. Western Washington University.

Laboratory assays measuring predator avoidance behaviors are valuable tools for assessing sublethal impacts in toxicology studies. The present work describes the design and implementation of an open-source, automated behavioral assay system to measure spontaneous and evoked motor behaviors in aquatic organisms. The system allows for video recording and control over light intensity across the experiment tank using pulse-width modulation (PWM) of voltage in LED light strips. By manipulating lighting, the assay system measures three behavioral endpoints that can be affected by chemical exposure: thigmotaxis (wall-hugging), scototaxis (preference for dark areas), and photomotor behavior (activity during alternating light and dark cycles). Zebrafish (Danio rerio) were chosen to optimize assay conditions, evaluate the performance of the test system, and to establish baseline behavior in unexposed, control conditions. Under these conditions, it is predicted that zebrafish will express a preference for darker environments, avoid the center of the tank, and exhibit reduced activity in light periods as an avoidance response to the threat of predation. Animal tracking will be conducted on recorded videos with Noldus EthoVision software and assessed for accuracy. The validation of these tools in this application will enable future studies to assess the impact of chemical exposure on motor behaviors. This system advances the capacity of environmental toxicologists to generate reproducible behavior data and provides a foundation for future investigation into the effects of environmental contamination.

Poster #14: A Validated Method for Accurate Isotopic Analysis of Total Mercury, Methylmercury and Inorganic Mercury in Environmental Samples.

Ben Wozniak‡, Elizabeth Crowther, Hakan Gürleyük, Dalton Reynolds, and Vedat Yılmaz.Brooks Applied Labs

Accurate compound specific mercury (Hg) isotope analysis is essential for tracing biogeochemical processes, identifying contamination sources, and differentiating between methylmercury (MeHg) and inorganic mercury (iHg) cycling in environmental systems. We developed and validated a method for online compound specific Hg isotope analysis using the Brooks Rand MERX automated analyzers coupled to a MC ICP MS. We assessed accuracy, precision, and method robustness across aqueous standards (including NIST 3133, NIST 8610 Almaden, and MeHgCl) and digested sediment and biota reference materials (MESS 4, TORT 3). Using an in house Python data processing workflow, we obtained δ202Hg reproducibility of ~0.13–0.18‰ (2SD) and Δ199Hg reproducibility of ~0.05–0.09‰ across materials. The method displayed low sensitivity to concentration mismatches between samples and bracketing standards and maintained consistent precision across a range of %MeHg compositions. We also demonstrated that accurate isotope ratios can be achieved with as little as 600 pg of total Hg. The results from various reference materials and client samples, as well as significant analytical characteristics of the method, will be discussed in this presentation.

Poster #16: Holistic source assessment of PCBs and PBDEs to the Hylebos waterway

Maya Faber‡[1], C. Andy James[1], Marielle Kanojia[1], and Alex Gipe[2].

[1]University of Washington Tacoma, [2]Washington Dept. of Ecology.

The Hylebos Waterway in Commencement Bay, located within the Puyallup/White River Watershed, remains one of the most contaminated waterways in Puget Sound. Toxic contaminants, such as polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs), threaten the health of aquatic organisms, including Endangered Species Act (ESA)-listed Chinook salmon (Oncorhynchus tshawytsha). Despite past remediation efforts, PCB and PBDE concentrations in the waterway remain elevated, exceeding fish health thresholds. Between 2023 and 2024, the Washington State Department of Ecology performed a contaminant source assessment using passive water samplers. The assessment identified elevated concentrations of PCBs and PBDEs in the waterway and surrounding drainage areas. Building on those efforts, the University of Washington Tacoma and Department of Ecology are implementing a multi-pronged source tracking study to identify inputs of PCBs and PBDEs from surface water/stormwater, sediments, and air deposition to the Hylebos Waterway. PCB congener distributions are assessed using multivariate and fingerprinting analysis to identify possible sources, assess spatial patterns, and determine the specific congeners driving site-to-site differences. These analyses help identify hotspots and pathways of PCB and PBDE loading that can be used to inform management recommendations to reduce inputs of PCBs and PBDEs to the Hylebos Waterway. This project is in coordination with the Port of Tacoma, the Puyallup Tribe of Indians, and other regional stakeholders.

Poster #18: Persistent Organic Pollutants in a Keystone Forage Fish: Comparisons in Pacific herring contaminants in Pacific Northwest waters.

Robert J Fisk‡, Louisa B. Harding, and Natasha Winnacott. WA Dept. of Fish & Wildlife

Persistent organic pollutants (POPs), including polychlorinated biphenyls, (PCBs), polybrominated diphenyl ethers (PBDEs), and legacy organochlorine pesticides such as dichlorodiphenyltrichloroethane and its metabolites (DDTs), remain widespread in marine ecosystems due to their persistence, hydrophobicity, and capacity for long-range transport. These compounds bioaccumulate in lipid-rich organisms and biomagnify through marine food webs, posing chronic risks to pelagic ecosystem structure and function. We hypothesized that POPs concentrations in Pacific herring (Clupea pallasii), a lipid-rich keystone mid-trophic forage fish, would exhibit distinct spatial patterns along the Northeast Pacific coast and its embayment's, reflecting regional contaminant sources and environmental retention. To test this hypothesis, herring were collected (2006-2008) from eight sites spanning from Queen Charlotte Island (British Columbia, CA) to San Francisco Bay (California, USA). Targeted congeners of PCBs, PBDEs, and DDTs were quantified and concentrations were log-transformed to evaluate spatial differences in contaminant burdens and chemical composition. POPs were detected in herring samples from all sites, with PCBs and PBDEs highest in Puget Sound, while DDTs were highest in San Francisco Bay, demonstrating clear spatial heterogeneity in contaminant burdens. Distinct regional congener profiles indicate localized exposure signatures rather than uniform coastwide contamination. As a keystone species with strong trophic connectivity, Pacific herring integrate regional contaminant stressors and provide an effective indicator of spatially explicit POPs exposure and associated trophic transfer to higher-level predators.

Poster #20: ^{1}H-NMR Metabolomics Reveals Functional Group–Specific Toxicity of Trisiloxane Surfactants in Honey Bees

Kelsey Bouse‡[1], Hannah Lucas[2], Carolyn Breece[2], Ellen Topitzhofer[2], Patrick N. Reardon[3,4], Chris Schmokel[1], Ramesh Sagili[2], and Serhan Mermer[1]. [1]Department of Environmental and Molecular Toxicology, Oregon State University, Corvallis, OR, 97331, [2] Department of Horticulture, Oregon State University, Corvallis, OR, 97331,[3] Department of Biochemistry & Biophysics, Oregon State University, Corvallis, OR, 97331, [4] Nuclear Magnetic Resonance Facility, Oregon State University, Corvallis, OR, 97331.

Honey bees (Apis mellifera; Hymenoptera: Apidae) are routinely exposed to agricultural adjuvants during crop pollination, including Trisiloxane Surfactants (TSS), which are widely applied to improve pesticide performance. Such exposure is especially significant in Central California, where nearly 60% of U.S. honey bee colonies are transported annually for almond pollination and encounter repeated tank mixes containing TSS. Despite this widespread use, TSS remain classified as unregulated “other ingredients,” even as evidence of their toxicity to pollinators grows. This study examines the toxicity and metabolomic effects of three TSS functional groups (acetyl-, methyl-, and hydroxy-) on honey bees. A preliminary-experiment was conducted with TSS-acetyl, TSS-methyl to find appropriate concentration ranges and validate methods for the larger study. For full experiment, honey bees were housed in cages and fed for eight days with sucrose solutions containing TSS-acetyl, TSS-methyl, and TSS-hydroxy across a range of concentrations. Preliminary 1H-NMR metabolomics data for TSS-acetyl and TSS-methyl indicated changes in metabolites associated with neurotransmission, stress, and energy metabolism. Specifically, reduced tyrosine suggested impacts on dopamine driven foraging behavior, elevated glutamine was consistent with nutritional stress, and increased kynurenate pointed to neurotoxicity via NMDA receptor blockage. Such metabolomics shift supports the hypothesis that TSS disrupt multiple physiological pathways beyond mortality alone. Ongoing analyses of a broader concentration range from full experiment, using multivariate approaches (PCA, PLS-DA) aim to elucidate functional group–specific mechanisms. Findings will improve understanding of the risks posed by TSS adjuvants and support science-based recommendations for pollinator health protection.

Thursday Platform Presentation Abstracts

‡ Presenting Author

Session 4: Science and Partnerships in the PNW

Ethical modeling of native plants: mapping rare and endemic plants of Cascadia

Grace Galles‡, Diana Rohlman and Sunil Khanna. Oregon State University.

The locations of many rare and endemic plant species in the Cascadia region are shifting, leading to changing plant communities and loss. For herbalists and Indigenous groups who rely on native plants for cultural and medicinal practices, mapping these plants may aid in the conservation and reintroduction of rare and endemic species. This raises ethical considerations, particularly when considering plants with cultural significance. Thus, we applied a common model to assess the ability to predict the location of the native plant Lomatium nudicaule (barestem biscuitroot) using limited physiological data, given its importance in Indigenous food, medicine, and cultural traditions in the region. We then assessed the ethics of modelling rare and endemic plants, recognizing that some plants may be considered protected Tribal knowledge. Several mapping strategies exist. One strategy, mechanistic modeling, can accommodate even minimal data on plant survival mechanisms to create a model that describes current and future (50 to 100-year forecast) projections of plant locations. We used the CLIMEX mechanistic modeling software to map Lomatium nudicaule, using available physiological data and 727 validated occurrences in the Cascadia region. We used the 'compare locations extended single species' module over the North American region using gridded data at a 10' spatial resolution, and the Access1.0 RCP8.5 30' climate change projection gridded data was used for future species distribution estimations for the year 2050. Maps of Ecoclimatic Index and stress indicators for heat, cold, flood, and drought conditions were produced to visualize the species distribution. Results suggest heat and cold stress changes in a high emissions scenario will shift the distribution of L. nudicaule more northward in latitude to due to rising temperatures over the Cascadia region. To assess ethical considerations related to mapping native plants, we are conducting interviews with herbalists to characterize potential ethical issues associated with this strategy. Our preliminary work has identified the following concerns related to mapping: it may lead to unsustainable harvesting practices and ecological damage; result in the biopiracy of rare plants for ornamental use; and destroy traditional medicines and foods, impacting the health and wellness of Indigenous communities. Modeling of rare and endemic plant species may provide broader insights into where and why shifts in species distribution may occur. For native plants used medicinally and culturally, this knowledge may assist conservation efforts, but additional considerations of Indigenous data sovereignty should be taken into account when modeling native plants.

How effectively do filters reduce the release of microplastics in stormwater along the Oregon coast?

Kervelle Baird‡[1], Elise Granek[1], Cara Poor[2], Susanne Brander[3], and Tala Navab-Daneshmand[4]. [1]Portland State University, [2]University of Portland, [3]Pew Charitable Trusts, Safer Chemicals, [4]Oregon State University.

Microplastics and microfibers that are not intentionally manufactured form from the use of tires, containers and clothing. Wind and water circulate these materials in the environment and organisms inhale and ingest them. Microplastics and microfibers have been linked to deleterious effects in a variety of terrestrial and marine organisms. Microplastics-Science Optimizing Solutions: Sources, Impacts and Strategies for Oregon tests the efficacy and ease of using filters on washing machines, dryers and storm drains to control the release of microplastics and microfibers into the environment. City staff were surveyed before and after installing filters on the storm drains. Six litres of stormwater were sampled from three drains and three outfalls in Cannon Beach and Yachats, three drains and one outfall in Pacific City and two drains and two outfalls in Depoe Bay using a 63-micron sieve during a sufficient Spring, Fall and Winter rain event before and after installing the filters. All samples included a simultaneous air fall control, and each community included a triplicate sample. Samples were density separated and filtered, dried and microplastics on the filters were analyzed using a Zeiss dissecting microscope and a Bruker focal plane array Fourier Transform Infrared Spectrometer. Baseline analysis showed microfibers, tire wear particles, foam, fragments and film (in order of abundance). City staff expressed varying enthusiasm and concern for the stormwater filtration intervention. These findings can guide widespread implementation of similar strategies to reduce the release of microplastics in stormwater.

Bridging Science to Action: CEC Strategic Planning at King County

Analise Lindborg. King County.

As contaminants of emerging concern (CECs) are identified with increasing frequency, local governments face a fundamental challenge: how to translate rapidly evolving science into coordinated, resourced, and equitable action across complex organizations. King County, Washington operates several services and systems including wastewater treatment, stormwater management, solid waste landfills, Metro and fleet operations, and an international airport. Coordinating actions to mitigate CECs across the County requires a structured, inter-departmental approach. To meet this challenge, King County developed a strategic planning process that involved convening cross-departmental work groups with various subject matter experts, conducting analyses to assess organizational capacity, establishing guiding principles, and defining missions, goals, objectives, and performance metrics. Strategic plans then guided the development of detailed action plans with defined actions, action teams, timelines, and resource allocation. This framework was applied to 6PPDQ beginning with a strategic plan (completed in 2025) and followed with an action plan (completed in 2026). The framework is also being applied to PFAS, with a strategic plan completed in 2024 and a draft action plan currently underway. This process is a blueprint for our future work on other CECs and was shaped by the practical realities of CEC management in a local government setting – including weighing priorities, allocating limited resources across departments, responding to evolving science and regulations, and adapting our approach along the way. We will provide a high-level overview of the King County services that intersect with CEC management and share what this CEC strategic planning approach looks like in an applied setting, along with a brief snapshot of completed and ongoing County actions that use science to address these CECs, informed by our planning process.

Partnering with Citizen Scientists to Advance 6PPD & 6PPD-Quinone Monitoring: Regulatory Readiness, Field Insights, and Emerging Sediment Methods

Louis Wagner, ALS Environmental.

6PPD-quinone (6PPD-Q), the tire-wear transformation product now recognized as the driver of urban runoff-induced coho salmon mortality, has spurred an exceptionally rapid regulatory response in Canada and the USA. In a span of only thirteen months, the U.S. EPA released Draft Method 1634 and published acute freshwater screening values, Washington State codified a 0.012 µg/L aquatic life toxics criterion, and British Columbia issued a 0.010 µg/L water quality guideline. To support compliance and research, ALS Canada has validated an ISO 17025-accredited, isotope dilution LC-MS/MS method that mirrors Draft EPA Method 1634, achieving routine and low-level limits of reporting well below these thresholds and water quality guidelines. ALS has also extended testing beyond the scope of Method 1634 to include accredited testing for 6PPD, the precursor to 6PPD-Q, and developed an optimized antioxidant preservative extending the stability of 6PPD to 14 days. This enables the quantification of both 6PPD-Q and its parent compound 6PPD at trace concentrations. Ultra-trace analysis methods for 6PPD-Q, capable of detection to 0.0002 µg/L (0.2 ng/L) and lower, have also been developed to support research into background and chronic exposure levels. New method developments will also be discussed for the simultaneous measurement of 6PPD and 6PPD-Q in sediments, reflecting growing interest in tire particle capture, sediment-associated transport, and depositional reservoirs as potential sources to receiving waters. Recent collaborative studies with the North Shore Streamkeepers (Wagg Creek, North Vancouver) demonstrated that 6PPD-Q concentrations during “first-flush” rainfall events reached 200–500 ng/L, exceeding acute guideline levels, while baseline (dry-weather) concentrations remained consistently measurable between 1–6 ng/L, suggesting potential chronic exposure even in the absence of active runoff. Follow-up rainwater sampling further confirmed 6PPD-Q detection at trace levels highlighting rainfall and airborne particulates as potential secondary transport pathways that may sustain trace background levels in receiving waters. In addition to detailing these analytical advances and recent regulatory updates, we will discuss possible next steps for monitoring and research, including the role of passive sampling for time-integrated exposure assessment, and the interest in tissue analysis for risk assessment studies.

Perceptions and Attitudes of Residents Living Near Superfund Sites in Oregon

Francesca Germano‡[1], Sunil K. Khanna[2], and Diana Rohlman[1]. [1]Department Environmental and Molecular Toxicology, Oregon State University, Corvallis, Oregon, USA 97331, [2]Center for Global Health, College of Health, Oregon State University, Corvallis, Oregon, USA 97331

Communities living near Superfund sites face long-standing environmental health and communication challenges, yet few studies center the lived exwperiences of residents directly impacted by these hazardous areas. This project explores how individuals residing within three miles of two Oregon Superfund sites (Portland Harbor and JH Baxter) understand, experience, and respond to environmental contamination and cleanup efforts. This study was reviewed and approved by the Oregon State University Institutional Review Board (IRB #HE-2025-1382). Participants were recruited through community organization email list servs. The study aimed to enroll 20 participants at each site (40 participants total) to capture a broad range of community perspectives. Interested individuals (n=127) completed a brief eligibility screening survey before being invited to participate. All eligible participants (n=24) completed a questionnaire and confidential virtual interview- during which they shared their perspectives on environmental health concerns, trust in agencies, communication effectiveness, the duration of cleanup processes, community engagement, and changes in daily life. Questionnaire items captured demographic characteristics, housing conditions, and other environmental and social factors influencing health. Interview questions focused on perceived health impacts, knowledge of cleanup progress, involvement in community organizations and decision-making, and the broader social or emotional effects of living near contaminated sites. For the Portland Harbor site, most (n=18) interviews have been completed, and the average time of each interview was about 20-25 minutes. For the JH Baxter site, recruitment is ongoing; interviews are not yet scheduled but have anticipated completion by February 15 2026. All participants will be compensated for their time with a $50 gift card. Common preliminary themes include distrust in agencies, persistent stress and anxiety due to proximity to the Superfund site, growing concern for other nearby pollution sources, and a desire for more communication and information from local agencies and organizations. The goal of this study is to identify key themes in community experiences to inform policymakers and local organizations and enhance communication and outreach strategies. Findings will contribute to a broader understanding of community concerns and will be shared in an open-access format to promote transparency and community benefit.

Session 5: Strategic Monitoring

Advancing our understanding of environmentally driven selenium speciation and bioaccumulation through a coal mine monitoring program

Claire Detering‡, Adrian de Bruyn, Cybele Heddle, Emma van Tussenbroek, and Mariah Arnold. WSP.

A monitoring program for a metallurgical coal mine in western Canada is investigating elevated concentrations of reduced and organic selenium species observed from the outflow of mine sedimentation ponds. These selenium species are highly bioavailable and can impact growth and reproduction in various organisms, including fish. Existing literature documents biological drivers as one mechanism that generates reduced and organic selenium species but there are limited examples of organoselenium behavior in surface water or of risk management strategies to mitigate generation of these species and their subsequent discharge into the receiving environment. The purpose of this monitoring program is to identify the spatial and temporal scale of selenium speciation, and its execution has created data-rich opportunities to investigate mechanisms driving the generation of reduced and organic selenium species with the goal of informing adaptive management. The study design is updated every three years, allowing the principal investigators to refocus study questions based on the learnings from previous cycles. This monitoring program has thus far gathered four years of data investigating mechanisms of selenium speciation and bioaccumulation across an active mine, tracking seasonal patterns, and most recently, using piezometer-type standpipes to monitor in-pond compartmentalization of speciation behavior. It incorporates non-standard monitoring approaches that document annual variability while serving adaptive management through science.

Evaluating Iron Nanogeochemistry Within the Nooksack River

Brianna Benner‡, Brooke Love, Amanda Ferrell, Kate Hermenet, and Manuel Montaño. Western Washington University.

River and stream networks are responsible for the transport of major and trace elements from continents to the oceans. Historically the study of biogeochemical cycling in rivers has divided samples into two size fractions, total (>0.45 µm) and dissolved (<0.45 µm), neglecting the specific contributions of colloids (1-1000 nm) and nanoparticles (1-100 nm). Iron oxide nanoparticles have been shown to play a large role in stimulating photosynthesis in estuaries and oceans. However, fluxes of iron from rivers are highly dynamic due to variability in flow rates caused by seasonal changes in temperature and precipitation. The Nooksack River in Whatcom County, WA has three forks fed by different sources, each experiencing peak flow at different times of the year. This study aims to better understand the influence of seasonal changes in water chemistry and hydrology across the three forks of the Nooksack on iron particle size, number concentration, and mineralogy. A combination of single particle inductively coupled plasma-mass spectrometry, X-ray diffraction, and scanning electron microscopy were used to characterize the iron-containing nanomaterials along the river. Preliminary results from the rain-dominated season demonstrate that of the three forks, the glacially fed North Fork contributes the most to iron concentrations in the mainstem, but that most of the iron was bound in suspended particulate matter above the dissolved size threshold. Iron-containing colloids and sediment were commonly associated with aluminum and silicon. By establishing a baseline of the iron nanoparticle populations and their behavior, we aim to better predict the response of iron nanogeochemistry to climate change.

PBDEs in the Snohomish Watershed: from exploratory data to unique regulatory solutions

Alex Gipe‡, William Hobbs, Tonya Lane, and Rachel McCrea. Washington Dept. of Ecology.

Since their phase out in the early 2000s, use of Polybrominated Diphenyl Ethers (PBDEs) has been drastically reduced, yet environmental concentrations are still detected at levels which impact biota. Regulating these environmental contaminants remains difficult due to a lack of water quality criteria, leaving limited approaches for regulatory agencies to reduce inputs from known sources. In Washington State the Department of Ecology has developed a novel approach to address PBDE discharges from wastewater treatment plants through permit requirements. We will present a case study of how Washington State agencies and their partners identified the sources of PBDEs impacting juvenile Chinook salmon in the Snohomish watershed and developed a regulatory solution to reduce their impact. In 2013, Washington State Department of Fish and Wildlife identified elevated concentrations of PBDEs in juvenile Chinook residing in the Snohomish estuary. Through subsequent studies further evidence demonstrated that a localized area of the estuary was impacting wild juvenile Chinook during their outmigration. From 2019 to 2022, the Department of Ecology performed a watershed scale PBDE source assessment. This study identified the Everett Pollution Control Facility (WPCF) as a source of PBDEs to the lower Snohomish estuary, showing that the discharge of treated wastewater contained levels of PBDEs which accumulated in sediments, biofilms, and juvenile Chinook prey items. To address these discharges, regulators from the Department of Ecology implemented changes to the WPCF's NPDES permit, including requirements to identify potential dischargers of PBDEs to the wastewater system, implementing best management practices to reduce PBDE discharges, and monitor influent and effluent levels of PBDEs at the WPCF. In addition to regulatory actions, novel PBDE treatment technology is now being examined to enact larger regional reductions to discharges from wastewater treatment plants. The Puget Sound National Estuary Program has invested in developing technologies to remove PBDEs at treatment plants, with a pilot scale study currently in the works. Through monitoring, source investigation, regulation, and technology development, PBDEs in the Snohomish watershed present a unique case study of how science, regulation, and technology can be utilized to address contaminants of concern in the environment.

Advancing passive sampling for 6PPD-Quinone monitoring in western Washington watersheds

Andrew Spanjer‡[1], Rhea Smith[2], Rachael Lane[1], Rich Sheibley[1], Chelsea Mitchell[3], and Jeremy Walls[3].
[1]U.S. Geological Survey, [2]Washington State Department of Ecology, [3]King County.

6PPD-quinone (6PPDQ), a tire-derived transformation product, is linked to acute mortality in coho salmon and is now a contaminant of emerging regulatory concern. Effective monitoring of this compound is critical for stormwater management and compliance with evolving water quality standards. Traditional grab sampling and automated pump systems are resource-intensive and often fail to capture short-lived storm pulses, limiting accurate exposure assessment. Passive samplers offer a cost-effective alternative for capturing time-weighted concentrations during these episodic events. This talk will compare two widely used passive sampling technologies, Polar Organic Chemical Integrative Samplers (POCIS) and Diffusive Gradients in Thin Films (DGT), for measuring 6PPDQ in Puget Sound receiving waters. Both samplers accumulate contaminants over time before reaching equilibrium, making their kinetic uptake phase valuable for estimating time-weighted average concentrations. Collaborative deployments by the U.S. Geological Survey, Washington State Department of Ecology, and King County have tested these samplers in diverse settings, including the Duwamish River watershed, streams of the Stormwater Action Monitoring (SAM) program, the Quinault River watershed, and other regional Puget Sound programs. Initial results indicate both POCIS and DGT effectively sorb 6PPDQ over multi-day to multi-month deployments. This presentation will compare their performance, highlight subtle technical differences, and discuss implications for regulatory compliance monitoring and best management practice (BMP) evaluation. Future work includes laboratory validation, integration into BMP inflow/outflow monitoring, and assessment of scalability for widespread adoption. By advancing passive sampling strategies, this research supports regional efforts to mitigate stormwater impacts and inform management decisions under emerging contaminant regulations.

Employing passive samplers for monitoring urban stream health and informing management of 6PPDQ

Chelsea Mitchell‡[1], Rhea Smith‡[2], Jeremy Walls[1], Andrew Spanjer[3], and Alex Lee-Tinger[4]. [1]King County, [2]Washington State Department of Ecology, [3]United States Geological Survey, [4]Trout Unlimited.

6PPD-quinone (6PPD-Q), a transformation product of the tire rubber anti-degradant 6PPD, has been identified as the cause of Urban Runoff Mortality Syndrome (URMS) in coho salmon. It is highly toxic to coho and other aquatic species, even at low surface water concentrations. While monitoring efforts have expanded rapidly since 2020, characterizing when and where aquatic life are exposed to lethal environmental concentrations remains difficult because 6PPD-Q occurs in episodic, storm-driven pulses, degrades quickly, and has toxic thresholds near analytical detection limits. To address these limitations, out inter-agency sampling team evaluated passive samplers as screening tools for 6PPD-Q in small streams across King County, Washington. Polar Organic Chemical Integrative Samplers (POCIS) and Diffusive Gradients in Thin Films (DGT) were deployed at multiple sites spanning a gradient of urbanization. Samplers provided time-weighted average concentrations, capturing cumulative mass loadings over multi-week deployments. Across basins with 5–53% impervious cover, estimated time-weighted average concentrations ranged from 0.4 to 67 ng/L 6PPD-Q. Results showed elevated loadings consistent with known URMS hotspots, and loadings generally increased with impervious surface cover. Our findings support the use of passive samplers as a sensitive, cost-effective tool for risk assessment, pollution identification, and long-term status and trend monitoring. By identifying hotspots, passive samplers can help prioritize locations for mitigation efforts and inform stormwater infrastructure investment planning.

Session 6: Assessing Toxicity in a Changing Environment

REU Interrupted: An Undergraduate's Lessons from a Zooplankton Ecotoxicology Project Halted by Bacteria

Brian John Weir. Portland State University.

Nontraditional model species like rotifers in ecotoxicology assays provide aspiring toxicologists training, and the lab skills to jumpstart a career. Come on a journey through an undergraduate's National Science Foundation summer research experience, complete with twists and turns. During the 10-week intensive program, rotifers from varying life-history habitats were exposed to sublethal copper concentrations, and their respiration was measured as a physiological proxy for metabolism. Six weeks into the program, control mortality skyrocketed to between 60-100%, far exceeding ASTM LC50 protocol parameters; visual signs of impending doom grew daily. Lab cultures had succumbed to not one but four bacterial strains. The remainder of the program was an exercise in accepting science on science's terms. We will review the timeline of the project, early warning signs, bacterial identification and eradication protocols, antibiotic administration, highlights of an exploratory case study, methods for determining zooplankton fitness, and strategies for keeping a positive attitude when your research project takes a detour.

Investigation and Analysis of Acute Toxicity from Copper and other Toxicants in Samples of Cyanide-Treated Wastewater from the Emergency Response Leach Solution Treatment Facility at Eagle Mine

Josh Baker‡[1,2], Kresimir Ljubetic[2], H.C. Liang[2], James Elphick[2], and David Kratochvil[2]. [1]Rise Over Run Environmental, [2]BQE Water.

The emergency response to the heap leach facility dam failure at Eagle Mine required the implementation of active water treatment to reduce concentrations of various contaminants to environmentally protective levels. Daily effluent samples (n>300) produced from the water treatment plant were assessed for toxicity with acute tests with rainbow trout and Daphnia magna to support the optimization of the water treatment process, demonstrate effective treatment and to confirm discharge criteria. A combination of toxicity identification evaluation (TIE) techniques and other lab-based studies were used to confirm causes of toxicity in samples. Copper was identified as a cause of toxicity during the optimization of the plant and findings from investigations indicated that: 1) adverse effects could originate from particulate forms of copper (e.g., copper hydroxides and/or sulphides), 2) information on the characteristics of dissolved organic carbon was important in establishing appropriate benchmarks for copper, and 3) the toxicity of dissolved copper was different when it was complexed with cyanide. This study highlights the importance of a strong understanding of the chemical speciation of toxicants and their modifying factors. After the optimization of the plant, and during active discharge, additional investigations were undertaken to identify other causes of toxicity, and the continuing improvement of plant processes was demonstrated through reduced adverse effects in sublethal toxicity testing. The toxicity tests and TIEs employed in the project provided a powerful monitoring tool for dynamic and adaptive active water treatment.

Early-Life Chronic Exposure to 6PPD-Quinone Alters Acute Sensitivity in Coho Salmon (Oncorhynchus kisutch)

Anastasia McConachie‡[1], Melissa Driessnack[1], Jeffrey Perala-Dewey[2], Nathan Ivy[1], and Jenifer McIntyre[1]. [1]Washington State University Puyallup Research and Extension Center, [2]Center for Urban Waters.

6PPD-quinone (6PPDQ), a transformation product of the tire additive 6PPD, is acutely toxic to coho salmon at low ng/L concentrations, yet little is known about how chronic early-life exposure influences subsequent sensitivity. Here, we examined whether developmental exposure history modifies acute toxicity responses to 6PPDQ. Eggs were fertilized on site and split evenly into control and treatment groups. Beginning 8 days post-fertilization, the treatment group was exposed to pulsed concentrations of 6PPDQ (100 ng/L), administered bi-weekly throughout early development, while control fish were maintained under identical conditions without chemical exposure. Survival was monitored and development tracked into the fry stage. Acute sensitivity was evaluated during the alevin stage and again during the fry stage using 24-h exposures to 6PPDQ spanning an environmentally relevant range (nominal 100 ng/L to 1000 ng/L). Early development was severely delayed in the fish chronically subjected to pulses of 6PPDQ. A single mortality event occurred in the exposed group coincident with a pulsed exposure at the time of swim-up. Dose-response curves of chronically exposed fish displayed reduced mortality relative to naïve controls. This difference in sensitivity was further supported by a targeted comparison in which control fry were subjected to a 24-h pulse alongside a scheduled pulse for the chronically exposed group. The exposed fry exhibited near-complete survival following the 24-hour pulse of 100 ng/L 6PPDQ (<1% mortality), whereas the naïve fish experienced 53-66% mortality. These results demonstrate pulsed exposures to 6PPDQ early in coho salmon development can alter acute toxicity responses later in development. This work illustrates the importance of developmental context and exposure history in evaluating toxicological risk and suggests that reliance on acute-only toxicity metrics may overlook biologically meaningful shifts in sensitivity under repeated low-level exposure scenarios.

How will increasing temperatures affect the uptake and toxicity of 6PPD-Q in juvenile coho salmon (Oncorhynchus kisutch)?

Amirah Casey‡[1], Julann Spromberg[2], Denis daSilva[2], Nathaniel Scholz[2], and Mark Scheuerell[1,3].
[1]University of Washington, [2]NOAA, [3]USGS, University of Washington.

Urbanization and climate change are two of the greatest threats to freshwater ecosystems. While their isolated impacts are well studied, their combined effects are increasingly concerning. Pacific salmon (Oncorhynchus spp.) are culturally, ecologically, and economically important, yet many populations remain threatened despite recovery efforts. Coho salmon (O. kisutch) are especially vulnerable to urban stormwater runoff, with pre-spawn die-offs up to 90%. The driver of this mortality syndrome is the globally ubiquitous tire-wear chemical 6PPD-Quinone (6PPD-Q). Additionally, warming surface waters are intensifying physiological stress in salmon. Although both climate change and urbanization independently elevate extinction risk, the interactive effects of temperature and 6PPD-Q remain poorly understood. To address this, we exposed juvenile coho to environmentally relevant 6PPD-Q concentrations (~50 ng/L) across a temperature gradient (8–14°C). Water chemistry analyses and state-space modeling showed loss of 6PPD-Q (used as a proxy for uptake) at 12 and 14°C was nearly 50% faster than at 8 and 10°C. Building on these findings, we will further assess how temperature-mediated differences in 6PPD-Q uptake translate to juvenile salmon mortality under the same exposure conditions. Combining uptake results with future stream temperature projections for Puget Sound, this work suggests juvenile salmon will increasingly encounter conditions that accelerate 6PPD-Q uptake, even under moderate warming scenarios. By linking contaminant uptake, temperature, and survival, our work highlights emerging threats to salmon persistence and critical challenges for conservation.

Development of a Web-Based Risk Screening Tool for Indigenous Shellfish Consumption

MacKenzie Allison‡[1], Jamie Donatuto[2], Jordan Smith[3], Susan Tilton[1], and Diana Rohlman[1]. [1]Oregon State University, [2]University of Washington, [3]Pacific Northwest National Lab.

Many coastal Indigenous communities consume shellfish at higher rates than the general population. This is reflected in higher state-level Indigenous consumption rates, which inform risk assessments. In Oregon and Washington, the current fish/shellfish consumption rate is 175 g/day, a significant increase from previous rates of 17.5 g/day and 6.5 g/day, respectively. This increased value was largely derived from the 1994 fish consumption survey conducted by the Columbia River Inter-Tribal Fish Commission (CRITFC). While the higher rate is more protective for Indigenous communities, the same 1994 CRITFC survey also found contemporary consumption rates as high as 389 g/day, and other local Tribes have published consumption rates higher than these states' current standards. As a result, risk assessment methods may be underestimating both cancer and non-cancer risk by not accounting for variable consumption rates among Indigenous communities. Indigenous risk assessments have demonstrated the utility of using Tribe-specific consumption rates and exposure routes. While many Tribes have active fish and wildlife communities and routinely conduct fish and shellfish sampling to assess exposure to common contaminants, their capacity to conduct their own human health risk assessments may be limited. In response, we are developing an accessible web-based Indigenous risk screening tool. The preliminary tool developed relied on an Indigenous risk assessment for shellfish consumption, using a Tribe-specific consumption rate. As Indigenous communities conduct their own sampling of fish and shellfish, they can enter the resulting chemical detection values into the tool, covering many contaminant classes, including polycyclic aromatic hydrocarbons, polychlorinated biphenyls, dioxins/furans, and pesticides. To ensure broad applicability across multiple communities, the tool will include customizable fields that allow users to select alternative consumption values (e.g., EPA values) or enter their own. With this, the tool can then calculate the average daily dose (ADD), which is used to calculate a hazard quotient for non-cancer risk. If the analyte is a known carcinogen, the ADD is also used to calculate cancer risk, which is done by multiplying the ADD by the carcinogen's cancer slope value, which yields the cancer-risk output value. The tool will be made available on a website that includes instructions, a guide, videos describing the tool's development, guidance on determining Indigenous risk assessment values, and other resources for further learning. We anticipate the screening tool will be used to support decision-making. 1. US EPA. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories; 2000. https://www.epa.gov/sites/default/files/2015-06/documents/volume2.pdf.

Science Communication Short Course Part 2: When Fish Speak English

Presented by Heidi Siegelbaum, Washington Stormwater Center at Washington State University

The Science Communication Short Course will feature two complementary sessions. The second session, "When Fish Speak English," will feature background on cognitive science, the realities of addressing the irrational human, communication advice and tools for effective science communication.

Attendees will come away with guideposts, resources and partake in conversation that will add to the richness of the discussion and experiences from the audience.

Poster Session II Abstracts (Thursday)

‡ Presenting Author

Poster #1: Toxicity of binary mixtures of 6PPDQ with Zinc or Copper in coastal cutthroat trout

Prarthana Shankar‡[1], Andrea J. Roth-Monzón[1], Ellie Dalsky[1], Blaine R. McCleskey[2], and John D. Hansen[1]. [1]U.S. Geological Survey, Western Fisheries Research Center, 6505 NE 65th Street, Seattle, Washington 98115, United States, [2]U.S. Geological Survey, Water Resources Mission Area, 3215 Marine St, Bldg 6, Boulder, CO 80309, United States.

Salmonids exposed to the tire-derived chemical 6PPDQ in the environment are simultaneously exposed to complex contaminant mixtures from urban stormwater runoff. Among these contaminants, zinc and copper, originating primarily from vehicle tires and brake pads, respectively, are well-documented as being harmful to salmonids. However, the extent to which these metals influence 6PPDQ-induced toxicity remains unclear. In this study, we use coastal cutthroat trout (CCT; Oncorhynchus clarkii clarkii), currently the second most sensitive species to 6PPDQ after coho salmon (O. kisutch), to evaluate mixture toxicity of 6PPDQ with zinc or copper. Preliminary 48-hour exposures revealed that 3000 µg/L zinc chloride (Zn), but not 100 µg/L Zn, significantly increased mortality in CCT embryos co-exposed to 1000 ng/L 6PPDQ compared to 6PPDQ alone. Transcriptomic analysis of surviving embryos indicated that majority of the gene expression changes at 48 hours were driven by 6PPDQ rather than zinc. Measured zinc concentrations were approximately 50% of nominal values, with minimal reduction over 24 hours, suggesting limited zinc uptake in 24 hours. Building on these findings, we are conducting 96-hour exposures of CCT embryos and parr to binary mixtures of 6PPDQ/Zn and 6PPDQ/copper chloride (Cu). Individual dose-response curves for mortality are first established [Exposure concentrations - 6PPDQ: 100 – 1000 ng/L, Zn: 1,000 – 5,000 µg/L, Cu: 50 – 5,000 µg/L], followed by mixture exposures using two concentrations of each metal and three 6PPDQ concentrations. Mortalities are recorded daily. Subset of the surviving embryos are sampled for RNA analyses, and remaining fish are assessed for hatch success, latent mortality, and growth after transfer to freshwater. Gills are sampled from surviving parr for determination of sublethal effects. Chemical concentrations are measured throughout to confirm nominal exposure levels of 6PPDQ, Zn, and Cu. Experiments and data analyses for the 96-hour studies are currently ongoing. This work will advance our understanding of how chemical mixtures influence acute 6PPDQ toxicity in sensitive salmonid species.

Poster #3: Comparing in vitro Metabolism of 6PPD-Q by Coho Salmon and Steelhead Fishes

Gunnar Goetz‡, Denis da Silva, and Irvin Schultz. NOAA Fisheries.

The stormwater-derived contaminant 6PPD-Q (N-(1,3-dimethylbutyl)-N′-phenyl-p-phenylenediamine-quinone) has received rapidly increasing attention due to its toxicity in several fish species. Its precursor, 6PPD (N-(1,3-dimethylbutyl)-N′-phenyl-p-phenylenediamine), is an antioxidant used in the tire manufacturing industry that reaches aquatic systems via stormwater runoff events. After its rapid oxidation in the environment, 6PPD-Q can have significant negative effects on the fish that reside in bodies of water that receive the runoff. Namely, coho salmon (Oncorhynchus kisutch) are incredibly susceptible to 6PPD-Q, dying off at concentrations as low as 40-90 ng/L (24-h LC50 value) whereas steelhead (Oncorhynchus mykiss) are only similarly affected at roughly 10-fold higher concentrations of 6PPD-Q. The precise differences between these species' metabolism of 6PPD-Q that result in their disjointed mortalities is still unknown. To quantify the metabolic activity for 6PPD-Q between coho salmon and steelhead, we generated liver microsomes from three individuals each of coho salmon and steelhead and conducted in vitro metabolism experiments. Metabolism reactions were terminated at several time points and 6PPD-Q and its metabolites were quantified using a UHPLC-MS/MS (ultra-high performance liquid chromatography tandem mass spectrometry). From these data, we plotted metabolism of 6PPD-Q and estimated its intrinsic clearance in both coho salmon and steelhead. We also assess potential metabolic differences that could be derived from the chirality of 6PPD-Q and its metabolites.

Poster #5: Model risk: What it is and why we should consider it

Julann Spromberg‡[1], Scott Hecht[1], Cathy Laetz[1], Tony Hawkes[2], and David Baldwin[2]. [1]Northwest Fisheries Science Center, NOAA Fisheries, [2]Office of Protected Resources, NOAA Fisheries.

Models can be an important tool in regulatory decision-making processes regarding natural resources, fisheries, and rare species. The utility of a population model depends on the available species data used for parameterization and the alignment of the model output with regulatory needs. Importantly, the confidence in the available data and the model rigor need to match the types of decisions to be made, the timeframe for reassessment, and the level of risk the regulator/agency deems appropriate. Model risk, defined as the possibility the model is wrong or the output is misapplied, may stem from data limitations, parameter estimation uncertainty, model misspecification, or inappropriate use of model output. A decision framework for considering whether and when to use a model's output as a line of evidence in a regulatory context has been proposed. The framework can assist regulators as they either work with modelers to construct new models or as they select from existing models to inform their decisions. Acknowledging and managing model risk increases the confidence of using models in regulatory contexts. As we make progress toward utilizing models in regulatory decision-making, use of this process will ensure models fit the regulatory question, reduce model risk, and increase user confidence in applying models.

Poster #7: Improving cell culture conditions for proliferation of Botryllus schlosseri epithelial cells

Alison Gardell‡[1], Idriana Jan Abinales[1], Baruch Rinkevich[2], and Dietmar Kueltz[3]. [1]University of Washington Tacoma, [2]Israel Oceanographic and Limnological Research, [3]University of California Davis.

Despite decades of research, the development of methods to reliably generate cell culture systems for marine invertebrates has been challenging. There are currently only a few marine invertebrate cell lines available compared to the thousands that exist for vertebrates. Botryllus schlosseri is a colonial tunicate species found globally and is a close relative to vertebrates. We sought to improve medium formulation to support the proliferation and longevity of B. schlosseri epithelial cells in vitro. Previous attempts have yielded low cell growth of only ~30 cells per seeded tissue and senescence within a few days. For this study, wild colonies of B. schlosseri were collected from local marinas followed by microdissection of zooids and buds for primary explants. We tested various ratios of complete medium to seawater while controlling for total osmolality. We found that 75% medium with 25% seawater (75/25) and 50% medium with 50% seawater (50/50) yielded the most consistent growth and highest number of cells within a 5 day period. We ultimately selected the 50/50 medium formulation and harvested cells at 1, 3, and 5 days for bulk RNA sequencing and proteomics. Future work will characterize the molecular phenotype of B. schlosseri epithelial cells in vitro and use this information to further optimize their proliferative capacity. Funding provided by NSF MCB-2127517.

Poster #9: Microplastics in Western Washington Drinking Water: A Preliminary Assessment

Ben Wozniak‡, TJ Blackburn, and Hakan Gürleyük. Brooks Applied Labs.

Microplastics (MPs) are increasingly detected across environmental and human exposure pathways, including drinking water. This study presents a preliminary assessment of MPs in western Washington drinking water using Laser Direct Infrared Imaging (LDIR). Samples were collected from municipal systems, island communities, and a natural spring. MPs were detected in most samples, demonstrating their pervasiveness across diverse water supplies. Total microplastic counts ranged from 5 to 44 particles depending on location, with distinct polymer profiles that may reflect influences from local water infrastructure or treatment characteristics. These findings highlight the need for continued monitoring and method refinement to better characterize microplastic occurrence in drinking water and to support environmental health and risk assessment efforts.

Poster #11: Elemental Imaging of Plant Leaves Using Laser Ablation-Inductively Plasma-Mass Spectrometry (LA-ICP-MS)

Ben Wozniak‡, Hakan Gürleyük, and Vedat Yılmaz . Brooks Applied Labs

Laser Ablation–Inductively Coupled Plasma Mass Spectrometry (LA ICP MS) enables high resolution, multi element imaging of biological and environmental samples. This work presents the preparation and validation of multi element gelatin gel calibration standards designed for semi quantitative imaging across ten trace elements. The gels demonstrated homogeneous element distribution and strong linearity with low detection limits across the 0–50 µg g^{-1} range. Accuracy testing using certified reference materials yielded recoveries between 71% and 140%, supporting their suitability for elemental bioimaging applications. We further demonstrate the application of LA ICP MS to elemental mapping of edible plant leaves, including bay and basil. Spatially resolved distributions of nutrients (Mn, Ni, Cu, Zn, P) and toxic elements (As, Cd, Pb, Hg) reveal heterogeneous elemental uptake patterns within leaf tissues. Controlled exposures revealed clear localization of arsenic, cadmium, and mercury within leaf tissues. This demonstrates LA ICP MS as a powerful tool for assessing contaminant uptake, nutrient dynamics, and exposure pathways relevant to environmental toxicology.

Poster #13: Assessing PFAS accumulation in transplanted native bay mussels from Puget Sound nearshore waters (2023-2024)

Michelle A. Stowell‡, Mariko Langness, Danielle Nordstrom, Samantha Dahlke, and Molly Shuman-Goodier. Washington Department of Fish & Wildlife.

Among the diverse group of chemicals classified as contaminants of emerging concern (CECs), per- and polyfluoroalkyl substances (PFAS) are of high interest due to their ubiquity and persistence in the environment, as well as their continued use in many commercial applications. However, their unique physiochemical properties and diverse molecular structures make it challenging to assess PFAS toxicity and biomagnification potential. The complexity of this contaminant group highlights the importance of monitoring PFAS across a variety of trophic levels and habitats. Since 2012, the Washington Department of Fish and Wildlife (WDFW) Mussel Watch program, a part of the Toxics Biological Observation System (TBiOS) unit, has monitored the exposure of Puget Sound's nearshore biota to a broad suite of contaminants. During Mussel Watch's biennial surveys, transplanted native bay mussels (Mytilus trossulus) are placed in anti-predator cages at intertidal locations throughout the Sound for the winter storm season. The mussels are then retrieved and analyzed for soft tissue contaminant levels. In the 2023-2024 survey, PFAS were among the analytes examined. After four months of exposure (mid-November through mid-March), whole-body soft tissue samples from 70 mussel monitoring sites were tested at SGS AXYS for 40 PFAS compounds. Here, we summarize PFAS detections and concentrations and examine the geographic distribution of PFAS in the Puget Sound nearshore environment. WDFW Mussel Watch's collaboration with Tribes, government agencies, nonprofit organizations, and volunteer groups enables a broad geographic reach and high spatial resolution of data, making this a valuable data set that could improve our understanding of the potential impacts of PFAS on ecosystem and public health.

Poster #15: Characterizing contamination of the Puget Sound benthic environment and the effects on English sole

Dwight Causey‡[1], James E. West[1], Jan Lovy[2], Sandra M. O'Neill[1], and Louisa B. Harding[1]. [1]Toxics Biological Observation System, Washington Department of Fish & Wildlife, [2]U.S. Geological Survey, Western Fisheries Research Center

English sole (Parophrys vetulus) is a key species for assessing contamination trends in Puget Sound's benthic ecosystem due to their wide distribution, close association with bottom sediments, benthic diet and local foraging. These characteristics make English sole a valuable species for monitoring sediment contamination and understanding the health of Puget Sound's benthic food web. The Toxics Biological Observation System has collected this indicator species across a range of sites since the 1990s. Here we provide an update to this long-term monitoring effort through 2023, using a Generalized Additive Mixed Model (GAMM) for determining temporal trends of contaminant concentrations while also identifying the biological effects of contaminants in English sole. Spatial variation in contaminant concentrations suggest low PCB inputs in North Puget Sound and Hood Canal, with higher inputs in Central and South Puget Sound. However, for the first time, all sites exceeded the PCB human health screening value (8 ng/g ww) in 2023. The highest PCB concentrations were associated with urbanized and industrialized areas including the Duwamish River, Elliott Bay and Tacoma City Waterway in Central and South Puget Sound. In particular, the Duwamish River and Eagle Harbor have experienced significant increases in PCB concentrations from the 1990s to 2023 while other sites are stable but remain elevated. Similar patterns were observed for PBDEs where urban areas had the highest concentrations. However, PBDEs at all sampling locations fell well below the human health screening value (34 ng/g ww). Evaluation of PAH-related liver disease and EDC-related reproductive impairment provide direct measures of contaminant related impacts to English sole health, and potentially other species in benthic habitats. Liver disease peaked in the mid-1990s throughout Puget Sound, particularly in urban and near-urban sites, but as recently as 2019, there was no evidence of elevated odds of liver disease compared to baseline conditions. In 2023, male English sole throughout Puget Sound showed a marked increase in vitellogenin production. All sites had at least two male fish expressing measurable levels of vitellogenin, with Carr Inlet and Elliott Bay having the highest odds of vitellogenin expression compared to reference sites. Additionally, female English sole are expected to be in a "post-spawning" state when sampled in the spring following their winter spawning. However, a high proportion of females at Carr Inlet and Elliott Bay where in a "ripe" or "spawning" state, further supporting the conclusion that these areas are contaminated with xenoestrogenic chemicals. Overall, anthropogenic contamination in the Puget Sound benthic environment is still prevalent and results in fish tissue concentrations that exceed health thresholds, exhibiting the need to continue monitoring efforts throughout the region.

Poster #19: A Spatial and Temporal Assessment of Metal Accumulation in Ulvoid Seaweeds

Ruth Sofield‡, Cristina La, Ivy Arden, Katie Knaub, Megan Lee, Chad VanHemert, Kei Inamura, and Kathy Van Alstyne. Western Washington University

The Ulvaceae family of algae is prevalent in the Salish Sea and is commonly harvested as a nutrient rich food but can also be used to biomonitor marine pollution. In 2021, *Ulva fenestrata*, *U. linza*, and *Ulvaria obscura* were collected from Ship Harbor in Anacortes, WA where a Washington State ferry terminal is located. Monthly samples were collected between April and September adjacent to the ferry terminal and at 4 additional sites at increasing distances from the terminal. Samples were acid digested and analyzed for total concentration of metals via ICP-MS. Metal-dependent spatial patterns arose in the results; generally, higher concentrations occurred near the terminal (e.g. Pb), whereas no consistent patterns emerged for others (e.g. total As and Cr). No consistent trends arose in temporal patterns of accumulation. Using results from the current study, previously published work, and consumption guidelines, we can provide a better understanding of how the levels of metal accumulation compare to other Ulvoids in the Salish Sea and whether consumption guidelines will be exceeded for metals.

Poster #21: Measuring Per- and Polyfluoroalkyl Substance Concentrations in the Lower Columbia River Using Passive Sampling Techniques

C Schmokel‡, K Gurfield, K Hall, L Tidwell, M Garcia-Jaramillo; K Anderson, and S Mermer. Oregon State University, Corvallis, OR.

Per- and polyfluoroalkyl substances (PFAS) are a class of anthropogenic organic molecules developed in the 1930s and used widely for a variety of applications including electronics, consumer items, and as a component of firefighting foams. One of the most striking characteristics of these compounds is their resistance to environmental degradation, and this, combined with their widespread and historic use has led to PFAS becoming ubiquitous in environmental matrices including surface water. Traditionally, concentrations of PFAS in surface waters are measured using grab samples, but this technique is limited in that it measures concentrations at a single point in time, and could produce misleading results if the waterway in question was subject to short-term or seasonal events, such as severe storms or periods of drought, which might affect PFAS concentrations. This study uses newly developed PFAS specific passive samplers (PassiveX™) to measure the concentrations of 40 PFAS analytes along the lower Columbia River. These samplers continuously absorb PFAS analytes from water over the course of their deployment, and are able to generate time-weighted average PFAS concentrations in river water. Starting in June of 2025, as part of a larger EPA funded effort to monitor bioaccumulative organic chemicals, these samplers have been deployed at ten sampling sites along a 170 mile stretch of the Columbia River from the Dalles to Astoria. Each sampler is deployed for approximately 28 days before it is recovered and replaced with a fresh sampler. The goal of this component of the Columbia River Basin project is to measure PFAS concentrations across this important stretch of water over the course of an entire year. This research will provide information about baseline PFAS concentrations in the Columbia River, and will also give insight into seasonal variability and the impact of tributary waterways, urban areas, and dams on PFAS concentrations.

Friday Platform Presentation Abstracts

‡ Presenting Author

Session 7: Assessing Toxicity in a Changing Environment

River Restoration Along Urbanization Gradients: A Salmon Metapopulation Perspective on Stormwater in Restored Habitats

Julann Spromberg‡[1], Blake Feist[1], and Nathaniel Scholz[2]. [1]Northwest Fisheries Science Center, NOAA Fisheries, [2]Western Washington University.

Habitat restoration targeted at mitigating urbanization impacts has focused on physical habitat degradation. However, aquatic habitats are also chemically degraded by urban development, often in the form of toxic stormwater runoff. The tire-derived chemical 6PPD-quinone has been identified as the acutely toxic causative factor in the urban coho salmon mortality syndrome. Estimates of coho population responses to stormwater impacts made prior to the identification of 6PPD-quinone focused on the loss of spawners, but recent data shows that juveniles are similarly sensitive and are exposed during freshwater residence. Updated metapopulation models examined abundance loss resulting from mortality during two life stages. Thousands of reaches, with water chemistry impaired by urban stormwater, are proposed for restoration and reconnection, through removal of fish passage barriers. Restoring access to habitat with impaired water chemistry from urban runoff can cause action at a distance - a drain on nearby unexposed populations - and result in a net loss of metapopulation abundance. Models show that poor quality habitat becomes a drain (sink) on populations in good habitat (source). Models examined factors that can influence the long-term population abundance after barrier removal. Prominent factors for coho are straying rates between populations and the amount and quality of newly available habitat, particularly stormwater induced mortality across different basins. Since modest changes in stormwater mortality cause large differences in productivity, implementing stormwater mitigation, such as green stormwater infrastructure in reconnected habitats, may result in large gains in abundance. Reconnecting habitats with high carrying capacity, low stormwater mortality and close links to stable source populations, provides the greatest opportunity for increasing coho abundance through passage barrier removal and restoration.

Evaluating the Effects of Anticoagulant Rodenticides in Coho Salmon (Oncorhynchus kisutch) through Dietary Exposure.

Melissa Driessnack‡ and Jenifer McIntyre. Washington State University.

Anticoagulant rodenticides (AR) are frequently employed to control rodents (e.g., rats) in domestic, municipal, agricultural, and conservation settings. The United States Department of Agriculture (USDA) engages in whole-island eradication of invasive rats using aerially dropped AR-containing cereal bait pellets to support the conservation efforts of native island species. In the Aleutian Islands of Alaska, invasive rats are being targeted for eradication due to their negative impacts on nesting seabird populations. In preparation for aerial dispersion events, risk assessments are needed to evaluate the potential for harm to non-target organisms, including fish. Among the species native to the Aleutian Islands are Pacific salmon, including coho (Oncorhynchus kisutch), which may be exposed to ARs primarily through dietary pathways. In this study, we conducted controlled invertebrate feeding trials to assess the effects of trophic exposure to two commonly used ARs, brodifacoum and diphacinone, in juvenile coho salmon. Colonies of mealworms (Tenebrio molitor) were reared on AR bait pellets and subsequently used as prey for juvenile coho salmon across chronic exposure studies. Survival was monitored throughout the exposures, and tissues (muscle and liver) were collected to quantify AR accumulation. Liver tissue was further analyzed for biomarkers of oxidative stress (CAT, SOD, and GPx), and plasma was collected to assess potential for sublethal delays in blood clotting time. Preliminary results indicate that low cumulative doses increased mortality in fish exposed to brodifacoum but not diphacinone. These findings highlight compound-specific differences in toxicity and underscore the importance of considering trophic transfer pathways when evaluating the ecological risks of AR use in island eradication programs.

Updates on the toxicokinetic behavior of 6PPD-Q in tolerant vs sensitive salmonid species

Denis da Silva‡, Li-Jung Kuo, Audriel Schlosser, Jeff Atkins, and Irvin Schultz. NOAA.

6PPD-Q continues to pose risks to salmonid species due to its presence in urbanized watersheds. A better understanding of the toxicokinetics of 6PPD-Q among salmonids with diverse sensitivity to this chemical is important to help unraveling its toxic differences. Our study focuses on assessing 6PPD-Q toxicokinetic behavior between a highly sensitivity species, coho salmon (Oncorhynchus kisutch), and a relatively low sensitive species, steelhead (Oncorhynchus mykiss irideus). Fish were exposed to 6PPD-Q via a static waterborne system up to 96 hours. All individual exposure tanks had a loading density near 1 g fish/L water. Water samples were collected throughout the experiments. At termination times (24, 48, and 96 hours), fish were euthanized, followed by sampling of blood, bile, liver, and carcass. Our laboratory has developed different protocols for measuring 6PPD-Q in fish tissues and water, all showing satisfactory analytical efficiency, sensitivity and reproducibility. Stability tests of 6PPD-Q in the exposure system without fish demonstrated no loss up to 96 hours. No statistical differences in 6PPD-Q uptake were seen between coho and steelhead. Approximately 70 % of 6PPD-Q was eliminated from the system (water plus biological tissues) by the end of the 96-h experiment, most likely due to metabolism. Additional toxicokinetic experiments used coho and steelhead fitted with a dorsal aortic catheter, which was used to administer 6PPD-Q as a bolus injection [1 ug/kg or 10 ug/kg (steelhead only)]. Blood was repetitively sampled from each individual fish via the implanted catheter up to 24 h after injection. The intra-arterial dosing experiments allowed us to estimate toxicokinetic parameters such as area under the curve (AUC), apparent volume of distribution at steady state (Vss) and total body clearance (Clb). Both species exhibited relatively high Clb and a Vss that was near or less than 1 L/kg. Some differences were observed between species, with coho salmon presenting higher Vss. Further investigations are needed to potentially detect significant differences in 6PPD-Q uptake, distribution and clearance between species. We have been conducting chiral 6PPD-Q analysis to assess differences on uptake and clearance of each 6PPD-Q stereoisomers that could potentially link with disparities in toxicity between these species. Additionally, we have identified and started quantitation of key hydroxylated metabolites of 6PPD-Q to help elucidate clearance and metabolism kinetics between these species.

Photosynthesis can increase pH, which can act as a toxicant and eliminate effective grazers

Frieda B. Taub‡, Natalie E. Stillwell, Rachel Haden Kasbohm, and Morrison Blue Helton. University of Washington.

Given adequate inorganic nutrients, green algae can increase pH to levels >10.5 that eliminate Daphnia magna, an effective algal grazer. Our experimental results were obtained in simple Closed Ecological Systems, but the results are consistent with publications of highly eutrophic European lakes where pH and grazer populations shifted seasonally; during the summer, the lakes developed Cyanobacteria blooms, high pH, and high O2, and the grazer populations lost Cladocera and Copepods and consisted mostly of Rotifers. Although lake studies in the US probably measure pH routinely, pH values are rarely provided in their journal publications. The LAGOS-US RESERVOIR database indicates that US lakes can reach pH values of >10, but the database does not include biota. We are trying to test the hypothesis that, given a high nutrient load, photosynthesis by Cyanobacteria or other Photosynthetic organisms can increase pH and eliminate effective grazers. The toxicity of metals ions and other ionized compounds, e.g. ammonia, are more toxic at high pH Our test system consists of three species of green algae, none of which has been described as producing a toxic substance (Ankistrodesmus, Scenedesmus, and Selenastrum), the grazer Daphnia magna, and unidentified microbes in Closed Ecological Systems of 250 ml (200 ml liquid and 50 ml gas volume). Of course, natural communities are much more complex and open to atmospheric exchange. Our experimental results and published literature suggest that phytoplankton can reduce effective grazers via high pH even without producing a specific toxic compound. Do you have hypereutrophic lake data to test this hypothesis?

Evaluating target tissues and cell types of 6PPD-quinone induced toxicity in coho salmon (Oncorhynchus kisutch)

Justin Greer‡, Ellie Dalsky, Carla Conway, John Hansen, and Jan Lovy. U.S. Geological Survey.

Stormwater pollutants, including 6PPD-quinone and other tire wear constituents, can have harmful effects on aquatic life, particularly in high traffic areas with increased stormwater pollutant loading. Coho salmon (O. kisutch) exposed to 6PPD-quinone succumb to mortality in as little as 2-3 hours from runoff in highly polluted areas. Efforts to identify the mechanisms of toxicity for 6PPD-quinone are needed to better understand ecosystem-wide impacts and inform the molecular structure of potential alternatives for tires. The mode of action for 6PPD-quinone that results in acute toxicity in such short time frames is unclear but may imply targeted toxicity to individual organs or cell types. To investigate potential targets of toxicity, coho salmon were exposed to a nominal 6PPD-quinone concentration of 100 ng/L for up to 24 hours. Animals were collected at multiple time points across the exposure, as well as when individuals began to show a loss of equilibrium, a characteristic sign of 6PPD-quinone induced toxicity. Histological assessments and whole-transcriptome RNA sequencing (RNASeq) were performed to examine effects on individual tissues. Histological analyses revealed variable tissue level effects, with little damage observed in most organ systems. RNASeq analyses are currently underway to correlate molecular perturbations with histological results. To further assess organ-level effects, primary cell culture models for gill cells and hepatocytes from coho salmon have also been developed. Using metabolic and cytotoxic assays previously shown to recapitulate species sensitivity, the sublethal effects of 6PPD-quinone on individual organs is currently being examined. Development of primary cell cultures from additional tissues is currently underway to broaden the scope of primary cell investigations.

Session 8: Risk in Reality

Cleaning Sediments and Restoring Ecosystems – Evolving Towards an Adaptive Risk Assessment and Management Framework

Bob Johnston. Applied Ecological Solutions.

Cleanup at many large contaminated sediment sites can be very costly, time consuming, and ineffective if larger scale pressures and ecological processes are not adequately addressed by the remedial design. Ideally, a holistic approach is desired for remedies that brings together remediation and reuse (restoration) by exploiting synergies that minimize costs and environmental impacts and achieves whole-system sustainability benefits. Sustainable remediation strategies should be informed not only by considerations of regulatory compliance but also by stakeholder goals, values and expectations. Over the last few decades, remedies selected at large contaminated sediment sites have focused on mass removal or the reduction of exposure to sediment-associated contamination to manage human health and ecological risks. Consequently, assessing contaminant-focused remedy effectiveness measures has been confounded by the complexity of ecosystem processes, the lack of comprehensive monitoring data sets, and the need to align remediation objectives with ecosystem recovery goals. Additionally, sediments are linked to processes occurring within the watershed making them susceptible to, and potential drivers of, chemical, physical and biological stressors from larger scale social and economic pressures, climate change, and other disturbances associated with the Anthropocene. Drawing on the results of case studies, key concepts and lessons learned to better integrate sediment cleanup and ecosystem recovery goals are discussed. By merging the risk assessment and adaptive management frameworks into an Adaptive Risk Assessment and Management framework that includes Plan-Do-Act-Check-Learn adaptive management cycle with the iterative risk assessment processes can better inform risk management decisions, maintain constant learning dialogue with Stakeholders, and help improve cleanup and restoration outcomes.

Same Element, Different Risk? The Importance of Modern Speciation Methods for Environmental Risk Assessments

Ben Wozniak. Brooks Applied Labs.

Hyphenated ICP MS techniques, such as LC ICP MS and GC-ICP-MS, have emerged as essential analytical tools for environmental site assessments, enabling detailed characterization of contaminants whose behavior is driven by chemical speciation rather than bulk (total) elemental concentrations. Speciation level data are particularly valuable for redox sensitive elements, where species specific differences in toxicity, mobility, and persistence can directly influence appropriate treatment technologies and remediation priorities. Regulatory methods exist for the speciation of some legacy inorganic contaminants (e.g., EPA Method 1632 for arsenic and EPA Method 7196A for hexavalent chromium); however, these methods were developed decades ago, at a time when understanding of the environmental chemistry of these elements was more limited and cleanup criteria were less stringent. Consequently, many legacy approaches suffer from matrix interferences and an inability to accurately detect and quantify the range of chemical species now recognized in environmental samples. In contrast, no regulatory methods currently exist to quantify the full range of environmentally relevant species for many emerging inorganic contaminants, including selenium and cobalt. Modern hyphenated ICP MS workflows offer substantial advantages over legacy methods, enabling simultaneous quantification of multiple species with improved sensitivity, selectivity, and chemical specificity. These techniques also provide the analytical flexibility needed to measure emerging species that are not addressed by existing regulatory frameworks. Adoption of advanced speciation methodologies is therefore increasingly critical for accurate site characterization and for the development of effective, cost efficient remediation strategies—particularly in an era of constrained monitoring budgets, workforce limitations, and evolving regulatory expectations. This presentation will highlight advanced hyphenated ICP MS approaches through case studies focused on both legacy contaminants (e.g., hexavalent chromium) and emerging species of concern (e.g., organoselenium compounds and metal–cyanide complexes).

Are the EPA Aquatic Life Benchmarks for Pesticides Protective for Aquatic Invertebrates

John D. Stark. Washington State University.

The United States Environmental Protection Agency (EPA) develops measures to determine concentrations of chemicals in aquatic ecosystems that are protective of aquatic organisms. The Aquatic Life Criteria (ALC) is the scientifically established standard that defines the maximum concentration of a pollutant in water that is considered safe for aquatic life. An Aquatic Life Benchmark (ALB) is an informational value used when data is limited, providing a reference point for potential aquatic life impacts, but not a strict regulatory standard. Therefore, an ALC is more definitive and legally enforceable, while an ALB is considered less certain and used for guidance when data is scarce. Unfortunately, very few ALCs have been developed thus far for pesticides and other chemicals. However, more, but still few ALBs have been developed. In this study, I asked – Are the EPA Aquatic Life Benchmarks Protective for Aquatic Invertebrates. To answer this question, I evaluated eight data sets that I had previously published on acute mortality of Cladocerans to various pesticides and for which EPA had developed ALBs. In those published studies, acute LC50s were presented. In this study, I developed concentration-response curves and compared where the ALBs were located, or not located, on these curves. The assumption I made was that the EPA ALBs would be protective for Cladocerans exposed to pesticides. What I found instead was that some of the ALBs were completely protective of Cladocerans, others would result in Cladoceran extirpation and others would result in a wide range of mortality. Results of this study indicate that the ALB process may be flawed and should be reevaluated.

A framework and basic rules for the use of quantitative methods for the estimation of probabilistic ecological assessment and management within the diverse landscapes of the Pacific Northwest

Wayne G. Landis. Huxley College of the Environment, Western Washington University.

The term “risk” is not in the title because many ecological assessments are not probabilistic. By definition risk entails probability and cause-effect pathways (see Fenton and Neil 2011). Only if the assessment incorporates probability and delineated causal pathways can it be labeled as a “risk” assessment. Fortunately, now there are multiple examples of risk assessment using Bayesian networks, Monte Carlo simulation and structural equation modelling across the world to produce environmental assessments for managing a diversity of systems, including those in the Pacific Northwest, British Columbia and California. These assessments rely on a variety of datasets from routine toxicity testing, measurements of contamination in the field, surveys of the occurrence and number of species, and extensive mapping. In many cases these data are summarized via statistical methods not designed to be applied to models of real ecological systems. Ecological systems are complex in the sense that they are sensitive to initial conditions, dynamics, contingent on the landscape and historical. Gradients in exposure to contaminants, water quality variables and species are the norm, and downstream events can affect upstream systems. Investigators in the field are limited by geography, access and safety in sampling and taxonomy makes identification of taxa to determine species composition lengthy. NOECs, SSDs, and the application of ANOVA with multiple tests or simple indices (Index of biotic integrity) are used to examine hypothesized cause-effect responses. The nature of ecological systems mean that many of the assumptions that underlie these conventional statistical tools or regressions are violated. However, there are a variety of other tools that have been demonstrated to be capable of assessing patterns can be used to discover and assess responses and patterns in the laboratory and the field. Multivariate statistics have been a mainstay in the ecological literature and J. Cairns and colleagues were early adopters. It was found that the multivariate and machine learning tools could detect treatment effects in Taub microcosms that persisted even after degradation of the contaminant. Since the early 2000s Bayesian networks, structural equation modelling and other tools have been applied to numerous risk assessments. In many software packages AI tools are built in (Case Learning) for the analysis of data and sensitivity analysis is routine. S. Graham for estuaries in Australia and Mentzel et al for Great Barrier Reef as an ecosystem are excellent examples of what is possible. I propose that more recent data analysis tools be evaluated according to their ability to bring information to improve the predictions of risk with sensitivity to multiple stressors evaluated and the uncertainties clearly defined.