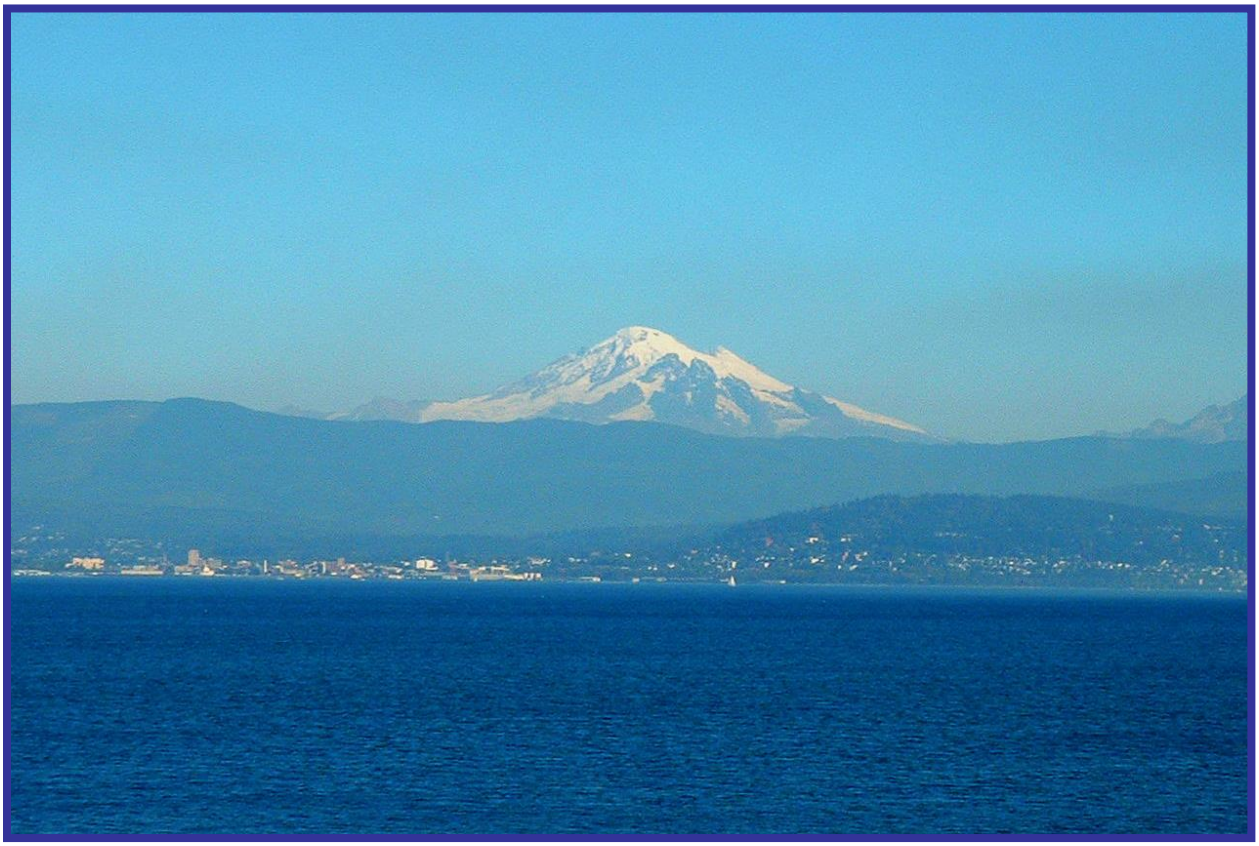
Program and Abstracts

Pacific Northwest Chapter

Society of Environmental Toxicology and Chemistry

(PNW-SETAC)

25th Annual Meeting



Bellingham, WA in foreground with Mt Baker in the distance Photo Courtesy A. Markiewicz

June 1 - 4, 2016

Four Points by Sheraton Hotel & Conference Center
714 Lakeway Drive
Bellingham, WA 98229

Four Points by Sheraton Hotel and Conference Center

714 Lakeway Drive, Bellingham, WA 98229
Phone: 1-360-671-1011, Fax: 1-360-676-8519, Website: http://www.fourpointsbellingham.com/

For Guests:

- Check-in time: 3:00 PM , check-out time: 12:00 PM
- Complimentary Wi-Fi in all public areas and high-speed internet in lodging rooms
- Complimentary parking in hotel parking lot
- Complimentary shuttle to/from airport from/to hotel

For Conference Attendees:

- Breakfast is provided for those who paid during registration
- Complimentary lunch is provided Thursday and Friday
- Morning and afternoon coffee break and refreshments provided Thursday and Friday
- Wireless internet available in all public areas, wired internet in business center
- Complimentary parking in hotel parking lot

Directions to Hotel (See Map 1):

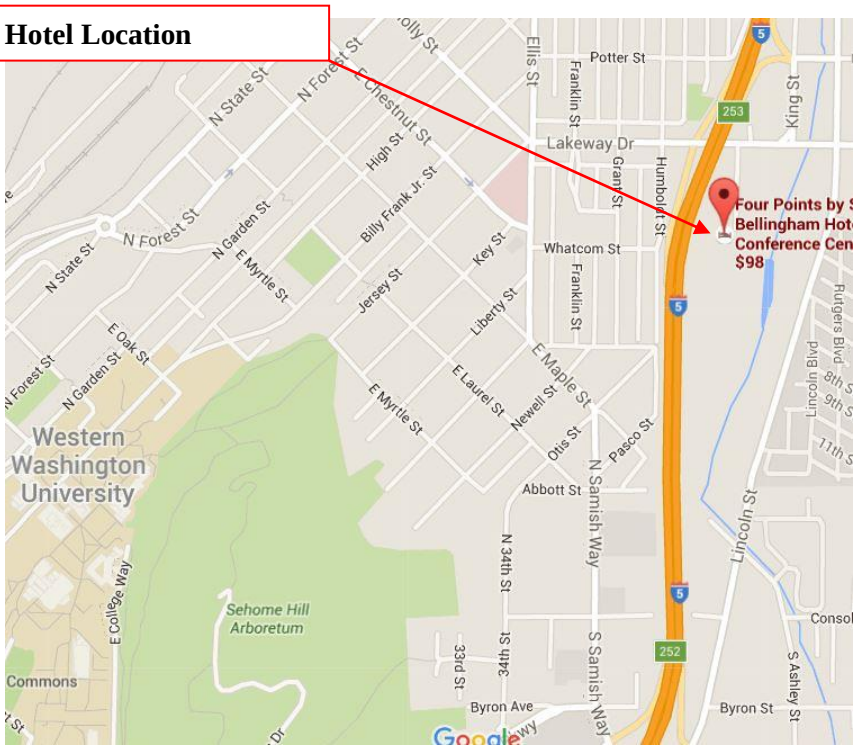
From the North:

- Travel south on I-5 and take exit 253, staying in the left lane
- Turn left at the traffic signal onto Lakeway Dr. and get in far right lane
- Take first right into the driveway of the Four Points Hotel

From the South:

- Travel north on I-5 and take exit 252, staying in the left lane
- Turn left at the stop sign and get in far right lane
- Proceed straight (north) through the traffic signal and keep right
- Go ~0.8 mi and turn left at the Four Points Sign into the Fred Meyer parking lot
- Continue along roadway past Fred Meyer parking lot and turn right into the hotel parking lot

Four Points Hotel Location



Wednesday Evening Welcome Reception

Western Washington University
516 High St., Bellingham, WA 98225

Viking Union Room 565, 5:30 PM – 8:30 PM

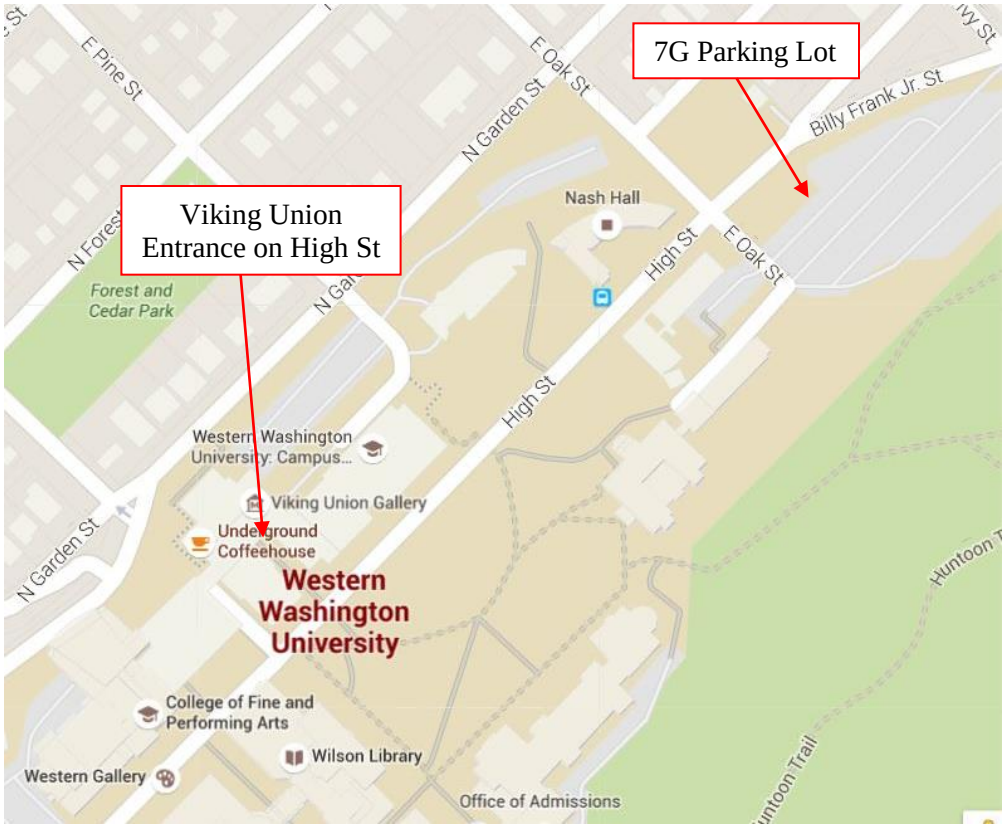
A parking lot, **7G**, has been reserved for those attending the Welcome Reception and driving a vehicle. **Carpooling is encouraged!** A parking permit is required to park and will be emailed to those who indicated they are attending the Welcome Reception. **You must display the permit on your dashboard!**

There are two main routes to get to Western and you are encouraged to check out the map available on Western's website.

Directions to Western from Four Points Hotel:

North Lincoln Street Route (more direct)

- Use the hotel's south exit (through Fred Meyer parking lot) and turn left (north) on Lincoln Street
- At the traffic signal turn left onto Lakeway Drive.
- Lakeway Dr. becomes Holly Street, a one-way street heading west once you pass the Ellis Street intersection.
- Stay in the left lane and turn left onto N. Garden Street
- Travel south on N. Garden St.
- Turn left onto Oak St. proceed past High St., and turn left into **7G** parking lot.
- Walk south along High St and follow signs to the Viking Union building. It will be on your right.



Optional Thursday Evening Cracked Crab Cruise
Bellingham Cruise Terminal/Alaska Ferry Terminal
355 Harris Avenue, Bellingham, WA 98225
http://whales.com/other-cruises/chuckanut-cracked-crab-evening-cruise/

You must arrive at 6:00pm for check in! We will be boarding the **Victoria Star 2** starting at 6:15 pm and departing at 6:30 pm from the Bellingham Cruise Terminal.

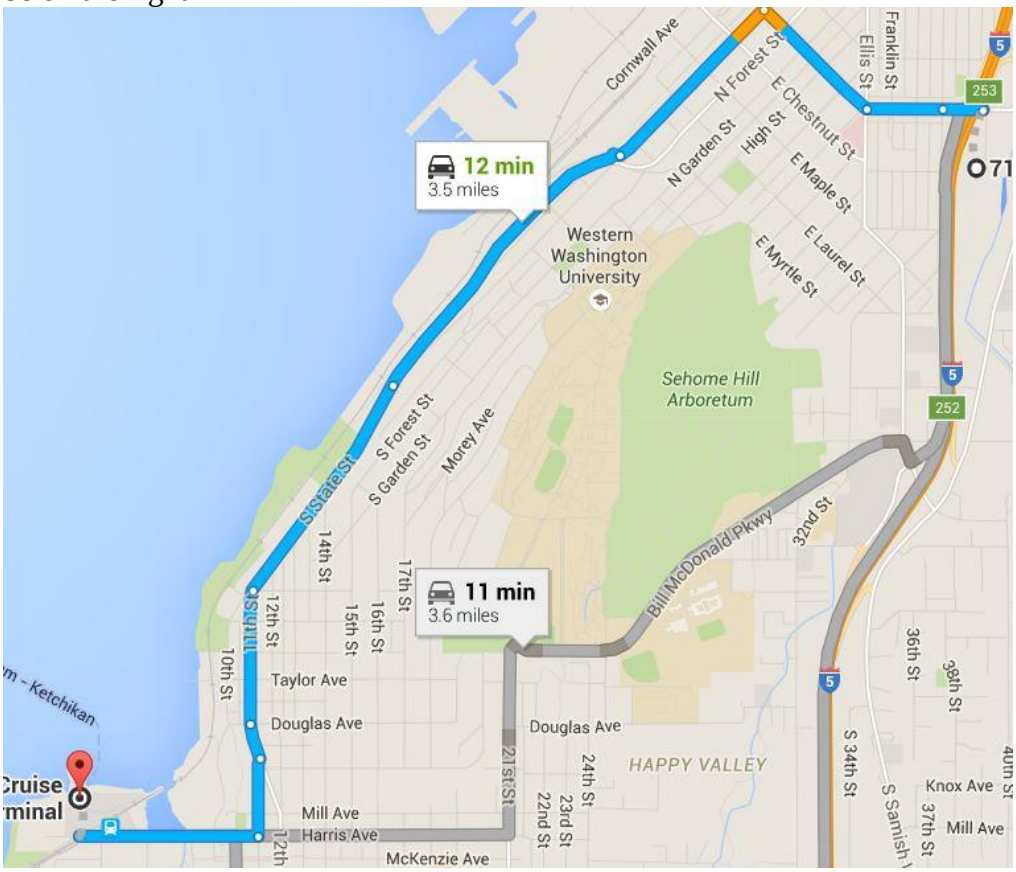
Each person will have received one drink ticket when you checked in to use towards Northwest wines and microbrews that will be served onboard in addition to a great selection of food (Dungeness crab, baked chicken, broccoli salad, roasted potatoes, garlic bread, and decadent dessert)

The cruise includes views of the Viti Rocks National Wildlife Refuge, Eliza and Lummi Islands, and Bellingham Bay

Directions to the Bellingham Cruise Terminal
Get specific directions from your starting point using the link provided or if coming from the Four Points by Sheraton use these:

Scenic Route (~12 minutes, 3.5 mi)

- Turn left from Fred Meyer parking lot onto Lincoln Street
- Turn left at the traffic signal onto Lakeway Dr. and stay in left lane
- Lakeway Dr. becomes Holly St, a one-way street. Stay left
- At State St. turn left and follow roadway along shoreline to Fairhaven District.
- Turn right on Harris Ave. and go to the end of the road. The entrance to the terminal will be on the right



PNW-SETAC
Meeting Sponsors

Special thanks to all our Meeting Sponsors!!

Student Travel Funds
Azimuth Consulting Group

Wednesday Evening Welcome Reception
Compliance Services International
Windward Environmental

Thursday and Friday Refreshments
Gradient Corporation
Integral Corporation
Northwestern Aquatic Sciences
Scientific Notations

Thursday Lunch
Compliance Services International

Friday Lunch
Windward Environmental

Student Presentation Awards
Compliance Services International
Gradient Corporation
Integral Corporation
Northwestern Aquatic Sciences
Scientific Notations
Windward Environmental

PNW-SETAC
Corporate Members

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

Corporate Members - Orca Level

Compliance Services International (CSI) specializes in global regulatory and scientific consulting services for product registration and risk assessment. Established in 1988, our diverse staff of experienced regulatory scientists develop strategies to meet specific needs for a global client base. Our services include USA & EU regulatory affairs, ecological risk assessment, endangered species analysis, endocrine disruptor evaluation, REACH chemical safety assessment, exposure modeling, study monitoring & data development, litigation support, information management systems, and task force management. Specialists in regulatory & scientific consulting - serving industry with dedication, expertise, and focus from offices in the USA and Europe. Please visit our website or contact us at info@complianceservices.com to learn more about CSI.

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

PNW-SETAC
Corporate Members

Corporate Members - Chinook Level

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

Gradient Corporation is an environmental and risk sciences consulting firm renowned for our specialties in Toxicology, Epidemiology, Risk Assessment, Product Safety, Contaminant Fate and Transport, Industrial Hygiene, Geographic Information Systems, and Environmental/Forensic Chemistry. Since 1985, Gradient has employed sound science to assist national and global clients with resolving their complex environmental and human health challenges. Our Scientists are nationally recognized experts and active contributors to the advancement of knowledge for science solutions. Focusing on rigorous, high-end science and creative problem solving, our engagements are led by teams with top credentials and unparalleled client focus.

Integral Consulting Inc. is an international science and engineering firm providing multidisciplinary services in health, environment, technology, and sustainability. Headquartered in Seattle, the company operates in 13 states across the nation. Established in 2002, Integral has grown to more than 140 employees spanning a range of scientific and engineering disciplines. We are known for providing cost-effective solutions to the complex technical challenges faced by our clients across a wide variety of public and private sectors, assisting them in project planning and management, regulatory strategy development, technical peer review, and expert services for litigation.

PNW-SETAC
Corporate Members

Corporate Members - Kingfisher Level

Northwestern Aquatic Sciences (NAS) has been providing environmental testing services since 1979. Specializing in aquatic toxicology, our professional staff can assist clients directly with their toxicity testing requirements or team with other consultants on multidisciplinary projects including whole effluent toxicity testing, marine and freshwater sediments, and soils. Located in Newport, Oregon, NAS has provided professional bioassay testing throughout the United States as well as some select international projects.

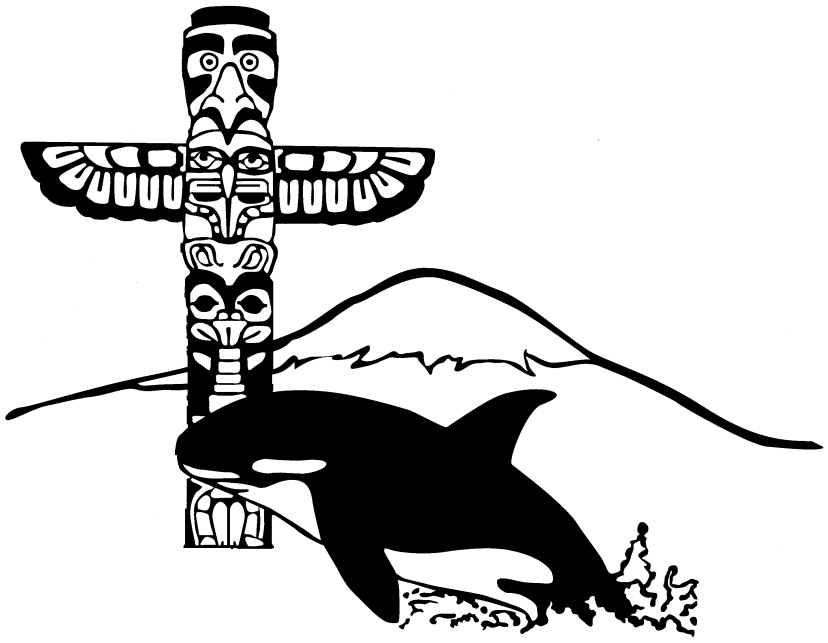
Scientific Notations LLC provides personalized and comprehensive writing and editing services, specializing in scientific documents. It is a small, women-owned business that can assist in manuscript preparation for publication, marketing a client's product to the scientific community, and helping non-English proficient authors get their manuscript formatted, edited, and ready for publication.

PNW-SETAC
Acknowledgments

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

Conference Organization:	Meagan Harris, Western Washington University Matt Luxon, Windward Environmental April Markiewicz, Western Washington University Ruth Sofield, Western Washington University
On-Site Coordinator:	April Markiewicz, Western Washington University
Abstract Review:	Jeff Wirtz, Compliance Services International Diana Dishman, Integral Consulting Inc. Julann Spromberg, NOAA/Ocean Associates Inc. Fan Wu, Oregon State University
Meeting Program:	Coreen Hamilton, AXYS Group Julann Spromberg, NOAA/Ocean Associates Inc. April Markiewicz, Western Washington University
Meeting Registration:	April Markiewicz, Western Washington University
Volunteer Coordinator:	Fan Wu, Oregon State University
Student Awards Coordinator:	Ruth Sofield, Western Washington University
Fundraising:	Jeff Wirtz, Compliance Services International Diana Dishman, Integral Consulting Inc.
Student Travel Awards:	Ruth Sofield, Western Washington University
Student Award Judges:	Julie Alaimo, King County Valerie Chu, Genwest/NOAA Scarlett Graham, Western Washington University Lauren Crandon, Oregon State University Alyssa DeLine, Oregon State University Meg Harris, Western Washington University Kathy Krepps, TestAmerica Inc. Wayne Landis, Western Washington University Alexander Lesher, Kennedy Jenks Consultants Darla Powell, TestAmerica Inc. Beth Power, Azimuth Consulting Group John Stark, Washington State University Mark Surette, Oregon State University Lauren Warner, US Army Corps of Engineers

25th PNW-SETAC ANNUAL CONFERENCE



Meeting Program

June 1 - 4, 2016

PNW-SETAC
Chapter Meeting Agenda

Wednesday, June 1st	***Four Points Hotel and Western Washington University***
7:30 AM – 9:00 AM	**Preconference/Registration Check-in** (**Hotel Lobby**)
7:30 AM – 8:30 AM	Breakfast (for those that paid during registration) (**Hotel Board Room**)
8:00 AM – Noon	**Cherry Point Tour**: Cherry Point Presentation (**Hotel Board Room**) followed by departure to Gulf Rd at ~ 8:30 am for tour and back at hotel by noon by **Michael Kyte**, Marine Biologist (see map and directions pages 4 and 5)
11:30 – 1:30 AM	**Lunch on your own!**
12:00 – 1:00 PM	*PNW-SETAC Board Meeting*
1:00 PM – 2:00 PM	**Preconference/Registration Check-in** (**Hotel Lobby**)
1:30 PM – 4:30 PM	**Georgia Pacific Site Tour**: Depart hotel to GP site followed by tour of site starting at 2:00 pm to 4:00 pm and back at hotel by 4:30 pm by **Brian Gouran**, Port of Bellingham (See maps and directions on pages 6 and 7)
1:30 PM – 3:30 PM	**Short Course**: *The Chemical Aquatic Fate and Effects Database and its Usefulness in Assisting Chemical and Oil Spill Response in Aquatic Environments* by **Valerie Chu** (Genwest Systems Inc/NOAA) (**Hotel Board Room**)
5:30 PM – 8:00 PM	**Conference/Registration Check-in** (**WWU Viking Union 565**)
5:30 PM	Welcome Reception beer and wine WWU Campus Viking Union Room 565 ABC (1 drink ticket provided)
6:00 PM	Presentation(s) by **Beth Power** and **Mike Johns**, 1st Chapter Conference Co-Chairs with **Wayne Landis** (1992 President) as MC.
6:30 – 8:30 PM	**Dinner (included in registration fee) VU 565 ABC**

Thursday, June 2nd	***Four Points Hotel***
7:30 AM – 5:30 PM	**Conference/Registration Check-in** (**Library Room**)
8:00 AM – 8:50 AM	Poster setup (**Terrace Room**)
7:30 AM – 8:30 AM	Breakfast (for those that paid during registration) (**Board Room**)
8:30 AM – 9:00 AM	Welcome & Opening Remarks: Chapter President **Julann Spromberg**, SETAC NA Representative **John Toll**, NASAC Representative **Fan Wu (Fairhaven Rm)**
9:00 AM – 12:00 PM	Platform presentations (**Fairhaven Room**)
10:20 AM – 10:40 AM	Refreshment break and poster viewing (**Terrace Room**)
12:00 PM – 2:00 PM	**Lunch Provided** (**San Juan Rooms**)
1:00 PM – 1:50 PM	Chapter Business Meeting, **All Welcome to Attend!!**
2:00 PM – 5:00 PM	Platform presentations (**Fairhaven Room**)
3:00 PM – 3:20 AM	Refreshment break and poster viewing
5:00 PM – 6:00 PM	Poster Social with refreshments (**Terrace Room**)
6:00 PM – 8:30 PM	Chuckanut Bay Sunset Cracked Crab Cruise (**See map and directions page iii**)

PNW-SETAC
Chapter Meeting Agenda

Friday, June 3rd	***Four Points Hotel***
7:30 AM – Noon	**Conference/Registration Check-in (Library)**
7:30 AM – 8:30 AM	Breakfast (for those that paid during registration) (**Board Room**)
9:00 AM – 12:00 PM	Platform presentations (**Fairhaven Room**)
10:20 AM – 11:00 AM	Refreshment break and poster viewing
12:00 PM – 2:00 PM	**Lunch Provided (San Juan Rooms)**
1:00 PM – 1:50 PM	Chapter Business Meeting, **All Welcome to Attend!!**
2:00 PM – 4:20 PM	Platform presentations (**Fairhaven Room**)
3:20 PM – 3:40 AM	Refreshment break and poster viewing
4:20 PM – 4:30 PM	Student Award Presentations, Closing remarks
4:30 PM – 5:30 PM	Poster Social with refreshments (**Terrace Room**)

Saturday June 4th	**On Your Own**
7:30 AM – 8:30 AM	Breakfast (for those that paid during registration) (**Hotel Board Room**)

Things to Do:

- **Service Project** (9:00 am to noon) with the Nooksack Salmon Enhancement Association (NSEA): Habitat restoration, invasive species removal, and planting at the Maritime Heritage Park (500 W. Holly St.). Supplies and tools provided. Take water to drink!
- WWU's: Lakewood on Lake Whatcom (rent a kayak, canoe, sailboat) for canoeing, swimming, kayaking, sailing (**For WWU, WCC, and NWIC members only**)
- Whale Watching Cruise (9:30 am – 5:30 pm) http://www.whales.com/Cruises/San-Juan-Adventure-Full-Day-Cruise.aspx
- WWU Campus Tour (self-guided) https://admissions.wwu.edu/visit/tour/self-guided-tour
- WWU Sculpture Tour (self-guided):
  - North Campus - http://westerngallery.wwu.edu/north-campus.shtml
  - South Campus - http://westerngallery.wwu.edu/south-campus.shtml
- Pedal Party Northwest - http://pedalpartynw.com/ (10 people for $250)
- Point Whitehorn Marine Reserve Tour - http://www.co.whatcom.wa.us/DocumentCenter/View/1001
- Mt Baker Geology Tours (https://nwgeology.wordpress.com)
- Whatcom Museum Exhibits (Whatcom and Lightcatcher Bldgs) https://whatcommuseum.org
- Mt Baker – Artist Point drive, hikes
- Birding, Biking, Golfing (Lake Padden Golf Course http://lakepaddengolf.com)

PNW-SETAC
Wednesday Morning Tour

8:00 AM, June 1, 2016

Cherry Point Presentation (Hotel Board Room) and Shoreline Tour

Instructor: **Michael Kyte**, Marine Biologist

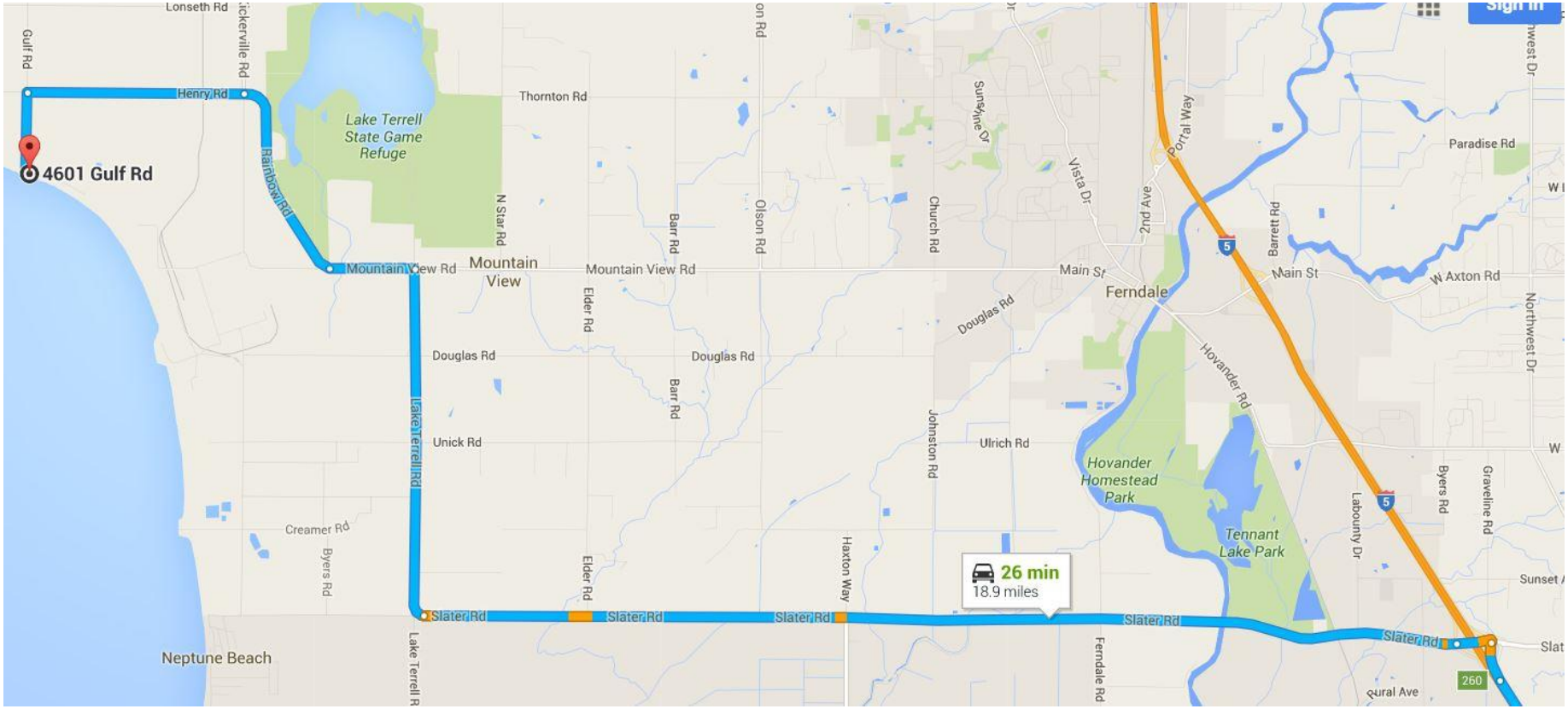
Overview: The Cherry Point shoreline in SE Georgia Strait is unique in the Salish Sea with its combination of extensive and varied natural and anthropogenic history, political controversy, juxtaposition of heavy industry and abundant natural resources, and dynamic physical and biological environments. In approximately 7 miles of shorelines one can find marine terminals of three heavy industries, spawning habitat for a stock of Pacific herring that once was nearly the most abundant in Puget Sound, a notable invasive species that has significantly modified the shoreline, an ancient Native American fishing structure, wastewater outfalls, contaminated sediments adjacent to very clean sediments, nesting bald eagles nearly adjacent to active industrial facilities, heavily used and highly valuable recreational and commercial resources, and more. All this is now contained within an official "Aquatic Reserve" established in 2010 by the WDNR to protect the natural resources of the area.

The initial presentation will provide an overview of the history, controversy, characteristics, and resources associated with this shoreline and adjacent marine, actually estuarine, environments. Our tour will visit at least two sites where we can view many of the characteristics described in the presentation. The first stop will be near the center of the Cherry Point shoreline (**see map on page 5**) where we can see the three active marine industrial terminals and remnants of a fourth. Aspects of the geological and biological environment will be apparent here also including the one tidal marsh present along the Cherry Point shoreline. The second stop will be at Birch Bay State Park on the eastern edge of the Cherry Point Aquatic Reserve where we can view a contrasting aspect of the Cherry Point Reach in the form of a protected bay with extensive eelgrass and shellfish beds. Finally, if time permits, a short walk at a third stop will bring us to an overlook of the northern part of the Cherry Point shoreline where we can view the shoreline and adjacent Georgia Straits and San Juan Island Archipelago. We might even be fortunate enough to see representatives of the resident Orca whales.

Michael Kyte is a marine biologist and semi-retired consultant with over 50 years of experience in marine biota and habitats. While originally from Washington, he has lived and/or worked in western Oregon, Alaska, B.C., and Maine. He attended Everett Community College, obtained a BS in Zoology from the University of Washington, and an MS in Zoology from the University of Maine. He has been studying the marine ecology of the Cherry Point region since 1967 and has conducted numerous studies, including monitoring and impact evaluation on many projects with the local industries since 1984. He has also conducted studies on submerged vegetation, Pacific herring, commercially important Dungeness crabs, contaminated sediments, and other topics.

Site 1: Gulf Road

- Exit from Four Points hotel parking lot using north exit.
- Turn right on Lakeway Dr., get in left lane, and turn left at sign to get on North I-5
- Take Exit 260 and turn left (west) onto Slater Road
- Turn right at Lake Terrell Road
- Turn left at Mountain View Rd that will become Henry Road
- Turn left at Gulf Road and follow roadway to shoreline. Park along the roadway.



PNW-SETAC
Wednesday Afternoon Tour

1:30 PM, June 1, 2016

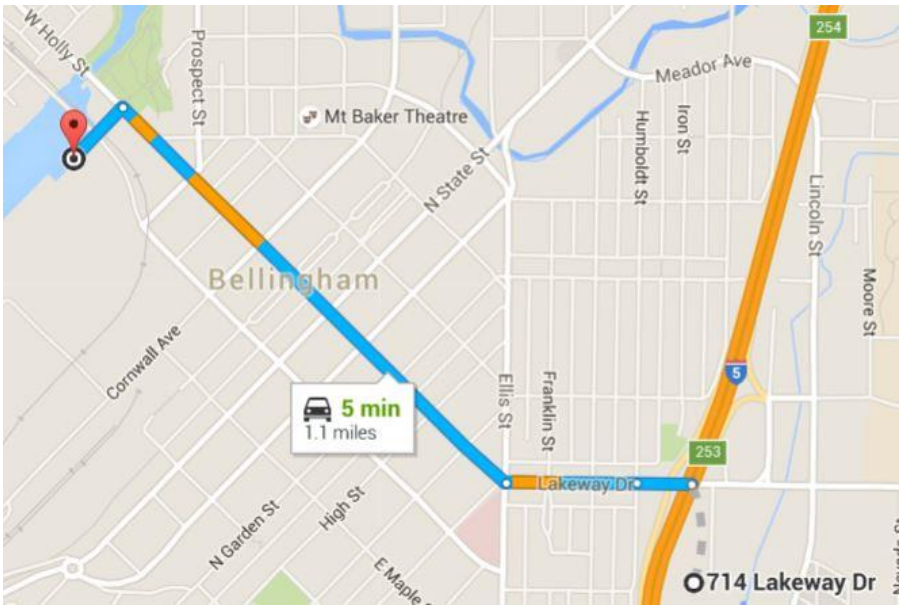
Georgia Pacific Brownfields – Central Avenue Entrance

Instructor: **Brian Gouran**, Port of Bellingham

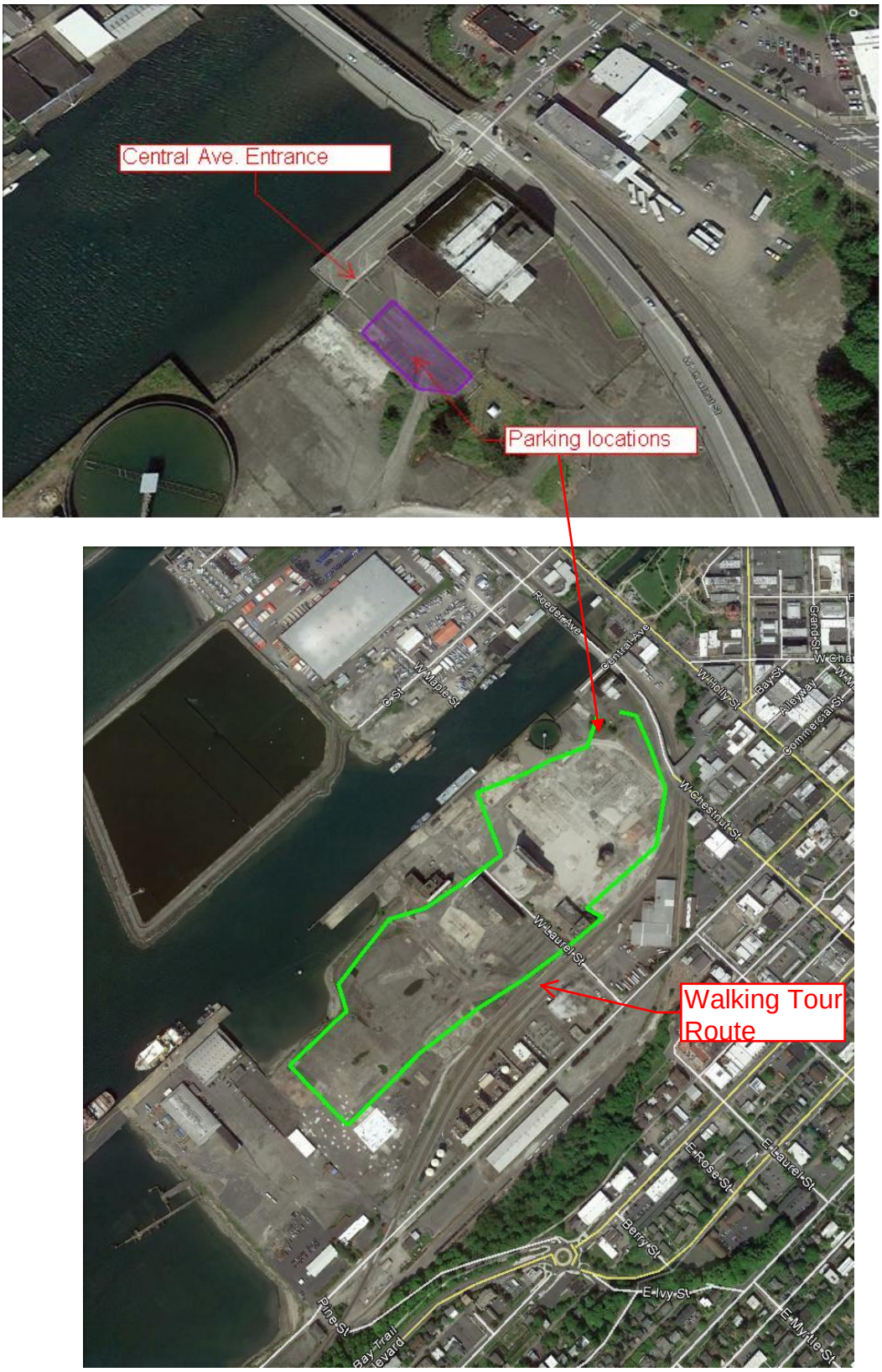
Overview
The Port of Bellingham and City of Bellingham are redeveloping 237 acres on Bellingham's central waterfront that was formerly a pulp and tissue manufacturing facility. A Master Plan has been approved to create a vibrant, mixed-use neighborhood with new parks and trails and thousands of new jobs. This large land area won't change overnight; it will be redeveloped in phases over the next 40-50 years of investment and development before the project is completely finished. This tour will cover clean-up activities that have taken place and planned redevelopment on lands just east of the Whatcom Waterway (see maps on this page and next).

Directions (less than 10 minutes from Four Points)

- Exit hotel through Fred Meyer parking lot to Lincoln St.
- Turn left on Lincoln and at the traffic signal turn left on Lakeway Dr.
- Lakeway Dr. will become Holly St., a one-way street going west.
- Proceed through downtown Bellingham
- Turn left on **Central Ave** and park in the parking lot on the left (see detail on next page).



Satellite View of Georgia Pacific parking location and tour area:



PNW-SETAC
Wednesday Afternoon Short Course

1:30 PM, June 1, 2016

CAFE Database Short Course – Four Points Hotel Board Room

Instructor: **Valerie Chu**, Genwest Systems, Inc./NOAA

Short Course Overview
Every year the National Oceanic and Atmospheric Administration (NOAA) responds to more than a hundred oil and chemical spills in aquatic environments. These spills can severely impact ecosystems by compromising the health of aquatic plants and animals, and their surroundings. NOAA's Emergency Response Division (ERD) developed the Chemical Aquatic Fate and Effects (CAFE) Database, which contains data for hazardous substances, including industrial chemicals, oils, dispersants, and chemically dispersed oils. This tool can aid responders in their assessment of the environmental fate and relative toxicity of the spilled chemical.

CAFE gathers existing data from several databases, as well as from peers, peer-review and gray literature, and required a comprehensive review and standardization process to ensure data quality. These data have been integrated into an interactive tool that facilitates on-the-fly queries. This user-friendly tool is composed of two modules: the Aquatic Fate and Aquatic Toxicity modules. The Aquatic Fate module contains data useful in understanding and predicting chemical behavior in aquatic environments; while the Aquatic Toxicity module contains acute toxicity data for a wide variety of aquatic organisms.

Toxicity data are summarized in the form of Species Sensitivity Distributions (SSDs), which can be used to characterize the potential risks of the spilled chemical to aquatic communities. CAFE contains fate data for 32,377 chemicals, and toxicity data for 4,498 chemicals, oils, dispersants and chemically dispersed oils. CAFE has been designed to allow for users to query toxicity data under different scenarios (chemical, oil only, dispersant only or dispersant and oil). NOAA scientists have successfully used CAFE to help inform the fate and potential effects of spills in aquatic environments. CAFE released its first version 1.1 in July 2015 and will soon be releasing version 1.2.

Attendees will be provided one hour of training using this database and have the rest of the time to work through scenarios.

PNW-SETAC
Thursday Platform Presentations
Morning Session

Thursday, June 2, 2016

9:00	**Welcome & Opening Remarks:**	**Julann Spromberg**, Chapter President **John Toll**, SETAC NA Representative **Fan Wu**, NASAC Rep Fan Wu

Environmental Priorities: Then, Now, and in the Future!

9:20	Mike Johns	Reconsidering Benthic Community Exposure and Trophic Transfer of Contaminants
9:40	Beth Power	A Risk-Ranking Methodology for Prioritizing Historic, Potentially Contaminated Mine Sites
10:00	Cat Curran	Sediment TIEs: What They Tell Us and Why We Do Them
10:20	**Break/Poster Viewing**	
10:40	Ruth Sofield	Education then and now - a reflection on what is different at the Universities
11:00	Frieda Taub	Questionable Decisions of the Past; They Made Sense Then

Climate Change Issues

11:20	Edward Bain	Impacts of Acid Rock Drainage on the Watershed of the Cordillera Blanca, Peru.
11:40	Lara Gaasland-Tatro	Ecological risk assessment for the future: using Bayesian networks to combine climate change projections in a multiple stressor risk assessment.
12:00		**Lunch Provided**

PNW-SETAC
Thursday Platform Presentations
Afternoon Session

Thursday, June 2, 2016

Elementary Toxicology

2:00	Josh Baker	Characterization of the effect of potassium on copper toxicity to rainbow trout
2:20	Diana Dishman	BLM-Based Updates to Copper Water Quality Criteria in Oregon; What is Changing and Why?
2:40	Spencer Morran	Investigating potential growth and reproductive effects of nestling exposure to methylmercury in Zebra Finches (Taeniopygia guttata)
3:00	**Break/Poster Viewing**	

Fate and effects of tiny things

3:40	Gunnar Guddal	Lichen As A Biomonitoring Tool: Analysis of Train Emissions With SEM Imaging and Sequential Extractions
4:00	Mark Surette	Investigating the Role of Surface Coatings in Stabilizing Gold Nanoparticles in Varying Aquatic Environments
4:20	Alyssa Deline	Development of Gold-labeled, Core/Shell Titanium Dioxide Nanoparticles for Tracking Behavior in Complex Media
4:40	Fan Wu	Differential chronic toxicity and uptake of CuO nanoparticle to *Daphnia magna* through altered delivery scenarios

5:00 **Poster Social with refreshments**

6:30 **Chuckanut Bay Sunset Cracked Crab Dinner Cruise**

PNW-SETAC
Friday Platform Presentations
Morning Session

Friday, June 3, 2016

Pesticide Toxicity

9:00	Abigail Nickelson	Evaluating the Effectiveness of Streamside Vegetation as a Mitigation Technique to Reduce Aerially Applied Pesticide Loading to Streams
9:20	Kayla Campasino	Aquatic Refugia: Relevance and Significance in Ecological Risk Assessment
9:40	Kathryn Kuivila	Pesticides in Shorebird Eggs Collected from National Wildlife Refuges in Oregon and Washington
10:00	Benjamin Maki	Arsenic Mobility and Bioavailability in Washington State Soils: An Investigation into the Influence of Hydrous Ferric Oxide, Earthworms, and the Arsenic Hyper-Tolerant *Brassica juncea* on the Fate of Arsenic in Soils

10:20 Break/Poster Viewing

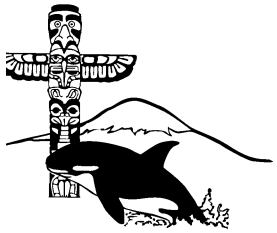
From Cells to Populations – Adverse Outcome Pathways

11:00	Hannah Wear	Cell-based computational model of early ovarian development in mice
11:20	John Stark	Advances in estimating the effects of chemical stressors on populations
11:40	Wayne Landis	Building a Predictive Adverse Outcome Pathway for Acetylcholinesterase Inhibitors for Population Scale Endpoints

12:00 **Lunch Provided**

1:00 to 1:50 PM **PNW-SETAC Business Meeting**

PNW-SETAC
Friday Platform Presentations
Afternoon Session



Friday, June 3, 2016

Impacts of Urban

2:00	Andrew Spanjer	Assessment of Juvenile Salmonid Health Across an Urban Gradient in Western Washington Wadeable Streams
2:20	Michelle Chow	Investigating physiological mechanisms of urban runoff toxicity to juvenile coho
2:40	Scarlett Graham	Predicting Risk to Estuary Water Quality and Patterns of Benthic Environmental DNA in Queensland, Australia using Bayesian Networks
3:00	Kenia Whitehead	Quantitative Integration of Multiple Lines of Evidence: The Use of Likelihood Ratios in Benthic Community Risk Assessment.
3:20	**Break/Poster Viewing**	
3:40	Julann Spromberg	Urban runoff differentially affects coho and chum salmon spawners

Exposures and Human Health

4:00	Tim Crowther	Analytical Testing Requirements for Monitoring Worker Exposure to Arsenic during the Giant Mine Remediation
4:20	Lindsay Du Gas	Make My Heart Go Boom: Potential Human Health Effects of Pentaerythritol Tetranitrate (PETN)
4:20	**Student Award Presentations**	
4:30	**Closing Remarks**	
4:30	**Social with Refreshments**	

PNW-SETAC
Poster Presentations

Presenter(s) (Bolded)	Presentation
Miranda L. Aiken Ruth M. Sofield	Sediment Quality Triad Analysis at a Model Toxics Control Act Site in Anacortes, Washington
Lauren Crandon Fan Wu A.M. Engstrom S.L. Harper	Determining Aggregation Behavior and Corresponding Surface Reactivity of Copper Oxide Nanoparticles using a Rapid Colorimetric Assay
Ben D. Leonard	Remediation Strategies for Wood Debris at a Log Transfer Facility in Southeastern Alaska
Nolan Reese **Jeffrey Pratt** Benjamin Maki Ruth Sofield	The Influence of Phosphate and Arsenic Redox State on Arsenic Toxicity to *Brassica juncea* and *Eisenia fetida*
Brandon Sackmann E.C. Revelas I. Stupakoff	Sediment Profile Imaging (SPI): Advancements in Computer-automated Image Processing and Standardization of Key Measurements
Nicole Seyster **Lindsey Soha** Scott Meyering Benjamin Maki Ruth Sofield	The Influence of Phosphate and Arsenic Redox State on Arsenic Mobility and Bioavailability in Soil
Sharmin Sultana T. Radniecki	Treatment of Landfill Leachate with ANAMMOX Bacteria Cultured in Sequencing Batch Reactors and Membrane Upflow Anaerobic Sludge Blanket Reactor
Lauren Templeton Bernie. Housen Jenise Bauman Troy Abel	Magnetic Biomonitoring of Polluted Trees in South Seattle

PNW-SETAC
Poster Presentations

Presenter(s) (Bolded)	Presentation
Kelsey van der Elst Lauren C. Warner	Summary of Dioxin/Furan Testing in the Dredged Material Management Program: 2010 – 2016
Lindsay K. Wallis C.G. Schmidt R.A. Matthews R.M. Sofield	Determination of Source and Spatial Trends of Black Carbon Deposition on Peruvian Glaciers
Hannah M. Wear M.L Mayo E.J. Perkins N.G. Vinas K.H. Watanabe	Elucidating Molecular Pathways Affected by Aryl Hydrocarbon Receptor-Estrogen Receptor Crosstalk Through Bioinformatics Approaches
Holly R. Young **Henry Cade** **Fischer Young** B. Maki R.M. Sofield	Kinetic and Equilibrium Sorption Modeling of Arsenite and Arsenate onto Lake Whatcom Sediments and Activated Carbon

Pacific Northwest Chapter

Society of Environmental Toxicology and Chemistry

(PNW-SETAC)

25th Annual Meeting

Platform Presentation Abstracts

(In order of presentation)

Reconsidering Benthic Community Exposure and Trophic Transfer of Contaminants

Mike Johns*, Lisa Saban, and Brian Church, Windward Environmental

Since time immemorial (or at least since the late 1980s), the biologically active zone in most sediment investigations has been operationally defined as a depth of up to 15 cm. As a consequence, data used to characterize sediment exposure is based on the chemical concentrations from samples homogenized covering the 15-cm depth horizon. The majority of benthic community members, however, may occupy only a small segment of the operationally defined biologically active zone, resulting in exposure that is far different than the chemical concentrations found in the homogenized 15-cm sample. Often, benthic communities that occupy the upper portion of the surface sediment may be more influenced by the chemical concentrations in the unconsolidated sediment layer (the fluff layer). The linkages between the fluff layer, benthic organism exposure, and fish tissues concentrations are important features in predicting remedy effectiveness. Reliance on the fluff layer as a food source by benthic organisms provides a pathway for chemical transfer to the biota that can be disconnected from the concentrations in the sediment. This presentation will discuss some of our recent work and implications for chemical transfer to upper level trophic organisms.

Contact Author: Mike Johns, Windward Environmental
200 W. Mercer St., Suite 401, Seattle, WA 98119
T: 206-812-5418, mikej@windwardenv.com

Through the Rearview Mirror: Development and Application of a Risk Ranking Methodology for Contaminated Sites

Power, B[*1] and Stewart, G[2]. [1]Azimuth Consulting Group Partnership, Vancouver, BC Canada, [2]Crown Contaminated Sites Program, Ministry of Forests, Lands and Natural Resource Operations, Victoria, BC, Canada.

In 1991, when the PNW SETAC Chapter had its first conference, the US had developed their early risk assessment guidance and Canada's was in progress. Standardization and methods development were a focus throughout the 1990s, into the early 2000s. By the beginning of the current century, risk-based approaches to environmental problems were not only accepted from a regulatory and policy perspective, but encouraged. In 2003, the Government of British Columbia established a new program called the Crown Contaminated Sites Program (CCSP) to manage provincial responsibilities for Crown Lands for sites where no responsible parties exist or can be found (i.e., orphaned and abandoned). In 2006, CCSP undertook to develop a risk ranking approach to prioritize their sites, allowing the Province to focus available resources on the highest risk sites. This paper describes the resulting Risk Ranking Methodology (RRM) and its application over the past decade for a portfolio of mine sites. The RRM uses a risk-based Preliminary Site Investigation to gather key information about the sites. The information for each site is then analyzed and summarized as attributes aimed at characterizing potential health and ecological risks. The summary information (more than 25 attributes) includes generic comparisons of exposure with effects levels (screening quotients) for human and ecological exposure pathways and factors such as: site size, contaminants driving highest screening quotients, indicators for human use and ecological values, and indicators of status of acid rock drainage. The summary information is then used in a workshop setting involving environmental professionals to evaluate relative rankings among sites and to identify subsequent management actions for each site. We describe lessons learned and the role of RRM, not only to rank sites based on risk, but to integrate risk-based thinking into site investigation and management for protection of human health and the environment.

Contact Author: Beth Power, Azimuth Consulting Group Partnership
218-2901 West Broadway, Vancouver, BC V6K 2G8
T: 604-730-1220, bpower@azimuthgroup.ca

Sediment TIEs: What They Tell Us and Why We Do Them

Curran, C.A*. and Bailey, H.C., Nautilus Environmental Company Inc., Burnaby, BC V5A 4N7 Canada

Sediment quality is typically assessed by some combination of benthic community studies, analytical evaluation of contaminants and toxicity, or may be inferred simply on the basis of exceedances of sediment quality guidelines. However, these approaches depend largely on statistical inference (e.g., correlation) and lack demonstration of actual linkages between contaminants and responses. The correlative approach is also limited by the assumption that all contaminants of interest are known prior to the assessment and are included in the suite of analytes measured. In general, toxicity identification techniques can be helpful in terms of delineating general causes of toxicity (e.g., metals, organics) that narrow the focus of the assessment. However, most investigations stop there, with the effects assessment limited by the analytical data available, making it problematic to identify unknown toxicants, multiple causes or contaminant interactions. Often this results in general conclusions regarding cause, with any associated discrepancies and uncertainties attributed to "matrix" effects. This paper describes an approach that allows for identification of causal factors, including unknowns, and demonstrates its application at a complex site with multiple legacy contaminants and more recent inputs, including contaminants of emerging concern.

Contact Author: Howard Bailey, Nautilus Environmental
8664 Commerce Court, Burnaby, BC V5A 4N7
T: 604-420-8773, F: 604-357-1361, josh@nautilusenvironmental.ca

Questionable Decisions of the Past; They Made Sense Then

Taub, F.B. University of Washington, Seattle, WA

Three decisions that appear dumb by today's standards but made sense at the time:

1. Why regulations were based on water samples and not organism concentrations,
2. Why the Toxic Substances Control Act didn't include chemicals that were produced for the purpose of being toxic, and
3. Why ecological systems were excluded, but single species toxicity was used for EPA's decision making.

Contact Author: Frieda Taub, University of Washington
School of Aquatic and Fisheries Sciences
1122 NE Boat Street, Seattle, WA 98105
taub@uw.edu

Impacts of Acid Rock Drainage on the Watershed of the Cordillera Blanca, Peru.

Bain, E.W.*; and Sofield, R.M. Western Washington University, Bellingham, WA

Water is an increasingly valuable and scarce resource due to global population growth, local anthropogenic activity and climate change. Many populations rely on threatened water sources that are at high risk of their supply being reduced both in quality and quantity. In the Ancash region of Peru, a large percentage of the population relies on water coming directly from the Cordillera Blanca mountain range, which is home to the highest density of tropical glaciers globally. This region's population depends on the glacier water for agriculture and drinking water, with little to no treatment. Due to climate change, these glaciers are currently receding and because of the local geology, changes in water quality have been observed. Acid rock drainage, which causes high metal loads and decreases in pH, is one of the consequences of these changes. Two months of sampling these high glacial valleys was an attempt to quantify the magnitude to which the water quality was affected in each valley. At each sampling location, on-site measurements were recorded and water samples collected for analysis through ICP-MS and IC. Geochemist Workbench and Visual MINTEQ with the biotic ligand model were used to predict the toxicity of Cu, Pb, Ni, and Zn. Results were analyzed with non-metric clustering to support which sampled valleys were most likely impacted by the acid rock drainage. Our results complement previous chemical measurements in these valleys and contribute new knowledge of the predicted toxicity.

Contact Author: Edward Bain, Western Washington University
Huxley College of the Environment
516 High St., Bellingham, WA 98225
Baine@students.wwu.edu

Ecological Risk Assessment for the Future: Using Bayesian Networks to combine Climate Change Projections in a Multiple Stressor Risk Assessment

Gaasland-Tatro, L.A.*; and Landis, W.G. Western Washington University, Bellingham, WA

Anthropogenic climate change is causing the earth to warm, and the consequences of warming will be on a continuum for species from extinction to thriving and expanding to larger ranges. There will be winners with climate change and there will be losers, and identifying organisms that management is more effective if we know where it should be targeted early on. Environmental factors and contaminant stressors present in their habitats complicate organisms' responses to climate change. Sites with legacy contaminants, like mercury, that stay in the environment for centuries will need to be managed for the mixed effects of climate change, environmental stressors and contaminants. In this study I used future temperatures from an ensemble of 10 global circulation models downscaled to a 12 km scale to assess the likely climate for 2071-2100. I used these predictions in a Bayesian network relative risk model for the mercury contaminated South River in Virginia, USA. All climate change models predict increased temperatures across the South River. From my ensemble of downscaled climate projections for the South River, I predict that the Carolina wren and the smallmouth bass will have reduced risk with warmer temperatures while the second fish, the white sucker, will have no change. This risk assessment provides early information on likely future conditions for long-term management of the South River. My methods for combining toxicological and climate change stressors in an ecological risk assessment will work for other sites and species. To demonstrate the applicability for a Pacific Northwest river, I created a conceptual model for a risk assessment for salmon in the Columbia River.

Contact Author: Lara Gaasland-Tatro, Western Washington University
Institute of Environmental Toxicology
516 High Street, Bellingham, WA 98225
T: 360-584-3082, gaasland@gmail.com

Characterization of the Effect of Potassium on Copper Toxicity to Rainbow Trout

Baker, J.A.*; Lucas, B.T.; Curran, C.A.; Elphick, J.R.; and Bailey, H.B. Nautilus Environmental Company Inc., Burnaby, BC

Copper is omnipresent in freshwater environments, with its dissolved ionic form (Cu^{2+}) being of toxicological importance. Regulatory bodies have developed water quality criteria for copper based on dissolved copper concentrations and have accounted for numerous modifying factors through the use of the Biotic Ligand Model (BLM), which is used to predict copper bioavailability and in turn toxicity. Deleterious effects of Cu^{2+} have been demonstrated on numerous cellular mechanisms of freshwater fish but the strongest evidence has been presented for the disruption of ionoregulation at the sodium-potassium transmembrane pump (e.g., reduced activity of the Na^{+}/K^{+} ATP-ase required to provide energy for the proper function of the pump). Despite the featuring role of Na-K channels in Cu^{2+} toxicity, work exploring the effect of freshwater K^{+} concentrations on Cu^{2+} toxicity is limited, although suggestive of a strong interaction. Our preliminary results from toxicity tests with rainbow trout suggest a synergism between concentrations of K^{+} and Cu^{2+} and a potential real-world example of their toxicological interactions. These data may also have implications to the BLM and olfactory effects to salmonids.

Contact Author: Josh Baker, Nautilus Environmental
8664 Commerce Court, Burnaby, BC V5A 4N7
T: 604-420-8773, F: 604-357-1361, josh@nautilusenvironmental.ca

BLM-Based Updates to Copper Water Quality Criteria in Oregon; What is Changing and Why?

Dishman, D.L. Integral Consulting Inc., Portland, OR

Elevated copper concentrations in surface waters can be toxic to aquatic organisms. The Clean Water Act directs delegated states to develop and enforce water quality criteria that protect sensitive organisms from acute and chronic toxicity. Water quality standards for copper adopted by Oregon in 2004 were rejected by EPA in 2013 when they were determined to be inadequate to protect ESA-listed species. EPA instead required that Oregon adopt criteria based on the Biotic Ligand Model (BLM), promulgated by EPA in 2007. The BLM incorporates 11 water quality parameters (i.e., temperature, pH, dissolved organic carbon, and several geochemical ions) to estimate the bioavailability of copper in calculating water quality criteria. The Oregon Department of Environmental Quality (ODEQ) is developing a rule and has published draft technical guidance to support implementation of the BLM as the state's copper water quality criteria. If approved, this rule would be the first of its kind to be adopted state-wide in the U.S. Simultaneously, EPA has proposed a rule for copper in Oregon intended to adequately protect sensitive species until ODEQ can implement a rule approved by EPA. Although both rules mandate use of the BLM to derive copper criteria, the methods proposed by ODEQ and EPA and their outcomes differ substantially. One key difference is between EPA and ODEQ approaches to deriving regional default parameter values used to calculate copper criteria when data are missing. A comparison of technical methods and assumptions between these proposed rules will be presented, as well as a discussion of potential changes to how discharge permit limits are set and how waterbodies are determined to be impaired in Oregon.

Contact Author: Diana Dishman, Integral Consulting Inc.
319 SW Washington St, Suite 1150, Portland, OR 97204
T: 503-943-3619, F: 503-284-5755, ddishman@integral-corp.com

Investigating Potential Growth and Reproductive Effects of Nestling Exposure to Methylmercury in Zebra Finches (Taeniopygia guttata)

Morran, S.A.M.*[1]; Eng, M.L.[2]; Williams, T.D.[1]; and Elliott, J.E.[3]. [1] Simon Fraser University, Burnaby, BC, [2] University of Saskatchewan, Saskatoon, SK, [3] Environment Canada, Science and Technology Branch, Delta, BC.

Methylmercury is a widespread contaminant that has been shown in multiple studies to cause behavioural and reproductive effects on piscivorous birds. It has been previously thought that birds that do not feed on fish (such as passerines) are not at risk for methylmercury toxicity. However, in recent years high blood mercury levels have been found in free living passerines. This has opened up a new area of study for methylmercury toxicity in avian species. Of the few previous studies on passerine species, most of them are lifetime exposure studies. Our lab's goal is to do shorter term exposures at different life stages using Zebra Finches (*Taeniopygia guttata*) as a model species to determine which stages are most sensitive. In the current study, the nestling stage was the target. Chicks hatched from clean (non-mercury exposed) parents were dosed with methylmercury (water only, 0.063 ug/ul, or 0.15 ug/ul per gram of body weight per day) from days 1 to 21 post hatch. This dosing period was used to simulate exposure from food provisioning by the parents. Growth of the chicks were measured until age 30, which is when they are considered independent. Despite a dose response relationship shown in our blood mercury analyses, no effects of dose were found for growth of the chicks. Once the chicks were over 90 days old (sexual maturity), mating trials with song recordings were conducted on the males while breeding experiments were conducted on the females. There were also no treatment effects found for male mating trials and song analyses or the female breeding trials. The lack of treatment effects in these experiments indicate that the nesting stage might be less sensitive in passerines, likely due the methylmercury burden being transferred to the growing feathers.

Contact Author: Spencer Morran, Simon Fraser University
8888 University Dr, Burnaby, BC V5A 1S6, Canada
T: 778-782-4502, smorran@sfu.ca

Lichen as a Biomonitoring Tool: Analysis of Train Emissions with SEM Imaging and Sequential Extractions

Guddal, T.G.*; Cade, H.T.; and Sofield, R.M. Western Washington University, Bellingham, WA

Epiphytic lichen have advantages in biomonitoring due to their sensitivity to air pollution, global distribution, and ease of use. In this study we attempt to extend the application of lichen as a biomonitoring medium by using sequential extractions and scanning electron microscope (SEM) with back-scatter electron (BSE) detector images to characterize exposure to train emissions. To do this, *Ramalina farinacea* were suspended in mesh bags on an uphill gradient 9.8 to 88.4 m from an active train track for four months. BSE images were produced of the lichen cortex, and processed with ImageJ to characterize particles by atomic mass, size, shape, and distribution within quadrats. A four-step sequential extraction was also performed to identify metal distribution in and on the lichen. Initial results show a greater density of diesel specific particles close to the tracks based on morphological and elemental profiles using BSE images and energy dispersive x-ray (EDX) spectroscopy. The SEM and sequential extraction data will be compared to MDA, chlorophyll degradation, and community structure endpoints from a previous study for additional understanding of these effects. Trends in particle distribution will also give insights on train emissions not associated with diesel engines.

Contact Author: Gunnar Guddal, Western Washington University
Huxley College of the Environment
516 High Street, MS 9079, Bellingham, WA 98225
T: 360 650-3520, F: (360) 650-2842, theothergunnar@gmail.com

Investigating the Role of Surface Coatings in Stabilizing Gold Nanoparticles in Varying Aquatic Environments

Surette, M.C.*; Dondick, A.R.; and Nason, J.A. Oregon State University, Corvallis, OR

The use of engineered nanomaterials (ENMs) is increasing worldwide and currently are found in a variety of consumer goods (*e.g.*, paints, plastics, and cosmetics). Due to the nature of their use, ENMs enter natural surface water environments, such as lakes, rivers and estuaries via point sources (*e.g.*, wastewater treatment systems) and non-point sources (*e.g.*, soils amended with ENM-containing biosolids). Recent modeling studies indicate that the environmental fate of ENMs in aquatic environments is strongly tied to their potential to aggregate with other ENMs (homoaggregation) and natural colloids (heteroaggregation). By influencing the environmental fate of ENMs, these dynamic and complex interactions can alter the potential risk posed by these materials. Currently, the mechanisms governing these interactions are poorly understood. One challenge researchers face is to understand how engineered surface coatings, typically applied to promote a desired behavior during their use, can alter those interactions. To address this challenge, this research investigated the role that common surface coatings have upon ENM stability (*i.e.*, the ability to resist aggregation) under complex, environmentally relevant conditions. Aggregation of gold-core nanoparticles (AuNPs) coated with various functionalized forms of polyethylene glycol (PEG, PEG-COOH, and PEG-Amine) and branched polyethylenimine (bPEI) were assessed in a range of environmentally relevant mediums; *e.g.*, pH 6-10 with varying ionic strengths and ion valence. This research also investigated the interactions of the ENMs with natural organic matter (NOM), a common macromolecule that is ubiquitous in natural aquatic environments. Initial findings suggest that surface coating can play a significant role in ENM stability across a wide range of aquatic chemistries. For example, results show that bPEI can stabilize ENMs in high ionic strength solutions, however, in the presence of NOM, bPEI-coated ENMs were found to aggregate at conditions typical of natural waters.

Contact Author: Jeffrey A. Nason, Oregon State University
School of Chemical, Biological, and Environmental Engineering
102 Gleeson Hall, Oregon State University, Corvallis, OR 97331-2702
T: 541-737-9911 F: 541-737-3099 Jeff.Nason@oregonstate.edu

Development of Gold-labeled, Core/Shell Titanium Dioxide Nanoparticles for Tracking Behavior in Complex Media

Deline, A.R.*; Young, W.M.; and Nason, J.A. Oregon State University, Corvallis, OR.

Titanium dioxide nanoparticles (TiO_2 NPs) are produced in large quantities for multiple consumer and industrial applications, many of which lead to the direct release of these materials into natural and engineered systems. Understanding the behavior and environmental effects of TiO_2 NPs is critical, but researchers must first overcome the challenge of distinguishing engineered NPs from high concentrations of naturally occurring titanium. To facilitate better detection and quantification of TiO_2 NPs in complex systems, gold-labeled core/shell TiO_2 NPs were developed. These particles were prepared using a seeded-growth synthesis and coated with TiO_2 by hydrolyzing titanium isopropoxide on particle surfaces. The properties and behavior of the particles were compared with those of unlabeled TiO_2 NPs with the goal of minimizing differences by modifying synthetic methods. The Au@TiO_2 NPs were accurately distinguished from background Ti and quantified at a concentration of 1.5 ppb Ti using the known gold-to-titanium ratio of the labeled particles. Ongoing spike-and-recovery experiments in natural water samples are designed to demonstrate the utility of labeled particles in environmentally-relevant matrices.

Contact Author: Alyssa Deline, Oregon State University
School of Chemical, Biological, and Environmental Engineering
103 Gleeson Hall, Corvallis, OR 97331-8528
T: 209-631-7949, F: 541-737-4600, delinea@oregonstate.edu

Differential Chronic Toxicity and Uptake of CuO Nanoparticle to *Daphnia magna* Through Altered Delivery Scenarios

Wu, F.[1*]; Bortvedt A.E.[1]; Crandon L.E.[1]; Harper B.J.[1]; and Harper S.L.[1,2]. [1]Oregon State University, Corvallis, Oregon, [2]Oregon Nanoscience and Microtechnologies Institute, Eugene, Oregon

Copper oxide nanoparticles (CuO NPs) are highly toxic to aquatic species and their extensive use results in inevitable release into surface water. Currently, few studies have addressed whether CuO NPs can be transferred through the aquatic food chain. Here, we investigated the uptake and trophic transfer of CuO NPs from the algae *Chlorella vulgaris* to *Daphnia magna*. We hypothesized that CuO NPs can be associated with algae cells and transported to predators through feeding exposure and that the chronic toxicity will be altered when compared to a direct CuO NP exposure. We observed strong surface associations and potential internalization of CuO NPs into the algae using hyperspectral imaging, and quantified the uptake with ICP-OES. Algae exposed to CuO NPs were fed to *D. magna* and toxicity and Cu uptake were evaluated. A parallel group of *D. magna* were directly exposed with equivalent concentrations of CuO NPs while being fed unexposed algae. We found that CuO NPs delivered through a feeding exposure significantly reduced neonate production compared to control. Significantly higher *D. magna* mortality was found in the direct exposure compared to the feeding exposure, which is likely due to the decrease of surface reactivity of nanoparticles caused by algae-particle hetero-aggregation. High concentrations of Cu were found in *D. magna* bodies and molted carapaces in both exposure scenarios, suggesting that CuO NPs were taken up by *D. magna* and are likely to be regulated through molting. We detected Cu in the neonates produced in the feeding exposure, but not the direct exposure, implying that *D. magna* may metabolize CuO NPs differently depending on the method of delivery. Thus, nanoparticle interaction with biota at one trophic level may alter the biological response to that nanoparticle at the next trophic level, and in a way that is dependent on different delivery scenarios.

Contact Author: Fan Wu, Oregon State University
1087 Agriculture and Life Science Building, Corvallis, OR 97331
T: 541-737-3971, wufa@oregonstate.edu

Evaluating the Effectiveness of Streamside Vegetation as a Mitigation Technique to Reduce Aerially Applied Pesticide Loading to Streams

Bahr, G.[1]; Bischof, M.[1]; Coffey, T.[2]; Demory, J.[1]; Drennan, M.[1]; Hancock, J.[1]; Tuttle, G.[1]; McLain, K.[1]; and **Nickelson, A.***[1]. [1]Washington Department of Agriculture, Olympia, WA [2]Washington State University, Pullman, WA

The National Marine Fisheries Service 2015 Biological Opinion on the registration of diflubenzuron, fenbutatin oxide, and propargite discussed opportunities for agricultural producers to receive reduced no-spray buffers where vegetative filter strips or riparian areas are in place to reduce pesticide loading to surface water. In 2015 WSDA conducted an edge of field monitoring study in Whatcom County, WA, to assess the effectiveness of riparian vegetation to reduce insecticide loading to surface water following aerial malathion applications on blueberries. Sites without dense woody vegetation were used as controls and compared to sites with established riparian vegetation communities. Riparian vegetation and channel geometry were characterized at 2 control and 3 vegetated sites. Eight aerial applications were monitored (4 at control and 4 at vegetated sites). Pesticide movement was assessed using depositional samplers placed on 6 transects running perpendicular to the stream at each site. Depositional samples were collected one hour after the pesticide application at the crop edge, the edge of the riparian vegetation facing the field, and in the center of the stream. Composite water samples were collected at each upstream and downstream location throughout the duration of the application and after completion. Field data

regarding pesticide application methodology, and weather conditions were also collected at all application events. Analysis confirmed that instream malathion deposition was significantly lower at vegetated sites than at control sites. In addition, increasing distance from edge of crop (both to vegetation and to water) and increasing canopy angle and canopy cover all resulted in statistically significant reductions in malathion deposition. This study provides evidence supporting the effectiveness of riparian vegetation at reducing drift into streams from aerial pesticide applications and therefore supports reduced no-spray buffers.

Contact Author: Abigail Nickelson, Washington State Department of Agriculture
Natural Resources Assessment Section, Office of the Director
PO Box 42560, Olympia, WA 98502-2560
T: (509)895-9338, Anickelson@agr.wa.gov

Aquatic Refugia: Relevance and Significance in Ecological Risk Assessment

Campasino, K.C.*; Giddings, J.M.; Campana, D.C. Compliance Services International, Lakewood, WA

Aquatic environments may receive unintentional exposure to pesticides applied to nearby agricultural fields. Ecological risk assessment (ERA) is a necessary tool for estimating the potential for adverse effects to aquatic ecosystems and associated biota, and is a requirement of the pesticide registration process. Current exposure models utilized in aquatic ERA assume a homogenous pesticide distribution within a water body, and effects analyses are based on standardized laboratory toxicity studies. While this approach utilizes the best available data and conservative assumptions, a more realistic approach could incorporate the influence of habitat refugia on exposure and recovery of aquatic organisms to estimate risk. Habitat refugia result from spatial and/or temporal variations in pesticide concentrations within an aquatic environment, creating areas or times where organisms may experience lower exposure concentrations compared to the water body as a whole. Additionally, uneven pesticide distributions within an aquatic environment allow species to recolonize heavily affected areas from less affected areas. These spatial and temporal variations may occur due to a variety of factors, including environmental heterogeneity, physicochemical properties of compounds, and environmental fate of compounds. For example, the hydrophobic nature of pyrethroids causes these compounds to sorb to aquatic macrophytes and sediments, rapidly reducing the bioavailable concentration in the water column. This presentation will discuss these phenomena in detail, using peer reviewed literature consisting of field and mesocosm studies. Future directions regarding the inclusion of refugia into ERA will also be discussed.

Contact Author: Kayla Campasino, Compliance Services International
7501 Bridgeport Way West, Lakewood, WA 98499
T: 253-473-9007, F: 253-473-2044, kcampasino@complianceservices.com

Pesticides in Shorebird Eggs collected from National Wildlife Refuges in Oregon and Washington

Kuivila, K.M.*[1]; Eagles-Smith, C.A.[2]; and Hladik, M.L.[3]. [1]US Geological Survey, OR Water Science Center, Portland, OR, [2]US Geological Survey, Forest and Rangeland Ecosystem Science Center, Corvallis, OR, [3]US Geological Survey, CA Water Science Center Sacramento, CA.

Shorebirds breeding in wildlife refuges in the western US can be exposed to current-use and legacy pesticides from surrounding agricultural fields and water bodies, which may result in toxicological risk to reproduction. Shorebird eggs were collected from active nesting sites at Hanford, Umatilla, and Malheur National Wildlife Refuges in Washington and Oregon, USA. Pesticide use, both current and historical, on the refuge and surrounding landscape varied among the three locations. The three shorebird species sampled (Long-billed Curlews, American Avocets, and Black-necked Stilts) have different diets and life histories that may also influence pesticide exposure. In particular, curlews nest and forage in the surrounding agricultural fields, whereas the other two species nest in marshes that often are adjacent to agricultural fields. Embryo age was estimated in the field using the egg floating technique and length, breadth and weight of each egg was measured. Contents of the eggs were removed and stored at −20°C until freeze-dried. For pesticide analysis, samples were extracted with a mixture of acetonitrile, hexane, water and salt. The acetonitrile layer was removed and cleaned up with 300 mg Z-sep+ and 900 mg of magnesium sulfate. The extract was split into two fractions for analysis: one fraction (still in acetonitrile) by LC/MS/MS and the other (solvent-replaced into ethyl acetate) by GC/MS/MS. In total, the eggs were analyzed for over 100 current-use and legacy pesticides and metabolites. This diversity of life histories (terrestrial vs. aquatic) among species may result in differences in egg-residue concentrations and help resource managers better understand casual linkages between pesticide use, residuals retained on terrestrial landscapes, and residuals processed through the aquatic food web. Future work will assess potential effects of pesticides on reproduction in shorebirds and other avian species.

Contact Author: Kathryn Kuivila U.S. Geological Survey
2130 SW 5th Avenue, Portland, OR 97201
T: (503) 251-3257, F: (503) 251-3470, kkuivila@usgs.gov

Arsenic Mobility and Bioavailability in Washington State Soils: An Investigation into the Influence of Hydrous Ferric Oxide, Earthworms, and the Arsenic Hyper-Tolerant *Brassica juncea* on the Fate of Arsenic in Soils

Maki, B.C.*; Hodges, K.R.; Ford, S.C.; and Sofield, R.M. Western Washington University, Bellingham, WA

Throughout the early to mid-1900's the pesticide lead-arsenate (LA) was applied to apple and pear orchards in Washington State with increasing frequency to combat orchard pests until its use was halted in the late 1940's with the onset of DDT. This application has resulted in elevated concentrations of residual arsenic contamination in old orchard topsoil with concentrations reaching upwards of 350 mg As/kg soil and an estimated 187,590 acres of potentially contaminated land in Washington. Iron oxides have been indicated to be a key factor in modulating the fate and transport of arsenic in the soil environment. We employed a factorial design to investigate the role of a specific iron oxide, hydrous ferric oxide (HFO), and soil organisms on the mobility and bioavailability of As (III) in locally collected soils. The majority of arsenic in our test soils was contained in the residual fraction (91% -96.5%), with between 3.4% and 8.8% of arsenic in fractions 1, 2 and 3 summed (indicating water soluble, lightly reducible and lightly oxidizable species, respectively). Concentrations of arsenic in leachate, plants and worms combined were ≤ 0.084% of total arsenic in each test condition. Earthworms in soils amended with both arsenic and HFO had 53.83% lower arsenic tissue concentrations when compared to samples from soils amended only with arsenic. Similarly, reductions in arsenic leachate concentrations and plant tissue concentrations were observed, however this was with a reduced magnitude and significance when

compared to decreases in earthworm tissue concentrations. The lack of significance of HFO in three of the leachate models and for plant bioavailability indicates that the role of HFO in arsenic mobility and bioavailability is more complicated than can be explained by the simple addition of HFO.

Contact Author: Benjamin C. Maki, Western Washington University
Department of Environmental Toxicology
516 High St. Bellingham, WA 98225
T: (360) 650-2847, F: (360) 650-7284, Benmaki1@gmail.com

Cell-based Computational Model of Early Ovarian Development in Mice

Wear, H.M.*; Eriksson, A.; and Watanabe, K.H. Oregon Health & Science University, Portland, OR

Normal development of reproductive organs is crucial for successful reproduction. In mice, the early ovarian developmental process occurs predominantly during the prenatal period and is regulated through a series of molecular signaling events. Exposure to reproductive toxins or other harmful perturbations during this period can lead to adverse reproductive outcomes in females. Computational models offer tools for predicting such potential unfavorable effects. Interestingly, a computational model simulating the normal cellular and molecular signaling interactions of ovarian development in mice does not exist. We hypothesized that a cell-based model for early ovarian development constructed using data from primary literature would simulate morphological changes and predict unknown cellular interactions. We have developed computational models to simulate early ovarian development in mice using Compucell3D software. The first phase of the model simulates the origin and proliferation of primordial germ cells (PGCs), chemoattractant signaling, and PGC migration to the gonadal ridge. The second phase shows the proliferation of PGCs, formation of germ cell nests, and breakdown of germ cell nests to form primordial follicles. Model accuracy and parameter sensitivity were evaluated using cell counts and visual comparison between simulation outputs and immunohistochemistry fluorescent and histological images from the literature. Temporal cell abundancies and cell structures are consistent with what has been observed in previous studies. When real data were absent, parameters were adjusted to reproduce observed biological outcomes, predicting unknown cellular interactions underlying development. For example, our model predicts that germ cell nest breakdown is due to change in the regulation of adhesion factors. In addition, the models serve as tools to assist with predictions of adverse reproductive outcomes due to perturbations at the cellular and molecular level. Adverse outcome pathways can be evaluated by adjusting parameters with data from in vitro studies to predict overall effects to the development of the mouse ovary.

Contact Author: Hannah Wear
Institute of Environmental Health at Oregon Health & Science University
Mail Code HRC3, 3181 SW Sam Jackson Park Road
Portland, OR 97239-3098
Tel: 503 346-3419, Fax: 503 346-3427, wearh@ohsu.edu

Advances in Estimating the Effects of Chemical Stressors on Populations

Stark, J.D. Washington State University, Puyallup, WA

Historically, point estimates such as the median lethal concentration (LC50) have been instrumental in assessing risks associated with toxicants to rare or economically important species. In recent years, growing awareness of the shortcomings of this approach has led to an increased focus on analyses using population endpoints. However, risk assessment of pesticides still relies heavily on large amounts of LC50 data amassed over decades in the laboratory. Despite the fact that these data are generally well replicated, little or no attention has been given to the sometime high levels of variability associated with the generation of point estimates. This is especially important in agroecosystems where arthropod predator–prey interactions are often disrupted by the use of pesticides. Using laboratory derived data of 4 economically important species (2 fruit fly pest species and 2 braconid parasitoid species) and matrix based population models, a method for bridging traditional point estimate risk assessments with population outcomes will be presented. The results illustrate that even closely related species can show strikingly divergent responses to the same exposures to pesticides. Furthermore, it will be shown that using different values within the 95% confidence intervals of LC50 values can result in very different population outcomes, ranging from quick recovery to extinction for both pest and parasitoid species. The implications of these results and the need to incorporate variability and uncertainty in point estimates for use in risk assessment will also be discussed.

Contact Author: John D. Stark, Washington State University
Puyallup Research and Extension Center
2606 W Pioneer, Puyallup, WA 98371
T: 253-455-4568, starkj@wsu.edu

Building a Predictive Adverse Outcome Pathway for Acetylcholinesterase Inhibitors for Population Scale Endpoints

Landis, W.G.*[1]; Graham, S.E.[1]; Stark, J.D.[2]; and von Stackelberg, K.E.[3]. [1]Western Washington University, Bellingham, WA, [2]Washington State University, Puyallup, WA; [3]Harvard University, Boston, MA

Adverse outcome pathways (AOPs) are linear acyclic models to describe the interaction of a toxicant with the molecular, cellular, organs and eventually the organism. Currently AOPs do not predict population scale effects. This paper presents how to describe the AOP framework using a Bayesian network to describe interactions at each biological scale to derive the key parameters for estimating population dynamics. These population parameters are survival and timing to first reproduction, survivorship between age classes, and reproduction at each age class. Bayesian networks are parameterized to include molecular interactions including synergistic and antagonistic effects. Age structured population models are used to incorporate ecological context including carrying capacity, density dependent or independent population control, and patch dynamics. Our pilot models are the effects of organophosphate acetylcholinesterase inhibitors both singly and in mixtures to Chinook salmon. We use the runs in the Pacific Northwest as the ecological setting. Supported by USEPA STAR Grant RD-83579501.

Contact Author: Wayne Landis, Western Washington University
Institute of Environmental Toxicology, Huxley College of the Environment
516 High St., Bellingham, WA 98225-9180
T: 360-650-6136, wayne.landis@wwu.edu

Assessment of Juvenile Salmonid Health Across an Urban Gradient in Western Washington Wadeable Streams

Spanjer, A.R.*[1,2]; Moran, P.W.[2]; and Beauchamp, D.A.[1,3]. [1]University of Washington, Seattle, WA, [2]US Geological Survey WAWSC, Tacoma, WA, [3]US Geological Survey WFRC, Seattle, WA.

The US Geological Survey (USGS) National Water-Quality Assessment Program conducted a regional assessment of water and habitat quality at 88 streams throughout the Puget Sound region during spring of 2015. As a part of this assessment the USGS program aimed to develop a fish health index to supplement their traditional ecological and water quality metrics. The intent is to identify mechanistic links between water quality and biological effects (exposure and/or harm) in salmonids throughout the Puget Sound region at perennial stream sites across a gradient of urban impact. Metrics for the fish health assessment include: size at age per degree day, average growth rate per degree day, energy content, field necropsy scoring, and the expression of 12-24 biomarker genes for toxicant exposure. Additionally, a bioenergetics framework is being used to place observed contaminant effects in the context of expected growth given site-specific environmental conditions. Field sampling concluded at the end of September. Currently, next-generation sequencing methods are being used to characterize differential gene expression between study sites and to identify biomarkers indicative of toxicant exposure. Presented here is the study design, field sampling and initial laboratory results.

Contact Author: Andrew Spanjer, University of Washington
School of Aquatic and Fisheries Sciences
PO Box 355020, 1122 NE Boat Street, Seattle, WA 98105
T: 360-318-3111, aspanjer@uw.edu

Investigating Physiological Mechanisms of Urban Runoff Toxicity to Juvenile Coho

Chow, M.I.*[1]; McIntyre, J.K.[2]; Young, G.[1]; and Scholz, N.L[3]. [1]University of Washington, Seattle, WA, [2]Washington State University, Puyallup, WA, [3]NOAA Northwest Fisheries Science Center, Seattle, WA

Urban runoff is a primary source of contamination into Puget Sound due to its ability to quickly mobilize a diverse mixture of contaminants. A decade of field observations have linked urban runoff to prespawn mortality (PSM) in adult coho salmon. Experimental exposures to urban runoff can replicate prespawn mortality symptoms and cause adult coho mortality within 4 hours. This study intended to 1) identify if juvenile coho are similarly affected by urban runoff, 2) characterize behavioral symptoms of PSM, and 3) investigate PSM physiological mechanisms. Juvenile coho were exposed to urban runoff and sampled in a time series throughout the exposure. Arterial blood was analyzed using a point-of-care blood analysis tool to measure several blood chemistry parameters. Initial blood analyses showed significant changes between control and urban runoff exposed juveniles, suggesting that urban runoff is causing metabolic acidosis in exposed fish. Additionally these changes in juvenile blood chemistry were similar to the blood chemistry of adult coho exposed to urban runoff.

Contact Author: Michelle Chow, University of Washington
School of Aquatic and Fisheries Sciences
1122 NE Boat Street, Seattle, WA 98105
mchow01@uw.edu

Predicting Risk to Estuary Water Quality and Patterns of Benthic Environmental DNA in Queensland, Australia using Bayesian Networks

Graham, S.E.*[2]; Chariton, A.A.[1]; and Landis, W.G.[2]. [1]CSIRO Land and Water, Lucas Heights, NSW, Australia, [2]Western Washington University, Bellingham, WA

Risk assessment and predictive modeling can inform natural resource management by demonstrating stressor-response pathways and quantifying the effects on selected endpoints. For this study, Bayesian networks (BNs) and the Relative Risk Model were used to develop a multiple stressor risk assessment to predict both risk to estuary water quality and patterns in benthic communities in a single integrated assessment. Similar to other coastal areas globally, Southeast Queensland (SEQ) is a highly developed region in which nutrient and sediment loading from anthropogenic activities are major stressors to water quality and biota. The combination of runoff from heavy rainfall, excess nutrients and organic matter cause phytoplankton blooms and eutrophication with depressed oxygen levels and changes in aquatic communities. Water quality objectives have been developed in to assess the condition of estuaries and guide management actions. BN risk assessment models were developed for three different estuaries in SEQ that estimated the probability of exceeding those objectives in sub-regions of the estuaries. The response of eukaryotic benthic communities to estuarine water quality was also modeled and endpoint response was synthesized. The benthic community data were collected via DNA metabarcoding where DNA is collected from environmental media (such as soil, sediment or water), sequenced, and identified using online databases. The methodology of building the models, current findings, and future use of the models for adaptive management will be presented.

Contact Author: Scarlett Graham, Western Washington University
Institute of Environmental Toxicology, 516 High Street, Bellingham, WA 98225
T: 360-650-6136, grahams7@students.wwu.edu

Quantitative Integration of Multiple Lines of Evidence: The Use of Likelihood Ratios in Benthic Community Risk Assessment.

Whitehead, K.*[1]; and Nielsen, D.[2] [1]Integral Consulting Inc., Olympia WA, [2]Integral Consulting Inc., Seattle WA

Decision processes used to integrate multiple lines of evidence frequently rely on categorical scoring systems or other qualitative assessment techniques. We present the use of statistical likelihood analysis which allows an objective, quantitative, and easily interpretable determination of the likelihood of community impairment from several independent lines of evidence. Likelihood analysis evaluates the relative probabilities that the observed community condition is representative of either an unimpaired or an impaired condition. Further, the results from each line of evidence or biological response can be quantitatively combined. In the context of evaluating the benthic community of a complex marine or estuarine site, the response to multiple stressors is ordinarily broken down into specific benthic infauna measures, such as abundance, richness, and dominance and/or evaluated via toxicity tests. Likelihood-based statistical methods provide a direct assessment of the relative probability that each of these measures indicates impairment and provides a means for their quantitative integration. The results are then interpreted in the context of chemical and environmental stressors (*e.g.* salinity, temperature or other water quality parameters). We will present the findings from likelihood analysis of benthic assessment data to form quantitative lines of evidence for benthic impairment and the integration of those results with synoptically collected sediment chemistry. In addition, the advantages and challenges of the approach as well as how the determined impairment relates to stressor information will be discussed. In the context of evaluating the benthos of a complex marine and estuarine site to multiple stressors, likelihood-based

statistical methods provided a direct measure of the evidence that each benthic line of evidence indicates impairment.

Contact Author: Kenia Whitehead, Integral Consulting Inc.
1205 West Bay Drive NW, Olympia, WA 98502
T: 360-705-3534 ext. 428, F: 360-705-3669, kwhitehead@integral-corp.com

Urban Runoff Differentially Affects Coho and Chum Salmon Spawners

McIntyre, J.K.[1] ; **Spromberg, J.A.***[2]; Cameron, J.[2]; Lundin, J.[2], Davis, J.[3], Stark, J.[1] and Scholz, N.L.[2]
[1] Washington State University, Puyallup, WA, USA. [2]NOAA NMFS/NWFSC, Seattle, WA USA. [3]US Fish and Wildlife Service, Lacey, WA USA.

In areas of the Salish Sea watershed with elevated vehicular traffic density, stormwater runoff causes pre-spawning mortality (PSM) in adult coho salmon (*Oncorhynchus kistuch*). Within a few hours of exposure, symptoms progress from lethargy and disorientation to loss of equilibrium, immobility, and eventually death. Although we do not know the precise cause of PSM, we previously determined that coho PSM is linked to storm events. Chum salmon (*O. keta*) spawning runs often overlap with coho. To determine whether chum are similarly susceptible to PSM, we co-exposed pre-spawn adult coho and chum to urban road runoff or well water in controlled exposures for 6 storm events. We monitored water quality and individual behavior throughout exposure. Exposures were terminated after 4 h or when fish became symptomatic. Only coho exposed to runoff became symptomatic. Across the 4-h exposure, chum appeared behaviorally unaffected by urban runoff. Furthermore, we employed a point-of-care blood analysis tool to measure a variety of blood parameters including ion concentrations and gases, pH, hematocrit, glucose, and lactate. Multiple blood chemistry parameters were affected in runoff-exposed coho compared to control coho. In contrast, chum exposed to runoff were much less sensitive than controls.

Contact Author: Julann Spromberg, Northwest Fisheries Science Center
2725 Montlake Blvd. E., Seattle, WA 98112
T: 206-302-2426 F: 206-860-3335; julann.spromberg@noaa.gov

Analytical testing Requirements for Monitoring Worker Exposures to Arsenic during the Giant Mine Remediation

Crowther, TG. ALS Environmental, Vancouver, BC

The abandoned Giant Mine Roaster Complex was a high risk site that needed to be decontaminated and deconstructed to make the site safer. The project involved the removal of 2 M kg of Arsenic Trioxide from the roaster complex, as well as a significant quantity of asbestos. Arsenic is a highly toxic substance with systemic effects. Arsenic is also naturally present in the environment and diet and can therefore contribute to the exposure of workers during the remediation. Urine samples of all workers were collected and analyzed weekly to determine exposure levels before and after their shifts and work was restricted if biological exposure levels were exceeded. The analytical testing method needed to be rapid in order to provide timely feedback to workers and project managers on the type of work that could be performed during the shift, and the analytical testing method needed to be able to accurately separate and quantitate the arsenic species that were toxic from those that are non-toxic. Using an analytical method that only determined total arsenic in the urine would have resulted in many workers missing a day's work and pay. The major non-occupational contributor of

inorganic arsenic was food with rice and rice products. Local seafood, shellfish and seaweed are also contributors along with many leafy greens, grains, nut and fruits, especially if locally grown and subject to the naturally high levels of arsenic in the soil and waters around the Yellowknife region. Exposure control monitoring during the remediation of the Giant Mine was largely successful due to the rapid speciation of arsenic species in urine samples, so that non-exposure sources of arsenic that were contributed from diet, personal hygiene and smoking could be quickly assessed and evaluated against the inorganic arsenic exposure from the inhalation of dust contaminated by arsenic trioxide.

Contact Author: Tim Crowther, ALS Environmental
8081 Lougheed Highway, Vancouver, BC V5A 1W9
T: 604-253-4188, tim.crowther@alsglobal.com

Make My Heart Go Boom: Potential Human Health Effects of Pentaerythritol Tetranitrate (PETN)

Du Gas, L.M.*; and Siemens Kennedy, T.L. SNC-Lavalin Inc., Burnaby, BC.

Pentaerythritol tetranitrate (PETN) was first synthesized in 1901and subsequently came into general use as an explosive after WWI. PETN ranks amongst the most powerful of the standard military explosives. On behalf of Health Canada, a comprehensive literature review was conducted to compile data on the physiochemical properties PETN, as well as the mechanism of action, toxicokinetics, and mammalian toxicity. The review was conducted to determine if and how potential exposure to PETN in environmental media may result in adverse effects to human health. PETN is unique in that it is not only an explosive material, but is also used therapeutically as a pharmaceutical agent, to provide symptomatic relief to patients with angina pectoris. The vasodilative effects of PETN, while beneficial in angina patients, could be considered adverse in inadvertently-exposed humans with normal cardiovascular function. The presentation will address therapeutic and toxicological effects resulting from PETN exposure, the development of toxicity reference values (TRVs) for PETN, and the uncertainty associated with the development of these TRVs.

Contact Author: Lindsay Du Gas, SNC-Lavalin Inc.
Environment & Geoscience
8648 Commerce Court, Burnaby BC V5A 4N6
T: 604-515-5151, F:604-515-5150, lindsay.dugas@snclavalin.com

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Poster Abstracts

(in alphabetical order)

Sediment Quality Triad Analysis at a Model Toxics Control Act Site in Anacortes, Washington

Aiken, M.L.*; and Sofield, R.M. Western Washington University, Bellingham, WA

The Scott Paper Mill Site in Anacortes, Washington was contaminated during historic industrial use. In 2010, remediation actions were undertaken to clean up the Site. During remediation, chemical and biological data were collected to assess the effectiveness of ongoing clean up actions and observe the impact of creosote pilings prior to removal. The sediment concentrations of polycyclic aromatic hydrocarbons (PAHs), total volatile solids (TVS), copper, and lead were measured at the sampling locations. Periphyton samplers were deployed for abundance and chlorophyll measurements. Additional field data was collected through deployed *Mytilus galloprovincialis* (mussel) cages where growth, bioaccumulation, and biomarkers were observed. Laboratory toxicity tests, including 24-hour dinoflagellate bioluminescence test and a *Neanthes arenaceodenta* growth test, were also conducted with the sediment collected from the site. We are combining these lines of evidence in a Sediment Quality Triad Analysis and will present the results.

Contact author: Miranda Aiken, Western Washington University
516 High St MS 9079, Bellingham, WA 98225
Phone: (360) 650-3520; Fax: (360) 650-2842; aikenm@students.wwu.edu

Determining Aggregation Behavior and Corresponding Surface Reactivity of Copper Oxide Nanoparticles using a Rapid Colorimetric Assay

Crandon, L.E.*; Wu, F.; Engstrom, A.M.; and Harper, S.L. Oregon State University, Corvallis, OR.

The ability to predict interaction with abiotic or biotic surfaces in complex systems would enhance understanding of the life cycle of nanoparticles (NPs) and assist in evaluation of risk. The aggregation behavior of NPs is a key process determining fate, transport, and bioavailability and is dictated by environmental interactions. In this study, we propose a method to evaluate NP homoaggregation and heteroaggregation, as measured by changes in surface reactivity. In order to observe NP reactivity, methylene blue dye is used as a chemical probe which is reduced by sodium borohydride in the presence of a NP catalyst. The resulting color change is observed with ultraviolet-visible spectrophotometry. We hypothesized that the rate of reaction is directly related to the NP aggregation state. Copper oxide (CuO) NPs were selected as a model NP in this study due to their widespread industrial and commercial applications and high reactivity. The relative reactivity of 1 mg/L CuO was evaluated after CuO NPs were allowed to either homoaggregate for 2 and 24 hours or heteroaggregate with green algae *Chlorella vulgaris* for 24 hours. The reaction rate did not significantly decrease after 2 hours of homoaggregation. However, the rate significantly decreased by almost 100% after 24 hours homoaggregation compared to non-aggregated CuO NPs, and by 34% when CuO NPs were heteroaggregated with algae cells. The decrease in reaction rates was likely due to a decrease in overall NP reactive surface area. The surface area of the CuO NPs stock suspension was calculated using nanoparticle tracking analysis. This method allows us to rapidly and efficiently assess both surface reactivity and agglomeration and can be applied to environmentally relevant complex suspensions.

Contact Author: Lauren Crandon, Oregon State University
School of Chemical, Biological, and Environmental Engineering
2750 SW Campus Way, Corvallis, OR 97331
T: 785-979-1954, crandonl@oregonstate.edu

Remediation Strategies for Wood Debris at a Log Transfer Facility in Southeastern Alaska

Leonard, B.D.*; Kellems, B.; Revelas, G.; and Fitzgerald, S. Integral Consulting Inc., Olympia, WA

Marine log transfer facilities (LTFs) are common in waterways in Oregon, Washington, and Alaska. Disturbance of floating logs shears off woody debris which then settles to the seafloor. Aggregations of this sort of wood waste deposited on top of marine and estuarine sediments can have negative impacts on the benthic environment and benthic communities. The dissolved oxygen demand and physical habitat alteration caused by this material may severely reduce benthic infauna abundance or disrupt community structure by replacing suspension feeders with deposit feeders. Section 404 of the Clean Water Act (CWA) allows states to mandate permits for any activity which results in the discharge of dredged or fill materials that may degrade the quality of U.S. waters. Wood waste is considered a potentially harmful fill material in this context and LTFs therefore require state discharge permits. The Alaska Department of Environmental Conservation (ADEC) requires annual dive surveys under its Wastewater Discharge Authorization Program to determine the extent and severity of wood debris coverage for LTF facility permits. In Alaska, a remediation plan for the facility must be implemented if wood debris exceeds both 1.0 acre of continuous coverage and a thickness of 10 centimeters at any point during a survey. This criteria was exceeded in 2013, 2014, and 2015 for an LTF in Tolstoi Bay, AK triggering the requirement for a remediation plan which was prepared by Integral. We considered the feasibility and effectiveness of several remediation options for accomplishing the site specific remedial action objective (RAO) to reduce wood debris. Remedial alternatives such as dredging, capping, and active bark dispersal were deemed not cost effective and would further harm the benthic community. Instead, monitored natural recovery with additional best management practice (BMPs) were deemed effective to achieve RAOs for the site.

Contact Author: Ben Leonard, Integral Consulting Inc.
1205 West Bay Dr. NW, Olympia, WA, 98506
T: 360-339-2625, bleonard@integral-corp.com

The Influence of Phosphate and Arsenic Redox State on Arsenic Toxicity to *Brassica juncea* and *Eisenia fetida*

Reese, N.M.*; **Pratt, J.M.***; Maki, B.C.; and Sofield, R.M. Western Washington University, Bellingham, WA

Arsenic speciation is an important factor influencing the toxicity of the metal. In the environment this oxyanion can exist in a reduced form as arsenite and in an oxidized form as arsenate. Arsenite is more mobile and more toxic to exposed biota. We will use a two-level, four-factor factorial design to identify the main effects and interactions with arsenite or arsenate, phosphate, *Einsenia fetida*, and *Brassica juncea*. Previous work has shown that the presence of phosphate increases the uptake of arsenic and in separate studies that earthworms also increase the uptake. The experiments will be done with replicates of four. The toxicity to *E. fetida* and *B. juncea* after four weeks will be measured with changes in growth and survival. A companion presentation will present the results on arsenic mobility and bioavailability.

Contact Author: Ruth Sofield, Western Washington University
516 High St., ES440, MS9181, Bellingham, WA 98225
T: 360-650-2181, ruth.sofield@wwu.edu

Sediment Profile Imaging (SPI): Advancements in Computer-automated Image Processing and Standardization of Key Measurements

Sackmann, B.S.*; Revelas, E.C.; and Stupakoff, I. Integral Consulting Inc., Olympia, WA

SPI camera technology was developed as a reconnaissance tool for characterizing physical, chemical, and biological seafloor processes. The SPI camera works like a sediment periscope. A digital camera is mounted inside a watertight housing on top of a mirrored prism. A frame with the camera and prism is lowered to the seafloor and the prism descends into the sediment and obtains an undisturbed cross-sectional image of the upper 20 cm of the sediment column. The SPI setup allows up to 100 locations to be imaged in a single day, far surpassing the density and areal coverage of information obtained with traditional sampling methods. The images allow direct measurement of sediment grain size, penetration depth, depositional layers, aerobic marine sediment layer (apparent redox potential discontinuity [aRPD]) depth, sediment textures, and infaunal successional stage (a function of benthic disturbance gradients), in addition to other ancillary parameters. Presently there is a lack of standardization in the measurement of features in SPI/PV images that can lead to biases in data quality and discrepancies in SPI/PV data interpretation among practitioners. Integral is developing a computer-automated system to help standardize the processing of SPI images. Image processing algorithms are being developed using a combination of open-source and commercially available software packages (e.g., MATLAB and OpenCV). Using a combination of techniques, the system automatically quantifies parameters that are currently subject to the skill and care of individual image analysts. Preliminary tests have shown that image analysis algorithms can generate estimates of penetration depth (a measure of sediment shear strength) and the aerobic marine sediment layer depth (aRPD). Additional parameters we propose to automate include grain size distributions, the type, number, and depth of biogenic structures (i.e., burrows, feeding pockets), and the thickness of any sediment deposits of interest such as disposed dredged material layers and sand caps.

Contact Author: Brandon Sackmann, Integral Consulting Inc.
1205 West Bay Drive NW, Olympia, WA 98501
T: 360-705-3534x412, F: 360-705-3669, bsackmann@integral-corp.com

The Influence of Phosphate and Arsenic Redox State on Arsenic Mobility and Bioavailability in Soil

Seyster, N.K.*, **Soha, L.L.***; Meyering, S.A., Maki, B.C.; and Sofield, R.M. Western Washington University, Bellingham, WA

Lead-arsenate pesticides were applied to orchards from the late 1800s to the mid-1940s which has resulted in approximately 187,588 acres of arsenic contaminated soil throughout Washington State. The presence or addition of phosphate within these soils is highly probable as it is a common fertilizer and used in these areas. Phosphate has been shown to increase the mobility of arsenic in the soil environment. In this study, a two level factorial design with four factors (2^4) will be used to test the effects and interactions of phosphate, earthworms, mustard plants, and As as arsenite or arsenate on the leachate concentrations and accumulation of arsenic into *Brassica juncea* and *Eisenia fetida* over a period of four weeks. Four replicates of each combination of factors were used. Leachate will be collected weekly and the arsenic concentrations, Eh and pH in leachate and soils measured throughout the experimental period. Arsenic accumulation in plants and earthworms will be measured after four weeks. This work builds on previous work in our lab that showed a change in arsenic bioavailability to plants in the presence of earthworms. Our results will provide a better understanding of the potential mechanisms for that change.

Contact Author: Ruth Sofield, Western Washington University
516 High St., ES440, MS9181, Bellingham, WA 98225
T: 360 650-2181, ruth.sofield@wwu.edu

Treatment of Landfill Leachate with ANAMMOX Bacteria Cultured in Sequencing Batch Reactors and Membrane Upflow Anaerobic Sludge Blanket Reactor

Sultana, S.*; and Radniecki, T. Oregon State University, Corvallis, OR

Anaerobic ammonium oxidation (anammox) has been recently recognized as a promising approach for biological nitrogen removal from landfill leachate because it has several advantages over traditional biological nitrogen removal treatment. It does not require oxygen or organic carbon, thereby reducing operating costs by 60%, and it produces low sludge volumes, thus reducing biological sludge disposal costs. Anammox bacteria anaerobically oxidizing ammonia with nitrite to for dinitrogen gas, which is bubbled out of the system. When combined with partial nitrification (the aerobic oxidation of half the ammonia to nitrite), anammox bacteria can be an efficient and sustainable solution to treat landfill leachate. However, leachate loading rates to the anammox reactor are critical due to the high concentrations of potential anammox inhibitors, including heavy metals, pesticides and nitrite. Anammox bacteria have been enriched from two sources; sludge from a full-scale anammox wastewater treatment plant in Rotterdam, Netherlands and sludge from the DC Water wastewater treatment facility in Washington, D.C. The sludge were enriched over a 6 month period in both sequencing batch reactors and in a novel carbon nanotube membrane upflow anaerobic sludge blanket reactor, which was used to capture planktonic anammox cells and enhance the anammox granulation process. To determine the effect of landfill leachate loading rates on anammox activity, partially nitrified Coffin Butte landfill leachate (Benton County, OR) was fed to each anammox enrichment in batch over a variety of nitrogen loadings. Anammox activity was observed over 3 days through the disappearance of ammonia and nitrite and the appearance of dinitrogen gas and were compared to controls fed anammox media.

Contact Author: Sharmin Sultana, Oregon State University
School of Chemical, Biological, and Environmental Engineering.
2426 NW Grant Avenue, Corvallis, Oregon 97330.
Phone: 541-286-8552, sultanas@oregonstate.,edu

Magnetic Biomonitoring of Polluted Trees in South Seattle

Templeton, L.A.*; Housen, B.; Bauman, J.; and Abel, T.D. Western Washington University, Bellingham, WA.

The South Park and Georgetown neighborhoods are located in the Duwamish River Valley in South Seattle where a large and diverse population of low-income and immigrant residents live and work. The Duwamish River Valley is also home to many mobile and industrial sources of air pollution. The microgeography of the valley's air pollution variability is poorly characterized. Seattle's air pollution riskscape has never been analyzed with leaf samples and this pilot project builds on a two-year Collaborative Problem Solving and Environmental Justice project funded by the EPA. Metallic fragments of vehicle exhaust and industrial air pollution will be collected via leaf samples in two Duwamish River Valley neighborhoods in South Seattle, South Park and Georgetown. Air pollution particles adhering to leaves will be analyzed with magnetic hysteresis and Saturation Isothermal Remnant Magnetization (SIRM). Leaves (50g) from 54 trees will be sampled in this study. To accomplish this, three neighborhood blocks will be randomly selected using common randomization techniques per neighborhood (total of six blocks). Leaves will be dried, weighed, and prepared for analysis to particulate matter concentrations from mobile and industrial combustion processes.

Contact Author: Lauren Templeton, Western Washington University
Huxley College of the Environment, 516 E College Way, Bellingham WA 98225
T: 360-650-3520, F:360-650-2842, laurentempleton94@gmail.com

Summary of Dioxin/Furan Testing in the Dredged Material Management Program: 2010 – 2016

Van der Elst, K.E.*; and Warner, L.C. Seattle District Army Corps of Engineers, Seattle, WA

Dioxin/Furans are a class of compounds, both naturally occurring and anthropogenically produced, that are persistent organic pollutants which are highly toxic to humans. These compounds, commonly referred to as dioxins, have been investigated for their toxicity to humans since the 1980's. In 2010, after a three year inter-agency public process, the Dredged Material Management Program (DMMP) agencies adopted guidelines for managing dioxin/furan congeners at the eight open-water dredged material disposal sites in Puget Sound. The guidelines were built around the need for dioxin testing at a limited number of projects based on a series of factors used to establish a reason-to-believe that dioxin might be present in the sediments. Six years after implementation, this study evaluates the trends seen in dioxin occurrence and concentrations in sediments from dredging projects, impacts to suitability of dredged material and performance of the disposal sites with respect to the site management objective for dioxin established in 2010.

Contact Author: Kelsey Van der Elst, USACE
Dredged Material Management Program
PO Box 3755, Seattle, WA 98124-3755
T: 206-764-6945, F:206-764-6602, kelsey.vanderelst@usace.army.mil

Determination of Source and Spatial Trends of Black Carbon Deposition on Peruvian Glaciers

Wallis, L.K.*[1]; Schmitt, C.G.[2]; Matthews, R.A.[1]; and Sofield, R.M.[1]. [1]Western Washington University, Bellingham, WA, [2]National Center for Atmospheric Research, Boulder, CO

The presence of light-absorbing particles (primarily black carbon) on glaciers has been shown to cause a decrease in surface albedo, thus potentially acting as a contributing factor to glacial recession through this decrease in reflectivity. This effect can be even more pronounced on tropical glaciers, where sunlight is more amplified due to mid latitudes and high elevations. This research was conducted over a three month period (June-August 2015) in the Cordillera Blanca mountain range in central Peru to determine spatial trends of black carbon deposition on these tropical glaciers and their potential sources (eg. industrial pollution, agricultural or forest burning). Snow samples were collected from seven mountains in the Cordillera Blanca range and analyzed for concentrations of effective black carbon (eBC) and various organic and inorganic analytes. Higher concentrations of eBC were found on the glaciers closest to Huaraz, the nearest large city, and two open-pit metal mines, as shown through both statistically significant differences in concentrations at near and far sites, as well as significant negative correlations with distance from each potential source and concentration ($p<0.05$). Concentrations of Cu and Zn in snow samples were found to be negatively correlated with their distance from the Cu-Zn mine, but not with distance from the Au-Ag mine. These results indicate that the city and mines may be potential sources of black carbon and other contaminants that are found in and on these glaciers. All measured analytes are being further analyzed with various multivariate statistical and partitioning techniques to attempt to gain a finer resolution in determination of sources of black carbon.

Contact Author: Lindsay K. Wallis, Western Washington University
Huxley College of the Environment
516 High Street, Bellingham, WA 98225
T: 651-674-3426, wallisl@students.wwu.edu

Elucidating Molecular Pathways Affected by Aryl Hydrocarbon Receptor-Estrogen Receptor Crosstalk Through Bioinformatics Approaches

Wear, H.M.[1]*; Mayo, M.L.[2], Perkins, E.J.[2]; Vinas, N.G.[2]; and Watanabe, K.H.[1]. [1]Oregon Health & Science University, Portland, OR, [2]Engineer Research and Development Center, U.S. Army Corps of Engineers, Vicksburg, MS

The aryl hydrocarbon receptor (AhR), when activated by dioxin-like compounds, binds to a xenobiotic response element (XRE) to alter transcriptional activity of proteins, such as cytochrome P450 enzymes. Although studies in fish and small mammals have shown that AhR is also involved in crosstalk with other receptors, for instance the estrogen receptor (ER), genes and pathways affected by AhR-ER crosstalk remain poorly understood. To better understand how AhR activity can modulate reproductive and other vital physiological endpoints, we used a computational approach to identify molecular pathways with the potential to be impacted by AhR-ER crosstalk. Previously, we had identified 13,000+ potential genes affected by AhR-ER crosstalk using bioinformatics approaches, in which genes were discovered containing an estrogen response element (ERE) and/or an XRE in the promoter region, 5000 base pairs upstream, of the zebrafish (*Danio rerio*) and mouse (*Mus musculus*) genome. Although experimental data has demonstrated AhR-ER crosstalk affecting the AhR and ER signaling pathway, few pathways outside of these have been shown to be impacted. Using this bioinformatics work as a basis, we hypothesize that signaling pathways affected by AhR-ER crosstalk could be identified by contrasting experimentally determined genes with those from our previous work. Pathways will be identified (e.g. Ingenuity Pathway Analysis) for genes containing an XRE and ERE in their promoter region, genes with an XRE or ERE conserved in both zebrafish and mouse, and genes experimentally shown to be affected by AhR-ER crosstalk. We will discuss how pathways found in zebrafish and mouse can be used to elucidate conserved pathways, and compare our findings with reports from the literature. This method of discovering novel molecular pathways affected by AhR-ER crosstalk could be used to inform development of mechanistic mathematical models predictive of adverse outcomes at the whole-organism level.

Contact Author: Hannah Wear, Oregon Health & Science University
Institute of Environmental Health
3181 SW Sam Jackson Park Road, MC HRC3, Portland, OR 97239-3098
T: 503 346-3419, F: 503 346-3427, wearh@ohsu.edu

Kinetic and Equilibrium Sorption Modeling of Arsenite and Arsenate onto Lake Whatcom Sediments and Activated Carbon

Young, H.R.*; **Cade, H.T.***; **Young, F.L.***; Maki, B; and Sofield, R.M. Western Washington University, Bellingham, WA

Arsenic from anthropogenic sources and geological weathering is a contaminant of concern in freshwater sediment environments of Washington State. Arsenite (As (III)) and arsenate (As (V)) are forms that are bioavailable to sediment-dwelling organisms. Activated carbon (AC) has been shown to be an effective in-situ treatment for decreasing bioavailability of organic contaminants in the sediment environment, but less has been done with inorganic contaminants because the bioavailability of cationic metals is often controlled by acid volatile sulfides and organic carbon. Because arsenic is an oxyanion, there is less understanding of what parameters control bioavailability, but the redox state is an important consideration. In this study, we will compare the sorption behavior of arsenite and arsenate to freshwater sediments in the absence and presence of AC. Metal adsorption and surface precipitation onto sediment particles are hypothesized to be the operative removal mechanisms of these metals in the environment.

Under laboratory controlled conditions at pH 6 and 20°C, batch experiments will determine if sorption to sediments in the presence of AC affects the sorption and resultant mobility of each arsenic species. The kinetics of sorption will be determined along with the K_d using Langmuir and Freundlich isotherm models. This work will provide a basic understanding of the role of AC as a sorbent for mobile arsenic species in the freshwater sediment environment.

Contact Author: Holly Young, Western Washington University
Huxley College of the Environment
500 E Myrtle Street Apt. 10 Bellingham, WA 98225
T: 425-263-2660, youngh4@students.wwu.edu