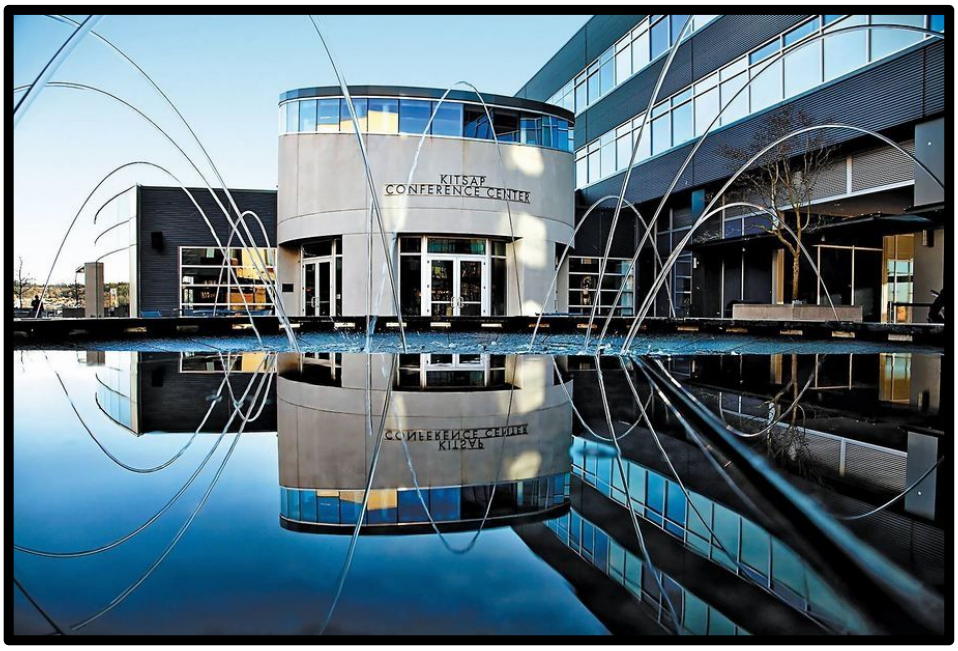
Program and Abstracts

Pacific Northwest Chapter
Society of Environmental Toxicology and Chemistry
(PNW-SETAC)

29th Annual Conference

Reflecting on our Past and Envisioning our Future



Kitsap conference center

February 27-29, 2020

Hampton Inn & Suites by Hilton
150 Washington Avenue, Bremerton, WA 98337

Kitsap Conference Center
100 Washington Ave, Bremerton, WA 98337

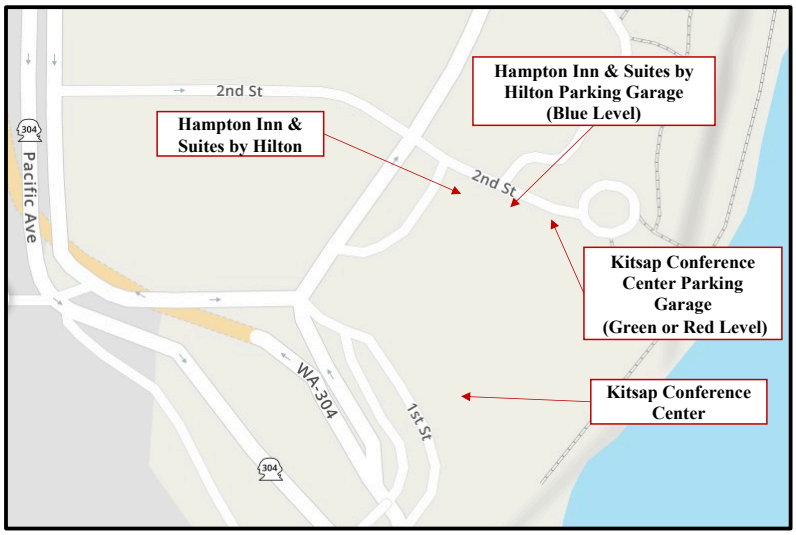
Conference Hotel - **Hampton Inn & Suites by Hilton**
150 Washington Avenue, Bremerton, WA 98337
Phone: (360) 405-0200

For Guests

- PNW-SETAC has reserved a block of rooms at a discounted rate ($114 per night, sales and occupancy taxes not included). Deadline to reserve a room is **January 27, 2020**. Please call the hotel directly for reservations and indicate you are with PNW-SETAC. The negotiated rate is not available online or via other booking services.
- Check-in time: 3:00 pm, check-out time: 12:00 pm
- Free hot breakfast, wifi, and fitness center access
- Self-parking (Blue Level, see Inlay map) for $7 per day (must be a hotel guest)

Bremerton, WA Conference Maps

Main Map: Courtesy of MapQuest



Inlay: Courtesy of MapQuest

Conference Location - **Kitsap Conference Center**
100 Washington Ave, Bremerton, WA 98337
Phone: (360) 377-3785, Fax: (360) 415-1054

Conference Center Events

- Registration and Check-in
- Thursday short courses
- Thursday evening Welcome Reception
- Friday platform and poster presentations
- Friday evening dinner (optional, paid when registering)
- Saturday morning platform and poster presentations

For Attendees

- Garage parking (Green or Red level, see Inlay map, Page 2) at a rate of $4 (0-3 hours), $18 daily maximum)

Directions from South SR-3

- Traveling South on SR 3 take the Kitsap Way exit.
- Turn left on Kitsap Way and go under the highway.
- Continue on straight on Kitsap Way and follow it as it curves to the right and left and becomes 6th Street.
- Continue on 6th Street to Pacific Avenue and turn right.
- Continue on Pacific Avenue to 2nd Street and turn left.
- Go one block on 2nd Street to Washington Avenue.
- Cross over Washington Avenue and enter the drive to the parking garage.

Directions from North SR-3

- Traveling North on SR 3 take the Puget Sound Naval Shipyard/Downtown Bremerton exit.
- Continue on exit road to Burwell Street and turn right.
- Continue on Burwell Street to Pacific Avenue.
- Continue on Pacific Avenue to 2nd Street and turn left.
- Go one block on 2nd Street to Washington Avenue.
- Cross over Washington Avenue and enter the drive to the parking garage.

Directions by Ferry (from Seattle)

- Take the Bremerton Ferry (West) from Pier 52 in downtown Seattle (Alaskan Way).
- Debark the ferry at Bremerton Terminal. If walking off the ferry, the conference center will be on your right.
- If driving, travel through tunnel to Park Avenue and turn right.
- Continue on Park Avenue to 4th Street and turn right.
- Continue on 4th Street to Pacific Avenue and turn right.
- Continue on Pacific Avenue to 2nd Street and turn left.
- Go one block on 2nd Street to Washington Avenue.
- Cross over Washington Avenue and enter the drive to the parking garage.

PNW-SETAC
Acknowledgements

Many thanks to all of you who volunteered your time to make this meeting possible:

Plenary Speaker:	John Stein, Puget Sound Partnerships Science Panel
Session Chairs:	Shawn Larson, Seattle Aquarium Jenifer McIntyre, Washington State University, Puyallup Erik Naylor, Maul Foster & Alongi, Inc. William Hobbs, WA Department of Ecology Bob Johnston, Applied Ecological Solutions Jeff Wirtz, Compliance Services International
On-Site Coordinator:	Ruth Sofield, Western Washington University
Abstract Review:	Kara Warner, Golder Erik Naylor, Maul Foster & Alongi, Inc.
Meeting Program:	Kaley Major, OR Department of Environmental Quality
Student Social:	Stephanie Maggio, Oregon State University
Meeting Registration:	Bob Johnston, Applied Ecological Solutions
Volunteer Coordinator:	Stephanie Maggio, Oregon State University
Student Travel Awards:	Bryson Finch, WA Department of Ecology
Student Presentation Awards:	Bryson Finch, WA Department of Ecology Ruth Sofield, Western Washington University
Fundraising:	Jeff Wirtz, Compliance Services International

PNW-SETAC
Meeting Sponsors

Special Thanks to all of our Meeting Sponsors!

Student Travel Awards
Compliance Services International
Anchor QEA

Student Best Presentation Awards
Maul Foster & Alongi, Inc.

Thursday Evening Welcome Reception
Windward Environmental LLC
Azimuth Consulting LLC

Coffee Breaks
Avocet Consulting LLC
EcoAnaylists, Inc.

Friday Poster Social
Golder

SETAC Books
SETAC North America

PNW-SETAC
Corporate Members
Orca Level

Please join us in thanking this year's Corporate Members!

Compliance Services International (CSI)

COMPLIANCE SERVICES INTERNATIONAL

Global Regulatory and Environmental Strategies since 1988

CSI specializes in global regulatory and scientific consulting services for product registration and risk assessment. Established in 1988, our diverse staff of experienced regulatory scientists develop strategies to meet specific needs for a global client base. Our services include USA & EU regulatory affairs, ecological risk assessment, endangered species analysis, endocrine disruptor evaluation, REACH chemical safety assessment, exposure modeling, study monitoring & data development, litigation support, information management systems, and task force management. Specialists in regulatory & scientific consulting - serving industry with dedication, expertise, and focus from offices in the USA and Europe.

Maul Foster & Alongi, Inc. (MFA)

MAUL FOSTER ALONGI

MFA is an integrated, multidisciplinary professional services organization consulting in the areas of environmental science, risk assessment, engineering, planning, health and safety, public involvement, and geographic information systems. MFA assists clients in successfully managing the risks and opportunities associated with their projects. With more than 100 employees in eight Pacific Northwest offices, MFA offers creative and award-winning professional services to clients representing diverse industry and municipal sectors.

PNW-SETAC
Corporate Members
Chinook Level

Windward Environmental, LLC

Windward Environmental is a Seattle-based consulting firm founded in 2000 on the premise that environmental consultants can best serve clients' interests by providing high-quality, defensible data for use in decision making. Our technical approach is based on sound scientific principles, identifying and investigating environmental problems transparently and without bias. Windward has a reputation for providing clients with superior service and results that make a difference, regardless of the size or complexity of the project. Windward prides itself on being a great place for young environmental scientists and engineers to develop their careers, and for leaders in the field to pursue their practices. Please visit our website (www.windwardenv.com) or contact us at info@windwardenv.com to learn more about Windward.

Anchor QEA

Anchor QEA provides a full range of science and engineering services to the public and private sectors, including planning and strategy development, scientific investigation, engineering design, and construction management. They employ more than 350 highly motivated people in offices across the United States who all enjoy working closely with clients toward common goals on water resources, surface and ground water quality, coastal development, habitat restoration, and contaminated sediment management projects. Anchor QEA enjoys working on some of the most challenging sites in the nation, and their completed projects are among the most successful in the industry.

Golder

Golder was founded in 1960 and is an employee-owned, global organization providing consulting, design, and construction services in the areas of mining, oil and gas, manufacturing, transportation, energy production, water resources, wastewater treatment, and environmental remediation. Currently, they employ over 6,500 people, operating from 165 offices worldwide, who provide technical expertise, innovative solutions and award-winning client service. Today, their clients represent the world's major industries and drivers of development: Oil and Gas, Mining, Manufacturing, Power, and Infrastructure.

PNW-SETAC
Corporate Members
Heron Level

Azimuth Consulting Group Partnership

Azimuth provides science-based assessments of the significance of environmental contamination. We created the Azimuth partnership to build a small, flexible team that is responsive to clients' needs. Our collective experience spans biology, ecology, toxicology, science policy and conflict resolution. These skill sets have been applied to a range of fields including risk assessment, environmental impact assessment, regulatory policy, permitting and monitoring. Among our senior staff we have two Contaminated Sites Approved Professionals Society (CSAP – risk assessors) and a Diplomate of the American Board of Toxicology (DABT).

Avocet Consulting, LLC

Avocet Consulting provides consulting services in the areas of aquatic site investigation and cleanup, regulatory development, insurance claims evaluation, expert witness and litigation support, and facilitation. Dr. Michelsen is an environmental scientist and geochemist specializing in the development of sediment and tissue quality guidelines, natural resource damage assessment, fate and transport of chemicals through aquatic systems, and climate change.

EcoAnalysts, Inc.

EcoAnalysts, Inc. is a small business consulting company headquartered in Moscow, Idaho and established in 1992 with the purpose of applying ecological sciences to management and stewardship of natural resources. We provide specialized ecological consulting and laboratory services (taxonomy and aquatic toxicology) to private and public-sector clients in North America and around the world.

EcoAnalysts provides scientific data, support and advisory services across the entire project life cycle to identify, assess, and manage consequences that may result in impacts to the natural environment or stakeholders. We are committed to helping our clients make good stewardship decisions that are socially and environmentally sound and sustainable and compliant with regulatory requirements and best practices. For more information, please visit us at www.ecoanalysts.com

29th PNW-SETAC ANNUAL CONFERENCE

Meeting Program

February 27 – 29, 2020

PNW-SETAC
Conference Agenda

Thursday, February 27th, 2020

9:00 AM – 2:00 PM	**Conference Check-in/Registration,** 3rd Floor Lobby of the Kitsap Conference Center
10:00 AM – 1:00 PM	**Short Course #1**: How much is too much?: Measuring Effects of Micro and Nanoplastic Debris in Aquatic and Terrestrial Organisms, **Instructors**: Dr. Susanne Brander and Dr. Stacey Harper, **Location:** Marina Vista 1 & 2
1:00 PM – 2:00 PM	**Lunch** (on your own)
2:00 PM – 5:00 PM	**Short Course #2**: Bayesian Networks and Risk Assessment Applied to the Adaptive Management of Ecological Structures and Human Well-being, **Instructor**: Dr. Wayne Landis, **Location:** Marina Vista 1
2:15 PM – 4:45 PM	**Excursion: Foot Ferry to Port Orchard Public Market (**self guided, $4 roundtrip). Depart Bremerton 2:15 PM; Arrive Port Orchard at 2:27 PM. Depart Port Orchard 4:30 PM; Arrive Bremerton 4:45 PM
5:00 PM – 7:00 PM	**Conference Check-in/Registration,** 3rd Floor Lobby of the Kitsap Conference Center
5:00 PM – 5:30 PM	**Chapter Board Meeting**, Marina Vista 3
5:30 PM – 8:00 PM	**Welcome Reception with Refreshments,** Marina Vista 3 Opening addresses from Chairman Leonard Forsman (Suquamish Tribe) and Mayor Greg Wheeler (Bremerton)
5:30 PM – 8:00 PM	**Poster Setup,** Glacier Cove 1 and 2

Friday, February 28th, 2020

7:30 AM – 5:00 PM	**Conference Check-in/Registration,** 3rd Floor Lobby of the Kitsap Conference Center
7:00 AM – 8:20 AM	**Poster Setup,** Glacier Cove 1 and 2
8:20 AM – 9:00 AM	Welcome address, Chapter President Ruth Sofield Report from SETAC NA, SETAC NA Board member Susanne Brander– Marina Vista 1, 2, and 3
9:00 AM – 5:00 PM	**Poster Viewing,** Glacier Cove 1 and 2
9:00 AM – 12:00 PM	**Platform Sessions** (+ break for refreshments and poster viewing), Marina Vista 1, 2, and 3
12:00 PM – 1:30 PM	**Lunch** (on your own)
1:30 PM – 2:20 PM	**Plenary Speaker** – John Stein, A Resilient Puget Sound — Lessons and Prospects, Marina Vista 1, 2, and 3
2:20 PM – 4:40 PM	**Platform Sessions** (+ break for refreshments and poster viewing), Marina Vista 1, 2 and 3
4:40 PM – 6:30 PM	**Poster Social,** Glacier Cove 1 and 2
6:30 PM	**Dinner** (for those who prepaid during registration), Marina Vista 3
8:00 PM	**Student Social,** Axe and Arrow Gastropub, 232 4th St, Bremerton, WA 98337

Saturday, February 29th, 2020

8:00 AM – 9:00 AM	**Conference Check-in/Registration,** 3rd Floor Lobby of the Kitsap Conference Center
9:00 AM – 11:30 AM	**Poster Viewing,** Glacier Cove 1 and 2
9:00 AM – 9:40 AM	**PNW-Chapter Meeting** – all welcome!!!, Marina Vista 1 and 2
9:40 AM – 11:30 AM	**Platform Sessions** (+ break for refreshments and poster viewing), Marina Vista 1, 2, and 3
11:30 AM	**Student Award Presentations,** Marina Vista 1 and 2
12:00 PM	**Adjourn**

Pacific Northwest Chapter

Society of Environmental Toxicology and Chemistry
(PNW- SETAC)

29th Annual Meeting

Schedule of Events and Presentations

PNW-SETAC
Thursday Short Courses

10:00 AM to 1:00 PM, Thursday, February 27, 2020, Marina Vista 1

How Much is too Much? Measuring Effects of Micro and Nanoplastic Debris in Aquatic and Terrestrial Organisms

Instructors: Dr. Susanne Brander and Dr. Stacey Harper, Oregon State University

Overview: Plastic is a defining pollutant in the Anthropocene, ubiquitous in the environment globally and presenting a sizable environmental challenge that extends throughout food webs, threatening organism and ecosystem health. Micro and nanoplastic debris are of particular concern since ingestion of synthetic particles and fibers has been documented in a variety of organisms, from aquatic to terrestrial. Although occurrence is widely documented, large knowledge gaps persist regarding the effects these micro and nanoscopic debris items may have in organisms that internalize, ingest, or respire them. Understanding the interactions that occur within (e.g. oxidative damage) and between organisms (e.g. trophic transfer) at different levels of biological organization in an environmentally relevant context is critical to accurately measure and predict the impacts of plastic pollution, to assess risk, and to predict potential population level impacts. This short course will cover the potential challenges presented by exposure to micro and nanoplastics in model and non-model organisms across marine, freshwater, and terrestrial taxa. We will highlight both field and laboratory research investigating responses to micro and nanoplastic exposure, some of which will be considered in the context of conditions induced by multiple stressors such as abiotic factors related to climate change or plastic exposure in the presence of other pollutants. We will present the state-of-the-science on micro and nanoplastic occurrence, highlight data gaps that need to be addressed, and will lead a discussion on the analytical techniques currently available and what we need in the future.

2:00 PM to 5:00 PM, Thursday, February 27, 2020, Marina Vista 1

Bayesian Networks and Risk Assessment Applied to the Adaptive Management of Ecological Structures and Human Well-being

Instructor: Dr. Wayne Landis, Western Washington University

Overview: The history and the current state of the art in employing Bayesian networks to risk assessment and adaptive management assessments was clearly demonstrated in the 40 years of ecological risk assessment session at the 2019 SETAC North America annual meeting in Toronto. It has been demonstrated in recent papers that the Bayesian network relative risk model and similar methods can be applied to both ecological and human well-being endpoints. In the past the methods have been seen as different due to different terminology and regulatory goals. However, they share the fundamentals of the exposure-response paradigm and deal with cumulative effects and heterogeneous endpoints. Now it has been demonstrated that Bayesian network relative risk models (BN-RRM) can be built to describe risk to ecological endpoints and human well-being. It is also possible to build adaptive management tools that assist in the planning of long-term management actions. In this class, attendees will learn some of the basic definitions of risk assessment, the application of Bayesian networks, learn how societal values are an integral part of the process, and how adaptive management is critical to assessment, restoration and protection. Numerous case studies will be presented as examples as well as some current research. The course will begin with a review of the basic principles of risk assessment and risk calculation methods. The second half will be spent in the exploration of case studies and answering questions.

PNW-SETAC
Port Orchard Public Market

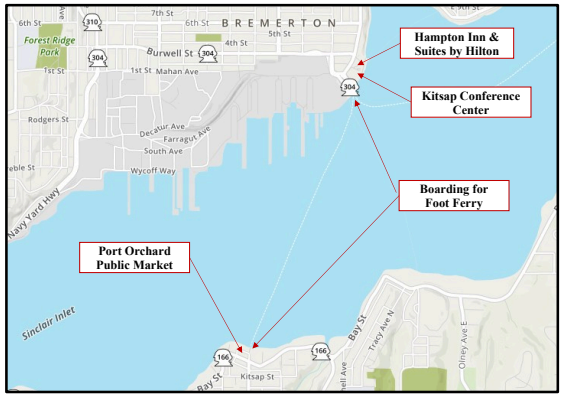
Excursion: Foot Ferry to Port Orchard Public Market, Self-Guided

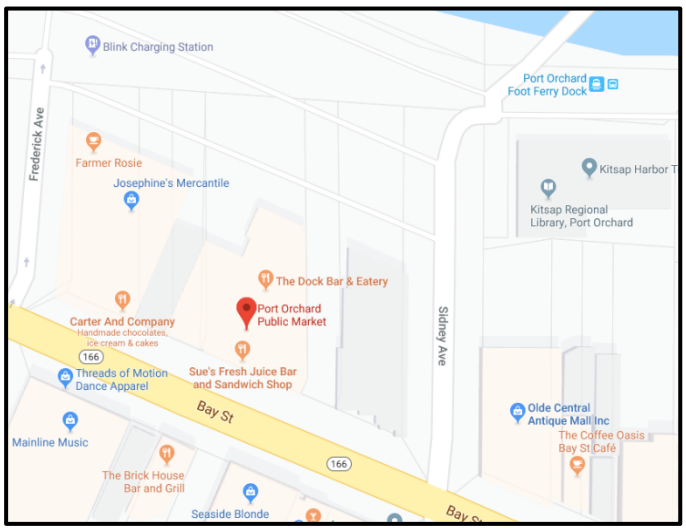
Port Orchard Public Market: 715 Bay St, Port Orchard, WA 98366
Bremerton Foot Ferry Dock ←→Port Orchard Foot Ferry Dock

2:15 pm, Thursday, February 27, 2020, Bremerton Foot Ferry Dock

The Port Orchard Public Market is located in the heart of downtown Port Orchard, and hosts many gift shops, vintage and collectible items, restaurants, and espresso and pastry shops. Board the Bremerton-Port Orchard Foot Ferry and head over to the Public Market to enjoy some shopping with the beautiful Sinclair Inlet acting as a backdrop. The trip to the Public Market is self-guided, so feel free to adapt your trip based on the Foot Ferry Schedule, but the suggested ferry departure from Bremerton is at 2:15 pm (arriving in Port Orchard at 2:27 pm), while the suggested return ferry from Port Orchard departs at 4:30 pm (arriving in Bremerton at 4:45 pm).

The Bremerton-Port Orchard Foot Ferry provides a cost effective way to get to the Port Orchard Public Market from Bremerton. The fare for the Foot Ferry is the same as for Kitsap Transit routed buses - $2.00 one-way full cash fare or $1.00 one-way reduced fare for eligible riders. Fares are payable with cash, a one-way ticket, or a monthly pass or E-purse loaded on an ORCA card. ORCA users receive a free two hour transfer to connect to other buses of the Foot Ferry. Cash riders can request a paper transfer when they board to connect to a bus in Bremerton, Port Orchard or Annapolis.





Map courtesy of MapQuest (left) and Google Maps (right)t

PNW-SETAC
Thursday Opening Address

6:00 pm, Thursday, February 27, 2020, Marina Vista 3

Chairman Leonard Forsman, Suquamish Tribe

Leonard Forsman has served as Tribal Chairman of the Suquamish Tribe since 2005. He has served on Tribal Council for a total of 27 years, worked as a professional archaeologist and is the former director of the Suquamish Museum. He also serves on the boards of the Kitsap Regional Coordinating Council, the Washington State Historical Society, the Seattle Waterfront Steering Committee, Suquamish Tribal Cultural Cooperative, the Suquamish Museum, the Washington Indian Gaming Association, the West Central Local Integrating Organization, and the Tribal Leaders Congress on Education. President Barack Obama appointed Chairman Forsman to the Advisory Council on Historic Preservation in 2013 and 2016 where he currently serves as Vice-Chairman. He grew up in Suquamish on the Port Madison Indian Reservation and continues to live there with his wife Jana Rice.

Mayor Greg Wheeler, Bremerton WA

In January 2018, Mayor Greg Wheeler began serving his first term as Mayor. He was a member of the Bremerton City Council in District 4 from 2010 through 2017, and served three years as President of the Council. He is a member of two service clubs and many government and nonprofit boards in the community and region.

Mayor Wheeler is a lifelong resident of Bremerton, Navy veteran, and retiree from the Puget Sound Naval Shipyard Engineering Department. He holds an MBA from Brandman University and BA from Chapman University. He and his wife Sunny have three adult children, a grandchild and two dogs.

PNW-SETAC
Friday Plenary Speaker

1:30 pm, Friday, February 28, 2020, Marina Vista 1, 2, and 3

A Resilient Puget Sound — Lessons and Prospects

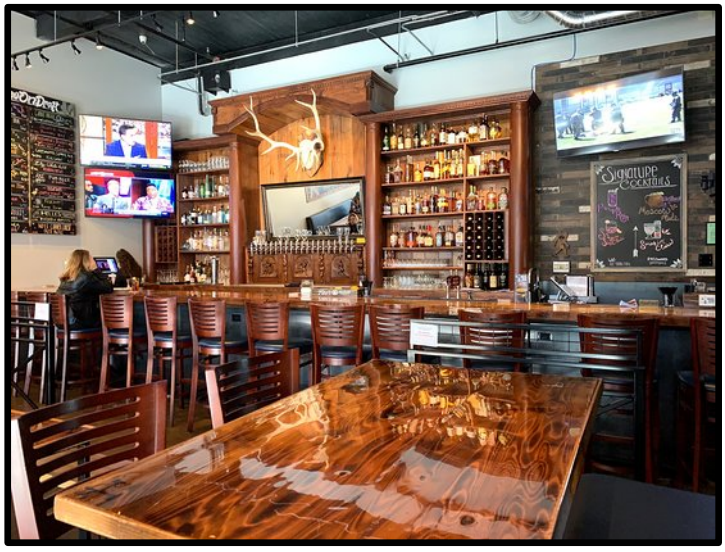
John Stein, Puget Sound Partnerships Science Panel

John Stein currently Scientist Emeritus with NOAA Fisheries. He served as the Chair of the Puget Sound Partnerships Science Panel, and is Vice-Chair of the board of the Skagit Watershed Council. Previously he was Science and Research Director of NOAA Fisheries' Northwest Fisheries Science Center in Seattle, WA. The Center's scientific responsibilities are for living marine resources (e.g., salmon, groundfish, and killer whales) and their habitats. John is an affiliate faculty member in the University of Washington's School of Aquatic and Fisheries Sciences, and was active in PICES (North Pacific Marine Science Organization) a multinational organization of Pacific Rim countries, and in his last position was Vice-Chair of Governing Council. At NOAA, in addition to his duties as Science Center Director he co-directed NOAA Fisheries California Current Integrated Ecosystem Assessment with the director of the SW Fisheries Science, and was the federal co-lead for Marine Planning on the west coast under the National Ocean Policy.

PNW-SETAC
Friday Student Social

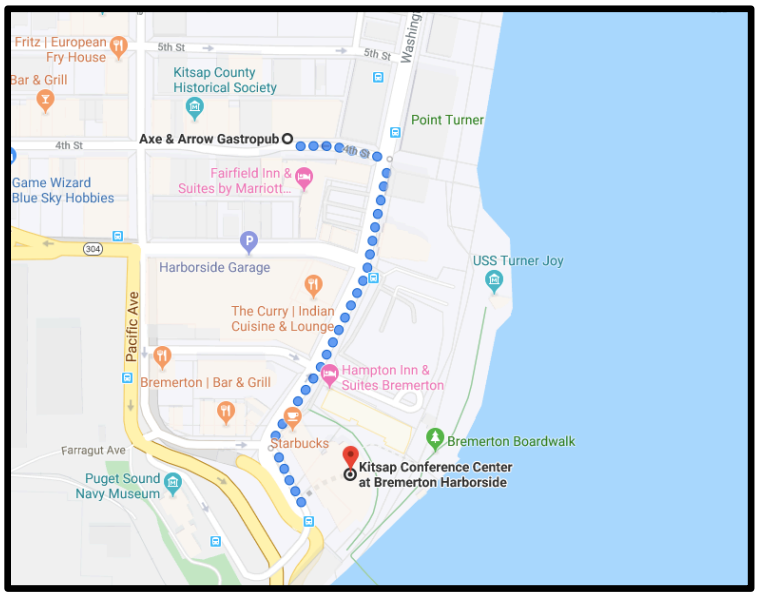
Axe & Arrow Gastropub
232 4th St, Bremerton, WA 98337

8:00 pm, Friday, February 28, 2020



Get to know your fellow PNW-SETAC students after a long day of platform and poster presentations at the Axe & Arrow Gastropub! It's located just a quick 5 minute walk northwest from the conference center (see map below).

Stephanie Maggio, PNW-SETAC At-Large (Student) Representative, will meet up with students at the Axe & Arrow Gastropub at 8:00 pm. The upstairs alcove will be set aside for our PNW-SETAC student conference attendees (sorry non-students have to find their own entertainment!). PNW-SETAC will buy the first round to kick-start the socializing!



Map courtesy of Google Maps

PNW-SETAC
Friday Platform Presentations
Morning Session

Friday, February 28, 2020, Marina Vista 1, 2 and 3

8:20 to 9:00 Welcome address, Chapter President Ruth Sofield
Report from SETAC NA, SETAC NA Board member Susanne Brander

Session Chairs: Shawn Larson and Jenifer McIntyre

Microplastics Monitoring and Toxicity

9:00	Shawn Larson	Seattle Aquarium Microfibers Research: Sampling Large Volumes of Water over Time Along the Waterfront in Elliott Bay, Washington
9:20	Allie Johnson	Toxicity of Leachates from Virgin and Field-aged Microplastics to *Americamysis bahia*
9:40	Britta Baechler	Microplastic Concentrations in Two Oregon Bivalves: Spatial, Temporal, and Species Variability
10:00	**Break/Poster Viewing**	

Advancing Risk Assessment

10:20	Wayne Landis	The Construction of a Conceptual Model and Bayesian Network Relative Risk Model for the Upper San Francisco Estuary
10:40	Steven Eikenbary	Addressing the Need for the Quantitative Risk Assessment of Gene Drives
11:00	Teresa Michelsen	A Machine-Learning Approach to Predicting Toxicity in Multivariate Data Sets
11:40	John Stark	Is the USEPA Tier II Risk Assessment Process Protective of Non-target Species Exposed to Pesticides?
12:00 to 1:30		**Lunch**
1:30 to 2:20		**Plenary Speaker: John Stein** **A Resilient Puget Sound — Lessons and Prospects**

PNW-SETAC
Friday Platform Presentations
Afternoon Session

Friday, February 28, 2020, Marina Vista 1, 2, and 3

Session Chairs: Erik Naylor and William Hobbs

Exploring Toxicity from Contaminants of Concern

2:20	Erik Naylor	A Review of the Environmental and Toxicological Significance of PFAS and How Regulatory Agencies are Responding
2:40	Elena Nilsen	Emerging and Legacy Contaminants Bioaccumulating in Pacific Lamprey (*Entosphenus tridentatus*) at Different Life Stages in the Columbia River Basin
3:00	Kaley Major	Early Life Exposure to Endocrine Disruptors Causes Multigenerational and Transgenerational Epigenetic Changes in a Fish Model
3:20	**Break/Poster Viewing**	

Monitoring Updates and Insights

3:40	Ariel Blanc	Differential Uptake of Metals Among Marine Clam Species from Two Working Harbors
4:00	Robert Johnston	Results from Biennial Mussel Watch Monitoring in Sinclair and Dyes Inlets, Puget Sound, Washington from 2010 to 2018
4:20	William Hobbs	Toxic Burdens of Freshwater Biofilms and Use as a Source Tracking Tool in Rivers and Streams
4:40	**Poster Social**	

PNW-SETAC
Saturday Platform Presentations
Morning Session

Saturday, February 29, 2020, Marina Vista 1, 2, and 3

9:00 to 9:40 PNW-Chapter Meeting – all welcome!!!

Remediation Strategies

Session Chairs: Bob Johnston and Jeff Wirtz

9:40	Alex Smith	In-Situ Passive Sampling to Measure Remedial Effectiveness at the Pacific Sound Resources Superfund Site
10:00	Gunther Rosen	*In Situ* Evaluation of Clean Dredged Material as an Alternative to Clean Sand for Enhanced Monitored Natural Recovery
10:20	Jeff Stern	Understanding the Relationships between Biological Receptors and Remediation of Contaminated Sediment Sites: Lessons Learned from 11 Case Studies of Sediment Remedy Effectiveness
10:40	Dan Berlin	Innovative Treatment of Wood Waste Sediments Using Reactive Amendments and DGT Passive Porewater Sulphide Testing Techniques
11:00	**Break/Poster Viewing**	
11:30	**Student Award Presentations**	
12:00	**Adjourn**	

PNW-SETAC
Poster Presentations

Glacier Cove 1 and 2

Presenter(s)	Presentation
Katie Benoit	The Presence of Persistent Organic Pollutants in the Snow in the North Cascade Mountains
Stephanie Blair	Blood-Brain Barrier Disruption in Coho Salmon (*Oncorhynchus kisutch*) Exposed to Urban Runoff
Anna Bolm	Microplastic Contaminants in Pelagic Zone Zooplankton and Seawater of the Northern California Current
Hannah Conroy and Kristina Chu	Assessing Composting Regulations across States for the Protection of Environmental and Human Health
John M. Dickens	Plastic Beach: Examining the Distribution and Abundance of Microplastics in *Mytilus californianus* along the California and Oregon Coasts
Claire Eberle	Impact of Pesticide Application Vector Control of *Aedes aegypti* in Ponce, Puerto Rico
Brian Hester	Selection of A Rapid Toxicity Screening Bioassay for Effluent Discharges from a Mobile Offshore Drilling Unit
Ashley Heuchert and Reuben Hart	Titrating DNA-damaging and Photoreactivating Radiations *in Vivo* in the Model Alga *Chlamydomonas reinhardtii*
Sara Hutton	Development of a *Menidia beryllina In Vitro – In Vivo* Linked Model

PNW-SETAC
Poster Presentations

Glacier Cove 1 and 2

Presenter(s)	Presentation
Baofeng Jia	The Endangered St. Lawrence Estuary Beluga's Skin Microbiome and Its Potential Relationship with Halogenated Flame Retardant Exposure
Katie Knaub	Occurrence of Microplastics in Bivalves in Northwest Washington
Katherine Lasdin	Spatial-temporal Occurrence of Microplastics in *Sebastes melanops* off the Coast of Oregon
Ben Leonard	Mitigation of Stormwater Toxicity with Permeable Pavement
Stephanie Maggio	Estimating *Daphnia magna* Population-level Response to a Recommended and High Chlorpyrifos Use Scenario at the Watershed Scale
Lane Maguire	Longevity of Bioretention Depths for Preventing Acute Toxicity from Urban Stormwater Runoff
Chelsea Mitchell	Removal of PAHs and *E. coli* Using Novel Stormwater Bioretention Amendments
Madison Pongon	Presence of Microplastics in Ephemeroptera, Plecoptera, and Tricoptera of North Cascades National Park

PNW-SETAC
Poster Presentations

Glacier Cove 1 and 2

Presenter(s)	Presentation
Robert Rauschendorfer	Investigating the Fate, Transport, and Impacts of Microplastics using Gold Nanoparticle Embedded PMMA Microgels
Priya Seetharaman	Using SEM/EDS To Investigate the Relationship Between Cell Surface Chemistry and Environmental Chemistry in *Chlamydomonas nivalis*
Julann Spromberg	Bioretention Prevents Urban Stormwater Impacts on Embryonic Development of Pacific Herring (*Clupea pallasii*).
Jonathan Strivens	Validation of Toxicological Interpretation of Diffusive Gradients in Thin-films in Marine Waters Impacted by Copper
Jennifer E. Van Brocklin	Investigating the Presence and Trophic Transfer of Microplastics in Ex- and In-Situ North American Otters Through Scat and Diet Analysis
Sarah Vanlandingham and Anne Fuenzalida	Microplastic Monitoring in *Richardsonius balteatus* from Ross Lake, WA
Jay Word	Pacific Herring (*Clupea pallasii*) Embryo Development Bioassay Results and Associated PAH Concentration for Exposure to an Oil Refinery Effluent

Pacific Northwest Chapter

Society of Environmental Toxicology and Chemistry
(PNW- SETAC)

29th Annual Meeting

Platform Presentation Abstracts

(in order of presentation)

Seattle Aquarium Microfibers Research: Sampling Large Volumes of Water over Time Along the Waterfront in Elliott Bay, Washington

Larson, S.*; Damazo, L. Seattle Aquarium, Seattle, WA.

The occurrence of microplastics in river and estuarine ecosystems is poorly characterized, especially in Puget Sound and the surrounding river systems. The present study at the Seattle Aquarium uses a 100 liter sampling protocol to measure the temporal and seasonal shifts of the microplastic load of Elliott Bay on Seattle's waterfront underneath the Seattle Aquarium. Many microplastic studies in the Puget Sound area have sampled multiple locations over a short period of time or even just once. The Seattle Aquarium sampled 100 liters of water every two weeks throughout 2019 from incoming pumps that pump 2500 gallons of saltwater per minute to our exhibits and post sand filters designed to remove particles up to 50 microns. These 100 liter water samples were processed for microfibers (microplastics and natural microfibers) using 63 micron sieves to filter and an oil extraction method to purify. The microfibers were quantified using an Olympus microscope at 60X power by both staff and volunteers. The majority of visually identified anthropogenic particles were found to be microfibers. The quality the microfibers we ran subsamples through FTIR to determine spectral signatures of the microfibers. The processed samples have resulted in an average of 2 microfibers per liter of water sampled from unfiltered Elliott Bay water and 0.8 fibers per liter of filtered saltwater. This study is unique in that it sampled water from the same location over an entire year demonstrating the temporal variability of microfibers in Elliott Bay, that may at times be affected by fresh water influx from the Duwamish River and city sewage overflow events (CFOs).

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Toxicity of Leachates from Virgin and Field-aged Microplastics to *Americamysis bahia*

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Microplastic monitoring studies have identified many types of plastic particles and fibers in several species and environments, but little is known about toxicological effects of different microplastic types and how these effects change as plastics age in the environment. Plastic polymers have varying chemical compositions and additives, meaning plastics could vary in toxicity just as different chemicals do. Plastics also tend to concentrate chemicals from their surrounding environments on the plastic surface, which may further alter toxicity. Leachate from plastics has been previously shown to cause acute toxicity to *Daphnia magna*, *Nitocra spinipes*, and *Amphibalanus amphitrite*. This study will be conducted to assess the acute toxicity of different microplastic leachate types (generated from either virgin microplastics or microplastics deployed in Bellingham Bay for 2.5 months) on the saltwater crustacean *Americamysis bahia.* Microplastics will be shaken in clean seawater for 24-72 hours to create leachate which may contain plastic additives, monomers, or in the case of the field-aged plastics, contaminants from Bellingham Bay. *Americamysis bahia* will then be exposed to plastic leachates at a range of concentrations, and mortality will be assessed after 96 hours of exposure. Results will be compared between microplastic types to rank their toxicity. To statistically support conclusions, concentration-response relationships will be modeled and 96-hour LC_{50} values will be compared with log-likelihood ratios to determine significant differences between microplastic types. Results collected to date will be presented.

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Microplastic Concentrations in Two Oregon Bivalves: Spatial, Temporal, and Species Variability

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Microplastics are an ecological stressor with implications for ecosystem and human health when found in seafood. We quantified microplastic types, concentrations, anatomical loadings, geographic distribution, and temporal differences in Pacific oysters (*Crassostrea gigas*) and Pacific razor clams (*Siliqua patula*) collected from 15 Oregon coast sites. Organisms were chemically digested and visually analyzed for microplastics, and material type was determined in a subset of particles using Fourier Transform Infrared Spectroscopy (FTIR). Microplastics were present in organisms from all sites sampled. On average, whole Pacific oysters and Pacific razor clams contained 10.95 ± 0.77 and 8.84 ±0.45 microplastics per individual, respectively. Contamination was quantified but not subtracted from averages. Over 99% of identified particles were microfibers. Spring samples contained more anthropogenic debris than summer samples in oysters but not razor clams. This study provides a baseline of microplastics in Oregon bivalves and is the first to determine Pacific razor clam concentrations.

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The Construction of a Conceptual Model and Bayesian Network Relative Risk Model for the Upper San Francisco Estuary

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An ecological risk assessment to be incorporated into an adaptive management framework is now being conducted for the Uppers San Francisco Estuary (USFE) using the Bayesian network-relative risk model. Bayesian networks (BN-RRM) have been applied to the RRM calculations to better estimate risk distributions, describe uncertainty, and illuminate sensitivity in a quantitative manner. In the case of the USFE we are implementing this analysis tool to provide a framework for decision making and the long term planning of restoration/management activities. The area has multiple sources, stressors, habitats and endpoints (MSSHE), making it tailored for our tool set. The study area is defined in part by the range of the Delta smelt, and the confluence of the Sacramento and San Juaquin Rivers, and the Suisan Marsh. These rivers along with additional tributaries, drain the Central Valley of California, one of the most productive agricultural areas in the United States. The water that passes through the study site also accounts for 70 percent of the drinking water of the state. There are also a number of RCRA, CERCLA and NPDES sites and a variety of land use types. This presentation will summarize the status of the conceptual model formulation, the applicability of the datasets, the designation of the risk regions, and the building of the Bayesian networks. It is an opportunity to observe the BN-RRM from the Estuary to the final product. This research is supported by grants from the CA Metropolitan Water District and the CA Department of Pesticide Regulation to Western Washington University.

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Addressing the Need for the Quantitative Risk Assessment of Gene Drives

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Bayesian networks have proven to be an appropriate risk assessment tool for quantitatively and probabilistically examining complex systems involving multiple stressors acting on multiple endpoints in a wide variety of situations. The emerging field of synthetic biology has the capacity to drastically alter ecological systems with the use of gene drive modified organisms as a method to alter population dynamics. The point of the release of a gene drive organism is for the introduced genetic material to propagate within the wild type population and persist within the environment. Currently, there are many proposed gene drive designs and no current regulatory framework that quantitatively assess the risk associated with the use of gene drive modified organisms released to the environment. This study proposes the use of Bayesian network relative risk assessment tools as a way to estimate the risk associated with the release of gene drives as vectors to control disease. We examine a case study modeling the release of gene drive modified *Aedes aegypti* mosquitoes, to reduce incidence of dengue and Zika virus in Ponce, Puerto Rico. The risk assessment describes how the gene drive may spread through the populations of wild type mosquitoes, decrease rates of disease, and probabilistically assess other direct and indirect effects that may arise from the use of the gene drives. The Bayesian network relative risk model allows us to quantitatively describe effects to human health and the uncertainty in our current state of knowledge regarding the effects of the use of gene drive modified organisms as a vector management strategy concerning arboviruses.

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A Machine-Learning Approach to Predicting Toxicity in Multivariate Data Sets

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The aim of this study was to apply a machine learning approach to predicting toxicity in multivariate data sets using a neural net algorithm, and compare the results to those obtained using sediment quality guidelines. A large data set used to calculate freshwater sediment quality guidelines in Washington State was selected so that predictive accuracy could be directly compared with the rigorous reliability testing that was conducted prior to rule promulgation. The data set includes 80 to more than 500 data points for 5 bioassay endpoints at two different levels of effects, and includes a mixed set of chemicals from sediment studies spanning 10 years with varying objectives and study designs. The neural network algorithm selected for use was developed by Ople software. Its Behavioral Assimilation (BASS) technology runs several multivariate statistical models, including gradient boosting, decision tree, random forest, logistic regression, and KNN, selects the best performing features of each, and develops a neural network tailored to the data set. The resulting neural net has the advantage of accepting missing data elements without the need for interpolation, unlike most other commonly used machine learning algorithms. Once deployed, the neural network analyzes the data and provides a final prediction that out-performs the component approaches. The software conducts 5-fold cross-validation and has a variety of optimization options and significance thresholds. Each statistical model was evaluated for overall accuracy, Type 1, and Type 2 errors. Predictive accuracies generated by the Ople neural net ranged from 90-100%, a significant improvement over existing predictive approaches. Type I and Type II error rates were nearly all below 5%.

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Is the USEPA Tier II Risk Assessment Process Protective of Non-target Species Exposed to Pesticides?

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The EPA Tier II pesticide risk assessment process consists of comparing a risk quotient, developed from the ratio of the expected environmental concentration to an acute or chronic toxocity endpoint, to a level of concern. This approach is not a probabalistic assessment. In this talk, I will present a comparion of the results of the EPA risk assessment process developed for the insecticide, chlorantraniliprole, to an acute and chronic population-level probabalistic risk assessment developed for *Ceriodaphnia dubia* exposed to this insecticide. The value of the current ecological risk assesement process will be discussed.

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A Review of the Environmental and Toxicological Significance of PFAS and How Regulatory Agencies are Responding

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Per- and polyfluoroalkyl substances (PFAS) are gaining increasing attention because of their presence in drinking water and human serum worldwide. PFAS are a group of thousands of manmade chemicals that have been used in a wide variety of products since the 1940s. Some of the best-known uses for PFAS chemicals are in aqueous firefighting foams, all manner of consumer products, nonstick coatings such as Teflon, and fast food containers. PFAS chemicals have a combination of environmental persistence and water affinity that enables their wide distribution in surface and groundwater; in addition, they migrate easily and threaten drinking water and aquatic habitats. PFAS chemicals have also been found in soil and sediment at source sites such as military and industrial facilities, wastewater treatment plants and biosludge application fields, and landfills. In addition to their environmental persistence, some PFAS chemicals accumulate in human and animal bodies over time. They have been linked to autoimmune diseases, thyroid disease, cancer, pregnancy and developmental complications, immune-system suppression, and high cholesterol.

The scientific community still doesn't know how harmful PFAS are, and the chemistry is complicated and developing. Even with limited information on PFAS, many states have implemented regulations, and more are on the way. This presentation will highlight the current understanding of PFAS chemicals, including environmental fate and transport, toxicity, exposure assessment, sampling and analysis challenges, regulations, and communication challenges.

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Emerging and Legacy Contaminants Bioaccumulating in Pacific Lamprey (*Entosphenus tridentatus*) at Different Life Stages in the Columbia River Basin

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After surviving several hundred million years, Pacific lamprey (*Entosphenus tridentatus*) returns have declined in the Columbia River Basin in recent decades and regional extirpation is feared. Pacific lamprey are ecologically and culturally important. Tribal people have relied on Pacific lamprey for food and medicine for generations. There are many gaps in our understanding of this species and threats to its survival. Studies have primarily focused on abundance and distribution, dam passage, and habitat improvement. Scientific study is also needed to understand the threat posed by contaminants to Lamprey survival, and to Tribal health. Developmental effects of contaminant body burden in Lamprey pre-adult life stages are not fully understood, but we know that elevated contaminant levels in adult Lamprey cause various sublethal effects. From 2011 through 2016, paired larval lamprey and sediment samples were collected from the Umatilla, Yakima, Deschutes, Hood, and Willamette Basins in Oregon and Washington. Adult Pacific lamprey were collected from harvest sites at Willamette Falls and the Deschutes River, and from bycatch at Bonneville Dam on the Columbia River. All tissue and sediment samples were analyzed for ~50 halogenated compounds including polybrominated diphenyl ether (PBDE) flame-retardants, polychlorinated biphenyls (PCBs), DDT compounds, and other organochlorine pesticides. A subset of tissue and sediment samples was also analyzed for a suite of emerging wastewater indicator compounds sourced from personal care products and other household goods. We will compare contaminant levels and compounds detected in tissues of different life stages of Lamprey and in different geographic locations to better understand the role of contaminants in the survival of Pacific lamprey, and potential threats to human health from consumption of adult Lamprey.

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Early Life Exposure to Endocrine Disruptors Causes Multigenerational and Transgenerational Epigenetic Changes in a Fish Model

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The inland silverside, *Menidia beryllina*, is a euryhaline fish native to the Eastern United States and a model organism in ecotoxicology. We previously showed that low-level exposure to endocrine disrupting chemicals (EDCs) early in life can cause a variety of effects in *M. beryllina*, from changes in gene expression to phenotypic deformities. In the present study, we explore the potential for early life exposure to EDCs to cause epigenetic changes in inland silversides, with a particular focus on transgenerational effects. EDCs included contaminants of emerging concern (the pyrethroid insecticide bifenthrin and the synthetic progestin levonorgestrel), as well as an estrogen (17-β ethinylestradiol), and an androgen (trenbolone) at exposure levels between 3 and 9 ng/L. In a multigenerational experiment, we exposed parental silversides to EDCs from fertilization until 21 days post hatch (dph). We assessed DNA methylation patterns for three generations (F0, F1, and F2) in whole body larval fish using reduced representation bisulfite sequencing (RRBS). We found significant ($p < 0.05$) differences in promoter and/or gene body methylation in treatment fish relative to controls for all EDCs. Using gene ontology enrichment and pathway analyses, we found that differentially methylated genes in EDC treatments included hormone receptors, genes involved in steroidogenesis, prostaglandin synthesis, sexual development, DNA methylation, protein metabolism and synthesis, cell signaling, and neurodevelopment. Differential gene methylation relative to control was often present in the F1 generation, exposed as primordial germ cells within larval parents, and sometimes noted into the F2 generation, which was unexposed to EDCs. These findings show that EDCs can cause altered methylation in genes that are functionally relevant to impaired phenotypes documented in EDC-exposed animals, and that EDC exposure has the potential to have effects on subsequent generations of unexposed fish.

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Differential Uptake of Metals Among Marine Clam Species from Two Working Harbors

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Clam biomonitoring within two working harbors in the Pacific Northwest has demonstrated large differences in metals accumulation among different clam species. The results are important to accurately estimate potential human health risks. Biomonitoring within these two adjacent harbors has included extensive testing of pollutant levels over several years at multiple locations and across a broad range of clam species. Tested species included those that are commonly consumed by local indigenous communities (e.g., *Saxidomus giganteus*, *Protothaca staminea*, and *Venerupis philippinarum*), as well as those that are present but very rarely consumed due to dietary preferences (*Macoma* sp.). At most locations, between two and five species were tested, allowing differences in metals bioaccumulation among species to be quantified. Variations in metals concentrations among the different species were considerable, most notably for antimony, beryllium, copper, lead, silver, and thallium. Of the tested species, *Macoma* sp. demonstrated the greatest accumulation of these six metals. Measured copper and lead levels in *Macoma* sp. were an order of magnitude higher than concentrations in other clam species collected at the same locations and under the same environmental conditions. Smaller differences among species were noted for several other metals (including arsenic, barium, chromium, cobalt, mercury, molybdenum, nickel, zinc, and vanadium), with *Macoma* sp. again showing the greatest accumulation of these metals. The results emphasize the importance of species selection to the accuracy of risk estimation and biomonitoring efforts. The *Macoma* sp. had been extensively used in early risk assessment and biomonitoring activities within one of these harbors, in part because these species are readily accessible. However, risk estimates derived from these data would be subject to extremely high bias, because metals concentrations were much higher in the *Macoma* sp. than in species commonly consumed by individuals within the local indigenous communities.

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Results from Biennial Mussel Watch Monitoring in Sinclair and Dyes Inlets, Puget Sound, Washington from 2010 to 2018

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As a component of a greater effort to assess the status and trends of ecological resources within Sinclair and Dyes Inlets, monitoring of a network of mussel watch sites was initiated in winter of 2010 and has continued every-other-year through 2018. Twenty-five indigenous bivalve monitoring sites were sampled biennially for a total of five campaigns. Indigenous mussels (*Mytilus* spp.) were collected at sites located near suspected sources (industrial, wastewater, and storm water outfalls; marinas, stream mouths, and other sources) as well as stations that were representative of ambient conditions in Sinclair and Dyes Inlets, the adjoining passages, and Liberty Bay in the Puget Sound, Washington. The objectives of this monitoring were to evaluate tissue concentrations to determine the spatial distribution of contamination, evaluate temporal trends, assess exposure levels in relation to screening benchmarks, and identify locations where corrective actions may be warranted. Whole body tissue samples were analyzed for trace metals (Hg, As, Cd, Cr, Cu, Pb, Ni, Fe, and Zn), 42 polycyclic aromatic hydrocarbon compounds (PAHs,) 21 polychlorinated biphenyl congeners (PCBs), lipid content, length, and stable isotopes of C and N. Tissue residue data from the monitoring network were evaluated to assess spatial differences, evaluate trends, assess potential ecological impacts, and compare the results to regional and national data sets. Ecological effects were evaluated by comparing residue levels to Critical Body Residue (CBR) thresholds of mussel tissue concentrations below which effects to mussel growth, reproduction, and survival are not expected. Results showed that mussel tissue residues were below CBR benchmarks at most locations, however there were sites that had elevated levels of PAHs, PCBs, Hg, and Cu. An overall decreasing trend in contaminant levels for most sites indicated improving environmental quality. The monitoring framework provides a context for identifying problems and evaluating the effectiveness of corrective actions.

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Toxic Burdens of Freshwater Biofilms and Use as a Source Tracking Tool in Rivers and Streams

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Biofilms, composed of periphyton, bacteria and organic detritus, are the base of the food web in many streams and rivers. This media adsorbs and actively sequesters organic and inorganic contaminants from the water column. Here, we demonstrate the utility of using the contaminant concentrations in the biofilm matrix as an environmental media in source tracking and understanding biological impacts at higher trophic levels. In this talk we will focus mainly on the use of biofilms in studies of organic contaminants. The concentrations of polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs) in coupled water – biofilm collections, show that there is a strong fidelity (congener composition and total concentrations) between dissolved compounds in the water and those bound to biofilms. Physical partitioning of PCB and PBDE congeners is the dominant mode of uptake from water to biofilm and bioaccumulation factor (BAF) - log Kow relationships suggest that PCB uptake is often near equilibrium between log Kow 5-7. In addition to organic contaminants, we show that the concentrations of metals in biofilms are effective at delineating and recording spatial and temporal differences in metals inputs compared to bed sediments and water samples. Using metrics of community structure in periphyton and ecological integrity in macroinvertebrates we were able to show the burden of metals in the biofilm matrix explained adverse impacts and variability in the metrics; in the case of the benthic index of biotic integrity (B-IBI), 96% of the variability is explained. This work provides new insights into the partitioning of organic chemicals onto biofilms and shows clear linkages between metals in the biofilm matrix and ecological health of invertebrates that depend on biofilms as a food source.

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In-Situ Passive Sampling to Measure Remedial Effectiveness at the Pacific Sound Resources Superfund Site

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During the 1998 remedial investigation for the Pacific Sound Resources (PSR) Superfund Site, dissolved-phased groundwater contamination and "fingers" of creosote-related Dense Non-Aqueous Phase Liquid (DNAPL) was observed to extend from the upland containment wall area towards the Marine Sediments Unit (MSU) within PSR. Following the investigation, subtidal sediments were capped with borrow materials at depths of 7 feet (near shore) to 3.5 feet (offshore). In 2011 passive sampling using polydimethylsiloxane (PDMS) fibers as a sorbent for 16 priority PAHs and Dibenzofuran (DBF) were inserted at 24 locations at depths up to 34 inches below the cap surface. In 2018, Texas Tech University performed the same in-situ analysis with the addition of a 25th location to evaluate whether the cap contains PAH contaminants that might suggest migration of the underlying cap materials. Porewater concentrations remained low throughout the site (total PAHs < 1 µg/L). $\sum PAH_{16}$ concentrations to the northwest portion of the site decreased to 100-200 ng/L in 2018 compared to 500-800 ng/L found in the 2011 sampling. Porewater $\sum PAH_{16}$ concentrations in the NE sampling location ranged from 32 ng/L to 879 ng/L with a majority of the observed porewater concentrations within the range of 500-600 ng/L with 11 out of 12 sampling sites showing modest increases in porewater concentrations from the 2011 analysis. Summed porewater concentrations of total PAHs are compared to the higher molecular weight PAHs (3+ ring PAHs) to identify mechanisms and the influence of hydrophobicity of the contaminants. Specific PAH depth profiles are also discussed and highlight amendment integrity and performance. There were limited effects of hydrophobicity indicating the limited sorption within the cap.

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In Situ Evaluation of Clean Dredged Material as an Alternative to Clean Sand for Enhanced Monitored Natural Recovery

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Thin layer clean sand (CS) placement has shown merit towards Enhanced Monitored Natural Recovery (EMNR) as an alternative to dredging at moderately contaminated sediment sites. The use of natural sediment including clean dredged material (CDM), referred to here as sediment EMNR (sEMNR), allows CDM with a natural level of binding capacity to sequester contaminants, and improve recovery relative to traditional EMNR. This study explored the use of CDM as thin cover, in direct comparison with other novel sediment remedies, at a mesocosm scale using Remedy and Recontamination Assessment (RARA) arrays. The arrays provided direct measurement of performance of a range of remedies (CDM, activated carbon, clean sand, control) while providing enhanced realism in comparison to laboratory treatability studies, and reduced costs and complexity compared to larger scale pilot studies. The arrays were placed in Pearl Harbor at a site moderately contaminated with PCBs/metals, where EMNR is a likely remedy. Lines of evidence included bulk chemistry, porewater (passive sampler) and invertebrate bioaccumulation, benthic community recolonization, potential recontamination based on sediment trap characterization, and other tools. All sediment remedies exhibited significant reduction of contaminants of concern relative to the native sediment for nearly all lines of evidence, with reductions generally a factor of 2-5 or more, while also meeting preliminary remediation goals. Statistically significant reductions with respect to bioavailability measures were reliably observed at 2- and 10-month monitoring periods for all treatments, with dredged material performing nearly as well as activated carbon in the short-term. Sediment trap material and 10-month surface sediment chemistry showed lower PCB and metal concentrations, suggesting that recontamination risk was low. These results indicate that CDM is a viable, and potentially better, alternative to CS for EMNR applications, especially at sites where CS is not economically feasible, and where long-term storage of CDM presents site-specific challenges.

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Understanding the Relationships between Biological Receptors and Remediation of Contaminated Sediment Sites: Lessons Learned from 11 Case Studies of Sediment Remedy Effectiveness

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In a recent collaborative workshop, we reviewed case studies of 11 large contaminated sediment sites to ascertain lessons learned regarding remedy effectiveness. The sites were located in the Pacific Northwest (6), Upper Midwest (2), South (1) and Northeast (2) regions of the United States. Remedies were completed between 3 and 30 years ago and remedial approaches included dredging, capping, cover, and monitored natural recovery. Common contaminants of concern included PCBs, PAHs (including NAPL), mercury, and creosote constituents. Each site was reviewed with respect to remedial objectives and risk drivers, a summary of early or completed remedy, significant remedy scope or schedule deviations, timing and effectiveness of source control, primary pre-and post-remedy monitoring elements, achievement of short- and long-term remediation objectives for surface sediment, if the remedy is on track to achieve long-term remediation objectives for water and/or biota, and key take home messages. Post-remediation monitoring generally focused on chemical concentrations in sediment, surface water, fish, and shellfish as well as porewater and cap integrity in the case of capping remedies. In a review of data from sediment cleanup sites in the Puget Sound, complexity in the linkages between sediment and fish tissue concentrations were identified, including variations in external inputs from point (industrial and municipal) and non-point sources (stormwater), releases from navigational and remedial dredging projects, and recirculation of contamination within the food web. Robust, long-term monitoring data are needed to demonstrate the exposure linkages affected by sediment cleanup. Overall, several themes emerged from the case study review. While remedial efforts were fairly successful at reducing surface sediment concentrations, the effectiveness of reducing contaminant concentrations in biota was mixed with some sites showing reductions consistent with expectations while others did not. The latter was generally attributed to an incomplete understanding of what controls contaminant concentrations in biota, particularly the link between sediment and tissue concentrations. Source control at the site and within the watershed was of primary importance and early or interim actions often resulted in significant progress toward meeting remedial objectives. At several sites, adaptive management in various forms was an effective way to deal with an evolving conceptual site model or changing site conditions.

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Innovative Treatment of Wood Waste Sediments Using Reactive Amendments and DGT Passive Porewater Sulphide Testing Techniques

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Esquimalt Harbour has historically been used for log rafting, log storage and wood mill operations over the last 70 years, resulting in the accumulation of over 200 hectares of wood waste deposits. As wood waste decomposes, it creates a biological oxygen demand in sediments that can reduce or eliminate oxygenated zones. This can lead to a buildup of compounds such as sulphides and ammonia, which are toxic to benthic organisms at higher concentrations. Public Services and Procurement Canada, on behalf of the Department of National Defence, has completed studies of wood waste sediments and is currently implementing a pilot project to address high sulphides in Esquimalt Harbour sediments. The studies include use of an innovative passive porewater sampling technique to quantify dissolved sulphide using the diffusive-gradient-in-thin-films (DGT) method to quickly and accurately measure porewater sulphide concentrations, which ranged from less than 1 mg/L to over 200 mg/L in harbour sediments. The DGT method is based on the reaction of sulphide with silver iodide and is becoming increasingly common as a reliable in situ technique for quantifying a range of sediment porewater constituents. Cleanup of wood waste impacted sediments has historically involved dredging, capping, or monitored natural recovery. However, in situ treatment amendments have the potential to oxidize or immobilize porewater sulphide. An innovative bench-scale testing program was conducted to assess the effectiveness of sand cover mixed with a range of treatment amendments to reduce bioavailable porewater sulphide concentrations in wood waste sediments. The results were used to design and implement a pilot project in Esquimalt Harbour to test the effectiveness of sand amended with iron carbonate to control sulphide concentrations and support a healthy benthic community. This presentation will describe the field investigations, bench-scale testing, design and construction of the pilot project, and initial monitoring results.

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Poster Presentation Abstracts
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The Presence of Persistent Organic Pollutants in the Snow in the North Cascade Mountains

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Persistent organic pollutants tend to deposit in high altitude areas due to cold condensation, and the effectiveness of snowflakes as scavengers for pollutants. Organic pollutants such as organochlorines may be transported by long range atmospheric transport or originate locally. These pollutants are known to cause a variety of toxic effects to organisms such as neurological, reproductive, and developmental damage. This study aims to develop a method to determine the organochlorine pollutants present in the North Cascade Mountains, and determine how the concentrations may change spatially and temporally. Snow samples were collected over the Summer of 2018 at Bagley Lakes, WA. Solid phase extraction and gas chromatography are being used to extract, qualify, and quantify organochlorine pollutants present in the snow samples. The pollutants we are analyzing in this study include aldrin, endrin, 4,4'-DDT, heptachlor, dieldrin, and lindane. Method development is on-going. Results to date will be presented.

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Blood-Brain Barrier Disruption in Coho Salmon (*Oncorhynchus kisutch*) Exposed to Urban Runoff

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Coho salmon (*Oncorhynchus kisutch*) are highly susceptible to diffuse contaminants present in urban stormwater, demonstrating acute mortality and behavioral symptoms indicating for cardiorespiratory impairment (e.g. surfacing, gaping) and neurological impairment (e.g. loss of equilibrium). Coho acutely affected by urban runoff also display hematological disturbances, such as a rise in hematocrit and loss of blood plasma electrolytes. To date, causal contaminants and toxic mode of action in so-called coho urban runoff mortality syndrome have remained a mystery. Our aim was to evaluate changes in vascular permeability as a potential mechanism of acute mortality in juvenile coho exposed to highway runoff and tire leachate. Blood-brain and blood-gill barrier disruption was evaluated by intracardial injection of albumin-complexed Evans Blue dye and cephalic cryoimaging. We found substantial plasma leakage in brain and gill tissue, which correlated with onset of loss-of-equilibrium behavior and increases in plasma protein and hematocrit. We conclude that acute mortality may be a direct result of blood-brain and blood-gill barrier disruption in coho, initiated by contaminants in both highway runoff and tire leachate. Further studies will explore the particular mode of action in blood-brain barrier disruption of coho exposed to urban runoff.

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Microplastic Contaminants in Pelagic Zone Zooplankton and Seawater of the Northern California Current

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Microplastics are ubiquitous in marine habitats globally yet knowledge of their spatial distribution and prevalence in the marine food web is limited. When present, microplastics are mistaken as food and ingested by marine animals causing physical or chemical damage to the organisms and potentially accumulating along trophic pathways. This study aims to quantify microplastic presence in the base of the Northern California Current food web by investigating zooplankton and their environment. We collected 79 plankton tows and 203 water samples from a 534 kilometer stretch between Trinidad Head, California and Cape Meares, Oregon, from three to 200 nautical miles offshore. Sample analysis will provide seasonal microplastic distribution patterns, presence in ecologically important zooplankton groups, and plastic composition prevalence. Microplastics present in zooplankton and seawater can have detrimental effects on marine food webs, impacting fisheries, local economies, and possibly consumers of higher trophic level marine species.

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Assessing Composting Regulations across States for the Protection of Environmental and Human Health

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Composting is an important tool for waste management that is both a method to reduce the volume of waste that might otherwise be disposed of in landfills and a way to supplement soil and manage erosion, sedimentation, and stormwater runoff. Municipal waste composting has seen some growth in the past decade, with percent of household composting diverted from total municipal waste increasing from 7% in 2000 to 10% in 2017. However, the U.S. Environmental Protection Agency (U.S. EPA) estimates that 30% of municipal waste has the potential to be composted. With the potential for further growth in the composting industry, environmental regulations need to be evaluated to ensure that compost sites protect both human health and the environment. In the United States, composting regulations are made on a state-by-state basis and therefore vary widely in detail and requirements. Regulations are often confusing, and composters frequently cite regulations and permitting as a challenge to facilities' financial viability and opportunities for expansion. We evaluated the regulations applicable to composters in ten states, including requirements for siting, operation and management, compost quality assurance, stormwater control, and monitoring and reporting. After evaluating these state-level requirements, we combined requirements across states to provide compost facility operators in all states with a site evaluation checklist that provides composters with best practice operational strategies to achieve protection of human health and the environment.

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Plastic Beach: Examining the Distribution and Abundance of Microplastics in *Mytilus californianus* along the California and Oregon Coasts

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Marine debris is a growing threat to the health of earth's oceans, globally. Microplastics are of particular concern in regard to their impact on marine environments and human health. This study characterized the quantity of plastics in the California blue mussel (*Mytilus californianus*) across a large geographic range. Mussels were collected and outplanted at 10 sites along the California and Oregon coasts (n=15/site). Suspected synthetic particles were found in mussels from all sites. Analysis of chemical composition of the isolated particles is being performed using Fourier-transform infrared spectroscopy (FTIR). Our study provides an environmentally relevant analysis of relative microplastic concentrations in mussels collected from relatively isolated intertidal sites, widely considered a sentinel species for biomonitoring, that are similar to levels reported by existing research on bivalves. The impacts of plastics on marine organisms are of concern due to possible effects on ecological health as well as in the context of human consumption, and this field of research is critical as plastic production is expected to increase over the next several decades.

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Impact of Pesticide Application Vector Control of *Aedes aegypti* in Ponce, Puerto Rico

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The *Aedes aegypti* mosquito is an important arboviral vector worldwide and is implicated in the transmission of several diseases in tropical and subtropical urban areas. In Ponce, Puerto Rico *Ae. aegypti* populations are controlled through integrative vector management to mitigate the transmission of dengue and Zika virus. Perpetual pesticide application in this region has led to the development of pesticide resistance in the *Ae. aegypti* population making current management approaches less effective over time. The goal of this study is to provide an analysis of the effectiveness of organophosphate and pyrethroid pesticides on mosquito populations within Ponce, Puerto Rico. This analysis will be used to help inform an adaptive management framework with the goal of integrating pesticide application and the release of gene drive modified organisms as vectors to reduce disease transmission. Advancements in gene drive research has the potential to drastically alter ecological systems and population dynamics by introducing synthetic genetic elements into a wild population with the goal of population suppression or replacement. The purpose of a gene drive release is to insert alleles that propagate within a wild-type population and persist within the environment while bypassing regular inheritance rates. This study examines toxicity data of pesticide resistant strains of *Ae. aegypti* and spatial relationships to determine the impact of pesticide application within Ponce for vector control. Bayesian network relative risk assessment tools are used to model how pesticide use and spatial population dynamics impact the effectiveness of pesticides on *Ae. aegypti* in Ponce, Puerto Rico.

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Selection of A Rapid Toxicity Screening Bioassay for Effluent Discharges from a Mobile Offshore Drilling Unit

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A study was performed to evaluate the potential biological impacts from 6 types of miscellaneous discharges from a remote arctic oil and gas mobile offshore drilling unit (MODU). Samples were initially evaluated for toxicity using a rapid (<1 h) initial screening test (echinoderm [*Dendraster excentricus*] fertilization test), and if toxicity was found, further testing was conducted using 3 chronic whole effluent toxicity (WET) tests. For an initial toxicity screening test to be an effective tool, the test should be adequately sensitive, and results should include a low incidence of false positives. The EC25 results from WET tests were reviewed as indicators of either observed toxic effects or false positives from the screening test. Screening of effluent samples for toxicity prior to rigorous sampling and investigation, particularly in challenging logistical situations such as this study, can be an effective method of reducing unnecessary effort, cost, and testing of vertebrate species, while continuing to safeguard aquatic ecosystems. This study established the usefulness of the echinoderm fertilization test for effluents discharged into marine waters. Additional tests for marine and freshwater discharges need vetting and there seems to be potential for expanded application within the regulatory framework. California and Gulf of Mexico general permits for offshore oil and gas exploration and point source extraction (CAG280000 & GMG290000, respectively) both require a 7-day chronic fish survival and growth test. An appropriate screening assay, such as the echinoderm fertilization test, could be used to reduce the testing of vertebrate species tested as mandated by these permits.

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Titrating DNA-damaging and Photoreactivating Radiations *in Vivo* in the Model Alga *Chlamydomonas reinhardtii*

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In plants, *photoreactivation* is an important defense against the DNA-damaging effects of solar UV radiation. In photoreactivation the cellular enzyme photolyase uses blue light to catalyze the reversal of DNA damage formed upon exposure of cells to UV. Experiments studying this process typically use a short-duration DNA-damaging application of UV followed by recovery for various periods in the presence of longer-wavelength photoreactivating light. Our novel approach is geared towards understanding the ability of photolyase to function effectively in the chronic UV-exposure conditions of field environments; we have developed a prototype device that allows us to titrate UV-C and photoreactivating light applied simultaneously to liquid cultures of Chlamydomonas (*Chlamydomonas reinhardtii*) for durations of up to thirty minutes. Here we describe the development of this device and our results to date; we find that, under the conditions of our initial experiments (1) we are able to reliably modulate the flux of DNA-damaging UV-C against a constant flux of photoreactivating light; and (2) simultaneous application of photoreactivating light significantly decreases the amount of DNA damage for a broad range of fluxes of UV-C, for exposures of up to thirty minutes duration.

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Development of a *Menidia beryllina In Vitro – In Vivo* Linked Model

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In vitro models for assessing toxicity to humans are well established, however, models related to ecotoxicological data are lacking, especially for brackish, coastal, and marine species. There is recent evidence suggesting that the toxicity of some chemicals may differ depending on the exposure salinity. As such, we are developing the first in vitro – in vivo linked model for saline, aquatic environments by using the inland silverside (*Menidia beryllina*), a euryhaline fish. We will take a 'middle out' approach to link in vivo phenotypic anchors to in vitro cell line responses to better predict population risk. First, we will perform early life stage toxicity testing with *M. beryllina* embryos and larvae to screen for apical endpoints and adverse phenotypes for a suite of pesticides at multiple salinities. Second, we plan to measure bioconcentration to estimate internal exposure. Next, we will establish equivalent in vitro dosing using immortalized cardiomyocytes, osteoblasts, and hepatocytes from our in vitro model, and screen for gene expression changes in the cell lines. Here, we present our progress toward early life stage screening and apical endpoints, as well as our progress in cell line development. This model will reduce the need for live animals used in toxicity testing and allow for an improvement in efficiency and accuracy for pesticide testing across salinities, which is vital given the increasing number of new compounds released onto the market and limited resources available for testing.

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The Endangered St. Lawrence Estuary Beluga's Skin Microbiome and Its Potential Relationship with Halogenated Flame Retardant Exposure

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Multiple sources of contaminants (e.g. industry runoff) represent toxicological hazards to coastal marine mammals. Persistent chemicals such as polybrominated diphenyl ethers (PBDEs) accumulate at high levels in the blubber of St. Lawrence Estuary belugas, posing a continuous threat to an already endangered population. Current beluga contaminant monitoring relies on skin biopsies, a highly invasive procedure that is challenging for the study of marine mammal populations. Skin microbiome analyses represent an innovative and non-destructive biomarker approach to monitor environmental contaminants and animal health. Presented here is an investigation of the beluga skin microbiome communities to understand the relationship between biopsy concentrations of halogenated flame retardants and the skin microbiome and, to identify potential biomarkers for early detection of altered ecosystem health. Biopsy samples were collected from the dorsal regions of adult St. Lawrence Estuary belugas and analyzed for the concentrations of 35 PBDEs and 13 emerging halogenated flame retardants. The skin microbiome was obtained through 117 samples, including skin swabs, sea water controls and sequencing controls using 16S amplicon-based DNA sequence analysis on the Illumina MiSeq platform. Further metadata analysis, including contaminant microbiome differential abundance analysis, was initiated using the taxonomic profiles of the skin microbiomes, sample metadata, and contaminant metadata. Skin microbiome analysis revealed that belugas have their own distinct skin microbiome, which differs from the surrounding seawater. There were no significant differences between the skin microbiome of male and female belugas nor at different geographic regions within the St. Lawrence Estuary. However, notably, we identified several bacterial taxa at the phylum and genus level that were strongly correlated with concentrations of contaminants, which warrant further investigation as potential biomarkers. Results to date suggest a potential utility of skin microbiome analysis for non-invasive monitoring of contaminants in belugas that warrants further study as a tool to aid investigation of such species at risk.

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Occurrence of Microplastics in Bivalves in Northwest Washington

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The number of studies regarding microplastics in marine organisms has been increasing in recent years. Microplastics are a concern in marine organisms because of their potential toxicity. Microplastics may themselves be toxic or may act as an avenue of toxicant exposure because of their ability to retain chemicals on their surface. The goal of this research is to contribute additional knowledge of microplastic accumulation in marine bivalve species. Samples were collected in July 2019 from sites in northwest Washington including *Leukoma staminea* and *Saxidomus gigantea* from 1 site and *Mytilus sp.* from 6 sites. Barron Point *Crassostrea gigas* and Penn Cove *Mytilus sp*. were purchased concurrently from a local supplier. Microplastic presence and characteristics (color and type) were assessed in whole-body tissue of bivalves. These bivalve tissues were digested in 10% potassium hydroxide at 40ºC, neutralized with 1 M citric acid, and filtered with 1.2 µm borosilicate glass filters. Microplastics were visually identified using 40x magnification and classified by color and type using a conservative approach. The following are results to date for observed microplastics in mussels. Fragments: 3-16% of the samples/site with a mean of 0.5 or less/mussel. Films: 10-35% of the samples/site with a mean of 0.1 to 0.73/mussel. Fibers: 86-96% of the samples/site with a mean of 4.4 to 8.4/mussel. No significant difference was found in the number of fibers/mussel between sites, however there was a significant difference (alpha = 0.05) when number of fibers was normalized for mass of tissue (wet weight). Sites with the smallest whole-body tissue had an average concentration of 32.6 fibers/gram tissue and the sites with the largest whole-body tissue had an average concentration of 2.6 fibers/gram tissue. This work is ongoing and the results from two additional clam species, *L. staminea* and *S. gigantea*, will be presented with these results.

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Spatial-temporal Occurrence of Microplastics in *Sebastes melanops* off the Coast of Oregon

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Increased plastic production and mismanagement of waste is widely documented to impact marine ecosystems. Microplastics are the most common plastic debris type and pose a hazard to organisms that ingest them. Opportunistic feeders, such as rockfish (*Sebastes* spp.), are susceptible to microplastic ingestion and are found along populated coastlines. Two life stages are being compared across several locations off the Oregon coast, either near / inside marine reserves or closer to populated areas. This is beneficial as the marine reserves are less than 10 years old in Oregon and will be assessed in 2023 to see if they are aiding in the protection of fish. Our work will determine whether plastic is being consumed at comparable amounts in both stages and if it could be bioaccumulating. The juvenile samples have been collected across eight years and doing a temporal comparison can aid in determining if plastic pollution is increasing or changing across time. Digestive tracts were examined to determine whether they contained suspected microplastics, and undigested prey items were analyzed separately. Data thus far show that the percent of adult fish obtained near populated areas and associated with marine reserves that contained suspected synthetics or microplastics was 10.3% and 26.7%, respectively. Fish caught near marine reserves contained more suspected microplastics than those sampled near a medium-sized coastal town (p-value = 0.016). Suspected microplastics have and will continue to be confirmed with micro-Fourier transform infrared spectroscopy. These data show that nearshore species may be impacted by waste management shortfalls and are consuming synthetic materials. Continued research is needed to determine how much plastic is found in surrounding waters, the amount ingested or accumulated by other marine organisms in this food web, and how it impacts vital species to better understand the health of the marine ecosystem.

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Mitigation of Stormwater Toxicity with Permeable Pavement

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Permeable concrete and asphalt are engineered to allow stormwater infiltration while maintaining structural resilience under heavy vehicle loads. Adding carbon fiber to the matrix of permeable pavements increases their tensile strength. Multiple studies have focused on evaluating the engineered design performance of these permeable materials. However, it is unclear whether these materials provide chemical treatment of surface stormwater runoff and whether they contribute toxic chemicals to effluent water. We evaluated permeable concreate and asphalt cores six inches in diameter and depth with and without the addition of carbon fiber. Control water and stormwater runoff from a busy arterial road were pumped at a low flow rate through each core. The use of control water is representative of rain water while the stormwater treatments show how these pavements may perform when exposed to diverted runoff from impermeable surfaces. After four hours of treatment influents and effluents were analyzed for water quality and chemistry (pH, conductivity, dissolved oxygen, PAHs, total suspended solids, dissolved organic carbon, and total and dissolved metals) and for zebrafish toxicity (*Danio rerio*). Results will show (a) how permeable pavements alter clean and polluted influents; (b) whether carbon fiber additions have an impact; (c) what effect aging over multiple treatments has on performance.

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Estimating *Daphnia magna* Population-level Response to a Recommended and High Chlorpyrifos Use Scenario at the Watershed Scale

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Pacific Northwest freshwater resources are key elements in the life history and ecology of Pacific salmon and steelhead (*Oncorhynchus* sp.). In addition to overfishing, critical habit degradation and loss has been identified as contributing to population decline, resulting in 28 evolutionarily significant units listed as threatened or endangered under the Endangered Species Act. Characterizing risks to Pacific salmonids and their food web related to pesticide exposure requires complex spatial and temporal information on life history and ecology, as well as pesticide use patterns and environmental fate. Probabilistic methods can be used to characterize realistic pesticide use practices while ecohydrologic models can simulate pesticide transport from the application sites to freshwater resources utilized by Pacific salmonids and their food web allowing for spatial and temporal estimation of exposure of aquatic receptors. *Daphnia magna* was chosen as a sensitive indicator of receptor response to freshwater toxicant exposure, allowing modeling results to be cautiously extrapolated to other less sensitive aquatic receptors. For this study, a probabilistic approach was used to characterize use practices of the organophosphate insecticide chlorpyrifos in the Zollner Creek watershed, Willamette Valley, Oregon between 2010 and 2011. The Soil and Water Assessment Tool was used to simulate the fate and transport of chlorpyrifos and chlorpyrifos-oxon, a degradation product of toxicological concern, and estimate aqueous exposure on toxicologically relevant timesteps. To investigate the impact of chlorpyrifos use practices on aquatic resources in the Zollner Creek watershed, we utilized daily model estimates of chlorpyrifos and chlorpyrifos-oxon concentrations, derived from a recommended- and high-use scenario, and a Tier 1 population model, parameterized with acute and chronic bioassay data, to evaluate the combined effect of chlorpyrifos and chlorpyrifos-oxon on *D. magna* population dynamics over a 2-year period.

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Longevity of Bioretention Depths for Preventing Acute Toxicity from Urban Stormwater Runoff

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The migration of coho salmon every fall from the ocean to freshwater streams coincides with increasing rainfall in the Pacific Northwest. Much of this rainfall runs off of asphalt and other impervious surfaces found in urban areas, such as the Puget Sound Basin, and into the very streams where salmon spawn. Exposure to urban stormwater runoff, which contains a complex mixture of contaminants, can be acutely toxic to coho salmon. Previous studies have demonstrated the effectiveness of bioretention treatment systems in treating urban runoff and preventing acutely lethal and sublethal effects to aquatic organisms. Municipalities are especially motivated to incorporate bioretention treatment systems into existing infrastructure in order to comply with National Pollutant Discharge Elimination System (NPDES) permit requirements. NPDES permits are administered by the Washington Department of Ecology (Ecology) and require local governments to manage polluted stormwater in order to mitigate the effects of pollution and contamination on downstream waters. The current study aims to determine the effectiveness and longevity of bioretention soil media over time at various infiltration depths, including those shallower than 18 inches, the depth currently required by Ecology. Stormwater runoff is being collected from a busy, urban road site and applied to experimental columns, containing five different depths of bioretention soil media. Runoff is applied at an accelerated rate in order to simulate 10 water years over two calendar years. The chemical and biological effectiveness of the columns in treating urban stormwater runoff will be assessed using analytical chemistry and the health of two fish species: juvenile coho salmon and zebrafish embryos. The study outcomes are expected to help inform stormwater managers, National Pollutant Discharge Elimination System (NPDES) permit coordinators, and others involved in stormwater management.

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Removal of PAHs and *E. coli* Using Novel Stormwater Bioretention Amendments

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Current stormwater permitting regulations in the state of Washington do not include performance goals for the treatment of pollutants like certain organic contaminants (Polycyclic Aromatic Hydrocarbons - PAHs) and bacteria (fecal coliform, *Escherichia coli*). As a first step in determining Best Management Practices (BMPs) for the treatment of these contaminants in stormwater runoff, a bench scale study was conducted to assess the contaminant removal efficiencies of several emerging bioretention soil media (BSM) amendments. The following treatments were compared in a bench scale stormwater filtration experiment: sand (control) and sand amended with two different high temperature pyrolysis biochars. Biochars were chosen for their adsorptive properties, availability, and ability to enhance desirable hydraulic properties in stormwater bioretention systems. In a series of three dosing experiments, small bioretention columns were dosed with 1) clean water (to leach medias) 2) PAH spiked stormwater, and 3) *E. coli* spiked synthetic stormwater. Influent and effluent from the columns were analyzed for PAHs and E. coli concentrations. Three-ring PAHs were detected at low levels in sand control effluents, while no PAHs were detected in biochar effluents. Both biochar treatments removed > 98% of TPAHs compared with ~50% removal by sand alone. Contrary to our hypothesis, the sand controls removed 5-50% more *E. coli* than the biochar-amended treatments, with one biochar outperforming the other by an order of magnitude. The best performing biochar was selected for use in a greenhouse-scale bioretention study which began in December 2019. This larger scale bioretention study will investigate the effect on PAH and fecal indicator bacteria removal of amending a typical bioretention soil media (60:40 sand:compost mixture) with biochar and/or fungi. Preliminary results from this work will also be presented at the conference.

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Presence of Microplastics in Ephemeroptera, Plecoptera, and Tricoptera of North Cascades National Park

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The presence of microplastics in glaciers has led to concern for freshwater systems connected to the glaciers. In areas such as the North Cascades (WA), glacier runoff could transport these microplastics into the watershed and into organisms in the streams. Benthic macroinvertebrates are good indicators of water quality because they may be sensitive to pollution. Their relatively low status on the freshwater food chain suggests the possibility for accumulated microplastics in macroinvertebrates to be a source of microplastics to predators, proving a hazard to the health of freshwater ecosystems. Samples analyzed in this study were Emphemeroptera, Plecoptera, and Tricoptera collected from several streams and lakes in the North Cascades National Park. Samples were collected in 2018 and preserved in ethanol. Samples were composited based on Order and site. Whole organisms were digested in 10% potassium hydroxide and filtered through a 1.2 µm borosilicate filter. Microplastics were identified under a microscope at 40X magnification and characterized by type and color. Plastic types included fibers, fragments, films, foams, and pellets. Presently, microplastics have been recovered from 100% of the 15 samples analyzed. A total of 138 microplastics were recovered. Fibers constitute the majority of recovered microplastics (99.1%). The three most common fibers are blue, black, and transparent. Blue fibers account for 47.6% of fibers, black 22.9%, and transparent 27.6%. One fragment was recovered, and no films, foams, or pellets were observed.

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Investigating the Fate, Transport, and Impacts of Microplastics using Gold Nanoparticle Embedded PMMA Microgels

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Plastic debris is a ubiquitous pollutant threatening marine and freshwater ecosystems. This debris is especially problematic within aquatic ecosystems where plastic debris displays adverse ecotoxicological effects. Of particular concern are microplastics, particles intentionally created at the micro- and nanoscale or those formed from the degradation of bulk plastic. Owing to their small scale, these microplastic particles express unique properties as a consequence of their enhanced surface area and exposed functional groups. The ability to detect and characterize microplastic particles has been an issue due to lack of sufficiently sensitive analytical techniques. To address this, gold nanoparticle embedded microplastics were explored for their use as proxies for microplastic environmental release; where they were subjected to simulated environmental conditions and quantified by single particle ICP-MS. The microplastics are comprised of a latex core encased in a polymethyl methacrylate (PMMA) shell to form a particle with an approximate diameter of 350nm. These microplastics are then embedded with gold nanoparticles which penetrate and reside beneath the PMMA surface. Consequently, these gold nanoparticle tagged microplastics (AuPMMA) have environmental interactions that mimic pure PMMA microplastics. To gauge their utility as microplastic analogs, their degradation and density properties were compared to virgin PMMA particles. This density comparison was performed to ensure similar transportation behavior; as well as explore the relationship between gold nanoparticle loading and AuPMMA particle density. In addition, weathering experiments were performed to assess their resilience under environmentally relevant solar irradiation, pH, and, temperature conditions. The AuPMMA particles were then quantified and characterized using single particle ICP-MS, where the detection of embedded gold nanoparticles served as a proxy for the PMMA microplastics. Future work will diversify metal nanoparticle and plastic types to be used along with expanding the ecological scope of addressing the impact of microplastics.

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Using SEM/EDS To Investigate the Relationship Between Cell Surface Chemistry and Environmental Chemistry in *Chlamydomonas nivalis*

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This study investigated the relationship between cell surface chemistry and environmental snow chemistry in snow algae (*Chlamydomonas nivalis)* collected from the Mount Baker-Snoqualmie National Forest, WA. Snow and algae samples were collected from algae fields near Bagley Lakes. Samples were collected on nine dates from 6/28/18 to 8/31/18, at 3-6 different sites per sampling date. Sites were grouped based on terrain characteristics: on top of lake, adjacent to lake, elevation above 1,315 m, on landslide, above Bagley Creek, and west of the lake. Snow chemistry was analyzed with ICP-MS after filtration through a 0.45 μm filter. Algae samples were preserved with paraformaldehyde and carbon coated before SEM/EDS analysis. Relative surface composition of N, O, Na, Mg, Al, Si, P, S, Cl, K, Ca, Cr, Fe, Co, Ni, Cu, Zn, As, Mo, Cd, Hg, and Pb were determined using Oxford AZtec software. These techniques were used to examine whether snow chemistry relates to algal chemistry and whether this relationship changes with location and season. Snow chemistry data was clustered on the Principle Components and shows that geographic features can explain the metals concentrations, but a confounding factor is the timing of when samples in certain geographic features could be accessed. A similar statistical analysis will be conducted with the elemental content measured in algae. The chemistry information will be related to community structure, which is on-going work in the Kodner (WWU) lab.

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Bioretention Prevents Urban Stormwater Impacts on Embryonic Development of Pacific Herring (*Clupea pallasii*).

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Urban stormwater runoff has become a significant water quality threat to aquatic habitats in the Salish Sea. Human population growth continues to drive development and land conversion in coastal watersheds, leading to greater imperviousness and increasing toxic stormwater runoff. Urban runoff is a complex chemical mixture, consisting of thousands of distinct compounds, the majority of which have not been identified or characterized in terms of adverse environmental effects. Many stormwater outfalls discharge directly to the nearshore marine environment. These areas provide spawning habitat for forage fish species, including Pacific herring (*Clupea pallasi*). We evaluated the developmental toxicity of urban runoff exposures in Pacific herring. In addition, we pre-treated runoff by soil bioretention to determine if conventional green infrastructure methods were protective for shore-spawning forage fish. Results indicate that stormwater exposures caused significant reductions in larval length and greater egg yolk area, consistent with a failure to mobilize embryonic energy stores (yolk). In addition, herring exposed to stormwater runoff exhibited cardiac injury including both functional (e.g., bradycardia, contractility) and morphological (e.g., increased atrium area) heart defects. The observed effects are consistent with the known cardiotoxicity of polycyclic aromatic hydrocarbons (PAHs) to fish embryos and could result in delayed adverse outcomes such as reduced cardiorespiratory fitness and subsequent mortality. Evidence from herring suggests that crude oil and stormwater have nearly identical effects on larvae, suggesting that regional storm events are creating localized “oil spills” in the vicinity of stormwater outfalls. Pretreating the stormwater by passing it through a bioretention filter prevented the developmental abnormalities. Incorporating green stormwater infrastructure methods in development and redevelopment projects, would reduce the incidence of outfalls acting like localized “oil spills”.

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Validation of Toxicological Interpretation of Diffusive Gradients in Thin-films in Marine Waters Impacted by Copper

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As part of the ambient monitoring program being conducted for the Puget Sound Naval Shipyard & Intermediate Maintenance Facility at Naval Base Kitsap in Sinclair and Dyes inlets of the Puget Sound, receiving waters of the Inlets are routinely monitored for trace metals and toxicity to assess water quality status, track progress in achieving water quality goals, and demonstrate protection of aquatic life. In 2016, aqueous metals bioavailability tracking, using diffusive gradients in thin-films (DGT) passive samplers was incorporated into the monitoring program. Nine subsequent in situ campaigns have recorded labile (C_{DGT}) Cd, Cu, Ni, Pb, and Zn at twelve stations. A current obstacle to regulatory acceptance of C_{DGT} data is validation of an uptake response that reliably mimics that of aquatic organisms. Towards reconciliation of C_{DGT} Cu and natural ligands in respect to toxicity, ex situ studies in 2018 quantified DGT lability of Cu in Sequim Bay seawater at varying dissolved organic carbon (DOC) concentrations (as Suwannee River natural organic matter), while simultaneously determining and modeling biota correlation (as EC50 values of *Mytilus galloprovincialis* [Mediterranean mussel] larvae). Embryo-larval development tests, using *Mytilus*, were selected as they are among the most sensitive saltwater bioassays used for aquatic life criteria development and are the basis for the current EPA Criterion Maximum Concentration of Cu in seawater. In the current study, *Mytilus* larvae Cu EC50s in seawater from five ecological communities with diverse DOC quality, were assessed against the previous model, and the toxicological protection provided by Cu-DOC binding is discussed in terms of fluorescence characterization.

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Investigating the Presence and Trophic Transfer of Microplastics in Ex- and In-Situ North American Otters Through Scat and Diet Analysis

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While an increasing number of studies have examined the presence and effects of microplastics in aquatic organisms like invertebrates and fish, there is still a dearth of knowledge about their impact on mammals in higher trophic levels. Both sea and river otters act as valuable indicators of ecosystem health and consume prey items that have been shown to contain microplastics. As such, we are investigating the ingestion of microplastics by sea otters (*Enhydra lutris*) and North American river otters (*Lontra canadensis*) in the North Pacific using scat. Our study includes samples from ex-situ and in-situ individuals and also analyzes otter prey items for microplastic particles in order to evaluate the role trophic transfer may have in microplastic ingestion by otters. This analysis could provide opportunities to understand the current level of microplastic ingestion by wild sea and river otters in using a non-invasive method, which may be beneficial to understanding sea and river otter population health. Beyond the impacts this knowledge could have for North American otter species, the results could provide information about the exposure of other species that share these ecosystems to microplastic pollution.

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Microplastic Monitoring in *Richardsonius balteatus* from Ross Lake, WA

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Recent work has shown that microplastics are present in glaciers. . This is a concern for waterbodies such as Ross Lake (WA) where glacier runoff may transport the microplastics into the watershed and be available to aquatic organisms. Currently there is no evaluation of how organism storage methods may impact microplastic recovery. In this study microplastic type and color in whole body *Richardsonius balteatus* **(**redside shiners) from Ross Lake were counted. Fish were collected from Ross Lake on July 6th, 2019. Approximately half of the samples were stored in ethanol and the remainder on ice. Characteristics including color and type (fragment, pellet, fiber, film, and foam) of recovered microplastics were compared between the two groups. To date, 19 fish stored in ethanol and 49 stored on ice have been analyzed. The average wet mass of ethanol-stored and ice-stored was 0.4329 and 0.3590g. A total of 166 total microplastics were identified in fish stored in ethanol (8.7 per fish). All the samples in ethanol had fibers; black fibers were the most prevalent at 78.9% of all fibers. Fragments and films were in 5% of the samples, and no pellets or foams were observed. A total of 229 total microplastics were found in the samples stored on ice (4.7 per fish). Fibers were found in 98% of the fish; black fibers were the most prevalent at 72% of all fibers. Fragments were in 10.20% of plastics in all samples stored on-ice, and films were in 8.16% of the samples, with no pellets or foams observed.

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Pacific Herring (*Clupea pallasii*) Embryo Development Bioassay Results and Associated PAH Concentration for Exposure to an Oil Refinery Effluent

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Pacific herring are an important resource in the Puget Sound and a keystone species for many of regional food webs. The effects of polycyclic aromatic hydrocarbons (PAHs) and oil exposure on herring development have been the focus of several studies, including a WDFW study examining the effects of background levels of PAHs to naturally spawned herring in the Puget Sound region. The goal of the present study was to expand upon this research by investigating the concentration of PAHs measured in a refinery effluent that expressed developmental or survival impacts to herring embryos based on WDOE Whole Effluent Toxicity (WET) testing methods. Pacific herring embryos were artificially fertilized within test chambers and exposed to concentrations of effluent for a period of 8 days. On Day 8 the developing embryos in all exposure concentrations were transferred to control water and monitored for hatch until Day 16. PAH concentrations were measured in the water and exposed eggs in the 100% effluent, as well as in the eggs at selected effects concentrations following 8 days of exposure. The no observed effect concentration (NOEC) for embryo development (expressed as normal-survival) was 50% effluent and the total PAH (TPAH) concentration in the eggs exposed to this dilution was 20.7 µg/kg. This result suggests that this TPAH concentration would not be expected to illicit an effect to herring embryo development following the standard WDOE WET method. The PAH concentrations in the egg tissue were similar between the LOEC (75% effluent) and the NOEC (50%), indicating that PAHs may not be the only driver of observed toxicity in this complex effluent mixture. The estimated TPAH exposure (measured TPAH in 100% effluent x CCEC %) at the edge of the mixing zone was approximately 0.015 µg/L, which was below the literature value of 0.23 µg/L for cardiotoxicity.

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