**Pacific Northwest Society of Environmental Toxicology & Chemistry**

# Meeting Program


**34rd Annual Meeting**
**The Grove Hotel, Boise, ID**
**April 14-16, 2025**

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## Oregon State University Department of Environmental and Molecular Toxicology

The integrated mission of the Department of Environmental & Molecular Toxicology (EMT) is to educate students in the toxicological sciences, to conduct research on the effects of chemicals and other agents on humans and the environment and to engage the public through extension and outreach. The EMT Department focuses on creating, disseminating, and applying new knowledge to enhance the treatment and prevention of human disease and to ensure the protection of the environment and public health.

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## Alta Science & Engineering, Inc.

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# Kingfisher Level Sponsors

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# Agenda, Monday, April 14

*Student is being evaluated for presentation award

| Start Time | Speaker | Platform Presentation Title |
|---|---|---|
| 9:00 AM | Conference Opens, Check-in, and Networking - Coffee refreshments, Location: Landing | |
| 9:40 AM | Mark Surette | Welcome Address by Chapter Vice President, Location: Cedar/Aspen |
| 10:00 AM | Plenary Speaker: Chairman Mason of the Shoshone Paiute Tribe | Title: Suffering of a tribe, how many generations will feel the effect?, Location: Cedar/Aspen |
| **11:00 AM** | **Break/Networking** | |
| **11:20 AM** | **Session 1: Mountains to Sea - Cross Systems Thinking: Mining** | |
| **Moderator: Claire Detering, WSP, Location: Cedar/Aspen** | | |
| 11:20 AM | Whitney Schroeder | Documenting the Bunker Hill lead poisoning story: An interdisciplinary approach to science communication |
| 11:40 AM | Ian von Lindern | Critical minerals in the State of Idaho: Rewriting a mining legacy or repeating mistakes of the past? |
| 12:00 PM | Faith Quigley* | Reevaluating the Legal Framework for the Future of Modern Critical Mineral Mining: Considering Public Health Risks in the Age of Clean Energy |
| **12:20 PM** | **Lunch provided at The Grove Hotel Meeting Rooms, Location: Evergreen** | |
| **1:30 PM** | **Session 1 Continued: Mountains to Sea - Cross Systems Thinking: Mining** | |
| **Moderator: Claire Detering, WSP, Location: Cedar/Aspen** | | |
| 1:30 PM | Lauren Zinsser | Long-term trends in metals and nutrients guide remediation and demonstrate success at a northern Idaho Superfund site |
| 1:50 PM | Racheal Thacker and Casey Bartrem | Increasing Tribal participation in the determination of mining on Indigenous lands: The Shoshone-Paiute Tribe Seven Generations Project |
| 2:10 PM | **Panel Session I:** Beyond the Surface: Voices from the Shoshone-Paiute Tribe on Environmental and Social Realities. Panel Members: Tribal Chairman Brian Mason, Racheal Thacker, Chris Cleveland (Shoshone-Paiute Tribe), Marissa Snapp (Tribal Environmental Protection Program (TEPP)) & Hattie Conklin (Owyhee Community Health Facility) | |
| **3:10 PM** | **Break/Networking** | |
| **3:30 PM** | **Session 2: Mountains to Sea - Cross Systems Thinking: Human Health & Contaminant Exposure** | |
| **Moderator: Julie Layshock, Pacific University, Location: Cedar/Aspen** | | |
| 3:30 PM | Marina R Steiner* | Salinity and Organochlorine Pesticide Contamination in Drinking Water in the Aral Sea Region of Karakalpakstan, Uzbekistan |
| 3:50 PM | Jennifer Lanksbury | Reel Partnership: King County Collaborates with Refugee and Immigrant Fishers to Advance Community Health |
| 4:10 PM | Christoff Furin | Metals, POPs, PFAS and Nutrients in Commercially Important Marine Fish Species from Alaska and their impact on fish consumption |
| 4:30 PM | Sara J. Hutton | Risk Assessment of Microplastics and Comparison of Species Sensitivity Distribution Methods |
| 4:50 PM | Peter Mullner & Steve Crowley | Educational Programming in Support of Domestic Mining |
| **5:30 PM** | **POSTER SESSION I: hor d'oeuvres and refreshments, Location: Evergreen, Ends at 7:00 PM** | |

# Agenda, Monday, April 14, continued

*Student is being evaluated for presentation award

**List of Monday Poster Presentations**

| Poster No. | Presenter | Poster Presentation Title |
|---|---|---|
| 2 | Lori-jon Waugh* | Filter Socks: A Simple, In-Line Addition to Optimize Fiber Capture in Microplastic Sampling |
| 6 | Grace Landaverde* | Exploring Iron, Manganese, and Zinc Behavior in a campus constructed wetland |
| 8 | Crystal Still | Acute Toxicity of Cobalt to a Freshwater Fish (Pimephales Promelas) and the Water Flea (Ceriodaphnia dubia) |
| 10 | Danielle Mulligan | Toxicity Identification Evaluation (TIE) for an Idaho Metals Mine: Possible Sources of Concern Point to Explosives |
| 12 | Jay Word | Evaluation of the Response of Juvenile Coho Salmon to a Pulsed Exposure of an Alkaline Brine Solution |
| 14 | Marlee Brown* | Roadway Runoff Induced Mortality in Juvenile Coho Salmon During Spring Storm Events |
| 16 | Robert Campbell | CCPD: A Potential Safer Alternative to 6PPD for the Environment |
| 18 | John Hansen | Sensitivity of Pacific lamprey to 6PPD-Q |
| 20 | Sara J. Hutton | Review and Meta Analysis of Best Management Practices for 6PPD-Quinone Stormwater |

# Agenda, Tuesday, April 15

*Student is being evaluated for presentation award

| Start Time | Speaker | Platform Presentation Title |
|---|---|---|
| 8:30 AM | Conference Opens, Check-in, and Networking - Coffee refreshments, Location: Landing | |
| **9:00 AM** | **Session 3: Mountains to Sea: Risk Assessment** | |
| **Moderator: Sara Hutton, GSI Environmental Inc., Location: Cedar/Aspen** | | |
| 9:00 AM | April D. Reed | Integrating a One Health Approach through Addition of Biological and Ecological Endpoints into Comprehensive E-Flows Assessments for the Limpopo River Basin, southern Africa |
| 9:20 AM | Jeremy Johnson | Human Health Risk Evaluation Approach for Recreating on CDA Lake |
| 9:40 AM | Grant Walter | Comparison of the Risk Assessment Process Using Discrete and Incremental Sampling Methodology for a Remote Site in Alaska |
| 10:00 AM | Marianne Batchelder | Risk Assessment in the Last Frontier |
| **10:20 AM** | **Session 4: Ocean and Estuarine Systems: Pollutant Impacts** | |
| **Moderator: Mark Surette, WSP, Location: Cedar/Aspen** | | |
| 10:20 AM | John Hansen | An in vitro approach for assessing orca skin health: focus on antiviral immunity |
| 10:40 AM | Ariel Blanc | How to Assess and Integrate Low PAH Bioavailability into a CERCLA Marine Risk Assessment; Bremerton Gas Works Superfund Site |
| **11:00 PM** | **Walk to Julia Davis Park. *Optional Activity* Meet in the "Landing" room to start a group walk in downtown Boise to a beautiful city park** | |
| **12:00 PM** | **Lunch provided at The Grove Hotel Meeting Rooms, Location: Evergreen** | |
| **1:20 PM** | **Session 5: Rivers and Freshwater Systems: Storm Water & Monitoring & Toxicity** | |
| **Moderator: Kenia Whitehead, GSI Environmental Inc., Location: Cedar/Aspen** | | |
| 1:20 PM | Nathan Ivy* | Canary in the Creekbed: Real-Time Flow-Through Experiments Demonstrate Urban Runoff's Role in Coho Salmon Declines |
| 1:40 PM | Jamie Fox | 6-PPD Quinone (6-PPDQ) in Sediment: Measurement, Occurrence and Partitioning |
| 2:00 PM | Justin Greer | Primary and immortalized cell models for evaluating the toxicity of 6PPD-quinone and other stormwater pollutants |
| 2:20 PM | Prarthana Shankar | Lethal and Sublethal Effects of 6PPD-quinone on Coastal Cutthroat Trout |
| 2:40 PM | Anastasia McConachie* | Investigating acute and sublethal toxicity of para-phenylenediamine derivatives in coho salmon (Oncorhynchus kisutch) for the evaluation of safer alternatives to 6PPD |
| **3:00 PM** | **Break/Networking** | |
| **3:20:PM** | **Panel Session II:** Bunker Hill Remediation and Mitigation Efforts and the Future of Coeur d'Alene Lake. Panel Members: Susan Spalinger (Alta Science and Engineering, Inc.), Rebecca Stevens (Coeur d'Alene Tribe), Jamie Brunner (Idaho Department of Environmental Quality), Lauren Zinsser (USGS) | |
| **4:20 PM** | **PNW SETAC Chapter Business Meeting, Location: Cedar/Aspen** | |
| | Michelle Knowlen | President's Address |
| | Sarah Hutton | Treasurer's Report |
| | Ruth Sofield and Mark Surette | SETAC NA |
| | | Board Nominations |
| | | Feedback from Members |
| **5:30 PM** | **POSTER SESSION II:** hor d'oeuvres and refreshments**, Location: Evergreen, Ends at 7:00 PM** | |
| **7:30 PM** | **Student Mixer - Bittercreek Ale House, all students welcome to drop-in at 246 N 8th St \| Boise, ID 83702** | |

# Agenda, Tuesday, April 15, continued

*Student is being evaluated for presentation award

**List of Tuesday Poster Presentations**

| Poster No. | Presenter | Poster Presentation Title |
|---|---|---|
| 1 | Maria Carolina de Almeida | Dispersed Microplastics in Brazilian Rivers Without Control, Monitoring and Environmental Protection Legislation |
| 3 | Brianna Benner* | Harnessing the power of spICP-MS in the study of nanogeochemical processes |
| 5 | Morgan Bender | Our Seafood, Our Knowledge - Developing a baseline for hydrocarbon concentrations in Alaskan coastal subsistence foods |
| 7 | Julie Layshock | Feeln' the Burn: Localized Air Quality Study in Oregon's Willamette Valley |
| 9 | Celeste Valdivia* | Molecular assessment of nickel toxicity in a non-model marine tunicate to facilitate cell line development. |
| 11 | Ruth Sofield | Effects of PCBs and PBDEs on Chinook salmon populations in Puget Sound, WA |
| 13 | Amirah Casey* | Pacific salmon at a Crossroads: a StoryMap |
| 15 | Kiersten Maxwell | Assessing Water Quality in South Puget Sound Watersheds: The Role of 6PPDQ and Emerging Contaminants |
| 17 | Ayden Mudd* | A Comparison of Commonly Used Extraction Methods for 6PPD-q |
| 19 | Mary Engels | Crayfish suitability for 6PPD-Q pollution biomonitoring in Aquatic Ecosystems |

# Agenda, Wednesday, April 16

*Student is being evaluated for presentation award

| Start Time | Speaker | Platform Presentation Title |
|---|---|---|
| 8:30 AM | Coffee, Refreshments, and Networking, Location: Evergreen/Landing | |
| **9:00 AM** | **Session 6: Rivers and Freshwater: Ecological Toxicity** | |
| **Moderator: Michelle Knowlen, EcoAnalysts, Inc., Location: Cedar/Aspen** | | |
| 9:00 AM | Chris Mebane | Finding Goldilocks: aquatic life criteria for copper that are too simple, too complicated, or just about right |
| 9:20 AM | Austin Baldwin | Quashing quagga: Fate and effects to the benthic community of a copper treatment to eradicate invasive mussels in a large western river |
| 9:40 AM | Jen McIntyre | Acute lethal and sublethal toxicity of anticoagulant rodenticides on Pacific salmon |
| 10:00 AM | Erin Murray | Spatial and temporal trends of mercury in fish from Duck Valley Indian Reservation reservoirs, southwestern Idaho and northern Nevada, 2007-2024 |
| **10:20 AM** | **Break/Networking** | |
| **10:40 AM** | **Session 7: Ocean and Estuarine Systems: Environmental Monitoring** | |
| **Moderator: Mark Surette, WSP, Location: Cedar/Aspen** | | |
| 10:40 AM | Sandra Dorning | Co-Producing a Toxics Research Agenda for Puget Sound Recovery |
| 11:00 AM | Lorrie Rea | Rising Sea Surface Temperatures in Western Aleutian Islands, Alaska Associated with Decadal Increase in Steller Sea Lion Pup Total Mercury Concentrations |
| 11:20 AM | Morgan Bender | Decades of citizen-driven environmental hydrocarbon monitoring from Prince William Sound, Alaska |
| **11:40 AM** | **Student Awards, Location: Cedar/Aspen** | |
| 11:50 AM | Michelle Knowlen | Closing Remarks |
| 12:00 PM | **In-Person Short Course** (with Lunch for participants), Presented by: Gunnar Guddal<br>Title: Python Scripting for Environmental Professionals: How to Think Like a Computer Scientist<br>Sign up is required, Location: Ivy, Ends at 3:30 PM | |
| **Optional Social Event Field Trip or Hike - TBD Wednesday afternoon** | | |

# Monday Plenary Speaker

## Plenary: Suffering of a tribe, how many generations will feel the effect?

**Presented by Shoshone Paiute Tribal Council Chairman Brian Mason**

The Shoshone-Paiute Tribe (SPT) of the Duck Valley Indian Reservation (DVIR) includes descendants who once freely occupied the area now known as Idaho, Nevada, and Oregon. DVIR is an economically and geographically isolated community located on the Idaho-Nevada border in the high great basin desert. The area is in the 70th percentile of U.S. low-income populations, the 75th percentile for U.S. unemployment rate, and the 73rd percentile in the state of Nevada for proximity to a Superfund site. Nationally, native communities on trust lands are the most poverty-stricken and face a disproportionate burden of environmental harm.

In 1985, the Bureau of Indian Affairs (BIA) discovered a leaking 16,000 gallon oil tank on the reservation. In the following years, water supplies smelled like hydrocarbons and petroleum sludge was found in the Owyhee public water supply. Until sovereignty in 1993, DVIR was under the jurisdiction of BIA who oversaw the plumes. Today, SPT and BIA are making efforts to work together to address the environmental impacts and preparing for a health assessment in the community.

SPT is also affected by the social injustices of mining. More than 600,000 Native Americans (up to 15% of the Native American population) live within 6 miles of an abandoned mine. Cancer mortality rates among Native communities have increased over a 20-year period, and are higher when compared to other at-risk groups. Compounding these challenges, Nevada accounts for about 80% of U.S. gold production and is the fourth largest gold producer in the world. Approximately 40% of Nevada production is from deposits in Elko County alone, where half of DVIR's territory and most of its population is located. However, SPT does not receive any royalties or tax revenue from the mines.

This plenary presentation will be given by Chairman Brian Mason of the Sho-Pai Tribal Council. Chairman Mason will share perspectives as the leader of a community grappling with a multitude of challenges. The Tribe is also grappling with a recent discovery of agent orange contamination due to US government activities, a superfund mine site 4 miles upstream of the reservation, a new rush on lithium reserves, and, most recently, federal spending freezes that threaten a significant portion of the funds used to support SPT, a non-revenue tribe reliant on government funds. These repeated injustices reiterate the need for a radically different approach moving forward and efforts towards justice during a rapidly evolving political climate.

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# Monday Platform Presentations and Panel Abstracts

‡ Indicates presenter

## Session 1: Mountains to Sea - Cross Systems Thinking: Mining

### Documenting the Bunker Hill lead poisoning story: An interdisciplinary approach to science communication

Whitney Schroeder, MPA‡, Ian H. von Lindern, PE, PhD, Margrit C. von Braun, PE, PhD, and Casey L. Bartrem, PhD. TerraGraphics International Foundation (TIFO).

In 1973-4, thousands of Idaho's Silver Valley children were lead-poisoned in one of the worst environmental disasters in US history. Following a fire that destroyed the pollution control system of the Bunker Hill lead smelter, the equivalent of 11 years of lead, arsenic, and other metals were released in 6 months. Within 5 miles of the smelter, 95% of children were clinically lead poisoned with blood lead levels averaging 70 µg/dL, 20 times the current reference values. The crisis prompted unprecedented public health and environmental responses, comprehensive soil remediation, and long-term health monitoring programs. Seminal studies published in 1977 on dose-response relationships between air lead and children's blood lead levels were the basis for the first lead air quality standards. Bunker Hill became the second largest U.S. Superfund Site, resulting in the remediation of >3500 homes and >7 square miles of protective soil barriers. The 20-year cleanup relied on blood lead monitoring of children and evaluation of dose-response relationships using the IEUBK model for lead. Individuals involved in the environmental and public health response programs accumulated collections of documents and photographs from corporate and civil litigation discovery, state, federal, local, and tribal governments, consultants and researchers, community advocates, and public hearings. These files, many salvaged from disposal, provide insight into an untold story of corporate and government actions that impacted workers and their families, in addition to the collective actions to bring justice and relief to residents. Cataloging, digitizing, and archiving these extensive records ensures that the full story of the Bunker Hill lead poisoning tragedy is preserved. The long-term goal is for these files to complement in-person interviews and be used in science communication to reach diverse audiences. This presentation will include an overview of the Bunker Hill lead poisoning tragedy and ongoing efforts to ensure the full story is available to future generations. Document preservation and development of science communication through digital storytelling will bridge the gap between complex concepts and public understanding, fostering informed decision-making. This interdisciplinary project is exceptionally important as the US experiences a resurgence of mining to meet the demand for critical minerals, ensuring that the public and policymakers can avoid repeating past mistakes.

**Critical minerals in the State of Idaho: Rewriting a mining legacy or repeating mistakes of the past?**

Ian von Lindern‡, Margrit von Braun, and Casey Bartrem. TIFO.

Idaho's 20th century commodity and metals production helped win two world wars and powered the nation's post-war economies. Simultaneously, mining and mineral processing were among the least regulated and taxed industries, severely damaging its natural resources and poisoning its citizens, most notably young children. The Gem State's legacy includes the worst epidemic of childhood lead poisoning and the US EPA's second-largest Superfund cleanup in the infamous Silver Valley. Similar to much of the US, the mining industry eventually declined in Idaho and abandoned mines, industrial waste, damaged landscapes, and contaminated communities were left behind, requiring billions of dollars in cleanup and restoration. Today, climate and geopolitical factors are fueling an unprecedented resurgence of precious, green, and strategic metal demands. Idaho and Nevada are returning to international prominence in gold, silver, lithium, cobalt, antimony, and rare earth mineral sources. Two of the world's largest silver, lead and zinc producers are reopening. State and federal governments are facing pressure to relax protections and accelerate permitting processes. Tribal governments are overwhelmed with mining consultations. Arguments for accelerating permitting include climate change, energy independence, remediation of legacy sites, and socio-economic benefits. However, recent reinterpretation of the Idaho toxic air product rules are radically increasing allowable carcinogenic emissions and avoiding well-established risk assessment protocols that inform air quality standards used to permit mines. This will result in 100-fold increases in allowable pediatric cancer risk, once again jeopardizing Idaho children and setting an unfortunate precedent for future mining activities. Fifty years ago, thousands of children in the Silver Valley were lead poisoned to maximize mineral industry profits. Today, Idaho has the opportunity to rewrite the state's troubled legacy by demanding responsible mining to meet this century's critical mineral demands. Through an analysis of historic events and present-day risk assessment methodologies, this presentation gives context to a rapidly evolving situation in which the State of Idaho is attempting to rewrite pediatric cancer risk assessment practices and repeat the costly mistakes of the past.

**Reevaluating the Legal Framework for the Future of Modern Critical Mineral Mining: Considering Public Health Risks in the Age of Clean Energy**

Faith Quigley, Juris Doctor Candidate‡ and Ian von Lindern, PE, PhD. TerraGraphics International Foundation.

The proposed reopening of the Stibnite Gold-Antimony Mine in Idaho has renewed national attention to the environmental and public health challenges associated with mining, particularly in the context of rising demand for minerals critical to national defense and climate-friendly energy technologies. The U.S. Mining Law of 1872, which governs all hardrock mining on federal lands, has not been meaningfully updated since its inception and lacks essential provisions for environmental protection, tribal consultation, and human health. To compensate for these gaps, a permitting system was developed in the late twentieth century. Environmental and human health standards, the foundation of each permit, were informed by Human Health Risk Assessments (HHRAs) of contaminated sites. While the permitting system addressed gaps in the Mining Law, this system has often been criticized for being resource and time-intensive. This presentation contends that modern reform of the legal framework governing hardrock mining requires integrating human health-based, environmental protections into the Mining Law itself, instead of relying on the permitting system, to mitigate public health risks and secure access to critical minerals. The recent reinterpretation of Idaho's air quality regulations for the Stibnite project demonstrates the need to amend the Mining Law itself. Like many environmental standards, Idaho's air quality permit standards were developed using HHRA to ensure all mines would meet minimum standards, rather than requiring mining projects to perform resource-intensive HHRAs for every mine. However, the proposed reinterpretation of these regulations for the Stibnite project initially failed to consider their human health-focused premise, threatening public health. This oversight, exacerbated by the Mining Law's lack of inherent environmental or tribal protections, could create risks not only for local communities and Idaho Tribes, but also sets a dangerous legal precedent for other mining operations in Idaho and beyond. The widening gap between outdated mining law and current regulatory frameworks, as seen in the Stibnite case, highlights the urgent need for legal reform to protect both human health and the environment, ensuring a sustainable and just future, and a truly "clean" energy transition.

**Long-term trends in metals and nutrients guide remediation and demonstrate success at a northern Idaho Superfund site**

Lauren Zinsser, U.S. Geological Survey.

More than a century of mining in northern Idaho's Silver Valley caused widespread metals contamination in water and sediment throughout the Coeur d'Alene River watershed. In 1983, the area was designated as a Superfund site, initiating extensive remediation efforts. The U.S. Geological Survey, in cooperation with the U.S. Environmental Protection Agency, has collected surface water quality samples in the watershed for over 35 years, generating an invaluable long-term data record to guide remedial actions and evaluate remedy effectiveness and environmental change. Constituents of concern in the watershed include mining-related total lead and dissolved zinc and total phosphorus. Both of the metals are toxic to wildlife, and total phosphorus affects the trophic status of downstream Coeur d'Alene Lake. We used Weighted Regressions on Time, Discharge, and Season (WRTDS) and bootstrapping methods to determine trends and associated statistical significance for total lead, dissolved zinc, and total phosphorus concentrations and loads in surface water. Results show large and statistically significant long-term declines in dissolved zinc throughout the watershed, and large and statistically significant long-term declines in total lead in the upper watershed, where remedial actions have been focused to date, although the lower watershed remains a major source of total lead. Trend analysis of total phosphorus data generates insights into dynamic watershed processes affecting this environmentally important constituent. This unique dataset, combined with the strong partnership between the U.S. Geological Survey and the U.S. Environmental Protection Agency, highlights the importance of maintaining long-term monitoring networks and applying robust statistical analyses to generate practical insights that support ongoing remediation work and environmental protection.

**Increasing Tribal participation in the determination of mining on Indigenous lands: The Shoshone-Paiute Tribe Seven Generations Project**

Racheal Thacker‡[1], Casey Bartrem‡[2], Marissa Snapp[1], Chris Cleveland[3], Whitney Schroeder[4], and Marina Steiner[4,5]. [1]Shoshone-Paiute Tribe (SPT) Tribal Environmental Protection Program (TEPP), [2]TerraGraphics International Foundation (TIFO) , [3] SPT Fish and Game Department, [4]TIFO, [5]University of Idaho.

The pursuit of a low-carbon future is not necessarily the same as the pursuit of a sustainable or just future. Like many Tribal communities, the Shoshone-Paiute (Sho-Pai) Tribe of the Duck Valley Indian Reservation (DVIR) is experiencing intense mining pressure related to minerals needed for low-carbon energy, an issue referred to as “green colonialism” by SPT. Historically, Tribal communities have experienced disproportionate impact by mining activities, including exposure to environmental contaminants, decreased fishing, hunting, and foraging, and loss of spiritual and cultural sites. Within 10 miles of US Tribal lands, there are 149 active or proposed Superfund sites, and >600,000 Native Americans live within 6 miles of an abandoned mine. DVIR is 4 miles downstream of a Superfund site that discharged mine waste into the river that runs through the reservation. US federal law requires Tribes to be consulted on any project on public lands that could impact their traditional territory. But the reality is that Tribes have limited resources to review the hundreds of mining proposals they receive each year, which requires the review of thousands of pages of detailed environmental impact statements (EIS), identification of potential impacts, and coordination with stakeholders and community members. Small communities like SPT are overwhelmed, unable to respond, and mines ultimately proceed without Tribal input. This presentation will review an ongoing collaboration between SPT, TerraGraphics International Foundation (TIFO), and other stakeholders that aims to tackle the “mining emergency” by developing a triage system to rapidly respond to the growing number of mining proposals. This includes training on EIS, GIS, federal law, and health risk assessment. Simultaneously, SPT is developing a database of traditional ecological knowledge, fish and game habitats, traditional and medicinal plant locations, and cultural sites to support a stronger understanding of the potential impacts of regional mining activities. The Tribal government is increasing community engagement by building awareness of federal laws and engagement in public comment periods. The project's foundation is Tribal knowledge of unique risk factors faced by the SPT community and unparalleled knowledge of ecological and cultural systems requiring special protection. The result of this project will be a system that supports a sustainable world at least Seven Generations into the future.

**Panel Session I: Beyond the Surface: Voices from the Shoshone-Paiute Tribe on Environmental and Social Realities**

Panel Members:

Tribal Chairman Brian Mason, Tribal Business Council, Shoshone-Paiute Tribe

Racheal Thacker, Tribal Environmental Protection Program (TEPP), Shoshone-Paiute Tribe

Chris Cleveland Fish and Game Department, Shoshone-Paiute Tribe

Marissa Snapp, Tribal Environmental Protection Program (TEPP)

Hattie Conklin, Owyhee Community Health Facility

Bands of the Shoshone and Paiute Tribes, once freely occupying the vast territories spanning Idaho, Nevada, and Oregon, have faced centuries of environmental and cultural injustices since the onset of colonization. Despite these injustices, the Shoshone-Paiute Tribe (SPT) of the Duck Valley Indian Reservation (DVIR) has maintained a longstanding connection to this land, protecting and caring for its resources from time immemorial. Like many Tribal communities across the United States, SPT is contending with mounting pressure from extractive industries driven by the growing demand for minerals essential to low-carbon energy technologies. Simultaneously, SPT is grappling with the legacy of past industrial activities on their land, including a mining Superfund site, hydrocarbon plumes from leaking underground storage tanks, and application and improper disposal of Agent Orange. The lingering effects of past activities and contamination endanger public health, critical habitat, cultural resources, and sacred sites. High rates of cancer and other illnesses among the tribal members are suspected to be linked to the contamination, leading to ongoing legal battles with the federal government regarding responsibility and cleanup efforts. This panel will bring together members from the Tribal Environmental Protection Program (TEPP), Fish and Game Department, and Cultural Department to discuss these pressing environmental toxicology issues. Current programs focused on managing pesticide use, developing the solid waste program, safeguarding water quality, and conducting air monitoring will also be discussed. Panelists will share insights into the challenges they face in safeguarding their communities and natural resources, the barriers they encounter in mitigating environmental harm, and the cultural and lifestyle impacts of these environmental threats. The conversation will center on the intersection of environmental health, resource management, and preserving traditional ways of life amidst the ongoing pressures of modern industry. Through hearing directly from Tribal leaders, attendees will gain a deeper understanding of the complex environmental toxicology issues facing Tribal communities, how they are compounded by social, economic, racial, and environmental injustices, and how SPT continues to fight to protect both their environment and cultural heritage for future generations.

# Session 2: Mountains to Sea – Cross Systems Thinking: Human Health & Contaminant Exposure

**Salinity and Organochlorine Pesticide Contamination in Drinking Water in the Aral Sea Region of Karakalpakstan, Uzbekistan: Lessons Learned in Western Water Issues**

Marina Steiner‡[1, 2], Casey Bartrem, PhD[2], Ian von Lindern, PE, PhD[2], Brock Keller[2], and Gregory Moller, PhD, FNAI[1]. [1]University of Idaho, [2]TerraGraphics International Foundation.

The rapid shrinking of the Aral Sea, largely due to unsustainable agricultural practices in an arid region, is widely considered one of the greatest ecological disasters in modern history. The crisis has inflicted damage on human and environmental health in the region, as regional water, soil, and dust are heavily contaminated with pesticides such as dichlorodiphenyltrichloroethane (DDT) and lindane, salts, and other contaminants. The Republic of Karakalpakstan was once home to the thriving Aral Sea economy, but is now laden with high rates of cancer, neurological disorders, and diarrheal and pneumonic diseases. In 2022, TerraGraphics International Foundation partnered with Médecins Sans Frontières, the Ministry of Health of Karakalpakstan (MOHK), and local researchers to conduct an environmental health risk assessment; findings indicated significant health risks due to contaminated drinking water, and a need to aggregate and analyze historic, hardcopy MOHK monitoring results kept in regional offices. These files contain years of routine salinity and organochlorine pesticide monitoring. In June 2024, project partners digitized monitoring data, which are now aggregated into a database for analysis. This database will enable partners to determine temporal trends in water quality over time, potentially identifying whether exposure levels correlate with the agricultural seasons, climate patterns, increasing water scarcity, and district location. Results from the June 2024 digitization and aggregation efforts will be presented, along with preliminary statistical analyses, including spatial and temporal trends identified. When utilized with ongoing environmental assessment and analysis, the outcomes of this project will identify trends and rates of change of water quality and highly exposed subpopulations. This will establish a more robust picture of environmental health risk and ultimately be used to develop a targeted health intervention strategy in the Republic of Karakalpakstan. This analysis and intervention strategy may be applied to similar communities in the Aral Sea basin and other inland seas, such as the Great Salt Lake in Utah, that are affected by agricultural chemicals, climate change induced drought, and water diversion. Lessons learned from the Aral Sea crisis and subsequent health interventions can thus serve as both a warning and model for the western US and beyond.

**Reel Partnership: King County Collaborates with Refugee and Immigrant Fishers to Advance Community Health**

Jennifer Lanksbury, Jenée Colton, Richard Jack, and Chelsea Mitchell. King County, Department of Natural Resources and Parks.

People from immigrant and refugee communities in King County, particularly those who are low-income and have limited English proficiency, can be disproportionately impacted by contaminants when they fish from polluted locations. Though they may have some knowledge about toxics in fish, fishers often want more guidance on safer choices. In 2021, King County's Toxicology and Contaminant Assessment (TCA) unit partnered with the Refugee Federation Service Center (RFSC) to explore contaminants in fish targeted by south King County immigrant and refugee communities. Our unit manages a long-term monitoring program that measures toxics in fish in marine and freshwaters of King County. We were interested in exploring equity by testing the typical assumptions made about the locations and species fished, and parts eaten, by local fishers. The project began with a survey to explore the fishing habits of southeast Asian and LatinX communities in King County. Among other new information, it revealed important fishing areas and species not currently tracked by our monitoring program. We used this information to design a fish sampling pilot project to 1) inform safer choices by the immigrant and refugee fishers and 2) help fill some data gaps in our monitoring program. Community fishers from the RFSC collected the fish in 2023 and samples were analyzed for a range of organic contaminants (e.g., PCBs, PBDEs, and PFAS) and mercury. Results of the project were presented back to the RFSC communities in late 2024. We worked with the Washington Department of Health, Public Health-Seattle King County and the RFSC to develop fish consumption recommendations based on the data collected. The resulting flyer, titled Healthy Fish-Eating Recommendations from King County educates fishers about contaminants in fish and guides them towards fishing choices that will reduce their overall exposure to contaminants in King County. This project was TCA's first effort to directly engage the communities of fishers we want to serve with our monitoring program. Completing this project provided us new information about how different ethnic groups in the County utilize our aquatic resources. Based on the information gained, we plan to revise the locations and fish represented in our monitoring program to make it more equitable and to provide contaminant information useful to more fishing communities in King County.

**Metals, POPs, PFAS and Nutrients in Commercially Important Marine Fish Species from Alaska and their impact on fish consumption**

Christoff Furin‡[1], John Burrows[2], Sarah Coburn[1], and Robert Gerlach[1]. [1]Fish Monitoring Program, Office of the State Veterinarian, Alaska Department of Environmental Conservation, [2] Alaska Seafood Marketing Institute.

Alaska's marine ecosystems are utilized by many species of fish and shellfish with commercial and subsistence importance. Alaska commercial fisheries provide a significant portion of seafood to the U.S. and international markets. There is concern about the contaminant load in ocean fish and the safety of consuming those fish. Mercury, PCBs and other legacy contaminants are commonly addressed, but emerging contaminants, such as PFAS, are also contributing to decisions about fish consumption. Fish accumulate both nutrients and contaminants from their diet, which can be transported long distances by migratory species that utilize seasonal feeding grounds. Alaska's marine ecosystems have a wide impact due to the long-distance migrations of some fish, birds, and mammals and because Alaska's seafood is consumed worldwide which can influence human health. This project, funded by NOAA, the Alaska Department of Environmental Health, and the Alaska Seafood Marketing Institute, evaluates several species of marine fishes for contaminant load (metals, PFAS, PCBs, OC pesticides, and PBDEs) and nutrient content (calories, proximate, vitamins, minerals, fatty acids, and amino acids). This information is useful to make informed decisions about fish consumption recommendations and to evaluate the status of marine ecosystem health and some of Alaska's popular seafood species.

**Risk Assessment of Microplastics and Comparison of Species Sensitivity Distribution Methods**

Sara J. Hutton‡, Erica N. Bishop, Kenia Whitehead, and Philip E. Goodrum. GSI Environmental Inc.

Most papers published on ecological risks of microplastics (MP) are based on laboratory studies with limited exposure profiles or field studies that focus on the occurrence of MPs in aquatic organisms. The current literature and knowledge regarding MP toxicity is sparse and often challenging to interpret, which can introduce uncertainty when conducting risk assessments (RAs). Most MP RAs currently published and some regulatory agencies use a species sensitivity distributions (SSDs) approach. SSDs are a commonly used method that compare toxicity across species by taking a single point (e.g., NOEC or EC50) from a dose response analysis, however this approach can also underscore the variability and uncertainty in the data. A refinement to the SSD approach is to use the concentration-response data from each study and integrate the curves into a composite curve. This approach was developed by USEPA's Office of Pesticide Programs to support ecological RAs of pesticides and subsequently applied to site assessments of legacy contaminants. This method produces a composite concentration-response curve and confidence interval that reflects the variability and uncertainty of the data. Here we compare the threshold values for MPs using both the traditional and refined SSD methods. We found that: 1. The use of ToMEx 2.0 data resulted in lower threshold values compared to the earlier version. 2.Incorporating concentration-response data led to wider confidence intervals compared to the traditional SSD approach, reflecting the high variability in MP toxicity studies. 3. Principal component analysis highlighted patterns related to particle shape, polymer type, and species sensitivity. The study found that the previously established threshold of 5 particles/L for Californias 2024 Integrated Report would decrease to 2 particles/L based on the updated ToMEx 2.0 data. However, our analysis emphasizes the complexities and uncertainties in MP toxicity data, highlighting the need for more refined approaches in risk assessment. This work also highlights the extent to which the methods used in RA reflect uncertainty which needs to be considered when conducing RAs.

## Educational Programming in Support of Domestic Mining

Peter Mullner‡ and Stephen Crowley‡. Boise State University.

There are powerful motivations for and barriers to successful responsible domestic mining. What are the roles education (particularly college education) can play in addressing these motivations and barriers? We have a model (interdisciplinary reciprocating education) of how such education might work that we would like to test. To do so requires partners. In this presentation we will i) share our model and its motivations ii) describe existing plans for implementing and testing our model (including our partnership with the Idaho Mining Advocacy Project, IMAP) and iii) open dialog about how to improve both the model and its testing.

# Monday Poster Presentation Abstracts

‡ Indicates presenter

### Poster #2: Filter Socks: A Simple, In-Line Addition to Optimize Fiber Capture in Microplastic Sampling

Lori-jon C Waugh‡[1], Stephanie Wang[2], and Maria T. Maldonado[1]. [1]Department of Earth, Ocean and Atmospheric Sciences, University of British Columbia, Vancouver, British Columbia V6T 1Z4, Canada, [2]Ocean Wise Conservation Association, Vancouver, British Columbia V6B 2N5, Canada.

Emerging research indicates that microplastic fiber fragments are some of the most commonly occurring microplastic contaminants in the coastal marine environment. However, poor capture efficiency in current microplastic sampling protocols prevents a true understanding of microplastic fiber fragment prevalence and dispersal within the coastal marine environment. Herein, we propose the addition of a stainless steel, in-line filter to improve the microplastic fiber fragment capture efficiency of an established large volume microplastic sampling assay from 6% ± 1% to 97% ± 5%. This filter can be added downstream to any aqueous sampling system, as a final catch of fine fiber fragments that are otherwise passing larger pore filters. We measured the sample volume capacity of our microplastic sampling assay, with the additional filter, across five aqueous environments surrounding Metro Vancouver, BC: near-surface Fraser River (126 ± 6 L), near-surface Burrard Inlet (63 ± 10 L) , Metro Vancouver secondary treatment wastewater effluent (20 ± 2 L), near-surface Southern Strait of Georgia (42 L), and intermediate waters of the Southern Strait of Georgia (> 667 L). This modification to established sampling protocols will better enable quantification and comparison of the most abundant microplastic type between regions of the marine environment.

### Poster #6: Exploring Iron, Manganese, and Zinc Behavior in a campus constructed wetland

Grace Landaverde‡, Katie Allen, and Dr. Manuel Montaño. Western Washington University.

Western Washington University has utilized a constructed wetland on the south campus for several years as a stormwater mitigation practice. This area is sampled regularly as part of the campuses Water Quality course, taught every quarter throughout the year for the past decade. However, only recently have metals been sampled. In Fall of 2023 metal concentrations decreased from the inlet to the outlet (manganese concentrations fell from 264.0 ppb to 76.1 ppb; zinc concentrations fell from 13.5 ppb to 5.47 ppb). In Spring of 2023, manganese concentrations on average increased from the inlet to the outlet (7.57 ppb to 461.0 ppb). The Spring 2023 data seems incongruent with current literature which suggests that metal concentrations decrease after passing through a constructed wetland as they are subject to uptake from sediment and vegetation. As a result of this knowledge gap, this Winter and Spring Quarter of 2025, we are investigating the redox conditions of Western Washington University's South campus constructed wetland by determining the speciation of three metals: zinc, manganese, and iron. The inlet, outlet, and associated groundwater of the wetland will be sampled alongside Padden Creek, Connelly Creek, Taylor Creek and grab samples from campus stormwater runoff. Aqueous samples will be collected and water quality parameters assessed (pH, TDS, ORP, DO). Total and dissolved metal concentrations will be analyzed using inductively coupled plasma-mass spectrometry (ICP-MS) and particulates characterized scanning electron microscopy. By sampling these locations, we will gain a better understanding of how metal speciation shifts throughout the wetland, and how wetland processes each play a different role in metal fate, transport, and toxicity.

**Poster #8: Acute Toxicity of Cobalt to a Freshwater Fish (Pimephales Promelas) and the Water Flea (Ceriodaphnia dubia)**

Still, C.‡,[1] Word, J. D.[1], Boyle, D.[2], and Stubblefield, W.[3]. [1]EcoAnalysts Inc., [2]Cobalt Institute, [3]Oregon State University.

Efforts have been ongoing to both improve and expand our understanding of the effect of water quality characteristics on the bioavailability and toxicity of cobalt (Co) to freshwater aquatic organisms. Acute toxicity tests with the freshwater fish, Pimephales promelas, and the water flea, Ceriodaphnia dubia, have shown that water quality conditions, such as pH, hardness, and dissolved organic carbon (DOC), play an integral role in controlling the bioavailability and toxicity of Co to aquatic organisms. Twenty-two 96-h acute P. promelas and seventeen 48-h acute C. dubia toxicity tests were performed using synthetic test waters prepared to cover the range of pH, hardness, and DOC concentrations typically observed in US surface waters. The pH of each sample was measured throughout testing using a daily calibrated probe (pH buffers were used to reduce pH drift during the experiments). Hardness was measured by titration as well as by calculation based on measured values of calcium and magnesium. All cobalt and DOC concentrations were measured in the test solutions. Of the three water quality parameters, hardness best correlated with organism survival for both P. promelas and C. dubia. P. promelas had a stronger correlation between LC50 and hardness, with an R2 value of 0.7735, while C. dubia had a weaker correlation with an R2 of 0.2742, potentially indicating hardness is not the only driving factor for cobalt toxicity in C. dubia. These studies will be used to develop and refine bioavailability-based models, both a biotic ligand model (BLM) and a multiple linear regression (MLR) model, to predict Co toxicity across a range of water types.

**Poster #10: Toxicity Identification Evaluation (TIE) for an Idaho Metals Mine: Possible Sources of Concern Point to Explosives**

Danielle Mulligan‡ and Mary Ann Rempel-Hester, Ph. D. EcoAnalysts.

Both compliance and accelerated chronic bioassay testing were conducted with effluent from an Idaho metals mine on Ceriodaphnia dubia. These tests showed significant mortality, exceeding the company's National Pollution Discharge Elimination System (NPDES) permit limit for toxicity. A Toxicity Identification Evaluation (TIE) was conducted. In this type of test, a series of manipulations of the effluent are performed to remove different classes of chemicals to determine which removals decrease toxicity. The TIE began with a review of the client's effluent chemistry data and known additives. A mass balance computation was also conducted to determine if the ratio of ions in the water was significantly altered from what is normally found in freshwater, which can cause toxicity. After this screening, nitrites and metals were identified as potential sources of toxicity. A phase (I) TIE approach was used, including a baseline test along with filtration, EDTA (Ethylenediaminetetraacetic Acid, two concentrations) and nitrate/nitrite ion exchange resin manipulations. The EPA TIE guidelines do not address the removal of nitrites specifically, therefore, the nitrite/nitrate removal resin test performed was a modification to the C18 solid phase extraction (SPE) treatments in the U.S. EPA guidelines. A significant biological response of the test organisms was detected in the baseline (unmanipulated sample) treatment. Of the four TIE tests performed, only the nitrite/nitrate removal resin decreased toxicity. It removed all toxicity, as measured by survival. This indicates that nitrites, not metals or other toxicants, were likely the main driver of toxicity. Following the TIE, the client made changes to their effluent treatment process and provided an additional sample for retesting which showed their changes were effective in removing both nitrites and toxicity. This study demonstrates that nitrites, common byproducts from explosives used in mining, should be considered as a potential source of toxicity in mining effluents that exceed permit limits for toxicity.

**Poster #12: Evaluation of the Response of Juvenile Coho Salmon to a Pulsed Exposure of an Alkaline Brine Solution**

Jay Word‡,[1], Michelle Knowlen[1], Matthew Galaska[2], and Nathan Soccorsy[2]. [1]EcoAnalysts, [2]Anchor QEA.

With strong scientific support, increasing atmospheric carbon dioxide (CO2) has been linked as a major contributor to global climate change. This and the establishment of carbon markets (Washington State 2021 Climate Commitment Act) have driven interest in development of effective atmospheric CO2 removal technologies. These emerging technologies need to be evaluated not only for efficacy of removing CO2 but also for potential ecological affects. This project addresses a marine CO2 removal technology that is progressing from bench scale to a temporary pilot study. To assess a specific potential for ecological effects, a mock system has been created to address ecological safety of the technology. Generally, this technology was designed to intake ambient seawater to a land-based facility. The facility produces alkaline-enhanced seawater that is discharged into the marine environment. In normal operational conditions the discharge is projected to have an elevated pH (9.8 ± 0.2). The project has identified a location, in Washington State, to implement pilot study. The harbor where the project would operate this pilot system is a known rearing ground for several important salmon species of the region. Prior to full-scale operation, the research team designed a laboratory study that would evaluate the response of juvenile coho salmon (Oncorhynchus kisutch) to a pulsed exposure of the mock discharge. This solution was introduced into test chambers holding smolted juvenile Coho salmon at a total concentration of 2.5% (replicating a modeled effluent concentration within the mixing zone at the field site) for a maximum exposure time of five minutes. After exposure, seawater flowed into the test chambers to slowly reduce and flush the alkaline solution over a 3-hr period. Video of each test replicate was collected and reviewed for signs of behavioral stress. At termination of each replicate, fish were measured, weighed, and assessed individually for physical abnormalities. Results indicate that there were no survival or behavioral effects to juvenile coho salmon when exposed to the alkaline solution. All fish appeared normal without erratic movement and attempted to evade capture upon test termination, indicating exposure to the alkaline sample did not appear to hinder their natural ability to evade predators. Further testing applying the methodology presented in this poster will allow for laboratory testing at differing discharge total concentrations or with similar species.

**Poster #14: Roadway Runoff Induced Mortality in Juvenile Coho Salmon During Spring Storm Events**

Marlee Brown‡. University of Washington.

Adult coho salmon (Oncorhynchus kisutch) spawners in the Puget Sound are sometimes subject to water quality linked acute mortality, often known as “Urban Runoff Mortality Syndrome (URMS). URMS, widely documented in adult coho during fall rainstorms, is primarily caused by an ozonation transformation product found in tires, 6PPD-quinone. However, despite the very high sensitivity of coho salmon to 6PPD-quinone, very little information exists for the earlier life stages such as juvenile coho during spring storm events. Juveniles exposed to 6PPD-quinone in laboratory studies are shown to die at concentrations (<100 ng/L) that are similar to those quantified in urban streams during the spring. To assess whether URMS applied to post-hatch juvenile coho salmon in springtime rearing habitat, we conducted an exposure study at a small hatchery facility located at Miller Creek in Burien, WA. Miller creek is a small urban watershed highly impacted by roadway runoff; we exposed juvenile coho to storm impacted Miller creek waters and compared water quality and mortality endpoints to groundwater-reared coho salmon as a control. During three spring storms in Miller Creek, 6PPD-quinone concentrations exceeded LC50 values (73 - 110 ng/L) and around 80% of Miller-Creek exposed juvenile salmon died when over a 24-36 hour period across multiple spring storm events.

**Poster #16: CCPD: A Potential Safer Alternative to 6PPD for the Environment**

R. Campbell‡,[1], A. Batoon,[1], D. S. Carson[2], P. Remuzat[3], M. Essers[4], and M. Wiedemeier-Jarad[4].[1]LANXESS Corporation, [2]Blue Frog Scientific, Edinburgh, United Kingdom, [3]Blue Frog Scientific, Lyon, France, [4]LANXESS Deutschland GmbH.

6PPD is an antioxidant and antiozonant that prevents rubber from degrading and reacting with oxygen (O2) and ozone (O3). It is widely used in the motor vehicle tire and general rubber goods sector. As a result of its function, when exposed to air, 6PPD reacts with ozone to form 6PPD-quinone (6PPD-Q). 6PPD-Q is highly toxic to aquatic organisms, and tire wear leading to environmental exposure from runoff has been directly linked to acute mortality in coho salmon (Tian et al., 2021), shown to be the most sensitive species. Here we present a series of environmental studies conducted on N1,N4-dicyclohexylbenzene-1,4-diamine (CCPD, CAS No. 4175-38-6) and 2-(cyclohexylamino)-5-(phenylamino)-2,5-cyclohexadiene-1,4-dione (CCPD-Q, CAS No. 1653-85-6). CCPD is an innovative substance designed as a replacement for 6PPD using safe-by-design concepts. The acute toxicity of CCPD and CCPD-Q to coho salmon was assessed in accordance with OECD TG 203 under GLP, using a flow-through design. The 96h LC50 of CCPD was determined to be 32 µg/L (measured) but CCPD-Q was determined not to be acutely toxic at the solubility limit of the test item in the test system of 149 µg/L (measured). The CCPD-Q results contrast with 6PPD-Q which has a 24h LC50 to coho salmon of 0.095 µg/L (Tian et al., 2021). The ready biodegradability of CCPD was determined in accordance with OECD TG 301D under GLP. CCPD achieved 61 % degradation after 28-days although the “10-day window” OECD ready biodegradability criterion was not met. However, the results demonstrate that CCPD is not persistent in the environment in accordance with EU and US PBT criteria. Compared to other commercial members of the p-phenylenediamine group of compounds currently used as antioxidants/antiozonants, CCPD is the only substance known to exhibit such a high level of biodegradation. Similarly, in a GLP study conducted in accordance with OECD TG 111, CCPD was determined to be hydrolytically unstable, with a significant pH dependence. The n-octanol/water partition coefficient was determined to be 4.8 at environmentally relevant pH and in a predominantly unionized form. Although (Q)SAR estimates indicate that the substance will not be bioaccumulative (BCF = 771, BAF = 773 (BCFBAF)). Overall, the results indicate that CCPD may be a more environmentally friendly alternative to 6PPD. Future work will elucidate the aquatic toxicity of CCPD to other relevant environmental species, and the performance of CCPD compared to other environmental and human health 6PPD Alternatives Assessment Hazard Criteria.

**Poster #18: Sensitivity of Pacific lamprey to 6PPD-Q**

John Hansen‡,[1], Lisa Weiland[2], Alexa Maine[3], Ellie Dalsky[1], and Teresa Liedtke[2]. [1]Western Fisheries Research Center, U.S. Geological Survey, [2]Western Fisheries Research Center—Columbia River Research Laboratory, U.S. Geological Survey, [3]Confederated Tribes of the Umatilla Indian Reservation.

Pacific lampreys (Entosphenus tridentatus) are native to the Columbia River drainage basin where they are one of the most widely distributed anadromous species. Lampreys play a significant role in the ecosystem and are a first food for Tribal nations where they hold significant cultural, spiritual, and medicinal values for tribal health, but over the last several decades, lamprey populations have been in decline. Stormwater runoff is a potential contributing factor for the observed population decline. In 2021, 6PPD-quinone (6PPD-Q) was implicated as the causative factor for Urban Runoff Mortality Syndrome for coho salmon. Importantly, studies addressing the toxicity of 6PPD-Q in fish species has demonstrated differential toxicity based upon the life stage. In this study we addressed the potential toxicity of 6PPD-Q on Pacific lamprey health using static exposures on two critical life stages. Larval lamprey, 30 days post hatch ("pre-feeding) and 2-5 years old larvae, were exposed to three concentrations (LCMS verified: 464, 2456, and 6387 ng/L) of 6PPD-Q for 24 hours to address acute toxicity. In addition to survival statistics, we also assessed potential histological alterations post exposure. This study provides the foundation for future research assessing potential health effects on lamprey populations due to contaminants found in stormwater.

**Poster #20: Review and Meta Analysis of Best Management Practices for 6PPD-Quinone Stormwater**

Sara J. Hutton‡, Casey R. Remmer, Emily Smith, and Kenia Whitehead. GSI Environmental.

The compound, 6PPD (N(1,3-dimethylbutyl)-N- phenyl-p-phenylenediamine), is added to tires as an antiozonant, antioxidant, and antidegradant; it is a critical component in tires that extends their lifespan and increases road safety (Figure 1). 6PPD transforms into 6PPD-quinone (6PPD-Q) in the presence of ozone and UV irradiation. In 2020, the structure of 6PPD-Q was first described (Tian et al. 2021) and "recent laboratory studies stated that 6PPD-Q was acutely toxic to coho salmon" (Gradient 2024). While an expansive effort is underway to find an alternative for 6PPD in tires, near-term action has also focused on stormwater mitigation through various approaches such as the installation of bioswales. Stormwater best management practices (BMPs), designed to reduce pollutants in stormwater before they reach receiving waters, are a potentially effective mitigation strategy to reduce environmental exposure to 6PPD-Q. Here we present a comprehensive review and meta-analysis of BMPs that treat 6PPD-Q in stormwater. Current federal and state emerging regulations are also discussed. Preliminary meta-analysis results show significant reduction of 6PPD-Q by biofiltration (87% reduction), permeable pavements (81% reduction) and wastewater treatment plants (10% reduction). Differences in removal efficacy appear between laboratory and field studies (86% and 41%, respectively), and between the source of water entering the BMP (sewage; 10%, spiked water; 99%, stimulated stormwater; 78%, and stormwater; 85%). Factors influencing variability within treatment types will be further analyzed, and the removal efficiency of co-contaminants will be explored. This review provides information for stormwater managers, engineers, aquatic conservationists, and researchers to potentially reduce concentration of 6PPD-Q contamination in stormwater runoff.

# Tuesday Platform Presentation and Panel Abstracts

‡ Indicates presenter

## Session 3: Mountains to Sea: Risk Assessment

**Integrating a One Health Approach through Addition of Biological and Ecological Endpoints into Comprehensive E-Flows Assessments for the Limpopo River Basin, southern Africa**

April D. Reed‡,[1], Gordon O'Brien[1], and Melissa Wade[2]. [1]Gulbali Institute, Charles Sturt University, Albury, New South Wales, Australia, [2]University of Mpumalanga, Mbombela, South Africa.

This presentation introduces a PhD project designed to enhance water and land management decisions in the Limpopo River Basin (LRB) of southern Africa by implementing a One Health approach and integrating biological and ecological endpoints into environmental flow (E-flow) assessments to reflect the socio-ecological systems of the LRB. A flexible and transparent method known as PROBFLO will be employed to assess E-flows and the potential risks of altered flows to LRB ecosystems and the services they provide. Building on regional-scale risk assessments conducted from 2021-2022, the project will extend the current suite of 28 Bayesian network models by adding 16-36 new models. The expanded set of risk models will include new causal pathways and integrate data on key indicator species, along with information from the LRB's floodplain and estuary sites for the first time, lending insights into the health of the river's ecosystems, which, when compared and contrasted with ecosystem services and community health endpoints, will inform cost-benefit analyses of water resource development options in the river catchments. The project aims to improve the predictive capabilities of the PROBFLO framework by enabling basin-wide and state-specific assessments alongside local site evaluations, which will help decision-makers assess the effects of upstream management decisions on both local and downstream endpoints. The risk assessment will support stakeholders from Botswana, Mozambique, Zimbabwe, and South Africa in developing collaborative and sustainable water management practices, ensuring that health and sustainability are prioritized in management decisions. This research addresses important issues such as water scarcity, water quality degradation, land degradation, and groundwater pressures, providing essential information and tools for making strategic, sustainable choices in the LRB. Additionally, the outcomes of this research have significant implications for regions beyond the LRB, including the Pacific Northwest (PNW). The PROBFLO framework can be adapted to address similar water management challenges in the PNW, where issues such as water quality, ecosystem health, and sustainable resource management are critical. By applying insights gained from the LRB, environmental professionals in the PNW can improve their water resource management strategies, promote multi-sector collaboration, and ensure the sustainability and health of their river ecosystems.

**Human Health Risk Evaluation Approach for Recreating on CDA Lake**

Jeremy Johnson‡, Susan Spalinger, Sarah Wepner, and Mara Thorhaug. Alta Science & Engineering, Inc.

Coeur d'Alene Lake is Idaho's second largest lake and a popular recreational destination, an economic catalyst for North Idaho and Eastern Washington, and the heart of the local communities. The lake is part of the CDA Tribe's indigenous Territory, and the southern third of the lake falls within their current Reservation boundary. Due to decades of historical mining activity in the "Silver Valley," millions of tons of metals-laden sediments were introduced into the CDA River and CDA Lake and remain present in the sediments on the lake bottom today. Given its location and popularity as a recreation and tourist destination, the Lake was the focus of a 2022 National Academies of Sciences, Engineering, and Medicine Study that recommended a lake-focused human health risk assessment be developed to evaluate exposures to people who frequent the lake. In response to the NAS recommendation, the Idaho Department of Environmental Quality and Alta Science and Engineering, Inc. (under contract to DEQ) have undertaken a project to assess current metals concentrations and potential resulting human health risks in CDA Lake and the Spokane River. A flexible and site-specific approach is being used to evaluate health risks from the unique exposure pathways present. This includes the derivation of site-specific risk-based screening levels and expanding upon the typical health screening evaluation by 1) considering site-specific bioavailability data and 2) evaluating newly collected contaminant data relative to local background soil/sediment data. The purpose of this presentation [poster] is to describe the site-specific approach used to derive risk-based screening levels and conduct the environmental sampling. This includes how site-specific information was used to define exposure factors and environmental media to sample; and, how EPA and ITRC risk assessment and lead guidance and policy are being used to refine sampling efforts, screening levels, and data interpretation. Examples of site-specific screening level derivation, sampling schemes/approaches, and guidance followed will be provided to supplement the presentation.

**Comparison of the Risk Assessment Process Using Discrete and Incremental Sampling Methodology for a Remote Site in Alaska**

Grant Walter‡ and Marianne Batchelder. Geosyntec Consultants.

Quantitative risk assessments have commonly used discrete sampling methods to evaluate the potential risk related to exposure to soil. Discrete soil samples are collected for the dual purpose of characterizing the nature and extent of contamination and the performance of a risk assessment. However, utilization of discrete samples for characterization of contaminant distribution may introduce sampling biases that result in either underestimating or overestimating risk related to soil exposure. Incremental sampling methodology (ISM) has emerged as an alternative to discrete sampling, which provides a more robust estimation of soil contaminant concentrations. There are few real-world risk assessments available that compare estimates based on collocated ISM and discrete samples. As part of an investigation for a remote site in the Aleutian Islands, collocated discrete and ISM samples were collected. These data provide a unique opportunity to investigate the impact of soil sample collection methods on the risk assessment process and were reviewed as part of a case study. This case study presents the results of a risk assessment performed under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) framework risk assessment and will present a comparison of the analyses using ISM and discrete soil samples.

**Risk Assessment in the Last Frontier**

Marianne Batchelder‡ and Grant Walter. Geosyntec Consultants, Inc.

Cleaning up contamination in Alaska can be a challenge - and we're not just talking about the bears and the mosquitoes! Risk Assessments can help to protect humans and wildlife while minimizing impacts of site cleanup. Assessing risk involves evaluating who and what might be affected by contamination and how they could be exposed. In many instances, evaluating risk as part of site characterization can help develop a cost-effective cleanup strategy that safeguards communities and ecosystems and avoids unnecessary damage to undeveloped and unimpacted lands. However, the traditional risk assessment framework used in the contiguous United States requires adaptation when applied to the remote arctic and subarctic regions of Alaska. This presentation will provide an overview of the risk assessment process and how we use it to clean up some of our most remote and beautiful landscapes.

# Session 4: Ocean and Estuarine Systems: Pollutant Impacts

### An in vitro approach for assessing orca skin health: focus on antiviral immunity

John D. Hansen‡,[1], Mark Jankowski[2], Justin Greer[1], Ellie Dalsky[1], and Dan Villeneuve[3]. [1]Western Fisheries Research Center (Seattle), U.S. Geological Survey, [2]Region 10, Laboratory Services and Applied Sciences Division, U.S. Environmental Protection Agency, [3]Office of Research and Development, U.S. Environmental Protection Agency.

The Southern resident killer (SRKW) whale population of the Salish Sea is critically endangered with recent studies predicting population collapse due in part to persistent organic pollutants. Of note, pollutants have been associated with the high prevalence of skin lesions in the SRKW population that is currently comprised of 72 individuals. Environmental stressors including starvation, navigational noise, microbial infection, and environmental contaminants have all been implicated as interacting factors for the decline of SKRW in part through diminished skin health. However, given uncertainties resulting from genetic and phenotypic variation across species, targeted biomedical tools for these imperiled mammals are desired. To address the potential for environmental contaminants to interfere with the skin barrier of SRKW, we developed primary dermal fibroblast (DF) cell lines from Biggs' killer whales (BKW). We assessed the potential toxic effects of two prominent environmental contaminants, 4-nonylphenol (4NP) and PFOS, on metabolism and antiviral immunity using a side-by-side exposure and immune response comparison between primary BKWDF and human dermal fibroblasts (HDF). We determined the EC20,50 values for 4NP and PFOS using metabolic and cytotoxicity assays for BKWDF and HDF cells. Cells were then exposed to EC20 concentrations of 4NP and PFOS and stimulated with the viral mimic Poly(I:C) to assess potential dysregulation of antiviral immunity. Like HDF, BKWDF mounted a significant induction of interferon-beta, interferon stimulated genes 15 (ISG15) and MX1 in response to Poly(I:C). Furthermore, single chemical exposure to either 4NP or PFOS resulted in immunomodulation of these key elements of antiviral immunity.

**How to Assess and Integrate Low PAH Bioavailability into a CERCLA Marine Risk Assessment; Bremerton Gas Works Superfund Site**

Ariel Blanc‡, Nathan Soccorsy, Jessica Goin, and Masa Kanematsu. Anchor QEA.

The Bremerton Gas Works Superfund site (Site) is a former manufactured gas plant (MGP) in Puget Sound, Washington. The MGP produced a gas supply via a carbureted water-gas process using black carbon briquettes. During MGP operations, briquettes were incidentally released to sediment and are still occasionally found in the intertidal area. Sediment PAH concentrations are elevated adjacent to the former gas works, raising concern for risk to ecological receptors and human shellfish consumers. The preliminary conceptual site model (CSM) identified briquettes as the major source of PAHs in sediment. Multiple studies were conducted to confirm the CSM and demonstrate limited bioavailability and risk from the briquette-sourced PAHs. These included sediment sampling, microscopic evaluation, bioassay testing, ex situ porewater testing, bioaccumulation tests, and in situ tissue collection. Sediment PAH concentrations exceeded benthic sediment criteria by up to 16 times, but no toxicity was observed in bioassays, indicating limited bioavailability. Consistent with the lack of toxicity, sediment porewater toxic units were less than 1. The microscale texture of briquette fragments in sediment was consistent with the published characteristics of lampblack, and the site-specific KOC values were 1 to 3 orders of magnitude greater than conventional KOC values, consistent with black carbon-affected sites. Porewater and sediment PAH concentrations were positively correlated with bioaccumulation test clam tissue concentrations, suggesting a causal relationship between Site sediment and tissue PAH. However, the measured porewater and tissue concentrations were notably lower than would be expected if the Site sediment were not influenced by black carbon and related Site-specific partitioning. This information, together with the lack of benthic toxicity at sediment PAH concentrations many times the benthic protection criteria, supports the CSM of limited PAH bioavailability in Site sediment due to PAH sequestration to the briquette material. Although no unacceptable risk, including wildlife consumption of prey from the Site, was identified for ecological receptors, human health cancer risks remained greater than the threshold due to relatively high area specific shellfish consumption rates. The CSM and site-specific bioaccumulation relationships will be used to inform human health-based preliminary remediation goals and alternatives development in the feasibility study.

# Session 5: Rivers and Freshwater Systems: Storm Water & Toxicity

### Canary in the Creekbed: Real-Time Flow-Through Experiments Demonstrate Urban Runoff's Role in Coho Salmon Declines

Nathan Ivy‡,[1], Jen McIntyre[1], Edward P. Kolodziej[2], Justin Greer[3], and John Hansen[3]. [1]Washington State University, [2]Civil and Environmental Engineering (UW Seattle), [3]USGS.

The rapid urbanization of the Pacific Northwest has dramatically increased impervious surfaces which are amplifying the impacts of stormwater runoff and increasing the threat of localized extinctions to salmonid populations. While sensitivity of sub-adult coho salmon to runoff has been studied in the laboratory, it has never been characterized for surface waters receiving runoff. We are currently conducting real-time flow-through experiments at Miller Creek to investigate how runoff exposure affects salmonids throughout freshwater life history stages. Miller Creek is a first order stream typical of those impacted by development in the PNW, with multiple inputs roadway runoff from local streets in addition to State Route 509 in Normandy Park, WA. Chronically exposing fish to real-time creek water replicates the dynamic and episodic nature of stormwater pulses and their impact on salmonids which is compared with a well-water control group. Key endpoints of our study include mortality rates, developmental anomalies, molecular biomarkers, and behavioral responses, which are assessed both prior to and during storm events. These biological endpoints are complemented by the quantification of toxicant concentrations through real-time water chemistry monitoring, which allows for the characterization of acute and sublethal exposure dynamics in urbanized watersheds. Data from spring storms in 2024 demonstrated the acute lethality to juvenile coho of surface waters receiving urban runoff, with >80% mortality across three representative spring storm events, compared to 0% mortality in controls. Embryos exposed since fertilization to creek water were 45% more likely to die than controls exposed to well water. Molecular and morphometric analyses are ongoing and intend to characterize the developmental and sublethal effects caused by chronic exposure. These efforts aim to inform strategies that address the pervasive ecological threats to salmonids posed by urbanization and its associated contaminants.

**6-PPD Quinone (6-PPDQ) in Sediment: Measurement, Occurrence and Partitioning**

Jamie Fox‡ and Bharat Chandramouli, Ph.D. SGS North America .

6PPD-quinone (6-PPDQ), an oxidation product of a common tire antiozonant 6-PPD, has been identified as one of the most toxic compounds to fish, particularly Coho salmon with an updated LC-50 (juvenile) of 41 ng/L. Other salmonids are affected to lesser degree and there's emerging data that suggests chronic effects at environmentally relevant levels. 6-PPD is released into the environment through shedding of rubber from tires, with runoff carrying 6-PPD and 6-PPDQ into surface water. Interaction with soil and sediments play a big part in determining the bioavailability, fate, transport, and remediation of 6-PPDQ. While methods such as EPA 1634 and similar for aqueous measurement are standardizing analysis in receiving waters, there has not been similar focus on understanding 6-PPDQ in soil and sediment. Emerging research indicates that 6-PPDQ has a high Koc and will tend to partition to the solid phase. Our study goals were to 1) Develop and validate standardized methods for measuring 6-PPDQ in solids 2) Assess concentrations of 6-PPDQ in soil adjacent to roads 3) Review and assess partitioning behavior of 6-PPDQ. Based on our existing method for 6-PPDQ in aqueous samples, we developed and validated a method to measure 6-PPDQ in solid samples including soil, sediments and wastewater treatment plant biosolids. Analogous to EPA 1634 for aqueous analysis, this method uses isotope dilution LC-MS/MS to measure 6-PPDQ at a reporting limit of 0.05 ng/g (ppb) to align with reporting limits of 0.1 ng/L in aqueous samples. The solid samples are extracted with acetonitrile and the aqueous extract is cleaned up by acetonitrile water partitioning using magnesium sulfate. All extracts are cleaned up with a silica SPE column and are analyzed by ultra-high performance liquid chromatography/mass spectrometry (UHPLC-MS/MS). Additional method validation including storage conditions and stability were studied. To understand concentrations of 6-PPDQ in solids, soil samples collected adjacent to a major highway, and minor roads were analyzed for 6-PPDQ. In addition, biosolid samples from municipal wastewater treatment were also analyzed for biosolids. A literature review was conducted to assess state of knowledge on the soil/sediment partitioning behavior of 6-PPDQ.

**Primary and immortalized cell models for evaluating the toxicity of 6PPD-quinone and other stormwater pollutants**

Justin Greer‡,[1], Ellie Dalsky[1], Rachael F. Lane[1], Mark Jankowski[2], and John D. Hansen[1]. [1]U.S. Geological Survey, [2]US EPA.

Stormwater pollutants, including 6PPD-quinone and other tire wear constituents, can have harmful effects on aquatic life, particularly in high traffic areas with increased stormwater pollutant loading. Coho salmon exposed to 6PPD-quinone can die in as little as 2-3 hours from runoff in highly polluted areas. Efforts to identify the mechanisms of toxicity for 6PPD-quinone are needed to better understand ecosystem-wide impacts and inform the molecular structure of potential alternatives for tires. The mode of action for 6PPD-quinone that results in acute toxicity in such short time frames is unclear but may imply targeted toxicity to individual organs or cell types. Results from histological assessments in our lab of coho salmon symptomatic with 6PPD-quinone toxicity have revealed little tissue damage in many organ systems. To further assess organ-level effects, we have developed primary cell culture models for gill cells and hepatocytes from coho salmon. Using metabolic and cytotoxic assays previously shown to recapitulate species sensitivity, the effects of 6PPD-quinone on individual organs is currently being examined. Further, cell lines models are also being deployed to investigate the toxicity of whole stormwater mixtures. In collaboration with the EPA, stormwater samples were collected during high runoff events in Seattle and concentrations of 6PPD-quinone and polycyclic aromatic hydrocarbons were quantified. Extracts were concentrated via solid phase extraction, and effects were examined in primary gill cells. Toxicity of stormwater extracts were further assessed using an immortalized cell line from coho salmon known to recreate 6PPD-quinone toxicity. By comparing toxicity and the stormwater 6PPD-quinone concentrations, the contribution of 6PPD-quinone to the total toxicity observed will be discussed.

**Lethal and Sublethal Effects of 6PPD-quinone on Coastal Cutthroat Trout**

Prarthana Shankar‡. USGS WFRC.

6PPD-quinone (6PPDQ) was recently implicated in inducing mass pre-spawn mortality events in adult coho salmon in the Pacific Northwest (PNW) United States and since then, studies have reported variable toxicity among salmonids. Coastal cutthroat trout (Oncorhynchus clarkii clarkii) is a widespread salmonid species in PNW watersheds impacted by stormwater pollution. However, 6PPDQ toxicity has yet to be studied in this species. Here, we investigate the acute toxicity of coastal cutthroat trout from 24-hour 6PPDQ exposures in early-stage alevin and juveniles, and both 24-hour and 96-hour exposures in 1+ year animals. Toxicity is measured as concentrations necessary to induce 50% mortality (LC50) in 24 hours or 96 hours, and we analytically verified exposure concentrations via ultra performance liquid chromatography-mass spectrometry both at the start and end of each exposure. In addition to acute toxicity, we also investigated sub-lethal effects on immune system function and swimming fitness. For immune system effects, we conducted a 24-hour LC20 exposure in juvenile coastal cutthroat trout, followed with an immersion challenge to a viral opportunistic pathogen, and monitored fish for five weeks. Swimming fitness was measured as the average critical swimming speed (Ucrit) in 1+ year fish exposed to an LC2 concentration of 6PPDQ for 24 hours. We found that 6PPDQ exposure to alevins, juveniles, and 1+ year animals had 24-hour LC50 concentrations of 267.4 ng/L, 93.5 ng/L, and 197.3 ng/L, respectively. The results demonstrate the life-stage dependence of 6PPDQ toxicity, and show that coastal cutthroat trout are sensitive to 6PPDQ at environmentally relevant concentrations. In addition, the 96-hour LC50 in 1+ year animals was around 2.5x lower than the 24-hour LC50 at the same life stage, and animals showed no evidence of recovery from chemical exposure when four 24-hour pulsed exposures were conducted over two weeks. While we hypothesized that 6PPDQ exposure would enhance disease susceptibility, we found trends for increased survival, decreased infection, and a lower number of viral-positive fish with 6PPDQ exposure, suggesting immune system activation by 6PPDQ. Ucrit values were significantly lower in 6PPDQ-exposed fish compared to control animals, demonstrating lower fitness of 6PPDQ-exposed fish. Overall, we found that 6PPDQ has acute effects in coastal cutthroat trout and also elicits sub-lethal effects on both the immune system and on swimming fitness. Current work includes an assessment of 6PPDQ-relevant mixtures in coastal cutthroat trout embryos. Our results provide data to inform the environmental risk assessment of 6PPDQ in the context of an economically and ecologically important fish species.

**Investigating acute and sublethal toxicity of para-phenylenediamine derivatives in coho salmon (Oncorhynchus kisutch) for the evaluation of safer alternatives to 6PPD**

Anastasia McConachie‡, Caitlin Lawrence, and Jenifer McIntyre. Washington State University.

6PPD-quinone, a toxic byproduct of the antiozonant 6PPD used in tires, has been identified as a cause of widespread coho salmon (Oncorhynchus kisutch) mortality. This highlights the need to develop safer alternatives to 6PPD. Our research has focused on the acute toxicity of para-phenylenediamine (PPD) derivatives 7PPD, IPPD, 44PD, and 77PD, emphasizing quinone formation as a key driver of toxicity. Coho salmon were exposed to these derivatives at variable concentrations for 24 hours to estimate median lethal concentrations (LC50s). Dose-response data reveal that 77PD (LC50: 159 ± 28 µg/L) and 44PD (202 ± 58 µg/L) are more toxic than 6PPD (519 ± 95 µg/L). Additionally, 7PPD (706 ± 123 µg/L) and IPPD (1113 ± 103 µg/L) exhibit lower toxicity than 6PPD in both parent and ozonated forms. Ongoing efforts include validating the toxicological profiles of ozonated 6PPD, 7PPD, and IPPD, as well as pure, commercially-sourced 7PPD quinone and IPPD quinone to determine the relative contribution of quinones vs other transformation products in the toxicity of ozonated mixtures. In tandem with acute lethality, we aim to investigate sublethal effects of these compounds over extended exposure periods. Severe vascular effects, including significant blood-brain barrier (BBB) disruption, have been observed near or just before loss of equilibrium (LOE) in coho salmon exposed to lethal concentrations of 6PPD quinone. Sublethal effects of this chemical and related PPDs may manifest earlier in the exposure timeline, warranting independent study. To describe a more nuanced timeline of toxicity progression, we will sample blood at early and intermediate exposure timepoints to quantify circulating inflammatory markers and identify other potential sublethal biomarkers preceding severe vascular disruption. To map toxicity progression, we will compare tight junction gene transcription levels linked to late-stage BBB failure, alongside inflammatory markers sampled at earlier exposure time points. By correlating exposure levels with thrombin concentrations in blood samples, and chemical accumulation in the liver and brain tissues, we aim to connect dose response data to sublethal endpoints, providing an integrative understanding of acute and chronic toxicity modes of action in coho salmon.

## Panel Session II: Bunker Hill Remediation and Mitigation Efforts and the Future of Coeur d'Alene Lake

Panel Members:

Susan Spalinger, Alta Science and Engineering, Inc.

Rebecca Stevens, Coeur d'Alene Tribe

Jamie Brunner, Idaho Department of Environmental Quality

Lauren Zinsser, USGS

The Bunker Hill Mining and Metallurgical Complex Superfund Site (Bunker Hill) is a complex mining megasite affecting thousands of residents and water quality in miles of rivers, tributaries, and Coeur d'Alene Lake. Historic mining has left millions of tons of contamination in area soils and riverine and lake sediments. Although Coeur d'Alene Lake is within the Bunker Hill Superfund Site, remedial actions for the lake were deferred pending the development and effective implementation of a Coeur d'Alene Lake Management Plan (LMP). The Coeur d'Alene (CDA) Tribe and the Idaho Department of Environmental Quality (IDEQ) share responsibility for water quality in Coeur d'Alene Lake under Clean Water Act authority and collaboratively developed the 2009 LMP. The LMP goal is to protect the lake by limiting basin-wide nutrient inputs that impair water quality and influence the solubility of metals contained in lake sediments. In a 2022 National Academy of Sciences review and evaluation of lake water quality, the NAS concluded that protecting the Coeur d'Alene Lake will require expanded monitoring efforts, regular syntheses of data, and targeted studies—all coordinated among various interest groups. This proposed panel session is intended to include the CDA Tribe, IDEQ, and EPA as panel members, moderated by Susan Spalinger, to discuss the challenges and successes of years of remediation and mitigation efforts at Bunker Hill, especially those making an impact on CDA Lake water quality and the CDA Tribe. This session would include the following topics using a combination of presentation (slides), question and discussion with panel members, and open Q&A from the audience: 1) A brief history of the Bunker Hill Mining and Metallurgical Complex Site (BHSS) and the Coeur d'Alene Tribe's and agencies' involvement. 2) A summary of how EPA utilized the Natural Resource Damage Assessment (NDRA) Trustees' ecological data to establish clean-up standards in the Lower Basin for waterfowl. 3) Why there has yet to be a remedy identified for CDA Lake and challenges ahead. 4) Examples of working together under CERCLA with remedy and restoration, highlighting a few projects in the Lower Basin and those outside of the contaminated area on the Reservation where cultural resources have been restored in clean habitats to offset where remedy has yet to occur in traditional gathering areas. 5) Lessons Learned by using the 4 R's: Responsibility, Respect, Reciprocity, and Relationships.

# Tuesday Poster Presentation Abstracts

‡ Indicates presenter

**Poster #1: Dispersed Microplastics in Brazilian Rivers Without Control, Monitoring and Environmental Protection Legislation**

Maria Carolina de Almeida‡[,1], Eliane Teixeira Mársico[2], Mônica Rodrigues Ferreira Machado[3], Flávio Alves da Silva[1], and Tatianne Ferreira de Oliveira[1]. [1]Federal University of Goiás, [2]Fluminense Federal University, [3]Federal University of Jataí.

Microplastics (MPs) are plastic materials with sizes equivalent to the thousandth part of a millimeter, they are particles of varying size between 5 mm to 1µm, which easily permeate through water filtration systems in sewage treatment plant systems. This is because such stations do not efficiently remove these and other micropollutants. Unfortunately, the MPs reach rivers, lakes, oceans, and all aquatic environments. Thus they pose a potential threat to marine life and human life. Its dispersion occurs in all environmental matrices, including aquatic, this is due to hydrological connectivity over long distances from rivers to the oceans and by the failures or lack of basic sanitation. In Brazil, research on the scope of detection, identification, and quantification of plastic pollution by MPs is concentrated on the coast and is already being conducted with the participation of several institutions and with significant results. Although for rivers and lakes, the research does not yet cover the interior of the Brazilian territory, given extensive exposure to MPs. The detection and quantification of MPs in Brazil have no guidelines through standards with parameters, tolerance limits, and official methodologies established. There is an emergency demand for exposure to pollution by MPs in the aquatic environment, due to the lack of implementation of public policies and regulatory standards as environmental protection measures in Brazil. As well, throughout the world, unfortunately, the methodologies are converging for the detection and quantification of MPs in a concise and precise way. In contrast, the Brazilian production of plastics, since it is a major world producer of plastic, and with incipient percentages of recycling of plastic waste generated. Recent data show an annual production of approximately 14 million tons of plastic waste, not counting the increase in the use of plastic masks and other materials related to the COVID-19 pandemic. However, this remains a largely unreported or underreported volume, and more than half of post-consumer plastic packaging in Brazil is managed without any control and monitoring. In this context, it is not yet clear how this will contribute to the occurrence of plastic and PM waste in Brazilian freshwater. This scenario requires consideration of several other crucial factors. Studies have been conducted mainly in marine and estuarine waters, while data on freshwater are scarce. Brazil has continental dimensions and the greatest water availability on the planet, however, the water demand is higher in regions with supply ranging from medium to low. Many densely populated urban areas in Brazil face chronic problems of flooding, inadequate levels of wastewater treatment, and solid waste in inappropriate management practices. Consequently, urban freshwater with tropical characteristics in Brazil presents an intriguing and complementary scenario to the marine environments that are most commonly studied (Sodré et al., 2023). Research states that for the proper conduct of experiments, it is necessary to have a prior characterization of the MPs (Zin; Wood, 2004). Plastics that have undergone degradation will have altered surface characteristics, resulting in increased surface area, exposed functional groups, and widening the size range due to fragmentation. Therefore, an adequate initial characterization as well as an understanding of how the experimental system can alter plastics is imperative. They should be characterized properly, applying well-known techniques such as scanning electron microscopy and infrared spectroscopy with Fourier transform, and from there, defining the composition of functional groups. Other forms of characterization may be conducted by applying additional techniques through spectrum libraries. Among these techniques, we can include Raman spectroscopy,

nuclear magnetic resonance spectroscopy, and near-infrared spectroscopy to compare the polymeric compositions. Nevertheless, there may be interaction between plastics, ions, and [continued]

[continued] organic matter, so such water quality characteristics should be reported in the studies (Shi et al., 2024). Regarding the aspects of legislation, no progress has been observed yet, although concern about plastic pollution has led to the classification of these materials as hazardous waste in some legislations, such as the United States Resource Conservation and Recovery Act, however, there are no specific regulations yet that set limits for MPs in food. Recently, global efforts have been directed towards the creation of a Global Plastics Treaty, aiming to reduce plastic pollution in oceans. Although this treaty seeks to address the production and disposal of plastics, unfortunately, there are no indications that specific limits will be established for MPs in food, especially fish. In Brazil, although there is a legal framework for food safety, many environmental pollutants, including MPs, still have no legislative limits. Studies indicate the need for greater attention to this fact to ensure food safety associated with fish consumption. In the Post-Graduated Program in Food Science and Technology, through research developed at the Laboratory of Food Quality and Control (LABfood), at the School of Agronomy of the Federal University of Goiás, in partnership with the LABfish Laboratory, of the Federal University of Jataí, and with the Laboratory for Physical-Chemical Control of Products of Animal Origin (LABCFQUÍMICO-POA), of the Fluminense Federal University, the Research Project on MPs in Freshwater Fish is being conducted in an unprecedented way in Brazil. The samples are fish from the rivers of the Paranaíba basin; the Araguaia River; and the Tocantins River are being collected and prepared for detection of MPs. Until then, the first front of research in rivers of the interior territory in Brazil was responsible for most of the water supply. MPs were detected in various locations around the world, causing widespread public concern. Freshwater systems have equivalent or perhaps worse contamination of MPs than marine environments. However, the quantification and toxicity in freshwater ecosystems for MPs continue to be underestimated, ignored, and not reported as much as compared with marine ecosystems, about their abundance, influence, and toxicity in biota and freshwater, since they are not inferior to a marine ecosystem. The current status of contamination by MPs in freshwater was revealed by Khan et al. (2024), and its potential environmental impacts such as ingestion and toxicity to freshwater fish were discussed. As a consequence, further investigations on the incidence and ecotoxicology of MPs in freshwater fish are necessary to fully understand the problem. Progress on concern implies a solid systematic basis as well as relevant legislation at the global and national level (EEA, 2012).

**Poster #3: Harnessing the power of spICP-MS in the study of nanogeochemical processes**

Brianna F. Benner‡ and Manuel D. Montaño. Western Washington University.

Single particle inductively coupled plasma-mass spectrometry (spICP-MS) has long been used to characterize inorganic engineered nanoparticles (ENPs), however its ability to analyze dilute nanoparticle suspensions also makes it ideal to study natural nanoparticles (NNPs) in the environment. Early use of this technique focused on the environmental release of ENPs into bodies of water, but more recently it has also been applied to study geogenic nanomaterials and their contributions to nutrient cycling and contaminant transport. NNPs are estimated to be 100,000,000x more abundant than engineered counterparts, therefore it is important to develop tools capable of understanding their behavior in environmental processes. Aggregation in particular impacts the transport of these materials as it is one of the main mechanisms by which NPs can be removed from the water column. In this study spICP-MS is used to measure the aggregation of gold and silica nanoparticles in response to changing pH, ionic strength, and oppositely-charged particles; determining how each parameter impacts particle size and the concentration of dissolved ions in solution. These measurements are compared to other techniques, such as scanning electron microscopy and dynamic light scattering, to demonstrate the merits of spICP-MS for the study of natural colloidal systems.

**Poster #5: Our Seafood, Our Knowledge - Developing a baseline for hydrocarbon concentrations in Alaskan coastal subsistence foods**

Morgan Bender‡.Fjord & Fish Sciences.

Spanning 6,640 miles along the coast of Alaska, 159 communities harvest hundreds of pounds of fish, shellfish, birds, marine mammals, and marine plants for consumption each year. Meanwhile, the threat of oil spills from shipping, tanker traffic, fishing, tourism, and industrial activities looms over these same subsistence harvest areas. Community members and harvesters express concern over potential hydrocarbon contamination from marine oil spills, both historical and anticipated. In response to these community concerns, this study aims to gather existing baseline data on hydrocarbon concentrations in marine subsistence food sources and create a comprehensive analytical toolkit for addressing data gaps. A systematic review will compile available hydrocarbon data using culturally appropriate methods, interviews with elders and local experts, and published literature. Preliminary data indicates a lack of studies addressing hydrocarbons in marine subsistence foods, with disparate chemical data points for fish, birds, and marine mammals. Most existing data was collected in the wake of the 1989 Exxon Valdez oil spill and, to a lesser extent, the 2004 Selendang AYU freighter spill. Intertidal blue mussels yield some of the substantial datasets from Southcentral and Southeast Alaska. Numerous pre-development baseline studies around the state, industry-funded research in the Chukchi Sea, and local government-funded studies on the North Slope are noted. Establishing a baseline understanding of hydrocarbon contamination is complicated by different quantification methodologies that employ varying numbers of polycyclic aromatic hydrocarbons, parent and/or alkylated compounds, dry and wet weights, lipid corrected weights, or poor data quality and study design. Understanding and communicating the contamination risks posed by marine oil spills is vital for food safety, security, and healthy Coastal Alaskan communities.

**Poster #7: Feeln' the Burn: Localized Air Quality Study in Oregon's Willamette Valley**

Julie Layshock[‡1], Cris Brethower [1], Betta Minervini[1], Ryan Helt[2], and Nicole Henry[3]. [1]Pacific University, [2]University of Oregon, [3]Precision Analytical.

Open burning is a cost-effective method for disposing of crop residues and other debris, but it generates significant smoke and respirable particulate matter (PM10 and PM2.5), which pose serious respiratory health risks and contribute to long-term environmental degradation. Despite these known impacts, open burning remains common, particularly in agricultural regions such as Oregon's Willamette Valley. This study aims to assess air quality in areas lacking routine monitoring. From 2022 to 2024, PM levels and PM-bound pollutants, including metals, polycyclic aromatic hydrocarbons (PAHs), and phthalates, were measured in Forest Grove, Oregon, located 25 miles west of Portland. Results indicate that open burning significantly contributes to elevated PM concentrations, highlighting critical implications for community health and policy development. Yearly and seasonal pollutant trends will also be discussed.

**Poster #9: Molecular assessment of nickel toxicity in a non-model marine tunicate to facilitate cell line development.**

Celeste Valdivia‡,[1], Theo K. Bammler[2], Buki Rinkevich[3], Dietmar Kültz[4],and Alison Gardell[5]. [1]School of Aquatic and Fishery Sciences, University of Washington, Seattle, [2]Genomics, Bioinformatics & Biostatistics, Microphysiological Systems Facility Core, University of Washington, Seattle, [3]Israel Oceanographic and Limnological Research, [4]Department of Animal Science, University of California, Davis, [5]School of Interdisciplinary Arts and Sciences, University of Washington, Tacoma.

The common and cosmopolitan marine tunicate Botryllus schlosseri possesses various cell types with significant potential to serve as versatile in vitro tools to address a variety of research questions. Despite decades of research efforts, an immortalized cell line has not been established for this species. Previous work sought to optimize methods to prolong cell longevity in culture and increase opportunities for spontaneous immortalization, however, all documented cultures enter quiescence after 72 hours in vitro. The regulatory mechanisms of somatic cell cycle arrest in B. schlosseri remain poorly understood. Further is unknown regarding the use of experimental induction of clastogenesis to introduce genetic modifications that circumvent or downregulate key quiescence pathways. This study evaluates cell cycle and DNA damage molecular responses in B. schlosseri following exposure to the known clastogenic compound, nickel (II) chloride. We first established the lethal concentration (LC50) of nickel in field-sourced B. schlosseri, (LC50 24-hour exposure = 614 mg L-1) as nickel toxicity had never before been characterized in this species. Mortality for the LC50 was determined observationally, marked by unresponsiveness of musculature in the body walls and cessation of hemolymph movement. A subsequent acute sublethal 24-hour exposure to nickel (II) chloride was conducted on field-sourced B. schlosseri colonies. Whole colonies were immediately preserved for RNA-sequencing and proteomic network analyses. The next phase of our research will analyze this -omics data to identify key molecular phenotypes potentiating cellular immortalization in this species. Furthermore, a single-cell gel electrophoresis DNA breakage assay will be used to determine the extent of nickel-induced DNA lesions in B. schlosseri. By integrating these findings, we seek to isolate molecular networks significant in B. schlosseri cell cycle control, laying the groundwork for synthetic manipulation for downstream cell line development efforts. Funding provided by NSF MCB-2127517.

**Poster #11: Effects of PCBs and PBDEs on Chinook salmon populations in Puget Sound, WA**

Ruth Sofield‡,[1], Maya Faber[2], C. Andrew James[2], John Best[3], and Sandra O'Neill[3]. [1]Western Washington University, [2]University of Washington Tacoma, [3]Washington Department of Fish and Wildlife.

Several wild Chinook salmon (Oncorhynchus tshawytscha) populations are listed as threatened or endangered. Declining populations have been attributed to salmon habitat quantity and quality, including the presence of anthropogenic contaminants. Chinook salmon are particularly susceptible to contaminant exposures during critical early life stages when they rear and forage in rivers and estuaries. The objective of this work is to understand the population-level impacts of exposures to PCBs and PBDEs on different salmonid populations in Puget Sound, WA, USA. We developed a set of life-history models for two different river systems. Chemical exposures in each life stage were estimated for populations, and some life stages, based on monitoring data collected in the region by the Washington Department of Fish and Wildlife. The effects of PCBs on population-relevant effects endpoints, included growth, survival, and reproduction; for PBDEs we focused on BDE-47 and BDE-99 exposures as they relate to host susceptibility to disease, using Listonella anguillarum as a model pathogen, and resultant mortality. The relationships between exposures and effects were informed by published exposure-response relationships and/or developed from the literature. These effects were used to adjust the probability of survival of key life-stage transitions in the population model. While the PBDE models are not complete, the results of the PCB model indicate that there was a measurable effect on the population from the chemical exposures, limiting the success of salmonid recovery and restoration activities. This highlights the need to improve our management of anthropogenic chemical loading to receiving waters.

**Poster #13: Pacific salmon at a Crossroads: a StoryMap**

Amirah Casey‡, University of Washington.

Toxic stormwater runoff and climate change represent a significant challenge for Pacific salmon conservation. Salmon are invaluable culturally, economically, and ecologically. To help frame the state of the science, I developed a virtual StoryMap to synthesize complex environmental health information within an easily accessible format. This resource targets general audiences using an engaging, multimedia format to bridge the gap between science and management. The StoryMap provides a historical overview of stormwater science and discusses implications for stormwater management (including green infrastructure solutions). The map links to technical resources, including open-access scientific publications, and considers how salmon recovery efforts are increasingly confronting the interacting threats of urbanization and climate change.

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**Poster #15: Assessing Water Quality in South Puget Sound Watersheds: The Role of 6PPDQ and Emerging Contaminants**

Kiersten Maxwell‡,[1], Dr. Jeffery Perala-Dewey[2], Melissa Gonzalez[3], Haley Sefi-Cyr[3], and Dr. Edward P. Kolodziej[2]. [1]University of Washington, [2]University of Washington Tacoma, Center for Urban Waters, Tacoma, WA, [3]Center for Urban Waters, Tacoma, WA.

Coho salmon populations in Puget Sound are increasingly threatened by water quality issues, particularly in roadway runoff-impacted watersheds. The available data indicates that 6PPDQ is primarily responsible for the acute mortality observed in coho salmon throughout the Puget Sound basin; however, the occurrence and temporal trends for 6PPDQ and other roadway derived contaminants of emerging concern (CECs) remain largely understudied in many small and medium sized watersheds. This project seeks to identify locations and periods of CEC pollution by analyzing water quality in small, ecologically relevant South Puget Sound watersheds, with sampling beginning (currently) during the 2024-2025 storm season. Targeted watersheds, including the Puyallup, Nisqually, and Deschutes, were prioritized by tribal personnel for their ecological importance and monitoring value. Data from these efforts will quantify concentrations and relationships between of 6PPDQ and other CECs and their potential impacts on water quality. The findings from this research will have important implications for regional conservation efforts and broader salmon recovery strategies to mitigate water quality impairment and improve the long-term health of aquatic organisms, particularly in prioritized spawning and rearing habitats for salmonids.

**Poster #17: A Comparison of Commonly Used Extraction Methods for 6PPD-q**

Ayden Mudd‡, Jordan Perkins, and Karin L. Lemkau. Western Washington University.

The rubber manufacturing industry uses additives to improve tire durability. One ubiquitous additive is the antioxidant and antiozonant 6PPD (N-(1,3-dimethylbutyl)-N'-phenyl-p-phenylenediamine) which helps prevent reactions with reactive oxygen species. When 6PPD interacts with atmospheric ozone it forms 6PPD-quinone (6PPD-q). Both, 6PPD and 6PPD-q, are found in tire wear particles that build up on roads and are flushed into waterways during rain events. 6PPD-q is of particular interest due to its extreme toxicity to coho salmon, white-spotted char, and brook trout. Since the discovery of 6PPD-q in 2020, several methods for sample preparation have been used in the literature, and in 2023 the EPA released a draft SPE-based extraction protocol (EPA method 1634)for processing samples. SPE-based methods can be costly and may not be practical for all researchers. Here we compare an EPA-based SPE method to other methods from the literature to examine method performance. We also explore sample stability post-extraction under a variety of storage conditions commonly encountered in an analytical lab setting.

**Poster #19: Crayfish suitability for 6PPD-Q pollution biomonitoring in Aquatic Ecosystems**

Mary Engels‡, Sultan Aljohani, Miles Bulter, Abbie Johnson, and Chloe Arthaud. University of Idaho.

Stormwater runoff is one of the most significant contaminant sources for freshwater aquatic ecosystems. (1,3-Dimethylbutyl)-N-phenyl-p phenylenediamine-quinone (6PPD-Q), a recently described organic pollutant that leaches from microplastic tire wear particles, is toxic to some aquatic organisms, particularly Coho salmon. However, the ephemeral nature of stormwater runoff events, which are the primary contamination pathway for 6PPD-Q, and the mobile nature of impacted aquatic species, monitoring for this pollutant is difficult. This study aims to evaluate the suitability of crayfish as a biomonitoring organism for 6PPD-Q exposure. Here we report on findings from the first phase of the study, a laboratory eco-toxicological experiment to demonstrate the accumulation of 6PPD-Q in crayfish tissues. The experimental design exposed the Columbia River Basin native signal crayfish (Pacifastacus leniusculus) to five different concentrations of 6PPD-Q (0, 5, 25,95, and 250 ng/L) and the invasive rusty crayfish (Faxonius rusticus) to nine different concentrations of 6PPD-Q (0, 5, 25, 95, 250, 500, 1,000, 5,000, and 10,000 ng/L). Replicate crayfish tissues and water samples were collected at 24, 48, and 96 hour intervals, and 6PPD-Q concentrations were quantified using a UPLC coupled to a triple-quadrupole mass spectrometer. Preliminary findings indicate that tissue accumulation does occur in quantifiable concentrations at higher exposure concentrations, but that the persistence in crayfish tissues over the study period is variable.

# Wednesday Platform Presentation Abstracts

‡ Indicates presenter

## Session 6: Rivers and Freshwater: Ecological Toxicity

**Finding Goldilocks: aquatic life criteria for copper that are too simple, too complicated, or just about right**

Christopher Meban‡. U.S. Geological Survey.

In the United States, all states have aquatic life criteria for copper, but in multiple vintages of hardness-based single-linear regression equations and in a few cases a biotic ligand model (BLM). More recently multiple-linear regression models (MLRs) that use dissolved organic carbon, hardness, and pH have been promoted. I evaluated the performance of each with copper (Cu), emphasizing the relative performance of hardness-based versus MLR-based criteria equations. The performance of criteria versions was evaluated with numerous toxicity datasets that were independent of those used to develop the MLR models, including olfactory and behavioral toxicity, and field and ecosystem studies. Within the range of water conditions used to develop the Cu MLR criteria equations, the MLR performed well in terms of predicting toxicity and protecting sensitive species and ecosystems. In soft waters, the MLR outperformed both the BLM and hardness models. In atypical waters with pH <5.5 or >9, neither the MLR nor BLM predictions were reliable. The hardness-based criteria performed poorly with all toxicity datasets, showing no or weak ability to predict observed toxicity. In natural waters, MLR and BLM criteria versions were strongly correlated. In contrast, the hardness-criteria version was often out of phase with the MLR and, depending on waterbody and season, could be either strongly overprotective or underprotective.

**Quashing quagga: Fate and effects to the benthic community of a copper treatment to eradicate invasive mussels in a large western river**

Austin Baldwin‡,[1], Erin Murray[1], Lauren Zinsser[1], Chris Mebane[1], and India Southern[2]. [1]USGS, [2]Idaho Department of Environmental Quality.

Copper-based chemical treatments are commonly used to eradicate invasive mussels in small ponds and lakes, but their use in large rivers has been limited. In 2023, in response to an early detection of invasive quagga mussels (Dreissena rostriformis), a 10-kilometer reach of the Snake River in southern Idaho was treated with an unprecedented 19,300 kg of chelated copper molluscicide to a target concentration of 1,000 µg/L for 10 days. In the days leading up to this treatment, we initiated a monitoring study to evaluate the transport and fate of the copper and its exposure and effects on the non-target benthic community downstream. Water samples were collected at seven locations throughout the treatment period, and sediment, periphyton, and benthic macroinvertebrates were collected before and after the treatment. Nearly half of the original mass of copper was removed from the water column via sedimentation, sorption to algae, or biological uptake within the 10-km treatment reach and the first 15 km downstream. Even so, dissolved copper concentrations exceeded the acute toxicity threshold for over two weeks at least as far as 28 km downstream. Sediment copper concentrations increased by up to 8.3-fold, exceeding the threshold effect concentration at several sites. Effects on benthic macroinvertebrates varied widely by taxa. From 0 to 28 km downstream, invertebrate abundances decreased 52-94%, with gastropods among the most affected group. Of the unique taxa present at these sites pre-treatment, 52-64% were not found post-treatment, but were replaced by other taxa, indicating a reorganization of the base of the food web. Additionally, from 0 to 15 km downstream, the percentage of individuals from tolerant taxa increased 2-15-fold. Findings from this study can help watershed managers plan future invasive mussel responses while also protecting culturally, economically, and ecologically important non-target species in large rivers in the western U.S. and elsewhere.

**Acute lethal and sublethal toxicity of anticoagulant rodenticides on Pacific salmon**

Jen McIntyre‡, Lillian Pavord, and Melissa Driessnack. WSU.

Invasive species have cascading negative effects on community structure and are detrimental to many ecosystems. Rat species have been especially problematic on island ecosystems. Eradication efforts typically include aerial applications of food pellets containing anticoagulant rodenticides, which inevitably results in pellets entering the aquatic environment. Two of the most commonly used anticoagulant rodenticides are brodifacoum and diphacinone. Trace amounts of these rodenticides have been detected in several fish species after pellet applications on rat infested islands. Many islands in the Aleutians Archipelago of Alaska are infested with brown rats (Rattus norvegicus). A pilot effort to eradicate rats on these islands is planned by the US Fish & Wildlife Service for Great Sitkin Island. This island includes spawning and rearing habitat for Pacific salmon. There is a large information gap for the aquatic toxicology of brodifacoum and diphacinone. To address this gap, we exposed Pacific salmon (Oncorhynchus kisutch and O. gorbuscha) to bait pellets during early development and monitored survival and developmental impairments. We also subjected juvenile O. kisutch to intraperitoneal injections to establish lethal and sublethal dose-response curves for each chemical. Despite the very low water solubility of brodifacoum and diphacinone, embryos and alevin accumulated both chemicals. Brodifacoum reduced survival and increased developmental defects; these effects were not observed from exposure to diphacinone. Juvenile coho were more sensitive to diphacinone than brodifacoum following IP injection. Ongoing research will test for acute lethal and sublethal effects from dietary exposure. This data will help inform policies regarding the use of these chemicals for rat eradications on the Aleutian Islands.

**Spatial and temporal trends of mercury in fish from Duck Valley Indian Reservation reservoirs, southwestern Idaho and northern Nevada, 2007-2024**

Erin M. Murray‡ and Christopher A. Mebane. USGS Idaho Water Science Center.

The Shoshone-Paiute Tribes of the Duck Valley Indian Reservation (Sho-Pai Tribes) manage reservoirs for commercial and recreational benefits, boasting trophy-sized rainbow trout that attract countless anglers year-round. Reservoirs are common environments for the methylation and bioaccumulation of mercury, a potent neurotoxin when elevated levels are consumed. In 2007, 2009, and 2013, the U.S. Geological Survey (USGS), in cooperation with the Sho-Pai Tribes, measured total mercury concentrations in rainbow trout from three reservation reservoirs. In all three study years, mercury concentrations in sampled rainbow trout muscle fillets were below 0.30 milligrams per kilogram wet weight, which is the EPA's recommended criterion based on protecting an adult consumer who eats an average of one 8-ounce meal every other week. To assess potential changes since 2013, the USGS repeated sampling in 2024 in the same three reservoirs. Hatchery fish from Desert Springs Trout Farm in Summer Lake, OR, were also sampled to quantify the background concentration of rainbow trout upon stocking the reservoirs. Fish were sampled using a non-lethal method to collect biopsy muscle plugs from a live fish instead of the typical muscle fillet method. The USGS also collected QAQC samples in non-surviving biopsied fish to compare the muscle plug results with fillet tissue results in the same fish. This presentation focuses on spatial and temporal trends of mercury in rainbow trout and presents limited results from three other species (largemouth bass, smallmouth bass, and yellow perch). We will also discuss challenges encountered with the muscle plug sampling method for consideration in designing other studies. Fish consumption advisories on tribal lands are determined by the Tribes, and these results will help Sho-Pai managers determine the mercury exposure risk to tribal members and visiting anglers.

# Session 7: Ocean and Estuarine Systems: Environmental Monitoring

### Co-Producing a Toxics Research Agenda for Puget Sound Recovery

Sandra Dorning‡, C. Andrew James, and Marielle Kanojia. Puget Sound Institute, University of Washington Tacoma.

Efforts to restore Puget Sound, a large estuary in Washington State, are guided by recovery plans including a Toxics in Aquatic Life plan which aims to reduce chemical contamination of aquatic fish and mussels in this ecosystem. However, scientific knowledge gaps can hinder implementation of effective actions within this recovery plan. To facilitate resolution of these knowledge gaps, University of Washington Tacoma's Puget Sound Institute (PSI) coordinated the co-production of a toxics research agenda for Puget Sound comprised of prioritized toxics research questions ("uncertainties"). PSI collated uncertainties from reports and other sources, worked with experts to screen some uncertainties for relevance to the toxics recovery plan, and engaged additional experts to prioritize the uncertainties. The resulting research agenda includes top five priority uncertainties in each of three topical lists (microplastics; 6PPD-quinone; and contaminants of emerging concern and legacy chemicals relevant to regional recovery targets) and ~90 other uncertainties of high, medium, and low priority within these three lists. These uncertainties provide an update to the Puget Sound toxics research agenda PSI produced in 2018-2019 during development of the toxics recovery plan. The updated research agenda will directly inform planning and implementation of the toxics recovery plan within the Puget Sound National Estuary Program and can inform other research activity and funding in the region. Research conducted in the broader Pacific Northwest and elsewhere could also help address many of the Puget Sound research priorities. In addition, PSI's co-development process could be used by other regions for the identification of their own research priorities to inform ecosystem recovery planning, funding, and research.

**Rising Sea Surface Temperatures in Western Aleutian Islands, Alaska Associated with Decadal Increase in Steller Sea Lion Pup Total Mercury Concentrations**

Lorrie D. Rea‡,[1], A.J. Warlick[2], S.G. Crawford[1], B.S. Fadely[2], and T.S. Gelatt[2]. [1]University of Alaska Fairbanks, [2]NOAA Fisheries, Marine Mammal Laboratory.

We identified a significant increase (340%) in median lanugo total mercury concentrations (natal hair; [THg]) in Steller sea lion (Eumetopias jubatus) pups sampled at rookeries (birth sites) west of Amchitka Pass, Alaska between 2011 and 2023. The proportion of pups in the western region with lanugo [THg] above 20 µg/g (one threshold of concern for pinnipeds) increased from 0.19 in 2011 to 0.74 in 2023, while this same pattern was not evident for two rookeries east of Amchitka Pass. The proportion of pups in the western region with lanugo [THg] above 30 µg/g increased from 0.13 in 2011 to 0.58 in 2023. Marine heatwave events were also noted in the Aleutian Islands during this timeframe. To understand whether [THg] in Steller sea lions were correlated with proxies for ocean conditions, we used generalized additive models (GAMs) to examine the correlation between lanugo [THg] and localized sea surface temperature (SST) in sea lion foraging areas near Aleutian Island rookeries west and east of Amchitka Pass, Alaska. Lanugo samples (n=888) from sea lion pups from five natal rookeries over nine breeding seasons (2011-2023) were analyzed for [THg] (µg/g dry weight). As lanugo [THg] is established in utero, all SST values were lagged one year (e.g., SST in fall-spring would be applied to lanugo from pups born and sampled in the following summer). Our GAM results indicated a strong positive correlation between pup [THg] and SST west of Amchitka Pass, but not for those pups sampled to the east. This relationship was even more pronounced when the regression response variable was the proportion of pups with [THg] > 20 µg/g (explaining approximately 80% of the variability). These differences in regional trends likely reflect varied environmental (abiotic and biotic) and food web responses to changes in SST. Increasing SST could potentially change the dynamics of bioavailable mercury in a food web, but research on [THg] in sea water, sediments, and the base of the food web is lacking in these remote regions. Sea lion prey species (fish and cephalopods) have not shown a dramatic increase in [THg] over the same decade, but prey sampled west of Amchitka Pass typically have higher [THg] than conspecifics to the east. Increasing SST may have changed the distribution and availability of some Steller sea lion prey, resulting in adult females consuming greater proportions of predatory prey with higher [THg] in more recent years. This change would impact mercury exposure for pups west of Amchitka, where prey have higher muscle [THg]. Future work will aim to elucidate the complex relationships between Steller sea lion population dynamics, environmental drivers, and mercury in the ecosystem.

**Decades of citizen-driven environmental hydrocarbon monitoring from Prince William Sound, Alaska**

Morgan Bender‡,[1], Danielle Verna[2], and Austin Love[3]. [1]Fjord & Fish Sciences, [2]Prince William Sound Regional Citizens' Advisory Council, [3]Independent.

Following the 1989 Exxon Valdez oil spill, concerned citizens and congressional legislation established the Prince William Sound Regional Citizens' Advisory Council to promote the environmentally safe operation of the Valdez Marine Terminal and the associated oil tankers in the spill-affected area. The Council's mandate includes monitoring the environmental impacts of the terminal and tanker operations at the end of the Trans Alaska Pipeline. Since 1993, there has been annual monitoring of marine sediments and intertidal blue mussels, with nearshore water monitoring via passive sampling devices added in 2016. Sampling sites in the North Gulf of Alaska include areas with current oil tanker activities (e.g., loading, anchoring, transport routes), previously oiled sites from the Exxon Valdez oil spill, and reference locations on the traditional lands and waters of the Chugach, Eyak, and Alutiiq/Sugpiaq peoples. In each sample, state-of-the-art analytical laboratories measure polycyclic aromatic hydrocarbons, saturated hydrocarbons, and petroleum geochemical biomarkers essential for oil spill forensics. Today, the dataset contains nearly 300 thousand chemical data points from 2000 samples. Over the past 31 years, hydrocarbon concentrations in Prince William Sound have fluctuated, with localized spikes linked to events such as the April 2020 spill at the terminal. Background hydrocarbon concentrations in sediments and mussels have remained in the low parts per billion range (i.e., <250 ppb 42 PAH) since the early 2000s. Oil spill forensics reveal that sediments sampled near the terminal exhibit Alaska North Slope crude petrogenic signatures, whereas all other stations show mixed petrogenic and pyrogenic signals. While monitoring has expanded and evolved over time, the dataset has maintained consistency for spatial and temporal comparisons. Despite its extensive coverage and annual analytical review focusing on hydrocarbon forensics and concerning concentrations, the dataset remains underutilized. There is significant potential for further exploration, providing insights into environmental change, hydrocarbon weathering, fate and transport processes, lingering oil, and the biological impacts of hydrocarbons. The utility of this long-term environmental monitoring program in maintaining a robust, independent baseline hydrocarbon database remains critical in light of rapid environmental change and the ongoing risk of petroleum pollution.

# Wednesday In-Person Short Course

**Python Scripting for Environmental Professionals: How to Think Like a Computer Scientist**

A free, hands-on short course
Taught by: Gunnar Guddal, Anchor QEA

Does coding feel like a black box? Or maybe you learned Python or R scripting through application rather than formal training? Join Gunnar Guddal with Anchor QEA for a hands-on short course tailored to environmental professionals, where you will learn coding fundamentals through computational thinking. The course uses Python, a versatile language for data analysis, visualization, and automation, to teach the essential skills for scripting your environmental work.

If you're new to coding, you'll build a strong foundation. If you're already coding, you'll explore fresh techniques and perspectives to refine your approach. You'll gain:

- A strong foundation in scripting and automation
- New techniques for improving existing code
- Creative strategies for solving real-world problems.

Students and professionals of all experience levels are welcome