Program and Abstracts

Pacific Northwest Chapter

Society of Environmental Toxicology and Chemistry

(PNW-SETAC)

26th Annual Meeting

The Lakefront Anchorage Hotel

April 20 - 22, 2017

The Lakefront Anchorage Hotel
4800 Spenard Road
Anchorage, AK 99517

The Lakefront Anchorage Hotel

4800 Spenard Road, Anchorage, AK 99517
Phone: 1-907-243-2300, FAX: 907-248-5923

For Guests:

- Check-in time: 3:00 PM , check-out time: 12:00 PM
- Free Wi-Fi
- Free self-parking
- Free airport transportation

Directions to Hotel (See Map 1):

From the Ted Stevens Anchorage International Airport:

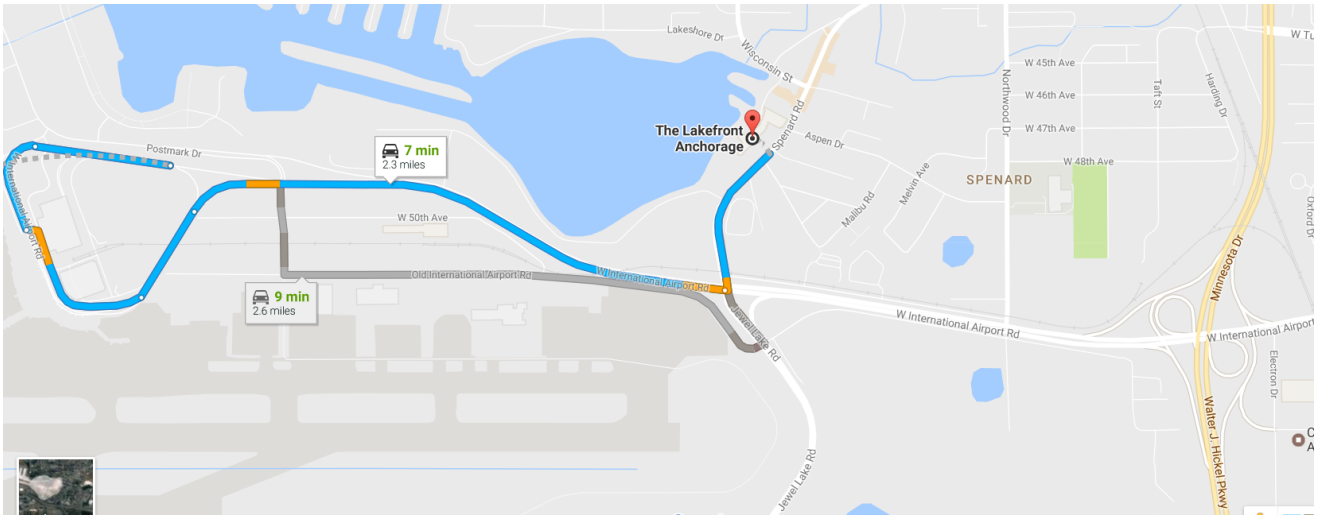
- Get on W International Airport Rd
- Follow road to the left then right for 2 miles
- Turn left on Jewel Lake Rd/Spenard Rd
- Continue to follow Spenard Rd
- The hotel is on the left

From the North on Walter J. Hickel Pkwy:

- Take the W International Airport Rd exit and stay right
- Turn right and merge onto W. International Airport Rd
- Turn right on Jewel Lake Rd/Spenard Rd
- The hotel is on the left

From the South on Walter J. Hickel Pkwy:

- Take the W International Airport Rd exit and stay left
- Turn left and merge onto W. International Airport Rd
- Turn right on Jewel Lake Rd/Spenard Rd
- The hotel is on the left



PNW-SETAC
Meeting Sponsors

Special thanks to all our Meeting Sponsors!!

Student Travel Awards
Azimuth Consulting Group

Thursday Evening Welcome Reception
Compliance Services International
Windward Environmental

Refreshment Breaks
Anchor QEA
Cardno ChemRisk
Major Marine Tours

SETAC Books and Short Course Funding
SETAC North America

PNW-SETAC
Corporate Members

Please join us in thanking this year's 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).

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.

Cardno is a professional infrastructure and environmental services company with expertise in the development and improvement of physical and social infrastructure for communities around the world. Specifically, its team provides services in the planning, design, management, and delivery of sustainable projects for local and international community programs.

It originated in Brisbane, Australia in 1945 as a small engineering consultancy known as Cardno & Davies, after Gerry Cardno and Harold Davies the founders. It contributed significantly to the development of Queensland through the post-war boom years. Today, Cardno has over 6,000 staff worldwide delivering physical, environmental and social infrastructure projects in more than 100 countries.

PNW-SETAC
Corporate Members

Corporate Members - Heron Level

Anchor QEA provides a full range of science and engineering services to the public and private sectors, including planning and strategy development, scientific investigation, engineering design, and construction management. We enjoy working on some of the most challenging sites in the nation, and our completed projects are among the most successful in the industry. Our clients recognize that the strength Anchor QEA brings to every project reflects our core values of technological leadership, integrity, superior product quality, and client satisfaction.

It has offices across the United States and a team of more than 300 scientists, planners, and engineers working closely with their clients towards achieving common goals on water resources, surface and groundwater quality, coastal development, habitat restoration, and contaminated sediment management projects.

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

Corporate Member – Kingfisher Level

Major Marine Tours offers world-class wildlife and glacier cruises to two of the most beautiful places in Alaska: Kenai Fjords National Park and Prince William Sound. We are a locally-owned, family company celebrating over 25 years of sharing the beauty of Alaska with our guests. See tidewater glaciers, stunning scenery, whales, and abundant wildlife from our cruises departing from the scenic harbor towns of Seward and Whittier. Most cruises feature onboard National Park Ranger narration and our famous Alaska salmon and prime rib buffet, freshly prepared and served while you cruise. Our "cruising restaurant" service maximizes your time on the water, allowing you to enjoy your meal without missing out on any of the sights.

PNW-SETAC
Acknowledgments

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

Conference Organization:	Julann Spromberg, NOAA/Ocean Associates Inc. Lori Verbrugge, US Fish & Wildlife Service Meagan Harris, Whatcom Conservation District April Markiewicz, Western Washington University
On-Site Coordinator:	Julann Spromberg, NOAA/Ocean Associates Inc
Abstract Review:	Leah Kenney, US Fish & Wildlife Service Lori Verbrugge, US Fish & Wildlife Service Kendra Zamzow, CSP2
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:	Lauren Crandon, Oregon State University
Student Awards Coordinator:	Ed Kolodziej, University of Washington
Fundraising:	Jeff Wirtz, Compliance Services International
Student Travel Awards:	Ed Kolodziej, University of Washington

26th PNW-SETAC ANNUAL CONFERENCE

Meeting Program

April 20 - 22, 2017

PNW-SETAC

Chapter Meeting Agenda

Thursday April 20th

7:30 AM – 9:00 AM	**Preconference/Registration Check-in** (Pre-Function Area)
8:30 AM – 4:30 PM	**Short Course** (Lake Spenard Room): *Statistics for Toxics Cleanup – A Washington State Perspective*. Instructor: **Art Buchan**, WA Dept. of Ecology **(PC or Parallels Desktop enabled MacBook Laptop required!**)
9:00 AM – 12:00 PM	**Short Course** (Turnagain Board Room): *Integrative Ecological and Human Well-being Risk Assessment.* Instructor: **Wayne Landis**, Western Washington University
11:30 – 1:30 AM	**Lunch** (optional box lunch paid for when you registered or on your own)
12:00 PM – 1:00 PM	*PNW-SETAC Board Meeting* (Turnagain Board Room)
1:00 PM – 2:00 PM	**Preconference/Registration Check-in** (Pre-Function Area)
1:30 PM – 4:30 PM	**Eagle River Nature Center Tour**: Depart hotel to the Nature Center where naturalists will provide a two-hour walking tour of the flora, fauna, and geology of the Eagle River Valley. (Meet in the lobby to board van)
5:30 PM – 8:00 PM	**Conference/Registration Check-in** (Pre-Function Area)
5:30 PM – 8:30 PM	**Welcome Reception & hors d'oeurvres (6pm)** (Redington Ballroom) (1 drink ticket)

Friday April 21st

7:30 AM – 5:00 PM	**Conference/Registration Check-in** (Pre-Function Area)
7:30 AM – 8:30 AM	Poster setup (Lake Spenard Room)
8:30 AM – 9:00 AM	Welcome Address, Chapter President **Jeff Wirtz**, SETAC Update (Redington Ballroom)
9:00 AM – 10:20AM	Platform presentations (20 min each) (Redington Ballroom)
10:20 AM – 10:40 AM	**Refreshment break, poster session** (Lake Spenard Room)
11:00 AM – Noon	Platform presentations (20 min each) (Redington Ballroom)
Noon – 1:30 PM	**Lunch (on your own!)**
12:45 PM – 1:20 PM	*PNW-SETAC Business Meeting* (Redington Ballroom)
1:30 PM – 4:40 PM	Platform presentations (20 min each) (Redington Ballroom)
2:50 PM – 3:20 PM	**Refreshment break, poster session** (Lake Spenard Room)
4:40 PM – 5:40 PM	**Poster Social with refreshments** (Lake Spenard Room) (1 drink ticket)
6:00 PM – 8:30 PM	**Dinner at the Lakefront** (optional, paid when registered) (Redington Ballroom) (1 drink ticket provided).

Saturday April 22nd

9:00 – 10:40AM	Platform presentations (20 min each) (Redington Ballroom)
10:40 – 11:00 AM	**Refreshment break, poster session** (Lake Spenard Room)
11:00 – Noon	Platform presentations (20 min each) (Redington Ballroom)
Noon	Closing ceremony with awards (Redington Ballroom)

PNW-SETAC
Thursday Short Course I

8:30 AM - Noon, Thursday, April 20, 2017

Turnagain Board Room

Integrative Ecological and Human Well-being Risk Assessment

Instructor: Wayne Landis, Western Washington University

Overview:
Risk assessment for ecological endpoints and human health and well-being are often seen as separate entities. As Harris et al (2017) has demonstrated they are not. Although the terminology and the criteria are based on the different histories of development, there is still the fundamental of exposure-response and the fact that both have to deal with cumulative effects. In a number of recent papers, it has been demonstrated that Bayesian network relative risk models (BN-RRM) can be built to describe ecological effects of Hg and other stressor and can estimate the efficacy of mitigation tools such as bank stabilization and best management practices. It is also possible to build adaptive management tools that assist in the planning of long-term management.

The class will use several examples to demonstrate how ecological and human well-being risk assessment can be integrated. Students should bring their own case studies as well. The course will begin with a review of the basic principles and calculation methods. Then second half will be the exploration of other case studies, some of which will be provided but the use of other examples supplied by students will be welcomed.

Contact Info: Wayne G. Landis, Western Washington University
Institute of Environmental Toxicology
516 High St., MS9180
Bellingham, WA 98225-9180
T: 360-650-6136, wayne.landis@wwu.edu

PNW-SETAC
Thursday Short Course II

8:30 AM – 4:30 PM, Thursday, April 20, 2017

Lake Spenard Room

Statistics for Toxics Cleanup –A Washington State Perspective

Instructor: Art Buchan, Washington State Department of Ecology

Overview: This is an introductory and interactive statistics course. The class begins with a refresher on general principals including measures of central tendency (mode, median, mean), variance/standard deviation/coefficient of variation, hypothesis testing, distributions, and outliers. We will then explore some of the free programs that allow the user to compare groups of data (e.g. treatment and control) through BioSTAT (USACE), calculate background and compliance values through MTCAStat (Ecology), and then calculate background and compliance values through ProUCL (US EPA).

Note: Please bring a laptop and mouse so you can work through the problems with the class.

The following statistical programs should be installed on your computer prior to class:

BioSTAT

ProUCL (version 5.1)

Contact Info: Arthur Buchan, WA Dept. of Ecology
300 Desmond Drive
Olympia, WA 98504
T: 360-407-7146, abuc461@ecy.wa.gov

PNW-SETAC
Friday Platform Presentations
Morning Session

Friday, April 21, 2017

8:30 Welcome & Opening Remarks Chapter President Jeff Wirtz

NASAC Rep

Session Chair: Sarah Allan, NOAA Office of Response and Restoration

Session: Pacific Northwest Salmon and Urban Runoff Toxicity

9:00	Nat Scholz	Coho salmon and the urban pre-spawn mortality syndrome
9:20	Andrew Spanjer	Genetic biomarker screening of juvenile coho from PNW urban perennial streams
9:40	Jenifer McIntyre	Identifying the sources of toxicity to urban road runoff
10:00	**John Toll**	**SETAC NA Representative**
10:20	**Break/Poster Viewing**	

Session: Toxicity of Complex Organic Mixtures

10:40	Katrina Counihan	Physiological effects of oil, dispersed oil, & dispersants on the Bay Mussel
11:00	Nat Scholz	Novel biomarker candidates for delayed cardiac injury to developing fish from oil spills
11:20	Lori Verbrugge	Pentachlorophenol, dioxins & furans in soil surrounding utility poles at Kenai national wildlife refuge
11:40	D. James Minick	Hazard assessment of a PAH Superfund mixture in the zebrafish developmental tox model
12:00 to 1:30 PM		**Lunch & PNW-SETAC Business Meeting (12:45-1:20)**

PNW-SETAC
Friday Platform Presentations
Afternoon Session

Friday, April 21, 2017

Session Chair: Kendra Zamzow, Center for Science in Public Participation

Session: Environmental impacts of resource development

1:30	Christopher Kasanke	Sulfolane biodegradation in contaminated subarctic aquifer substrate
1:50	Kendra Zamzow	Independent investigation of reclamation at exploration drill holes at Pebble copper prospect
2:10	Nancy Johnston	Measuring air toxic & sulfur compounds - comparison of remote, rural and urban areas in ID & WA
2:30	Angela Perez	Child and adult exposure and health risk evaluation from use of metal-containing cosmetics sold in the US
2:50	**Break/Poster Viewing**	

Session: Quantitative Tools for ERA

3:20	Emily Lescak	Gene-by-environment interactions drive developmental response to antibiotics in stickleback
3:40	Alison Gardell	Insight into perchlorate's mode of action using threespine stickleback as a model
4:00	Jim Berner	Use of blood soaked filter paper for assessing the chemical feeding ecology of Hg
4:20	Wayne Landis	Integrating adverse outcome pathways into the Bayesian model for landscape scale risk assessment
4:40	**Poster Social**	

PNW-SETAC
Saturday Platform Presentations
Morning Session

Saturday, April 22, 2017

Session Chair: Jeff Wirtz, Compliance Services

Session: Ecotoxicology

9:00	Hugo Villavicencio	Trophic ecology of heavy metals in Lake Atitlan, Guatemala
9:20	Lorrie Rea	Regional variations and drivers of He and Se concentrations in mercury and selenium concentrations in Steller sea lions
9:40	Veronica Padula	Impacts of plastic marine debris on Bering Sea seabirds: Phthalates in muscle & reproductive tissue"
10:00	Kate Fremlin	Bioaccumulation of POPs within a terrestrial food-web of an avian predator - Coopers Hawk
10:20	**Break/Poster Viewing**	
10:50	Ariel Blanc	Targeted site-specific avian risk refinement in support of remedial decision-making
11:10	Mandy McDougall	Developing a trophic bioaccumulation model for PFOS in a marine food web
11:30	**Student Award Presentations**	
12:00	**Wrap Up/Adjourn**	

PNW-SETAC
Poster Presentations

Presenter(s) (Bolded)	Presentation
Miranda L. Aiken Ed Bain Ruth M. Sofield	Temporal analysis of stream water chemistry in the Cordillera Blanca of Peru
Brandi Bundy John Andrews Damien Ketcherside J. Rivero-Zevallos Nancy Johnston	Analysis of Air Pollutants in Rural Idaho near a Pulp Paper Mill
Michelle Chow Jenifer McIntyre	Characterizing the Behavioral Response Induced By Urban Runoff in Juvenile Coho Salmon
Valerie Chu Meagan Harris Scarlett Graham Lindsay Wallis Chelsea Mitchell John Stark Katharine. von Stackleberg Wayne Landis	Assessing the Effects of Chemical Mixtures using a Bayesian Network-Relative Risk Model (BN-RRM) Integrating Adverse Outcome Pathways (AOPs)
Andrew Cyr C.J. Sergeant J.A. Lopez M. Bower T.M. O'Hara	The Influence of Feeding Ecology and Migration Barriers on Mercury Accumulation in Dolly Varden Char (*Salvelinus malma*)
Kimberly Diep **Wyatt Carstans** Jaye Morris	Investigating Stella's Marsh in Edmonds, WA: a Sustainable Communities Partnership Project

PNW-SETAC
Poster Presentations

Presenter(s) (Bolded)	Presentation
Hannah Gerrish Andrew Cyr J.M. Castellini J.A. Lopez T.M. O'Hara	Biopsy Punches as a Cost Effective and Efficient Tool to Monitor Mercury in Fish Muscle
Taylor Haskins Jenifer McIntyre L. Rozmyn N. Winters John Stark	Toxicity of Roof Runoff and its Effects on Coho Salmon and other Aquatic Organisms
Leah Kenney M.K. Reeves A.A. Poe K.J. Mock H. Huff F.A. von Hippel J.E. Trammel M. Geist	Contaminant Assessment Process for the Alaska Maritime National Wildlife Refuge and the Alaska Bering Sea Islands Landscape Conservation Cooperative
Leah Kenney F.A. von Hippel C.A. Eagles-Smith J.T. Ackerman R.S.A. Kaler J.E. Trammel	Mercury Concentrations in Freshwater Forage Fish from the Aleutian Archipelago, Alaska
Ben Leonard B. Du Jen McIntyre Ed Kolodziej Nat Scholz John Stark	Research Goals for Environmental Impacts of Cost-Effective Green Stormwater Infrastructure Technology

PNW-SETAC
Poster Presentations

Presenter(s) (Bolded)	Presentation
E. Mayo **Andrew Cyr** A. Whiting J.A. Lopez T.M. O'Hara	Trophic Feeding Ecology of Mercury in Kotzebue Sound Fish: Emphasis on Monomethylmercury
Chelsea Mitchell Meagan Harris Valerie Chu Scarlett Graham Lindsay Wallis Katharine von Stackleberg Wayne Landis John Stark	Incorporating Spatially Explicit Metapopulation Models as the Adverse Outcome Pathway Endpoint of a Bayesian Network- Relative Risk Model
Amanda Smith **Eric Lawrence** C. Charlton Ian Moran Ruth Sofield	Metal Mixture Toxicity in *Lactuca sativa*
Roger Vang Stephanie Kennedy J.M. Castellini L.D. Rea T.M. O'Hara A. Ferrante	Change in Haptoglobin Concentrations in Steller Sea Lions (*Eumetopias Jubatus*) and Environmental Exposure to Mercury: Chemical Assay Interference?
Lindsay Wallis April Markiewicz Wayne Landis	Incorporating Climate Change into the Prediction of Risk to Pacific Herring and Estuary Habitat in Puget Sound
Gina Ylitalo **Raphaela Stimmelmayr** J.L. Bolton	Analyses of urine and bile of marine mammals for metabolites of polycyclic aromatic hydrocarbon metabolites by two analytical methods

Pacific Northwest Chapter

Society of Environmental Toxicology and Chemistry

(PNW-SETAC)

26th Annual Meeting

Platform Presentation Abstracts

(In order of presentation)

Novel Biomarker Candidates for Delayed Cardiac Injury to Developing Fish from Oil Spills

Gardner, LD[1]; Peck, KA[2]; Linbo, TL[2]; Cameron, J[2]; Block, BA[1]; Scholz, NL[2]*; Incardona JP[2]. [1]Stanford University Hopkins Marine Station, Pacific Grove, CA, [2]Northwest Fisheries Science Center, National Oceanic and Atmospheric Administration, Seattle, WA

Fish heart development is disrupted by exposure to very low levels of crude oil, leading to deficiencies in juvenile cardiorespiratory performance. While these effects most likely underlie the population level impacts of oil spills, they are poorly understood at the molecular level. Bioavailable compounds in crude oil, including polycyclic aromatic hydrocarbons (PAHs), disrupt K^+ and Ca^{2+} fluxes controlling action potentials and excitation-contraction (EC) coupling in cardiomyocytes. During organogenesis, acute exposure leads to cardiac arrhythmia and/or reduced contractility, which in turn lead to secondary defects in heart looping and ventricular growth. At higher exposure levels, heart malformation is severe and lethal to larvae, but lower exposure levels lead to grossly normal heart development. However, surviving fish grow to have reduced swimming performance, coupled to subtle defects in cardiac anatomy and histology. These defects included abnormal ventricular shape, reduced compact myocardium, and an abnormal hypertrophic-hypercellular response in spongy myocardium. Severe malformation during embryogenesis was recently linked to altered expression of bone morphogenetic protein (BMP) family members in transcriptome studies. In this study we used RNA sequencing (RNAseq) in juvenile pink salmon (*Oncorhynchus gorbuscha*) to identify molecular changes associated with abnormal ventricular shape and pathological hypertrophy following transient embryonic exposure. We found dose-dependent up-regulation of *nkx2.3* and *nkx3*.3, NKX homeobox transcription factors not previously known to be expressed by cardiomyocytes. In addition, the largest class of genes with altered expression was involved in innate immunity. These genes were up-regulated by cardiomyocytes in the absence of a cellular inflammatory response. Our findings support a cardiomyocyte-intrinsic role for innate immune response genes in pathological hypertrophy, and identify potential new candidates for biomarkers of delayed cardiac injury from embryonic oil exposure.

Contact Author: Nathaniel Scholz, NOAA Northwest Fisheries Science Center, 2725 Montlake Blvd E Seattle, WA 98112, T: 206-817-1338, F: 206-860-3335, Nathaniel.scholz@noaa.gov

Genetic Biomarker Screening of Juvenile Coho Salmon from Pacific Northwest Urban Perennial Streams

Spanjer, AR[1*]; Moran, PW[2]; Roberts, SB[1]; Beauchamp, DA[3]. [1]University of Washington, Seattle, WA; [2]US Geological Survey WAWSC, Tacoma, WA; [3]US Geological Survey WFRC, Seattle, WA

Coho salmon (*oncorhynchus kisutch*) are a culturally and commercially significant Pacific salmon species that spend the first year of life in their small natal streams. This extended rearing time makes them an ideal species to use for monitoring chemical impacts on fish found in urban streams. The purpose of this study was to characterize the hepatic gene expression of juvenile Coho from 10 streams in the Pacific Northwest where watersheds spanned a gradient of urban land-use intensity and to relate expression to concurrently measured contaminant concentrations. Next-generation sequencing (RNAseq) was used to construct the transcriptome of this non-model species using sequencing data from 24 individuals originating from 4 different streams. This resulted in 123,068 unique annotated contigs. Differential expression analysis of this transcriptome data was used to identify 52 stress genes of interest for comparison of expression profiling among fish from all 10 streams. Derived sequences were used to design custom Nanostring probes for expression analysis of identified genes using the nCounter platform. Multivariate methods were used to relate water contaminant concentrations to gene expression levels. Initial results indicate that high concentrations of herbicides, specifically 2,4-D and Triclopyr, are significantly correlated to increased expression of genes involved in detoxification of organic contaminants. These include cytochrome p450 genes (CYP1A1, CYP2K5, and CYP2K1) and Glutathione S-transferase P. Results from this expression profiling as it relates to contaminant concentrations within sampled streams and how this work fits into a larger study characterizing juvenile salmonid health as part of the US Geologic Survey's 2015 Pacific Northwest regional assessment study will be discussed.

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

Identifying the Sources of Toxicity to Urban Road Runoff

Pratt, J.[1]; Mudrock, E.[2]; McIntyre, J.K.[2]*. [1]California Polytechnic State University, San Luis Obispo, CA
[2]Washington State University, Puyallup, WA

Urban stormwater runoff contains a complex mixture of contaminants that is toxic to aquatic animals, including acute mortality in adult coho salmon spawners. In an embryo-larval fish model (zebrafish; *Danio rerio*), urban stormwater runoff was previously shown to be developmentally toxic, particularly to the cardiovascular system. Sub-lethal effects caused by exposure include developmental delay and microphthalmia, as well as cardiovascular abnormalities including improperly looped hearts and pericardial edema. The contaminant(s) causing these effects is currently unknown. One approach to identifying the relevant contaminants is to first isolate the compartment in which the contaminant is found. The majority of chemical contaminants in road runoff are derived from motor vehicles, including a number of particulate and liquid sources. We identified sources that are expected to contribute the most contaminants to road runoff. The particles included tire dust, brake dust, and vehicle exhaust. The liquids included windshield washer fluid, antifreeze, motor oil, transmission fluid, brake fluid, and power steering fluid. Samples of each source were tested for dose-dependent acute lethal and sublethal toxicity using zebrafish embryos. Embryos were exposed to dilutions of each source for 48 h beginning at the blastula period (2-5 hours post-fertilization). At 48 h, surviving embryos were removed from their chorion and imaged for later analysis from digital still and video. Sublethal metrics were analyzed to determine dose-response metrics for each source. We will present data on the relative toxicity of these road contaminant sources and an initial assessment of their relative contribution to the toxicity of road runoff.

Contact Author: Jenifer McIntyre, Washington State University, School of the Environment, Puyallup Research & Extension Center, 2606 W Pioneer Ave, Puyallup, WA 98371, T: 253-445-4650, jen.mcintyre@wsu.edu

Physiological Effects of Oil, Dispersed Oil and Dispersants on a Sentinel Cold Water Species, the Bay Mussel

Counihan, Katrina L. Alaska SeaLife Center, Seward, AK

Oil and gas drilling have been occurring in Alaska since the 1950s, and offshore drilling is expected to increase as regions in the Arctic become ice-free. As petroleum development increases so does the risk of another oil spill. Oil spills can have a devastating effect on the marine environment and chemical dispersants are supposed to mitigate that effect. However, the majority of toxicity testing with dispersed oil or dispersants alone has primarily been conducted at temperate conditions, with species that do not inhabit Arctic and subarctic regions, or with dispersants that are not approved for use in Alaska. Therefore, the project with the following objectives was conducted: 1. Conduct spiked exposure tests with bay mussels in seawater with oil, Corexit 9500 or oil dispersed with different concentrations of Corexit 9500; 2. Assess various physiological responses of bay mussels to the oil, dispersant and dispersed oil in the spiked exposure tests at different time points; 3. Determine the polycyclic aromatic hydrocarbon content of the oil and dispersed oil treatments used in the mussel exposures. Bay mussel mortality was monitored in each treatment during the exposure experiments. Physiological responses were assessed using biomarkers, which are measurable biological processes that indicate exposure to environmental stressors. Contaminants, such as oil and dispersants, have multiple effects on organisms, so various biomarker assays were used including: RNA:DNA ratio, heat-shock protein levels, P450 activity, superoxide dismutase activity and micronuclei presence. The goal of this project was to develop a monitoring tool to assess recovery of coastal ecosystems using bay mussels in the event of an oil spill. Bay mussels are ideal for monitoring programs because they are ubiquitous, sessile organisms that bioaccumulate pollutants through filter-feeding. They would also be easily sampled for cost-effective monitoring programs in the case of an oil spill.

Contact Author: Katrina Counihan, Alaska SeaLife Center, PO Box 1329, 301 Railway Avenue, Seward, AK 99664, T: 907-224-6336, F: 907-224-6371, katrinac@alaskasealife.org

Novel Biomarker Candidates for Delayed Cardiac Injury to Developing Fish from Oil Spills

Gardner, LD[1]; Peck, KA[2]; Linbo, TL[2]; Cameron, J[2]; Block, BA[1]; Scholz, NL[2]*; Incardona JP[2]. [1]Stanford University Hopkins Marine Station, Pacific Grove, CA, [2]Northwest Fisheries Science Center, National Oceanic and Atmospheric Administration, Seattle, WA

Fish heart development is disrupted by exposure to very low levels of crude oil, leading to deficiencies in juvenile cardiorespiratory performance. While these effects most likely underlie the population level impacts of oil spills, they are poorly understood at the molecular level. Bioavailable compounds in crude oil, including polycyclic aromatic hydrocarbons (PAHs), disrupt K^+ and Ca^{2+} fluxes controlling action potentials and excitation-contraction (EC) coupling in cardiomyocytes. During organogenesis, acute exposure leads to cardiac arrhythmia and/or reduced contractility, which in turn lead to secondary defects in heart looping and ventricular growth. At higher exposure levels, heart malformation is severe and lethal to larvae, but lower exposure levels lead to grossly normal heart development. However, surviving fish grow to have reduced swimming performance, coupled to subtle defects in cardiac anatomy and histology. These defects included abnormal ventricular shape, reduced compact myocardium, and an abnormal hypertrophic-hypercellular response in spongy myocardium. Severe malformation during embryogenesis was recently linked to altered expression of bone morphogenetic protein (BMP) family members in transcriptome studies. In this study we used RNA sequencing (RNAseq) in juvenile pink salmon (*Oncorhynchus gorbuscha*) to identify molecular changes associated with abnormal ventricular shape and pathological hypertrophy following transient embryonic exposure. We found dose-dependent up-regulation of *nkx2.3* and *nkx3*.3, NKX homeobox transcription factors not previously known to be expressed by cardiomyocytes. In addition, the largest class of genes with altered expression was involved in innate immunity. These genes were up-regulated by cardiomyocytes in the absence of a cellular inflammatory response. Our findings support a cardiomyocyte-intrinsic role for innate immune response genes in pathological hypertrophy, and identify potential new candidates for biomarkers of delayed cardiac injury from embryonic oil exposure.

Contact Author: Nathaniel Scholz, NOAA Northwest Fisheries Science Center, 2725 Montlake Blvd E, Seattle, WA 98112, T: 206-817-1338, F: 206-860-3335, Nathaniel.scholz@noaa.gov

Pentachlorophenol, Chlorinated Dioxins and Furans in Soil Surrounding Utility Poles on the Kenai National Wildlife Refuge in Alaska

Verbrugge, L.A.*[1], Kahn, L.[2], Morton, J.M.[2]. [1]U.S. Fish and Wildlife Service, Anchorage, AK, [2]U.S. Fish and Wildlife Service, Kenai, AK

An electric utility company maintains above-ground transmission lines within the Kenai National Wildlife Refuge under U.S. Fish and Wildlife Service-issued right-of-way permits. Most supporting poles have been treated with commercial pentachlorophenol mixtures known to contain trace amounts of chlorinated dioxins and furans. These contaminants can migrate from treated poles to surrounding soils, posing potential risks to human health and ecological receptors. To characterize risk and ensure best management practices for pole replacement and/or removal, we collected surface soil samples near twelve utility poles for measurement of pentachlorophenol, chlorinated dioxin and furan congeners, and selected polycyclic aromatic hydrocarbons. There were six sets of paired poles; each set consisted of a pole installed in the 1950s, a pole installed within the past twenty years, and a representative background sample of nearby soil. Samples were collected at 0, 25, and 50 cm from each pole. Pentachlorophenol, dioxin and furan concentrations in soil were high at the base of each pole, and diminished approximately ten-fold from 0 to 25 cm, and again from 25 to 50 cm out from the pole. The average soil concentrations of 2,3,7,8-tetrachlorodibenzo-p-dioxin toxicity equivalents were 15.2, 5.17 and 1.52 ppb at 0, 25 and 50 cm distances from the pole, respectively (dry weight). Pentachlorophenol concentrations were 1800, 160, and 18 ppm at 0, 25, and 50 cm distances from the pole, respectively (dry weight). Contaminant levels near the poles are orders of magnitude above screening levels for risk to both human and ecological receptors, warranting a more comprehensive risk assessment. This issue presents complex challenges for state environmental regulators, public land managers, and utility providers who strive to manage risk and protect human health and the environment, while continuing to provide electricity to Alaskan communities at a reasonable cost.

Contact Author: Lori Verbrugge, U.S. Fish and Wildlife Service, 1011 E. Tudor Road, MS 361, Anchorage, AK 99503, T: 907-786-3483, F: 907-786-3848, lori_verbrugge@fws.gov

Hazard Assessment of a Representative PAH Superfund Mixture in the Zebrafish Developmental Toxicity Model

Minick, D.J.* and Geier, M.C.*, Tanguay, R.L., Anderson, K.A. Oregon State University, Corvallis, OR.

Exposure to PAHs at Superfund Sites occurs as complex mixtures. Traditional risk assessment and management practices focus on the additive toxicities of individuals PAHs, which may be misleading if there are synergistic or antagonistic mixture effects. Construction of sufficiently similar mixtures afford risk assessors and managers a more practical and refined tool for assessing mixture toxicity. Low density polyethylene passive sampling devices were used to determine the freely dissolved concentrations of PAHs at the Portland Harbor Superfund site. Subsequently, a representative mixture, termed "Supermix 10" (SM10), was constructed from the average relative ratios of the ten most abundant PAHs. The developmental toxicity of the individual PAHs and SM10 was determined using the high throughput embryonic zebrafish assay. Concentration dependent developmental toxicity was observed for SM10. Comparison of individual and SM10 LC_{50} values suggest synergism. Tissue specificity of CYP1A1 expression was determined with immunohistochemistry for both the individual PAHs and SM10, and AhR dependence of CYP1A expression was assessed for SM10.

Contact Author: D. James Minick, Oregon State University, Department of Environmental and Molecular Toxicology, ALS 1007, Corvallis, OR 97331, T: 208-841-1119, david.minick@oregonstate.edu

Sulfolane Biodegradation in Contaminated Subarctic Aquifer Substrate: Applying Laboratory Experiments to an Industrial Problem

Kasanke C.P.* and Leigh M.B. University of Alaska Fairbanks, Fairbanks, AK, 99775.

Sulfolane is an industrial solvent used to de-acidify natural gas and selectively remove lighter aromatics from petroleum. Sulfolane has a high affinity for water and is associated with one of the largest groundwater contaminant plumes in the state of Alaska, spanning roughly a 5.5 by 3.2 km area. Due to the size of the contaminant plume in North Pole, Alaska, we questioned if there was any potential for sulfolane biodegradation to occur in subarctic aquifer substrate, and if so, what factors limit biodegradation *in situ*. Aerobic and anaerobic microcosm studies were performed at 4 - 8°C using groundwater and substrate from the contaminated aquifer. Aerobic sediment slurries contained different sulfolane concentrations with and without nutrient addition. Since portions of the plume also contain hydrocarbon contamination, we assessed the effect of hydrocarbon co-contamination on sulfolane degradation. Anaerobic sediment slurries were established under nitrate, sulfate, and iron reducing conditions. Sulfolane losses only occurred due to aerobic biodegradation, with no detectable losses occurring in sterile controls or in anaerobic incubations. Hydrocarbon co-contamination retarded the rate of sulfolane biodegradation. The addition of a mineral nutrient solution significantly stimulated biodegradation at sulfolane concentrations far above those present *in situ*, but had no effect at low sulfolane concentrations. However, in microcosms containing only groundwater in the absence of aquifer solids the addition of a nutrient solution was crucial for sulfolane biodegradation to occur. This research indicates that sulfolane-degradation potential exists in the aquifer but that oxygen limits biodegradation *in situ*. Nutrient limitations would need to be addressed if attempting to bioremediate extracted groundwater. Currently, we are working to identify sulfolane degraders using stable isotope probing and to investigate their distribution throughout the aquifer in relation to environmental and geochemical parameters. Findings from this microbial community analysis will also be presented.

Contact Author: Christopher Kasanke, University of Alaska Fairbanks, Institute of Arctic Biology, P.O. Box 751906, 909 N. Koyukuk Dr., Fairbanks, AK, 99775, T: (701) 870-4069, e-mail: cpkasanke@alaska.edu

Independent Investigation of Reclamation at Mining Exploration Drill Holes at the Remote Pebble Copper Prospect, Alaska

Zamzow, K.L.* and D. Chambers. Center for Science in Public Participation (CSP2), Chickaloon, Alaska.

This work describes a rare opportunity for scientists to examine the status of exploratory mining drill holes after they have been reclaimed. The proposed Pebble mine -- a copper, gold, molybdenum prospect -- has been explored since 1988, with most exploration occurring 2004-2012. Exploration was helicopter supported in a remote area, and no drilling has occurred since 2012. Local residents and a tribal consortium reported concerns that drill holes were improperly closed, contaminating wetlands and potentially salmon-bearing waters. In August 2016 independent scientists visited 100 of the 1,300 drill holes. Soil and water pH were determined on site and samples were analyzed for total metals, cations, anions, and petroleum. The site investigation determined that 36 of 100 sites had been fully reclaimed, 27 had minor reclamation issues, and 44 had environmental impacts such as uncontrolled metal-laden artesian flow or drill cuttings creating acidic, high copper conditions on land. A previous study indicates that the dissolved organic matter in site streams will be quickly overwhelmed if additional copper is introduced, increasing copper bioavailability.

Contact Author: Kendra Zamzow, Center for Science in Public Participation (CSP2), PO Box 1250, Chickaloon, AK 99674, T: (907) 354-3886, kzamzow@csp2.org

Measuring Air Toxic and Sulfur Compounds in Air – A Comparison of Remote, Rural and Urban Areas in Northern-Central Idaho/Eastern Washington

Johnston, N. A. C. Lewis-Clark State College, Lewiston, ID 83501 USA

The objective of this ongoing study is to characterize and quantify the composition of the air in the Lewis-Clark valley located in Northern-Central Idaho. This is a rural region with a pulp paper mill as a primary source of air pollution. No long-term studies of this nature have been conducted on the region. Considering the local industrial emissions, air toxics and sulfur compounds are expected to be higher than surrounding areas. To investigate this, sorbent tubes were used to collect air samples which were analyzed using thermal-desorption gas chromatography-mass spectrometry. Elevated levels (ppbv) of dimethyl sulfide, dimethyl disulfide, carbon disulfide, and butanethiol were observed closer to the paper mill, with dimethyl disulfide being the most concentrated. We will summarize both seasonal and daily variations of these and other compounds, with an emphasis on human health implications.

Contact Author: Nancy A. C. Johnston, Lewis-Clark State College, Division of Natural Sciences and Mathematics, 500 8th Avenue, Lewiston, ID 83501, USA, T: 208-792-2233, F: 208-792-2064, najohnston@lcsc.edu

Child and Adult Exposure and Health Risk Evaluation Following the use of Metal- and Metalloid-containing Costume Cosmetics Sold in the United States

Perez, A.L.*[1], Nembhard, M.[1], Monnot, A.[1], Bator, D.[2], Madonick, E.[3], Gaffney, S.H.[1]. [1] Cardno ChemRisk, LLC, San Francisco, CA, Portland, OR, [2] University of Michigan School of Public Health, Ann Arbor, MI, [3] Brooks Applied Labs, Bothell, WA

Costume cosmetics (lipstick, body paints, eyeshadow) were analyzed for metals using inductively coupled plasma mass spectrometry (ICP-MS). Sb was detected in all samples (range: 0.12-6.3 mg/kg; d.f. 100%), followed by Pb (<0.15-9.3 mg/kg), Ni (<0.20-6.3 mg/kg), Co (<0.5-2.0 mg/kg); with d.f. 80% each, Hg (<0.00015-0.0020 mg/kg; d.f. 50%) and As (0.53 mg/kg, d.f. 10%). Ingestion and dermal exposures were estimated for child- and adult-intermittent and adult-occupational users. Adult-occupational users exceeded the U.S. EPA Reference Dose (RfD) for Sb and the CA Proposition 65 maximum allowable dose level (MADL) for Pb was exceeded for all user scenarios. The Pb dose from body paint was sufficient to raise blood lead levels (BLL) in all user scenarios above baseline BLLs from 0.2 µg/dL to 1.9 µg/dL per the Adult Lead Model (ALM) and child Integrated Exposure Uptake Biokinetic (IEUBK) blood Pb models. Change in BLL was less than 1 µg/dL amongst the child and adult-intermittent users, the benchmark change in BLL developed for health risk assessments for children. Adult-occupational users exceeded the CA Proposition 65 NSRL intake value of 15 µg/day, which corresponds to an increase of 1.2 µg/dL above baseline levels using ALM. Exposure of occupational users of costume cosmetics should be evaluated further to prevent unnecessary metal exposure.

Contact Author: Angie Perez, Cardno ChemRisk, LLC, 5415 SW Westgate Dr. #100, Portland, OR 97221, T: (415) 618-3209, Angela.perez@cardno.com

Gene-By-Environment Interactions Drive Developmental Responses to Environmentally Relevant Levels of Antibiotic Exposure in Threespine Stickleback Fish

Lescak, E.A.*, Lucas, R.B, Sparks, K., Campbell, K., Ireland, K., and Milligan-Myhre, K.C.A. University of Alaska Anchorage, Anchorage, AK 99508 USA

Impacts of low levels of antibiotics in aquatic environments are largely unknown, but they have great potential to influence a wide variety of biotic processes, such as host-microbiota interactions. Given the importance of the microbiome to the health and development of the host, it is crucial to understand both its stability and response to disturbance. Threespine stickleback fish (*Gasterosteus aculeatus*) are widely used model organisms for understanding the effects of contaminants on development and are emerging as model organisms for studying host-microbe interactions. We use *in vitro* experiments to test the growth of bacterial strains isolated from stickleback guts in environmentally relevant levels of tetracycline as well as *in vivo* experiments to test the effects of tetracycline exposure on host development and microbial community diversity. Our *in vitro* assays reveal variation in growth rates among bacterial isolates exposed to a range of tetracycline concentrations and suggest that microbial community composition within hosts will change at sub-clinical exposure concentrations. Our *in vivo* experiments show that gene-by-environment interactions drive differences in morphological, but not behavioral, responses to short-term tetracycline exposure early in development, suggesting population-level variation in developmental instability. Future work will focus on the influence of tetracycline exposure on immune system development and microbial community diversity in fish chronically exposed to antibiotics throughout their lifespan. Results will increase our understanding of how a population's response to microbial disturbance could be indicative of its resilience to environmental perturbations.

Contact Author: Emily Lescak, University of Alaska Anchorage, Department of Biological Sciences, 3211 Providence Drive Anchorage, AK 99508, T: 907-786-6953, elescak@alaska.edu

Insight into Perchlorate's Mode of Action Using Threespine Stickleback as a Model

Gardell, A.M.[1,*], von Hippel, F.A.[2], Adams, E.M.[2], Dillon, D.M.[2], Petersen, A.M.[3], Postlethwait, J.H.[4], Cresko, W.A.[4], and Buck, C.L.[2] [1]University of Alaska Anchorage, Anchorage, AK, [2]Northern Arizona University, Flagstaff, AZ, [3]Oregon State University Cascades, Bend, OR, [4]University of Oregon, Eugene, OR

Perchlorate is a ubiquitous environmental contaminant that has widespread endocrine disrupting effects in vertebrates, including threespine stickleback (*Gasterosteus aculeatus*). The target of perchlorate is thyroid tissue where it induces changes in the organization, activation, and morphology of thyroid follicles and surrounding tissues. To test the hypothesis that some phenotypes of perchlorate toxicity are not mediated by thyroid hormone, we chronically exposed stickleback beginning at fertilization to perchlorate (10, 30, 100 ppm) or control water with and without supplementation of either iodide or thyroxine (T_4). Stickleback were sampled across a one-year timespan to identify potential differences in responses to treatment combinations before and after sexual maturation. We found that most thyroid histomorphological phenotypes induced by perchlorate (follicle proliferation, reduced follicle area (adults only), colloid depletion, thyrocyte hypertrophy (subadults only)) were significantly ameliorated by exogenous iodide supplementation. In contrast, treatment with exogenous T_4 did not correct any of the thyroid-specific histopathologies induced by perchlorate. Whole-body thyroid hormone concentrations were not significantly affected by perchlorate exposure; however, supplementation with iodide and T_4 significantly increased T_4 concentrations. This study also revealed an increased erythrocyte area in the thyroid region of perchlorate-exposed adults, while lipid droplet number increased in perchlorate-exposed subadults. Increased erythrocyte area was ameliorated by both iodide and T_4, while neither supplement was able to correct lipid droplet number. Our finding on lipid droplets indicates that exposure to perchlorate in early development may have obesogenic effects.

Contact Author: Alison Gardell, University of Alaska Anchorage, Department of Biological Sciences, 3211 Providence Dr., Anchorage AK, 99508, T: 907-786-4775, F: 907-786-4607, amgardell@alaska.edu

Use of Blood Soaked Filter Paper for Assessing the Chemical Feeding Ecology of Hg

O'Hara, T.M.[1], Castellini, J.M.[1], Rea, L. [1], Templeton, M. [1], J.E. Berner[2]*. [1] University of Alaska Fairbanks, Fairbanks, Alaska, [2] Alaska Native Tribal Health Consortium, Anchorage, Alaska

The Alaska Native Tribal Health Consortium (ANTHC; main partner) and the University of Alaska Fairbanks (UAF) participate in the Rural Alaska Monitoring Program (RAMP). The RAMP represents a major One Health project in the Department of Veterinary Medicine at the UAF and many units within ANTHC. The ANTHC has received most of the funding for RAMP from the US Department of Interior and the US Environmental Protection Agency. We utilize whole blood soaked filter papers (FP) from vertebrates to measure blood constituents. For this presentation we focus on the use of dried FP for determining contaminants (mercury) and nutrients (selenium) with respect to measures of chemical feeding ecology (C and N stable isotopes). In light of climate change driven processes that alter ecological interactions we have addressed development of field and laboratory techniques to allow for a more simplified and reliable sampling (e.g., reduced burden in field, no requirements for freezing or refrigeration, easily transported) so as to expand the scope of our efforts. We present validation of our methods using whole blood (gold standard) as compared to FP products (direct analysis of FP, use of FP eluate). We have shown that FP can be used to assess the interactions of Se and Hg (e.g., TSe:THg molar ratio) and the chemical feeding ecology of Hg (e.g., assess role of trophic level in determining Hg concentrations). Our data shows very strong agreement between measures in whole blood and we will present this information across numerous species and scenarios. These methods will allow for more involvement of hunters and biologists in remote locations using inexpensive sampling methods to advance our understanding about Hg, Se and the role of feeding ecology in a changing environment.

Contact Author: Jim Berner, Alaska Native Tribal Health Consortium, Department of Community and Environmental Health, Division of Community Health, Alaska Native Tribal Health Consortium, 4500 Diplomacy Drive, Anchorage, Alaska 99508, T: 907 729 3640, jberner@anthc.org

Integrating Adverse Outcome Pathways into the Bayesian Network Relative Risk Model for Landscape Scale Ecological Risk Assessment

Landis, W.G.[1], Chu, V.R.[1], Graham, S.E.[1], Harris, M.J.[1], Mitchell, C.J.[2], Stark, J.D.[2] ,von Stackelberg, K.E.[3] , Wallis, L.K.[1]. [1]Institute of Environmental Toxicology, Western Washington University, Bellingham, WA USA, [2]Puyallup Research and Extension Center, Washington State University, Puyallup, WA USA, [3]Center for Health and the Global Environment**,** Harvard, Cambridge, MA USA

Adverse outcome pathways (AOPs) are conceptual constructs that synthesize existing knowledge on the linkages between molecular initiating events and adverse outcomes at higher levels of biological organization. However, AOPs do not currently make quantitative predictions about population scale effects that would be relevant to decision-making. That has now changed. We will demonstrate how an AOP becomes integrated into a Bayesian network-relative risk model (BN-RRM) that is able to take a pesticide concentration and translate that to a probabilistic description of effects to Chinook Salmon populations. The parent nodes of the Bayesian network are comprised of the concentrations of the pesticides and key environmental variables. The pesticide concentration is translated into acetylcholinesterase (AChE) inhibition probabilities using exposure-effect regression models. Rates of inhibition are then transformed into probabilities of swimming inhibition and fish mortality. In a parallel pathway environmental variables such as temperature are similarly expressed as effects. Both pathways feed nodes that inform the age structure population model outputs. A Monte Carlo age structured population model is run that provides the probabilities of population numbers for all combinations of potential endpoints. Examples of single chemical pesticide impacts will be presented for the Skagit and Nooksack Rivers of Northwest Washington. This research is supported by USEPA STAR Grant RD-83579501

Contact Author: Wayne G. Landis, Western Washington University, Institute of Environmental Toxicology, 516 High Street, MS 9180, Bellingham, WA 98225, T: 360-650-6136, wayne.landis@wwu.edu

Trophic Ecology of Heavy Metals in Lake Atitlán, Guatemala

Villavicencio, H.A.[1]; Von Hippel, F.A.[2]; Chandra, S.[3]; Rejmankova, E.[4]; Burkhead, J.[1]; Stecyk, J.[1]. [1]University of Alaska Anchorage. [2]Northern Arizona University, Flagstaff. [3]University of Nevada, Reno. [4]University of California, Davis.

Lake Atitlan is a volcanic lake in the Department of Sololá, Guatemala, located in the southwestern highlands of the country. It is Central America's deepest lake and one of Guatemala's main touristic attractions. Lake Atitlán has experimented drastic ecological changes during the last years. It suffered from cultural eutrophication that caused a cyanobacteria bloom (*Limnoraphis robusta*) in 2009 (Rejmankova et al., 2011). The Tropical Storm Agatha introduced sediments from the watershed that augmented phosphorus (P) concentrations temporarily in the lake by 60% in 2010 (Corman et al., 2015). The lake has several invasive fish species; the black bass (*Micropterus salmoides*) led the endemic Atitlán grieve (*Podilymbus gigas*) to extinction, the carp (*Cyprinus carpio*) contributes to the increase of the trophic level of the lake, and the South American devilfish (*Pterygoplichthys disjuctivus*) appeared for the first time in 2017. Lake Atitlán has an extensive use of agrochemicals in its watershed, such as fertilizers with high levels of phosphorus and nitrogen, and fungicides with high concentrations of heavy metals (OIRSA, 2006). The first part of my study expounds the new fish structure and the lake trophic web using diets and stable isotopes of (□13) and nitrogen (□15). I reveal the relative dominance of the invasive fishes over the native species, and differences in the lake bay biochemistry regarding location. The second part of my study exposes the heavy metal ecotoxicology of the lake's snails, crabs and fishes, showing that the aquatic invertebrates have higher levels of toxic metals than the fish species. In this project, I created a modern fish inventory for Lake Atitlán, established its trophic ecology, set the bases for invasive species management, and elucidated heavy metal toxic risks for the locals, who consume the snails, crabs, and fishes as their main source of protein.

Contact Author: Hugo Villavicencio, University of Alaska Anchorage, Department of Biological Sciences, 3211 Providence Drive, Anchorage Alaska, 99508-4614, T. 907 9476089, F. 907 7864607, hugolvillavicencio@gmail.com

Regional Variations and Drivers of Mercury and Selenium Concentrations in Steller Sea Lions

Rea LD*[1], Castellini JM[1], Correa L[1], Fadely BS[3], Burkanov, VN[3,4],Rehberg, MJ[2], and O'Hara TM[1]. [1]University of Alaska Fairbanks, Fairbanks, AK, [2]Alaska Dept. of Fish and Game, Anchorage, AK, [3]NOAA National Marine Fisheries Service, Seattle, WA, [4]Far East Branch of Russian Acad. of Sci., Petropavlovsk-Kamchatsky, Russia

One factor for lack of recovery of endangered Steller sea lions (SSL, *Eumetopias jubatus*) in Alaska may be low natality. Mercury exposure can be neurotoxic to piscivorous mammals and impact reproduction. We measured total mercury concentration ([THg]) in lanugo (pelage grown *in utero*) of 722 SSL pups to assess fetal exposure during late gestation. We measured the molar ratio of total selenium to THg concentrations ([TSe:THg]) in whole blood collected from 135 pups to assess Se availability to potentially provide protection from the adverse effects of Hg. Finally we measured stable isotope ratios in sections of vibrissae (whiskers) of 170 young pups grown during late gestation to track diet variations between adult females that likely impact Hg exposure during this critical fetal development period. Lanugo [THg] ranged from 0.6 to 73.7 µg/g dw with the lowest median [THg] in Southeast Alaska (SEA; K-W ANOVA $p<0.0001$, $Z>1.96$). Median [THg] was higher in the western and central Aleutian Islands (WAI and CAI) than in Russia, the eastern Aleutian Islands (EAI) and western Gulf of Alaska (WGOA) ($p<0.0001$, $Z>2.81$). In the WAI approximately 20% of pups had [THg] above published risk thresholds for other mammals, compared to 6.6% of pups in CAI, and 1% of pups in EAI. Whole blood molar [TSe:THg] was significantly lower in the WAI and CAI (minimum 2.0 and 1.9, respectively) compared to the EAI and WGOA (minimum 7.4 and 9.3, respectively) suggesting there may be a limitation on the potential protective function of Se in these regions with the highest [THg]. Pups born with the highest [THg] in their lanugo (> 30 µg/g) had significantly higher $\delta^{15}N$ in vibrissa sections grown during late gestation ($p=0.0018$, $Z>1.96$) suggesting their mothers may have incorporated higher trophic level fish into their diet that led to a higher Hg exposure.

Contact Author: Lorrie D. Rea, Institute of Northern Engineering, University of Alaska Fairbanks, P.O. Box 755910, Fairbanks, AK 99775, T: 907-474-7572, LDREA@alaska.edu

The Impacts of Plastic Marine Debris on Bering Sea Seabirds: Detection of Phthalates in Muscle and Reproductive Tissue

Padula, V.M.*[1,2], Hagedorn, B.[3], and Causey, D.[1]. [1]Department of Biological Sciences, University of Alaska Anchorage, Anchorage, AK 99508, [2]College of Fisheries and Ocean Sciences, University of Alaska Fairbanks, Fairbanks, AK 99775, [3]ASET Laboratory, University of Alaska Anchorage, Anchorage, AK 99508

The plastic debris that enters the Pacific Ocean eventually reaches the seabird communities of the Bering Sea. Seabirds and the fish upon which seabirds feed may mistake plastic debris for food items and ingest them. They are consequently exposed to numerous plastic-associated chemicals, particularly endocrine-disrupting compounds like phthalates. We do not know the full extent of phthalate exposure in seabirds, nor do we understand well their effects on seabird health. The objective of this research is to build a foundation of knowledge of phthalate exposure in Bering Sea seabirds that can improve our understanding of their correlative effect on seabird reproduction and survival, population dynamics, and, more broadly, ecosystem health. We quantified concentrations of six phthalate congeners in seabird tissues: DMP (Dimethyl phthalate), DEP (Diethyl phthalate), BBP (Benzyl butyl phthalate), DBP (Dibutyl phthalate), DEHP (Diethyl hexyl phthalate), and DnOP (Di-n-octyphthalate). To date, we have analyzed muscle tissues from 128 individuals representing 11 seabird species breeding in six island groups in the Bering Sea ecosystem (Fox, Four Mountains, Andreanof, Rat, Buldir, and Near). We have found detectable levels of at least one of the six congeners in 109 individuals, with and without visible plastic material in their stomachs. The presence of phthalates without physical evidence in the stomach suggests that exposure occurs through ingestion of microplastic particles that passed through seabirds' intestinal systems, or through ingestion of contaminated prey items. Average cumulative phthalate concentrations suggest geographic and species-specific differences, eg. Crested Auklets (*Aethia cristatella*) from the Rat Islands. Additionally, we detected phthalates within reproductive tissues (enlarged ovarian follicles) from 11 female seabirds. This raises the question of whether or not exposure to endocrine-disrupting compounds such as phthalates impacts chick development and long-term health.

Contact Author: Veronica Padula, University of Alaska Anchorage/Fairbanks, College of Fisheries & Ocean Sci., 5362 Larkspur St, Anchorage, AK 99507, T: 973-902-1351, vmpadula@alaska.edu

Bioaccumulation Assessment of Persistent Organic Pollutants Within A Terrestrial Food-Web of An Avian Top Predator, the Cooper's Hawk (*Accipiter cooperii*)

Fremlin, K.[1], Elliott, J. E.[2], Green, D[1]., and Gobas, F. A. C.[1]. [1]Simon Fraser University, Burnaby, BC; [2]Environment and Climate Change Canada, Pacific Wildlife Research Centre, Delta, BC

Several types of persistent organic pollutants (POPs), including legacy compounds, such as PCBs and DDE, flame retardants and perfluorinated compounds, are released from multiple sources into the ambient environment and can negatively impact many physiological functions and ultimately survival and reproduction of exposed wildlife. Protocols to assess bioaccumulation of these persistent chemicals within terrestrial systems are far less developed compared to aquatic systems. Currently regulatory agencies in Canada, the USA, and the EU use only bioaccumulation information for fish to assess the bioaccumulation potential of chemicals. However, recent studies have shown that some chemicals that are not bioaccumulative in aquatic food-webs can significantly biomagnify in terrestrial food-webs. To better understand the bioaccumulation behavior of chemicals in terrestrial food-webs, we aim to produce a food-web model to assess the presence of and biomagnification of POPs in an apex avian predator, the Cooper's hawk (*Accipiter cooperii*). Avian predators are particularly useful indicators of environmental change and ecosystem health as greater bioaccumulation is often seen in avian species than mammalian species. We focused our study sites around 17 Cooper's hawk nests within urbanized areas of Metro Vancouver. We sampled the hawk's food chain by collecting samples of common prey species, mainly American robins, (*Turdus migratorius*), European starlings, (*Sturnus vulgaris*), and House sparrows (*Passer domesticus*). To represent the lower trophic levels several species of ground-beetles (*Carabidae spp.*), sow and pill bugs (*Oniscidea spp.*), earthworms (*Lumbricidae spp.*), and Himalayan blackberries (*Rubus armeniacus*) were also collected. Soil and air samples were also collected near hawk nesting sites. All samples have been analyzed for a variety of contaminants listed as monitoring priorities by the Chemical Management Plan of the Canadian government. Data will be entered into a food-web model to examine terrestrial bioaccumulation processes.

Contact Author: Kate Fremlin, Simon Fraser University, Department of Biological Sciences, 8888 University Drive, Burnaby, BC V5A 1S6, T: 778 996 8129 E: kfremlin@sfu.ca

Targeted Site-specific Avian Risk Refinement in Support of Remedial Decision-Making

Blanc, A.M.*[1], Hennessy, D.[1], Hovel, W.R.[2] and Larsen, M.[3]. [1]Anchor QEA, LLC, Bellingham, WA, [2]Anchor QEA, LLC, Mission Viejo, CA, [3]Anchor QEA, LLC, Tacoma, WA.

Avian risk associated with exposure to legacy contamination within a 2.5 km^2 waterlot of Victoria Harbour, BC has previously been identified as part of a comprehensive, FCSAP-reviewed risk assessment. Potential risk (HQ>1) associated with Harbour-wide exposure to PCBs and dioxin/furans were found for resident cormorant and Great Blue Heron. Risk to Great Blue Heron was of specific concern due to the potential magnitude of exposure and sensitivity to PCBs and dioxin/furans and its listed status. A refined avian risk assessment was conducted using conservative site-specific modifications to reduce uncertainty in risk estimates and to provide the targeted, location-specific information necessary for guiding future risk and/or remedial decision-making. Victoria Harbour was re-evaluated in subareas that were based on specific patterns of sediment contamination and different exposures to stormwater-related contaminants. Targeted sampling of avian prey within the subareas was completed; several species of sculpins, known to show high site-fidelity, and shore crabs, also known to move and forage within small distances, were collected. Subarea-specific sculpin tissue PCB and dioxin/furan concentrations and composition reflected those in sediment, indicating that the prey items selected were representative of ongoing bioaccumulation. The refined risk estimates indicated that individual birds are not at risk from foraging in most of the Harbour, and that risk is potentially unacceptable (HQ>1) for birds preferentially foraging in a small, discrete nearshore area of the Harbour. Potential risks corresponded to higher sediment and prey tissue PCB and dioxin/furan concentrations in only this nearshore subarea; no other risks were found in 5 other subareas evaluated. The refined risk evaluation used a targeted approach to more accurately identify risk and tie it to one discrete area making up a small portion (<0.02 km^2) of the Harbour. Results from this study may be used to inform future risk management or remediation measures.

Contact Author: Ariel Blanc, Anchor QEA, LLC, 1605 Cornwall Avenue, Bellingham, WA 98225, T: 360-715-2713, ablanc@anchorqea.com

Developing a Trophic Bioaccumulation Model for Perfluoroalkyl Substances in a Marine Food Web

McDougall, MRR*; Gobas, FAPC. Simon Fraser University, Burnaby, BC.

Food web (or trophic) bioaccumulation models are useful tools for estimating the bioaccumulative tendencies of persistent organic pollutants, and are regularly used for regulatory assessment of industrial chemicals. Many existing models are designed to evaluate neutral, lipophilic compounds, yet numerous compounds of concern, such as perfluorinated alkyl substances (PFASs), are ionizable and/or proteinophilic in nature, thus exhibiting unique bioaccumulation behaviour. In this study, an existing food web model was modified to evaluate the bioaccumulation, biomagnification, and trophic magnification of one particular PFAS, perfluorooctane sulfonate (PFOS), in a marine food web. The model was tested against measured concentrations of PFOS from a bottlenose dolphin *(Tursiops truncates)* food web in Charleston Harbor, SC. PFOS was expected to bioaccumulate and biomagnify in this food web. PFOS concentrations predicted by the modified model were in better agreement with empirical measurements compared to predicted concentrations from the existing model. Different metrics of measuring bioaccumulation were also examined in this study; the results support the utilization of holistic, food web-scale measurements of bioaccumulation (e.g., the trophic magnification factor, or TMF), particularly in food webs containing both water- and air- respiring organisms.

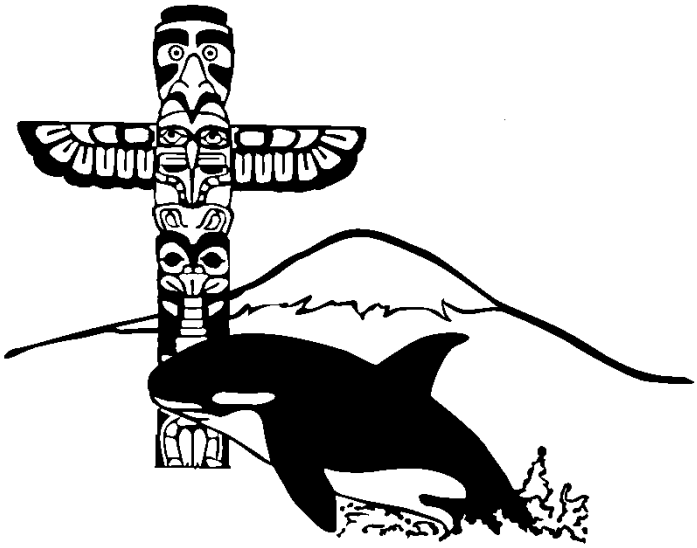
Contact Author: Mandy McDougall, Simon Fraser University, School of Resource and Environmental Management, 8888 University Drive, Burnaby, BC, V5A 1S6, T: 604-349-3885, F: 778-782-4968, mmcdouga@sfu.ca

Pacific Northwest Chapter

Society of Environmental Toxicology and Chemistry

(PNW-SETAC)

26th Annual Meeting



Poster Abstracts

(in alphabetical order)

Temporal Analysis of Stream Water Chemistry in the Cordillera Blanca of Peru

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

Due to an accelerated rate of tropical glacial recession in the Cordillera Blanca of Peru, a large area of sulfide-rich rocks have been exposed and altered the biogeochemistry of the glacial streams. From 2012-2016, five research expeditions analyzed the water quality of the streams in the Llanganuco, Quilcayhuanca, and Llaca Valleys. In situ temperature and pH, and field samples were collected at headwaters, confluences, and downstream of the glacial source. The field samples were analyzed for major anions using ion chromatography and metal concentrations using inductively coupled plasma mass spectrometry. Toxicity was modeled using the Biotic Ligand Model. The lines of evidence are currently being analyzed using principal component analysis to determine temporal and spatial trends as they relate to the emergence of the sulfide-rich rocks; preliminary results show a strong relationship between presence of the rocks and decreased pH along with elevated metal and sulfate concentrations.

Contact author: Miranda Aiken, Western Washington University, 516 High St MS 9079, Bellingham, WA 98225, T: 360-650-3520, F: 360-650-2842, aikenm@students.edu

Analysis of Air Pollutants in Rural Idaho Near a Pulp Paper Mill

Bundy, B.A.*; Andrew, J.P.; Ketcherside, D.; Rivero-Zevallos, J. A; Johnston, N.A. Lewis-Clark State College, Lewiston, ID 83501 USA

The objective of this ongoing study is to characterize and quantify the composition of the air in the Lewis-Clark valley located in Northern-Central Idaho. This is a rural region with a pulp paper mill as a primary source of air pollution. No long term studies of this nature have been conducted on the region. Considering the local industrial emissions, air toxics and sulfur compounds are expected to be higher than surrounding areas. To investigate this, sorbent tubes were used to collect air samples which were analyzed using thermal-desorption gas chromatography-mass spectrometry. Elevated levels (ppbv) of dimethyl sulfide, dimethyl disulfide, carbon disulfide, and butanethiol were observed closer to the paper mill, with dimethyl disulfide being the most concentrated. We will summarize both seasonal and daily variations of these and other compounds, with an emphasis on human health implications.

Contact Author: Brandi Bundy, Lewis-Clark State College, Division of Natural Sciences and Mathematics, 500 8th Avenue, Lewiston, ID 83501, T:208-792-2295, F: 208-792-2064, babundy@lcmail.lcsc.edu

Characterizing the Behavioral Response Induced By Urban Runoff in Juvenile Coho Salmon

Chow, M.I.[1*] and McIntyre, J.K.[2]. [1]University of Washington, Seattle, WA, [2]Washington State University, Puyallup, WA

Urban stormwater runoff is a highly complex mixture known to cause mortality events in wild adult coho salmon (*Oncorhynchus kitusch*). Coho prespawn mortality has been observed around the Pacific Northwest in urban streams and can affect 60-100% of fall runs (Scholz et al. 2011). Affected fish display a range of visible symptoms ranging from surface gaping, gilling, immobility, and a loss of equilibrium. To better understand the progression of symptoms observed during runoff exposures, I developed a behavioral model using juvenile coho. Using a flow through tank, the behaviors of juvenile coho (n = 12) were monitored in control water for 4 hours. Following the control observations, fish were transferred to collected urban runoff and exposed until moribund. Exposures were recorded for the entire duration using cameras above and below the tanks. Juvenile coho showed a clear progression of symptoms leading to mortality when exposed to urban runoff. Behaviors progressed from an increase in surface activity, a mild to severe loss of equilibrium, to an eventual loss of buoyancy. Characterized behaviors will be phenotypically anchored to physiological measurements to explore the pathophysiology causing mortality from 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

Assessing the Effects of Chemical Mixtures using a Bayesian Network-Relative Risk Model (BN-RRM) Integrating Adverse Outcome Pathways (AOPs)

Chu, V.R*[1]., Harris, M.J. [1], Graham, S. E., Wallis, L.K. [1], Mitchell, C.J. [2], Stark, J.D.[2], von Stackleberg, K.E[3]. and Landis, W.G. [1]. [1]Western Washington University, Bellingham, WA 98225, [2]Washington State University Puyallup Research and Extension Center, Puyallup, WA 98371, [3]Harvard Center for Risk Analysis, Boston, MA 02115

There are long-standing uncertainties about toxicity of chemical mixtures to populations. Laboratory toxicity tests have confirmed synergistic and antagonistic effects to individuals, but not to populations. We will conduct a regional scale ecological risk assessment by evaluating the effects chemical mixtures to populations with a new Bayesian Network- Relative Risk Model (BN-RRM) incorporating an Adverse Outcome Pathway (AOP). We started applying this new BN-RRM framework in a case study with organophosphate pesticide mixtures (diazinon, chlorpyrifos, and malathion). Acetylcholinesterase inhibition (AChE) was chosen the molecular initiating event and the Puget Sound Chinook salmon (*Oncorhynchus tshawytscha)* and Coho salmon (*Oncorhynchus kisutch)* Evolutionary Significant Units (ESU) were chosen as population endpoints. Dose-response equations will be generated from the mixtures, integrated into the new BN-RRM framework and then overall risk will be calculated for the populations. Preliminary results indicate that organophosphate pesticide mixtures act synergistically and impair olfactory function that lead to loss of antipredator, homing and reproductive behavior which lead to changes in population age structure and patch dynamics. Assessing mixtures through this new BN-RRM framework is an innovative method of predicting effects to populations. This research will demonstrate a probabilistic approach to synthesize the effects of mixtures and predict impacts to populations.

Contact Author: Valerie Chu, Western Washington University, Institute of Environmental Toxicology, 516 High Street, MS 9180, Bellingham, WA 98225, T: 360-650-6136, chuv@wwu.edu

The Influence of Feeding Ecology and Migration Barriers on Mercury Accumulation in Dolly Varden Char (*Salvelinus malma*)

Cyr, A.P.[1*], Sergeant, C.J.[2], Lopez, J.A.[1], Bower, M.[1], and O'Hara, T.M.[1]. [1] University of Alaska Fairbanks, Fairbanks, AK, [2] National Park Service, Southeast Alaska Inventory and Monitoring Program, Juneau, AK

Assimilation of mercury (Hg) into food webs is directly influenced by ecological factors such as local habitat characteristics, species' migration patterns, and feeding behavior. Total Hg concentrations ([THg]) in biota from subarctic latitudes are driven both by broad spatial processes such as long range atmospheric transport and more local influences such as biotransport and geology that can influence the development of long-term monitoring protocols. Due to the large range of spatial and temporal scales associated with these drivers, in conjunction with local sources, even relatively "pristine" protected lands such as national parks are undergoing Hg accumulation. We measured [THg] and stable isotopes of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) in 104 Dolly Varden char (*Salvelinus malma*) collected in the summer of 2012 from the Indian River in Sitka National Historical Park and the Taiya River watershed in Klondike Gold Rush National Historical Park. We sampled fish below and above natural migration barriers to upstream salmon movement. There were no differences in Dolly Varden mean [THg] between sites when standardizing fork length. Unadjusted [THg] in Dolly Varden varied relative to fish size and $\delta^{15}N$ enrichment values. While previous studies generally demonstrate that [THg] increases with higher $\delta^{15}N$ values, we found that Dolly Varden below migration barriers and foraging on salmon eggs had the highest $\delta^{15}N$ values among all sampled individuals, but the lowest [THg]. Dolly Varden residing below anadromous barriers had $\delta^{13}C$ values consistent with marine carbon influence. Mercury accumulation is variably influenced by several factors and in some cases, as noted here, not consistently for fish length or $\delta^{15}N$ values, while influenced by river type (local geology), location within a river (with respect to anadromous barriers), as well as access to different types of forage.

Contact Author: Andrew Cyr, University of Alaska Fairbanks, College of Fisheries and Ocean Sciences, 905 N. Koyukuk Drive, 245 O'Neill Building, P.O. Box 757220, Fairbanks, Alaska 99775-7220, T: 907-699-9722 acyr1@alaska.edu

Investigating Stella's Marsh in Edmonds, WA: a Sustainable Communities Partnership Project

Diep K.Q.*, Carstens W.C., and Morris J.E. Western Washington University, Huxley College of the Environment, Bellingham, WA

In early 2015, citizens of Stella's Landing in Edmonds, WA became concerned about a section of the Edmonds Marsh, locally known as Stella's Marsh. Observing dramatic changes of the wetland vegetation, the concerned citizens and the City of Edmonds partnered with Western Washington University in the Sustainable Cities Partnership to evaluate possible environmental risks associated with Stella's Marsh. The intent of our study is to develop a sampling plan to determine potential contaminants in Stella's Marsh, Edmonds, WA. We plan to do this by taking sediment core samples and water samples. Sampling will include local streams and creeks in the area, as well as sampling in multiple areas in the wetland. We will explore and determine the best sampling design for our study, in which we will consider source sampling (sampling different creeks flowing into the marsh), gradient sampling (from creek sources towards the bay), and a comparative study (Stella's Marsh versus Edmonds Marsh across from the freeway). Prior to analyzing our samples, we will consult with an additional Sustainable Communities Partnership team that is preparing a Phase I Environmental Site Assessment (ESA) for Stella's Marsh. By collaborating with the ESA group, we will determine which contaminants or groups of contaminants might be likely in our sediment and water samples and specify our contaminant analysis. Residents of Stella's Landing have voiced concerns about invasive species in Stella's Marsh, posing a potential secondary study after our sediment and water analysis.

Contact Author: Kimberly Diep, Western Washington University, Huxley College of the Environment, 516 High St, Bellingham, WA 98225, T: 208-412-7716 email: diepk@wwu.edu

Biopsy Punches as a Cost Effective and Efficient Tool to Monitor Mercury in Fish Muscle

Gerrish, H.N.[1*], Cyr, A.P., Castellini[1], J.M., López, J.A.[1], O'Hara T.M.[1]. [1]University of Alaska Fairbanks, Fairbanks, AK

Mercury (Hg) is a toxic ubiquitous element that bioaccumulates and biomagnifies in fish. Fish are a significant food source for much of the world and form the main diet of many marine and freshwater species. Monitoring Hg content of fish to establish and maintain health and consumption guidelines is essential for food safety. Most Hg monitoring and analysis techniques in fish are labor intensive, lethal, and require many steps. Biopsy punches may offer a more efficient alternative, allowing comparatively quick, easy, efficient, and cost effective monitoring of mercury, and put sample acquisition in the hands of sport fishermen, commercial fishing companies, resource managers, subsistence users, and researchers, including catch and release. Here we report the relative accuracy of biopsy punches when compared to currently established methods (full thickness muscle fillet). Muscle samples were taken from 127 fish from 6 species, freeze-dried, homogenized, and analyzed on a Milestone ® DMA-80 mercury analyzer (thermal decomposition, Hg amalgamation and atomic absorption detection). Values were then compared with those from a 6mm biopsy punch taken from the same area of each fish and subsequently analyzed wet, without processing, on the DMA-80. Mercury concentrations measured in biopsy punches and full muscle samples were strongly correlated (slope = 1.12, r^2 = 0.95), demonstrating that the biopsy punch could be an accurate tool to replace full muscle sampling. Several caveats were identified with the need for optimization of the DMA-80 analytical method, issues that could be solved with further research. Additional questions have arisen, notably can this technique be applied in a non-lethal manner for live capture and release of fish for monitoring purposes. Such possibilities are promising and would allow Hg monitoring to be more accessible to members of the community and provide opportunities for easier outreach, education, and communication.

Contact Author: Hannah Gerrish, University of Alaska Fairbanks, P.O. Box 82183, Fairbanks, AK 99708, T: (907)978-1126, hngerrish@alaska.edu

Toxicity of Roof Runoff and its Effects on Coho Salmon and other Aquatic Organisms

Haskins Taylor*J.; McIntyre J.K.; Rozmyn, L.; Winters, N; Stark, J.D. Washington State University, Puyallup WA

The impact of stormwater runoff to aquatic ecosystems and the use of Green Stormwater Infrastructure (GSI) to remediate this impact are increasing important areas of scientific study particularly in areas of the world affected by heavy rain during the winter months. Salmon are commercially and culturally important species to the Pacific Northwest United States. Many wild salmon populations are in decline with specific populations categorized as threatened or endangered. There have been reports in recent years of large die-offs of Coho salmon in small rivers and streams; these deaths often occur before spawning furthering the decline of the population. Urban runoff has high levels of various pollutants that have been shown to cause negative effects on several aquatic species, including salmon. A variety of roofing materials contain metals, as well as organic and inorganic chemicals. These chemicals have been shown to leach during rain events, ultimately ending up in stormwater, which then enters rivers and streams and eventually salt water systems. In this study, we investigated the capacity of several roofing materials to leach pollutants during rain events, in the Puget Sound region of Washington State. We also evaluated the toxicity of runoff from these roofing materials to three aquatic species, the water flea, *Cerodaphnia dubia*, zebrafish, *Danio rerio*, embryos and Coho salmon, *Oncorhynchus kisutch*. The results of this study will provide insight into the potential effects of roofing materials on salmon and some of their prey items as well as the chemical loading of roofing materials into bodies of water over an extended time period.

Contact Author: Taylor Haskins, Washington State University, School of the Environment, 2606 W Pioneer, Puyallup, WA, 98371, T: 512-538-8004, F: 253-445-4571, Taylor.p.haskins@wsu.edu

Contaminant Assessment Process for the Alaska Maritime National Wildlife Refuge and the Alaska Bering Sea Islands Landscape Conservation Cooperative

Kenney, L.A.*[1], Reeves, M.K.[2], Poe, A.A.[1], Mock, K.J.[3], Huff, H.[3] von Hippel F.A.[4], Trammel, J.E.[5], Geist, M.[5]
[1]US Fish and Wildlife Service, Anchorage, AK, [2]US Fish and Wildlife Service, Honolulu, HI, [3]University of Alaska Anchorage, Anchorage AK, [4]Northern Arizona University, Flagstaff, AZ, [5]Alaska Center for Conservation Science, Anchorage, AK

The U.S. Fish and Wildlife Service Contaminant Assessment Process is a methodology that identifies and summarizes known past, present, and potential contaminant issues on National Wildlife Refuges. The Alaska Maritime National Wildlife Refuge (ANMNWR) is a landscape scale refuge with a World War II military history and varied contaminant inputs. Working with the Alaska Bering Sea Islands (ABSI) Landscape Conservation Cooperative (LCC) and multiple state, federal, and tribal entities, we compiled and synthesized contaminants information within AMNWR and the ABSI-LCC region. Our primary objectives were to: 1) develop a publicly accessible contaminants database with interactive spatial capacity; 2) conduct a spatial and temporal analysis of mercury concentrations in select wildlife throughout the study area; and 3) conduct a landscape scale vulnerability assessment using contaminated sites data, and wildlife and human health risk data. We compiled and organized over 70,000 records of organic and inorganic contaminant data for soil, rock, water, and wildlife tissues into the online database. Preliminary results from the mercury synthesis analysis indicate spatial trends in mercury concentrations, with highest mercury concentrations in numerous taxa collected from the western Aleutian Islands. In general, variation in mercury was predictable by species and taxa groupings, where those taxa with higher trophic position (e.g., raptors and marine mammals) were higher in mercury compared to lower trophic organisms (e.g., benthic invertebrates). The landscape scale contaminants vulnerability assessment and mercury synthesis will be used to highlight priorities for subsistence, human health, and wildlife management concerns in the region.

Contact Author: Leah Kenney, US Fish and Wildlife Service, Ecological Services, 4700 BLM RD, Anchorage, AK, 99507, T: 907-271-2440; F: 907-271-2786; leah_kenney@fws.gov

Mercury Concentrations in Freshwater Forage Fish from the Aleutian Archipelago, Alaska

Kenney, L. A.*[1], von Hippel, F.A.[2], Eagles-Smith, C.A.[3], Ackerman, J.T.[4], Kaler, R.S.A.[1], Trammel, J.E.[5]
[1]US Fish and Wildlife Service, Anchorage, AK, [2]Northern Arizona University, Flagstaff, AZ [3]USGS Forest and Rangeland Ecosystem Science Center, Corvallis, OR, [4]USGS Western Ecological Research Center, Dixon, CA, [5]Alaska Center for Conservation Science, Anchorage, AK

The Aleutian Archipelago (Aleutians) is an isolated arc of >300 volcanic islands that separates the North Pacific Ocean and Bering Sea. Despite the remoteness of the Aleutians, elevated levels of contaminants, including mercury, have been documented in marine organisms throughout the archipelago. The Aleutians are a critical region for avian conservation, supporting more than ten million seabirds, as well as sea ducks and waterfowl that rely on freshwater ecosystems for foraging and breeding habitat. Elevated levels of mercury in forage fish pose serious health consequences for fish-eating wildlife. We evaluated mercury concentrations of 1,121 resident-freshwater fish samples of three species: the threespine stickleback (*Gasterosteus aculeatus*), the ninespine stickleback (*Pungitius pungitius*) and Dolly Varden (*Salvelinus malma*). Samples were obtained across a 3,000 km longitudinal gradient of 11 islands spanning from the western Aleutians to the Gulf of Alaska. Mercury concentrations for stickleback and Dolly Varden differed significantly among islands. There were no apparent longitudinal trends in mercury concentrations. We found greater variation in fish mercury concentrations within islands than among islands and percent shrub/scrub was the most important landscape variable in predicting fish mercury concentrations. These results provide the first mercury levels in resident-freshwater fishes across the Aleutians, and provide important baseline information for which to further elucidate sources and pathways of mercury, as well as potential mercury exposure to fish-eating wildlife.

Contact Author: Leah Kenney, US Fish and Wildlife Service, Ecological Services, 4700 BLM RD, Anchorage, AK, 99507, T: 907-271-2440; F: 907-271-2786; leah_kenney@fws.gov

Research Goals for Environmental Impacts of Cost-Effective Green Stormwater Infrastructure Technology

Leonard, B.D.[1]*; Du, B.[2]; McIntyre, J.K.[1]; Kolodziej, E.[2]; Scholz, NL[3]; and Stark, J.[1]. [1]Washington State University, Puyallup, WA, [2]University of Washington, Tacoma, WA, [3]NOAA NMFS/NWFSC, Seattle, WA

Nonpoint sources of pollution in urban stormwater runoff contribute to environmental contaminants entering aquatic ecosystems. The effects of these pollutants are difficult to quantify, but a growing body of research shows that stormwater runoff is toxic to many aquatic organisms. Large stormwater events are common in the Pacific Northwest due to frequent precipitation and the increasing size of urban environments. Surface runoff generated from these events flows across impermeable surfaces such as asphalt and concrete until it is collected in a drainage system, seeps into soil, or directly enters a body of water. The composition of stormwater varies spatially and temporarily. It is generally accepted that highly urbanized environments produce stormwater with higher concentrations of contaminants. However, rural areas also present issues stemming from agricultural land use practices. Along busy roadways a major component of stormwater contamination includes chemical constituents of automobile waste. Several cost-effective technologies exist that aim to reduce the negative impacts of stormwater runoff in the environment. Treatment technologies that utilize natural processes to clean stormwater in a cost-effective manner are referred to as green infrastructure (GI) techniques. However, these systems must be fully evaluated before their wide-spread potential can be implemented. These technologies are currently being tested at the Washington State University (WSU) Puyallup Research and Extension Center (REC). As a graduate researcher, I hope to address several questions regarding the feasibility of these systems: 1) What effects do stormwater contaminants have on aquatic organisms? 2) To what extent, if any, do GI technologies reduce the toxicity of stormwater to aquatic organisms? 3) Do laboratory models of GI technologies provide meaningful results that can be applied to field studies? 4) How do the GI technologies studied compare to other stormwater treatment technologies? 5) How can GI technologies be improved?

Contact Author: Ben Leonard, WSU Puyallup REC, 2606 W Pioneer Ave, Puyallup, WA, 98317,T: 360-339-2625, benjamin.leonard@wsu.edu

Trophic Feeding Ecology of Mercury in Kotzebue Sound Fish: Emphasis on Monomethylmercury

Mayo, E.[1], Cyr, A.P.[1*], Whiting, A.[2], Lopez, J.A.[1], and O'Hara, T.M.[1 1] [1] University of Alaska Fairbanks, Fairbanks, AK, [2] Village of Kotzebue, AK

Monomethyl mercury ($MeHg^+$), a potent neurotoxin and endocrine disruptor, accumulates in some fish tissues. $MeHg^+$ is more bioavailable from the diet than inorganic Hg forms because of its high assimilation efficiency, thus the majority of Hg in many tissues is $MeHg^+$. People who consume large quantities of fish, such as fish-based subsistence cultures including many native Alaskan communities, can potentially be at risk of consuming large quantities of $MeHg^+$, depending on the $\%MeHg^+$ of the fish species that make up their diet and the commonly measured THg (includes all forms of Hg). We hypothesize that $\%MeHg^+$ ([$MeHg^+$/total Hg) * 100]) is independent of feeding ecology, as indicated by $\delta^{15}N$, or fish size, a proxy for age. We analyzed fish donated by subsistence fishermen, (Kotzebue Sound, Alaska) to assess the potential for $MeHg^+$ load. We analyzed muscle samples from 100 fish representing five species for total Hg concentrations [THg], [$MeHg^+$], and stable isotopes of nitrogen ($\delta^{15}N$), and carbon ($\delta^{13}C$). We determined that [THg] and [$MeHg^+$] increased with $\delta^{15}N$ in three of the species. For the species studied, we determined that regardless of feeding ecology, or fish size, $\%MeHg^+$ remained relatively constant in muscle, at >85%. We suggest this is due to a diet predominately composed of MeHg+, high assimilation efficiency of $MeHg^+$, and lack of demethylation processes independent of the age or feeding ecology of the fish. This information highlights the importance of understanding Hg accumulation dynamics in fish to better evaluate and set health consumption guidelines with attention to forms of Hg (e.g., %MeHg+).

Contact Author: Andrew Cyr, University of Alaska Fairbanks, College of Fisheries and Ocean Sciences, 905 N. Koyukuk Drive, 245 O'Neill Building, P.O. Box 757220, Fairbanks, Alaska 99775-7220, T: 907-699-9722 acyr1@alaska.edu

Incorporating Spatially Explicit Metapopulation Models as the Adverse Outcome Pathway Endpoint of a Bayesian Network- Relative Risk Model

Mitchell, C.J.*[1]; Harris, M.J.[2], Chu, V.R.[2], Graham, S.E., Wallis, L.K.[2], von Stackleberg, K.E.[3], Landis, W.E[2], Stark, J.D.[1]. [1]Washington State University Puyallup Research & Extension Center, Puyallup, WA 98371, [2]Western Washington University, Bellingham, WA 98225, [3]Harvard Center for Risk Analysis, Boston, MA 02115.

Population viability analysis is useful tool for assessing the environmental risk of toxicants because it produces endpoints relevant to managers and can be manipulated to compare the potential outcomes of conservation actions. In general, many Environmental Risk Assessments (ERAs) lack utility and realism because they fail to incorporate the combined effects of lethal and multiple sub-lethal impacts, environmental stressors, and chemical mixtures into a relevant endpoint for managers. To improve the utility of regional scale risk assessment, we are developing a Bayesian Network-Relative Risk Model that incorporates the combined effects of toxicants and environmental stressors into an Adverse Outcome Pathway (AOP) framework linking environmental conditions to spatially explicit metapopulation models. As a primary case study for this new model, we are examining the impacts of organophosphate (OP) insecticides on ESA-listed chinook (*Oncorhynchus tshawytscha*) and coho (*Oncorhynchus kisutch*) salmon populations using site specific data from the Lower Skagit, Nooksack, Cedar, and Yakima River watersheds in Washington State. The AOP within the BN-RRM links concentrations of OPs to Acetylcholinesterase (AChE) inhibition, which is then linked to sub-lethal impacts that are incorporated into matrix metapopulation models through age-specific reductions in survival and reproduction. The outcome of this effort will be an adaptable management tool that uses existing, disparate data to link realistic toxicant concentrations to probabilistic population outcomes. The preliminary results of this model development suggest that environmentally realistic concentrations of OPs may slow the growth of salmon populations, undermining the success of current restoration efforts.

Contact Author: Chelsea Mitchell, Washington State University, 2606 W Pioneer, Puyallup, WA 98371, T: 508-685-0343, chelsea.mitchell@wsu.edu

Metal Mixture Toxicity in *Lactuca sativa*

Smith, A.* M.; Lawrence, E. J.*; Charlton, C.; Moran, I.; Sofield, R. M. Western Washington University, Huxley College of the Environment, Bellingham WA

Metals are often found in the environment in mixtures. In models used to assess the impact a chemical has in the environment there is limited mixture toxicity data. The USEPA has begun to incorporate these models into their risk assessment framework because they can more accurately represent the toxicity of a metal in the environment. In this project we are testing the toxicity of binary metal mixtures to *Lactuca sativa* (lettuce seedlings) and using the results to characterize joint action of those mixtures. The mixtures are all combinations of the following metals: aluminum, cadmium, copper, iron, zinc. The metals include both micronutrients and metals with no known biological function. We are determining whether the metals act synergistically, antagonistically, or additively with respect to root length. Studying mixture toxicity will lead to better understanding the mechanisms of metal toxicity that determine the differences in mixture effects. Ultimately, this can lead to better informed decisions when assessing the hazard of metals in the environment and creating regulations. Further research in this project is focused on how the presence of a metal alters bioavailability and accumulation of other metals.

Contact Author: Eric Lawrence, Western Washington University, Huxley College of the Environment, 3327 Northwest Ave Apt 6, Bellingham, WA 98225, T: 206-291-7703, lawrene@wwu.edu

Change in Haptoglobin Concentrations in Steller Sea Lions (*Eumetopias Jubatus*) and Environmental Exposure to Mercury: Chemical Assay Interference?

Vang, R.T.*; Kennedy, S.N.; Castellini, J.M.; Rea, L.D.; O'Hara, T.M.; Ferrante, A. University of Alaska, Fairbanks, AK, USA

The Western Distinct Population Segment (WDPS) of Steller sea lions (SSL) have experienced decline, and some regions have yet to recover ("endangered" status). Reasons for the decline are unknown. Some SSL pups from the WDPS have relatively high concentrations of whole blood total mercury ([THg]) compared with the de-listed region. Considering monomethyl mercury ($MeHg^+$) is absorbed and transported through the placenta, developing young may be at risk of adverse effects from mercury. Measurements of the mean acute phase inflammatory protein haptoglobin (Hp) in young SSLs from regions of decline were significantly lower than other regions. Furthermore, individuals with [THg] above clinical effects thresholds as defined by Health Canada (>0.1 ppm) had lower mean Hp than individuals with lower [THg]. The relationship between Hp and [THg] is not well defined. Considering various forms of mercury may interact with proteins similar to Hp, we aimed to test if the addition of various forms of mercury affect the colorimetric Hp assay. We designed three experiments using methyl mercury hydroxide (MeHgOH) and THg to spike the commercial colorimetric Hp assay and test for potential interference. We hypothesized that the addition of MeHgOH and THg to the Hp assay would not affect the determination of Hp concentrations. Our results demonstrated that the addition of MeHgOH and THg did not alter the measurement of Hp concentration from the expected standard concentration. Furthermore, when adding MeHgOH to SSL serum, Hp measurements did not change. This information supports the hypothesis that measurements of Hp are not significantly influenced by the presence of Hg at levels relevant to WDPS SSLs. We conclude that Hp concentrations measured in SSLs over these ranges of mercury concentrations are reliable, and that the relationship of Hp concentrations with THg exposure in SSLs reflects a biological phenomenon rather than an artifact of assay interference.
(Word count, 300)

Contact Author: Stephanie N. Kennedy, University of Alaska Fairbanks, Department of Chemistry and Biochemistry, P.O. Box 82672, Fairbanks, AK 99708, T: 970-817-4849, snkennedy@alaska.edu

Incorporating Climate Change into the Prediction of Risk to Pacific Herring and Estuary Habitat in Puget Sound

Wallis, L.K.[1], Markiewicz, A.J.[1] and Landis, W.G.[1]. [1]Institute of Environmental Toxicology, Western Washington University, Bellingham, WA USA,

A major issue in the Salish Sea and specifically the Puget Sound is how to incorporate the potential risks posed by climate change into the management of the marine nearshore regions. This pilot project uses the Bayesian network relative risk model (BN-RRM) to assess those risks using two indicator endpoints important for assessing the recovery and protection of the Puget Sound ecosystem. The endpoints are: 1) the change in persistent organic pollutant concentrations in Pacific herring, and 2) the probability of changes to estuary habitat and coastal agricultural lands due to inundations in river deltas from changes in storm frequency, high river flows and increases in sea level. BN-RRM models will be developed for each endpoint with the cause-effect pathways modified to include pathways that describe the inputs due to changes in climate to a specific region. The climate change predictions will be based on downscaled global climate models for two areas, the Skagit River watershed and the habitat of the Cherry Point stock of Pacific herring. This presentation will depict the initial cause-effect conceptual models and the BN-RRM derived from these pathways. This research project is supported by an interagency agreement with the Washington State Puget Sound Partnership.

Contact Author: Wayne G. Landis, Western Washington University, Institute of Environmental Toxicology, 516 High Street, MS 9180, Bellingham, WA 98225, T: 360-650-6136, wayne.landis@wwu.edu

Analyses of Urine and Bile of Marine Mammals for Metabolites of Polycyclic Aromatic Hydrocarbon Metabolites by Two Analytical Methods

Ylitalo, G.M[1], Bolton, J.L.[1], Stimmelmayr, R.*[2] [1] Environmental and Fisheries Sciences Division, Northwest Fisheries Science Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Seattle, WA 98112, [2] Department of Wildlife Management, North Slope Borough, Barrow, AK 99723

Concentrations of polycyclic aromatic hydrocarbons (PAHs) and their metabolites in tissues and fluids of subsistence-harvested marine mammals on the North Slope, Alaska as baseline exposure levels of oil-spill related contaminants are lacking for marine mammals, particularly endangered or threatened populations (e.g., ice seals, bowhead whales, polar bears) from the Arctic. Identification of the appropriate tissues/fluids to assess recent exposure of marine mammals to oil components must be determined, as well as the type of oil spill-related contaminant (e.g., parent polycyclic aromatic hydrocarbons (PAHs), metabolites of PAHs). To help address these data gaps, various matrices of Arctic marine mammals collected during subsistence harvests were analyzed for PAHs and PAH metabolites using analytical methods developed at the NWFSC. We present our findings on metabolites of polycyclic aromatic hydrocarbons (PAH MET) in bile and urine of important Arctic marine mammal subsistence species determined by two different analytical methods (i.e., high-performance liquid chromatography/fluorescence screening and liquid chromatography-tandem mass spectrometry). Overall, the levels of PAHs metabolites were low or below the lower limit of quantitation for the majority of bile samples analyzed. Comparative bile data on naturally oil-fouled ice seals is provided. Our results provides a unique baseline data record against which future comparisons can be made.

Contact Author: Raphaela Stimmelmayr, Department of Wildlife Management, North Slope Borough, Box 69, Barrow, AK 99723, T: 907-852-0350, Raphaela.stimmelmayr@north-slope.org