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Laurentian SETAC 23rd

CONFERENCE & AGM

Queen's University | Kingston, ON

June 8, 2018

ON THE CUTTING EDGE

INNOVATIONS IN ENVIRONMENTAL TOXICOLOGY AND CHEMISTRY

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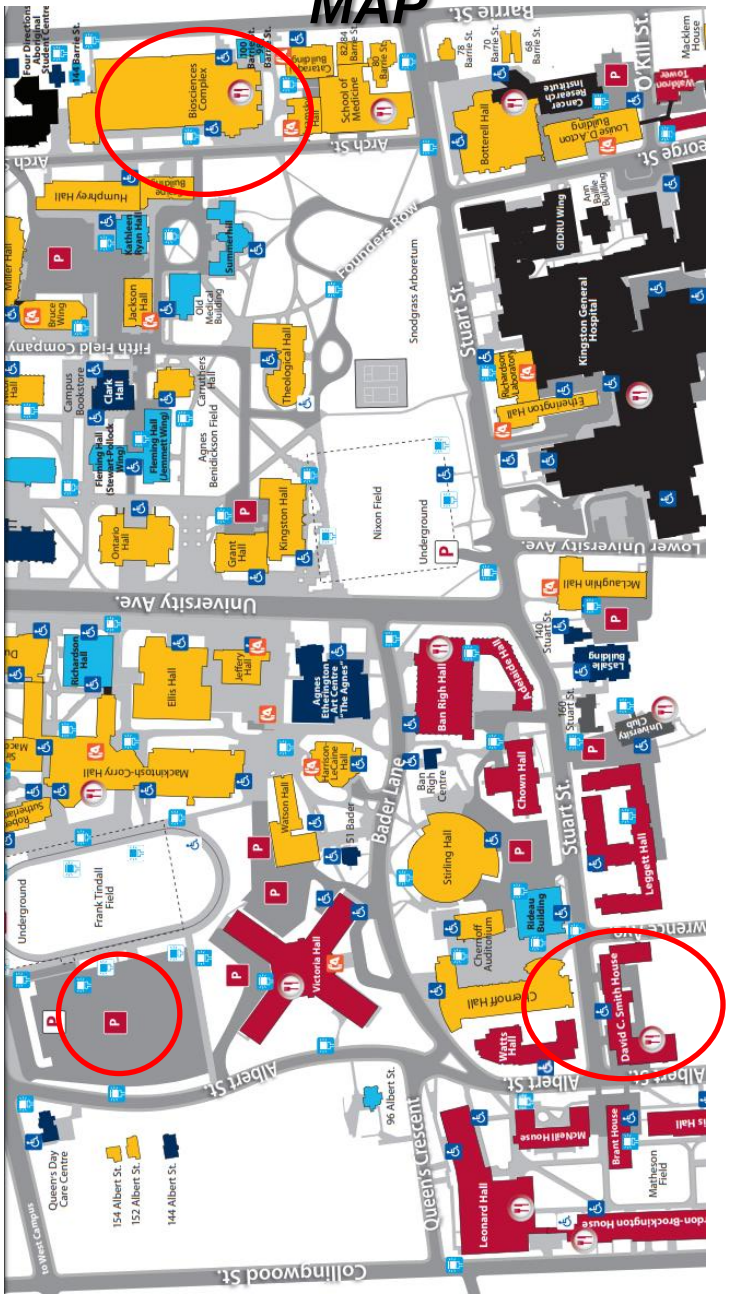

CONFERENCE PROGRAM

Friday, June 8th 2018

Time	Location	Schedule Item
8:30 – 9:00	Biosciences Complex Atrium	***Registration***
		Poster set-up
9:00 – 9:30	Room 1102	***Opening Remarks*** – Wilson Lau, L-SETAC President; Ève Gilroy & Oana Birceanu, Diversity in Science Committee ***SETAC North America Update*** – Greg Schiefer, SETAC North America Executive Director
9:30 – 10:15	Room 1102	***Past, Present and (Potential) Future of Environmental Protection (From a Toxicologist's Viewpoint)*** **David Poirier** Senior Laboratory Scientist, Ontario Ministry of the Environment and Climate Change
10:15 – 11:00	Atrium	***Posters*** *and Morning Break (Student poster judging)*
11:00 – 11:45	Room 1102	***It Takes a Village: Building Community-University Partnerships as a Viable Model for Environmental Research*** **Dr. Andrea Kirkwood** Associate Professor, Faculty of Science, University of Ontario Institute of Technology

CONFERENCE PROGRAM *(cont'd)*

Friday, June 8th 2018

Time	Location	Schedule Item
11:45 – 1:00	Atrium	*Buffet Lunch*
12:00 – 1:20	Room 1102	***Annual General Meeting***
1:20 – 1:40	Rooms 1102 & 1120	***Concurrent Platform Presentations*** **Sessions A & B**
1:40 – 2:00		
2:00 – 2:20		
2:20 – 2:40		
2:40 – 3:20	Atrium	***Posters*** *and Afternoon Break (Student poster judging)* **& Book Draw**
3:20 – 3:40	Rooms 1102 & 1120	***Concurrent Platform Presentations*** **Sessions C & D**
3:40 – 4:00		
4:00 – 4:20		
4:20 – 5:00	Room 1120	***Student Judges meet***
	Atrium	*Take down posters*
5:30 – 7:00	**Grizzly Grill** *395 Princess St.*	***Student Awards Social***

Platform Presentations

Time	Session A: Environmental Risk Assessment & Remediation Room 1120
1:20 – 1:40	**An Approach to Scoring Toxicity Data for the Development of Wildlife TRVs** Thackeray, Nicole[1], Harriet Phillips[1], Katherine Woolhouse[1] & Stacey Fernandes[1] [1] Canada North Environmental Services, Markham, ON
1:40 – 2:00	**Conceptual Site Models: The Role they Play in Environmental Remediation** Danielle Thorson[1] & Dr Gary Wealthall[1] [1] Geosyntec Consultants Inc, Guelph, ON
2:00 – 2:20	**Reassessment of the BUI "Degradation of Wildlife Populations" for the Hamilton Harbour AOC** Ève A.M. Gilroy[1], Marilyn Baxter[2], Kristin O'Connor[3], Jim Quinn[4], David Moore[5], Laud Matos[6] [1]Green House Science, Burlington, Ontario [2]Hamilton Port Authority, Hamilton, Ontario [3]Hamilton Harbour Remedial Action Plan, Burlington, Ontario [4]McMaster University, Hamilton, Ontario [5]Canadian Wildlife Service, Burlington, Ontario [6]Environment and Climate Change Canada, Toronto, Ontario
2:20 – 2:40	**Case study: deriving a site-specific water quality objective for arsenic using the Canadian Council of Ministers of the Environment Species Sensitivity Master Version 3.0** Nesbitt, Richard A.[1], Neil J. Hutchinson[1] [1] Hutchinson Environmental Sciences Ltd.

*** Student presentation**

Platform Presentations (cont'd)

Time	Session B: Cutting Edge Techniques Room 1102
1:20 – 1:40	**Can microRNA secreted from trout be used to detect their response to stress?** *Ikert, Heather[1] , P. Marjan [1] , A.C. Doxey[1] , M.R. Servos[1] , J.P. Giesy[2] , B.A. Katzenback[1] , And P.M. Craig[1] [1] Dept. of Biology, University of Waterloo, Waterloo, ON, Canada, [2] Dept. of Veterinary Biomedical Sciences, University of Saskatchewan, Saskatoon, SK.
1:40 – 2:00	**Sub-Lethal Toxicity of Halogenated Acetic Acids (HAAs) on Daphnia magna investigated using 1 H NMR Based Metabolomics** *Lisa Labine[1] , Myrna J. Simpson[1] [1] Department of Chemistry, University of Toronto, Toronto, ON
2:00 – 2:20	**^{1}H NMR-based metabolomics of *Daphnia magna* sub-lethal exposure to a mixture of triphenyl phosphate, triclosan and diazinon in the presence of dissolved organic matter** *Vera Kovacevic, André J. Simpson & Myrna J. Simpson Department of Chemistry, University of Toronto, 80 St. George Street, Toronto, ON, M5S 3H6, Canada; Environmental NMR Centre and Department of Physical and Environmental Sciences, University of Toronto Scarborough, 1265 Military Trail, Toronto, ON, M1C 1A4
2:20 – 2:40	**An 'omics perspective on the sublethal effects in the Western clawed frog exposed to a naphthalene sulfonic acid** *Wallace, Sarah J[1,6], Shenfield A[2], Leclerc A[2], Prosser RS[3,4], de Solla SR[5], Balakrishnan VK[3], and Langlois VS[1,2,6] [1]Chemistry and Chemical Engineering Department, Royal Military College of Canada, Kingston, ON, [2]Department of Biology, Queen's University, Kingston, ON, [3]Aquatics and Contaminants Research Division, Environment and Climate Change Canada, Burlington, ON [4]School of Environmental Sciences, University of Guelph, Guelph, ON [5]Ecotoxicology and Wildlife Health Division, Environment and Climate Change Canada, Burlington, ON, [6]Centre Eau Terre Environnement, Institut national de la recherche scientifique, Québec, QC

*** Student presentation**

Platform Presentations (cont'd)

Time	Session C: Oil Sands & Naphthenic Acids Research Room 1120
3:20 – 3:40	**The interplay of methane and ammonia as key oxygen consuming constituents in early stage development of Base Mine Lake, the first demonstration oil sand pit lake** Florent Risacher[1,2], Patrick Morris[1], Daniel Arriaga[1], Corey Goad[1], Tara Colenbrander Nelson[3], Gregory F. Slater[1] and Lesley A. Warren[3] [1] School of Geography and Earth Sciences, McMaster University, Hamilton ON, L8S 4K1, [2] Geosyntec, Guelph ON, N1G 3Z2, [3] Dept. of Civil and Mineral Engineering, University of Toronto, Toronto, ON, M5S 1A4
3:40 – 4:00	**Naphthenic acids disrupt vocalization in Western clawed frogs** *Zhang, W., Gutierrez-Villagomez, J.M., & Trudeau, V.L. Department of Biology, University of Ottawa
4:00 – 4:20	**Profiling volatile organic compounds from naphthenic acids, acid extractable organic mixtures, and oil sands process-affected water** *Gutierrez-Villagomez, Juan Manuel[1], Juan Vázquez-Martínez[2], Enrique Ramírez-Chávez[2], Jorge Molina-Torres[2], Vance L. Trudeau[1] [1] Department of Biology, University of Ottawa, Ottawa, Ontario K1N 6N5, Canada, [2] Departamento de Biotecnología y Bioquímica, CINVESTAV Unidad Irapuato, Guanajuato, México

*** Student presentation**

Platform Presentations (cont'd)

Time	Session D: Metals and Pesticides in the Environment Room 1102
3:20 – 3:40	**Characterization of metal toxicity in cryptic species of *Hyalella azteca*** *Sinclair, Kate M.[1], Jonathan D.S. Witt[1], D. George Dixon[1] & Warren P. Norwood[2] [1]Department of Biology, University of Waterloo, Waterloo, ON [2]Environment and Climate Change Canada, Canada Centre for Inland Waters, Burlington, ON
3:40 – 4:00	**Does reporting significant effects of pesticides translate into greater citations in the future?** Hanson ML[1], Deeth LE[2], Prosser RS[3] [1] Department of Environment and Geography, University of Manitoba, Winnipeg, Manitoba [2] Department of Mathematics and Statistics, University of Guelph, Guelph, Ontario [3] School of Environmental Sciences, University of Guelph, Guelph, Ontario
4:00 – 4:20	**Acute oral toxicity and risks of potential neonicotinoid replacements to the Common Eastern Bumble Bee (*Bombus impatiens* Cresson)** *Mundy, Kayla A.[1], Ryan Prosser[1], Nigel E. Raine[1] [1] School of Environmental Sciences, University of Guelph, Guelph, Ontario

*** Student presentation**

Poster Presentations

Toxicity of novel fire suppression gels to aquatic and terrestrial organisms

*Graetz, Sarah, Paul Sibley & Ryan Prosser
School of Environmental Sciences, University of Guelph, Guelph, ON

Developing multigenerational exposure of the earthworm *Eisenia andrei* to neonicotinoid pesticides

*William J. Martin, Paul K. Sibley & Ryan S. Prosser
School of Environmental Science, University of Guelph, Guelph, ON

The influence of sediment composition on the toxicity of naphthalene sulfonates to benthic invertebrates *Tubifex tubifex* and *Hyalella azteca*

Matten, K.J.[1], Gillis, P.L.[2], Toito, J.[2], Milani, D.[3], Bartlett, A.J.[2], Parrott, J.L.[2], Balakrishnan, V.[2], and Prosser, R.S.[1]
[1] School of Environmental Sciences, University of Guelph, Guelph, ON, Canada
[2] Aquatic Contaminants Research Division, Environment and Climate Change Canada, Burlington, ON, Canada
[3] Watershed Hydrology and Ecology Research Division, Environment and Climate Change Canada, Burlington, ON, Canada

Toxicity of diluted bitumen to rainbow trout (*Oncorhynchus mykiss*) alevins

*Adams, Julie E.[1], Barry N. Madison[1,2], Kelli Charbonneau[1], Marie Sereneo[1], Lucie Baillon[3], Valérie S. Langlois[1,3,4], R. Stephen Brown[1,5], and Peter V. Hodson[1,2]
[1] School of Environmental Studies, Queen's University, Kingston, ON, CA
[2] Department of Biology, Queen's University, Kingston, ON, CA
[3] Centre Eau Terre Environnement, Institut National de la Recherche Scientifique, Québec City, QC, CA
[4] Department of Chemistry and Chemical Engineering, Royal Military College of Canada, Kingston, ON, CA
[5] Department of Chemistry, Queen's University, Kingston, ON, CA

*** Student presentation**

Poster Presentations *(cont'd)*

Overview of draft Canadian Water Quality Guidelines for the protection of aquatic life for manganese

Kathleen McTavish and Tamzin El-Fityani
National Guidelines and Standards Office, Environment and Climate Change Canada

Deriving predicted no-effect concentrations for ecological risk assessments (ERAs) conducted under the *Canadian Environmental Protection Act* using a new assessment factor (AF) approach

Drew MacDonald, Alexander Okonski and Lesley Lander
Ecological Assessment Division, Science and Technology Branch, Environment and Climate Change Canada (ECCC)

The influence of physicochemical parameters on bioaccessibility-adjusted hazard quotients for copper, lead and zinc of urban street dusts and soils

Dehghani, Sharareh[1, 2], Farid Moore[2], Luba Vasiluk[1], Beverley A. Hale[1]
[1] School of Environmental Sciences, University of Guelph, Guelph, ON N1G 2W1
[2]Department of Earth Sciences, College of Sciences, Shiraz University, Shiraz, 71454, Iran

Time-dependent *Daphnia magna* metabolomic monitoring of exposure to propranolol

Tae-Yong Jeong[1] and Myrna Simpson[1]
[1] Department of Physical and Environmental Sciences, University of Toronto Scarborough, Toronto, ON

*** Student presentation**

Session A: Environmental Risk Assessment & Remediation Room 1120

An Approach to Scoring Toxicity Data for the Development of Wildlife TRVs

Thackeray, Nicole[1], Harriet Phillips[1], Katherine Woolhouse[1] & Stacey Fernandes[1]

[1] Canada North Environmental Services, Markham, ON

E-mail: nicole.thackeray@cannorth.com

Key Words: FCSAP, Ecological Risk Assessment, TRVs, Wildlife

Under the federal contaminated sites action plan (FCSAP) a framework was developed to carry out ecological risk assessments for federal contaminated sites. A number of different modules have been developed to help practitioners conduct ecological risk assessments. In 2016, a draft version of Module 7 was published which provides default wildlife toxicity reference values (TRVs). The draft default TRVs are dose-based (mg chemical/kg body weight/day). In developing the default TRVs a quality rating based on the merits, limitations and uncertainties was used to assist federal site custodians in decision making. A similar quality ranking was developed in-house to provide a level of confidence in the wildlife TRVs that are developed for use in ecological risk assessments, as well as to aid in focussing literature search efforts in the future when updating TRVs. The scoring system was based on the number of species for which adequate toxicity data were available (robustness of the database) and the nature of the toxicity values (no effects levels or low effects level). This presentation will discuss how the TRVs were derived and provide examples of the scoring system.

Conceptual Site Models: The Role they Play in Environmental Remediation

Danielle Thorson[1] & Dr Gary Wealthall[1]

[1] Geosyntec Consultants Inc, Guelph, ON

E-mail: dthorson@geosyntec.com

Key Words: conceptual site model, high resolution site characterization, data integration

Environmental remediation goals and objectives inform the development of conceptual site models, based on a detailed understanding of site-specific conditions. A conceptual site model is a living document that is continuously evaluated against, and updated with, site specific data to achieve a robust and defensible understanding of site conditions to select, design, implement and assess the performance of remediation technologies. These models play a critical role in evaluating associated remediation risks and identifying and communicating what we know and, importantly, what we do not know about a site.

By reference to best-practice guidance and real-world examples, we illustrate the development of various forms of conceptual site models through hypothesis testing, high resolution site characterization, data integration and data visualization. Ultimately, the successful implementation of an environmental remedy requires a credible conceptual site model, based on defensible data, that is communicated effectively to all stakeholders.

Reassessment of the BUI "Degradation of Wildlife Populations" for the Hamilton Harbour AOC

Ève A.M. Gilroy[1], Marilyn Baxter[2], Kristin O'Connor[3], Jim Quinn[4], David Moore[5], Laud Matos[6]

[1]Green House Science, Burlington, Ontario
[2]Hamilton Port Authority, Hamilton, Ontario
[3]Hamilton Harbour Remedial Action Plan, Burlington, Ontario
[4]McMaster University, Hamilton, Ontario
[5]Canadian Wildlife Service, Burlington, Ontario
[6]Environment and Climate Change Canada, Toronto, Ontario

The Hamilton Harbour Remedial Action Plan highlighted beneficial use impairments to colonial waterbirds, including Loss of Fish and Wildlife Habitat and Degradation of Wildlife Populations. Habitat restoration efforts have been implemented, notably, by the construction of three nesting islands along the northeastern shoreline of the Harbour in the mid-1990s, and the creation of Tern Islands in Windermere Basin in 2013. The long-term objective is to reach self-sustaining mixed waterbird populations, with a general increase of the rarer species and a reduction of the overabundant species. Experimental management of waterbird populations was deemed necessary for reaching target population goals.

Target population figures for the Hamilton Harbour colonial waterbirds were revised in 2012. The Hamilton Harbour Remedial Action Plan is presently reassessing population trends until 2017, to determine whether the six colonial waterbird species are meeting management targets, to assess the success of adaptive management, and to provide recommendations on future monitoring and management to ensure sustained RAP achievements.

Case study: deriving a site-specific water quality objective for arsenic using the Canadian Council of Ministers of the Environment Species Sensitivity Master Version 3.0

Nesbitt, Richard A.[1], Neil J. Hutchinson[1]

[1] Hutchinson Environmental Sciences Ltd.

E-Mail: richard.nesbitt@environmentalsciences.ca

Key Words: arsenic, site-specific water quality objective, statistical derivation approach, CCME long-term freshwater guideline

Arsenic is a naturally occurring element that has been found to co-occur with gold deposits in at least three operating and permitted mines in Nunavut. Weathering of mine pit walls are predicted to result in concentrations above the long-term freshwater Canadian Water Quality Objective (WQO) of 0.005 mg/L. Elevated concentrations are expected to persist in perpetuity posing a risk to aquatic life. A site-specific water quality objective (SSWQO) was derived to evaluate the impact of elevated arsenic concentrations in the receiving environment.

The SSWQO was derived following Canadian Council of Ministers of the Environment's (CCME) protocols following the statistical derivation approach. An updated dataset was compiled excluding non-resident species and the SSWQO was modeled using the Species Sensitivity Distribution (SSD) Master Version 3.0 software.

Species were ranked according to their sensitivity to arsenic. Cumulative distribution functions were plotted using Hazen plotting positions for each of the normal, logistic, extreme value and gumbel models. Model fit to the plotted data was evaluated on four metrics: the Anderson-Darling Goodness-of-Fit, the overall mean sum of squared error terms (MSE), the MSE in the lower tail and the spread between the upper and lower confidence limits at the concentration modelled to impact 5% of all species (HC5).

A final SSWQO of 0.019 mg/L was calculated using the logistic model. The logistic modelled HC5 was selected for the SSWQO as it was tied with the normal model for the lowest cumulative ranking on the four metrics and produced a lower and therefore more conservative water quality objective.

Session B: Cutting Edge Techniques
Room 1102

Can microRNA secreted from trout be used to detect their response to stress?

Ikert, Heather[1] , P. Marjan [1] , A.C. Doxey[1] , M.R. Servos[1] , J.P. Giesy[2] , B.A. Katzenback[1] , And P.M. Craig[1]

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Key Words: microRNA, trout, stress, technique

Measurements of waterborne environmental DNA are currently being employed to identify both invasive and endangered fish species in Canadian waterways. However, little research has examined the potential of environmental RNA within the water as a marker of health of a given population. MicroRNA (miRNA) are stable, targeted, post-transcriptional regulators of mRNA, and are therefore useful markers that can be linked to phenotypic responses. Changes in miRNA in tissues and circulation have previously been measured in fish in response to acute and chronic stress. This study examines the potential sources of waterborne miRNA from rainbow trout following an acute stressor to demonstrate the utility of miRNA as an environmental marker of stress. Following a three-minute air exposure, adult rainbow trout epithelial mucus and gills were collected. Gills were processed by the removal of blood followed by immersion in saline, in order to collect miRNA that would be released into water. From these samples, miR-21 was quantified via RT-qPCR in order to identify its presence and expression levels. This target miRNA was also measured in water samples from a trout confinement stressor as well as from the Grand River to validate the presence of miRNA within the water column. Ultimately, measurement of miRNA isolated from skin mucosa, secreted from gills, and measured in the water leads to the potential use of waterborne miRNA as non-invasive biomarkers of stress in fish.

Sub-Lethal Toxicity of Halogenated Acetic Acids (HAAs) on Daphnia magna investigated using 1 H NMR Based Metabolomics

Lisa Labine[1] , Myrna J. Simpson[1]

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Key Words: *Daphnia magna*, metabolomics, Nuclear Magnetic Resonance (NMR), Halogenated Acetic Acids (HAAs)

Disinfection by-products are emerging contaminants which are primarily generated through the treatment of water using chlorination methods, which are discharged into freshwater ecosystems. In drinking water, halogenated acetic acids (HAAs) are regulated by Health Canada and must be below concentrations of 80 µg/L. Using ^{1} H NMR metabolomics along with multivariate statistics we investigated the metabolic changes to Daphnia magna following sublethal exposure to dichloroacetic acid (DCAA), trichloroacetic acid (TCAA) and dibromoacetic acid (DBAA). The LC50 of the HAAs were measured and found to be: 206.5 mg/L for DCAA, 354.3 mg/L for TCAA and 298.1 mg/L for DBAA. A 48 hour sub-lethal metabolomics exposure experiment was conducted using adult daphnids using a range of HAAs concentrations: DCAA (4-20 mg/L), TCAA (7-35 mg/L) and DBAA (5-29 mg/L). Principal component analysis (PCA) showed significant changes to the metabolome with the highest concentration (20.65 mg/L) and a lowered concentration (5.16 mg/L) of DCAA. PCA scores plot of TCAA and DBAA show a shift of the metabolome relative to the control but these were not significantly significant due to the large variation in D. magna responses relative to the control. Quantification of metabolites found significant changes in the amino acid proline across 11 of the 15 total experimental exposures. An increase in proline suggests an increase in defence against oxidative stress within the organism. While other metabolites changes may not have been found to be significant, all of the evaluated metabolites show a shift from the control. The metabolite variation is non-monotonic for the HAAs tested. Future data analysis of other metabolites will investigate the toxic mode of action stemming from sub-lethal acute exposure to these HAAs on D. magna using ^{1} H NMR metabolomics.

^{1}H NMR-based metabolomics of *Daphnia magna* sub-lethal exposure to a mixture of triphenyl phosphate, triclosan and diazinon in the presence of dissolved organic matter

Vera Kovacevic, André J. Simpson & Myrna J. Simpson

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Key words: organic contaminants, water flea, metabolic profiling

Triphenyl phosphate (TPhP), triclosan, and diazinon are organic contaminants of emerging concern because they are frequently detected in freshwater. These three contaminants are hydrophobic which makes them likely to sorb to dissolved organic matter (DOM) and change their bioavailability and consequently sub-lethal toxicity. ^{1}H nuclear magnetic resonance (NMR)-based metabolomics was used to investigate how DOM at 1 and 5 mg organic carbon/L alters the metabolic response of *Daphnia magna* exposed to equitoxic mixtures of TPhP, triclosan, and diazinon. The contaminant concentrations in the mixture were set to an equal percentage of their 48-hour lethal concentration to 50% of the population (LC_{50}) value, which is 1250 µg/L for TPhP, 330 µg/L for triclosan and 0.9 µg/L for diazinon. Exposure to the mixture at 1% of the LC_{50} values did not notably alter the *D. magna* metabolome and DOM did not change this. Exposure to the contaminant mixture at 5%, 10%, and 15% of the LC_{50} values did significantly alter the metabolic profile and there were significant decreases in glucose, serine and glycine and significant increases in asparagine and threonine. This was a different metabolic response compared to single contaminant exposures and this suggests that the contaminant mixture had combined effects which lead to altered energy metabolism in *D. magna*. The presence of both DOM concentrations did not change the mode of action of the contaminant mixture which suggests that the potency of these contaminants did not change after sorption to DOM. These findings improve the understanding of the impact of DOM on sub-lethal mixture toxicity of organic contaminants at levels detected in freshwater.

An 'omics perspective on the sublethal effects in the Western clawed frog exposed to a naphthalene sulfonic acid

Wallace, Sarah J[1,6], Shenfield A[2], Leclerc A[2], Prosser RS[3,4], de Solla SR[5], Balakrishnan VK[3], and Langlois VS[1,2,6]
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[2]Department of Biology, Queen's University, Kingston, ON
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Key Words: amphibian, microarray, metabolomics, glutathione

Naphthalene sulfonic acids (NSA) are priority chemicals being assessed by the Government of Canada's Chemicals Management Plan that act as dispersants and are components in industrial lubricants, corrosion inhibitors and commercial jet fuels. However, little is known about their toxicity to aquatic organisms. Western clawed frogs (*Silurana tropicalis*) were exposed to sand spiked with i) 17 – 1,400 µg/g calcium dinonylnapthalene sulfonate (CaDNS) from egg to larvae in an acute study, and with ii) 25 µg/g CaDNS until the peak of metamorphosis in a chronic study. Mortality increased with exposure to 250 µg/g CaDNS and the prevalence of malformations increased at 14 µg/g CaDNS in the water. In addition, chronic exposure to CaDNS increased the variation in individual developmental stage and smaller body size at metamorphosis. Over 3,600 genes were differentially expressed in embryos exposed to CaDNS. Suppression of genes involved in cellular response to oxidative stress occurred in embryos (e.g. glutathione reductase and peroxidase) but these differences disappeared by metamorphosis. NSAs altered the concentrations of 95 non-targeted metabolites including the reduced and oxidized form of glutathione. These data provide insights towards developing an adverse outcome pathway.

Session C: Oil Sands & Naphthenic Acids Research Room 1120

The interplay of methane and ammonia as key oxygen consuming constituents in early stage development of Base Mine Lake, the first demonstration oil sand pit lake

Florent Risacher[1,2], Patrick Morris[1], Daniel Arriaga[1], Corey Goad[1], Tara Colenbrander Nelson[3], Gregory F. Slater[1] and Lesley A. Warren[3].

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Key words: Oil Sand, pit lake, geochemistry, oxygen

Bitumen exploitation in Athabasca's oil sand region generates considerable amounts of tailings that need reclamation. Base Mine Lake, the first commercial scale pit lake, is currently being assessed as a potential reclamation strategy in the oil sands. To become successful, pit lakes must achieve the ecological role of a natural lake, which includes colonization of the water by macrofauna, therefore necessitating the water cap to be oxic. Due to the reductive nature of the tailings stored at the bottom, oxygen consuming constituents (OCC) such as methane and sulfide are released into the overlying water, potentially posing a threat to the success of the reclamation. Here, geochemical and physicochemical data collected over a two year period will be presented, showcasing the evolution of the oxygen consumption dynamics in the early stages of Base Mine Lake. An emphasis will be put on the rapid change in the main OCC observed in the water cap within the two year period. Modelling of these changes offers a better understanding of the development and interactions of the microbial processes that are driving oxygen consumption. Further insights into the management of the future pit lakes will be discussed.

Naphthenic acids disrupt vocalization in Western clawed frogs

Zhang, W., Gutierrez-Villagomez, J.M., & Trudeau, V.L.

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Key Words: naphthenic acids, endocrine disruption, courtship behaviour, clawed frogs

Naphthenic acids (NAs) are carboxylic acids naturally occurring in petroleum. They are the main toxic component of wastewater from Alberta's oil sands and are detectable in surrounding ecosystems despite a zero-discharge policy. Frogs are especially vulnerable with their permeable skin, but studies have focused on larvae with little research on adults. In fish, sublethal levels of NAs act as endocrine disruptors, at least partially as anti-androgens. Since reproduction is governed by hormones, endocrine disruptors impact sexual behaviour across taxa. Male Western clawed frogs *(Silurana tropicalis*) use androgen-dependent calls for both inter- and intra-sexual selection. As NAs may be anti-androgenic, we tested the hypothesis that NAs disrupt vocalization. To characterize toxicity, adult frogs were exposed to 1-20 mg/L NA (a commercial Sigma extract) for four days with no obvious effects on health or swimming activity. To assay behavioural disruption, individual males were injected with human chorionic gonadotropin to induce vocalization following a five day NA exposure. Two types of calls were assessed for total duration: advertisement calls, which attract females, and short trills, which are used for male-male competition. At 4 mg/L NA, advertisements were inhibited ($p = 0.005$), but short trills were unaffected ($p = 0.53$). At 20 mg/L NA, both advertisements and short trills were inhibited ($p = 0.01$ and $p = 0.0008$ respectively). While adults can tolerate high levels of NAs, an acute, sublethal exposure can disrupt courtship behaviours in otherwise healthy frogs. As males vocalize for mate attraction and social dominance, NAs may impact reproductive fitness.

Profiling volatile organic compounds from naphthenic acids, acid extractable organic mixtures, and oil sands process-affected water

Gutierrez-Villagomez, Juan Manuel[1], Juan Vázquez-Martínez[2], Enrique Ramírez-Chávez[2], Jorge Molina-Torres[2], Vance L. Trudeau[1].

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Key Words: crude oil, naphthenic acids, volatiles, solid-phase microextraction

Naphthenic acids (NAs) are complex mixtures of carboxylic acids naturally occurring in crude oil and can be found in nature after oil spills. They are also generated as waste from oil sands in Alberta. We used headspace solid-phase microextraction (SPME) coupled to gas chromatography-electron impact mass spectrometry (GC–EIMS) for the qualitative analysis of the volatile organic compound (VOC) profile of three commercial NA blends, and an acid-extractable organic (AEO) mixture from a tailings pond in the Canadian Oil Sands region. We identified 54, 56, 40 and 4 compounds in S1, S2, Merichem NAs and AEOs, respectively, including aliphatic and cyclic hydrocarbons, carboxylic acids, alkylbenzenes, phenols, naphthalene and alkyl-naphthalene, and decalin compounds. A sample of oil sands process-affected water (OSPW) from a tailings pond and aqueous solutions of the NA blends were analyzed to evaluate the matrix effect on the VOC profile. The compound identification was limited by low signal and co-elution in the AEO and OSPW samples. Principal component analysis (PCA) and clustering analysis showed that commercial extracts have VOC profiles similar to each other, but distinct from the AEO and OSPW samples. The identified compounds have different mechanisms of toxicity, including genotoxicity and carcinogenicity, representing health and environmental hazards.

Session D: Metals and Pesticides in the Environment Room 1102

Characterization of metal toxicity in cryptic species of *Hyalella azteca*

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Key Words: metals, aquatic invertebrates, cryptic species complex, saturation model

The freshwater amphipod *Hyalella azteca* has been frequently used in toxicology since the 1980s due to its ease of culture, general sensitivity, and broad North American geographic range. However, modern molecular methods have revealed wild *H. azteca* populations to comprise a complex of 85 cryptic species, among which considerable genetic diversity underlies minimal phenotypic divergence. Despite such high diversity, most laboratories culture a single species (clade 8). The Canada Centre for Inland Waters (CCIW) in Burlington, Canada appears to be the only site that maintains a different species (clade 1). Only recently has the impact of species-level diversity within this complex on toxicity results been investigated. This presentation will summarize results obtained in our laboratory of responses of the two commonly used *H. azteca* species to four metals. We urge that future toxicity tests with *H. azteca* include molecular identification.

Does reporting significant effects of pesticides translate into greater citations in the future?

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Keywords: peer review, data quality, bias

As scientists, we are tasked with letting evidence guide our conclusions. In the world of pesticides this takes on added importance as the data can influence ecological and human health outcomes and regulations, and even the manner in which we grow food. Yet, there seems to be a reticence to engage with the totality of the pesticide ecotoxicology literature, especially papers that report few or no effects or low risk to non-target organisms. We suspected that these studies would have fewer citations than studies that report significant effects or risk for the same compound, and this would be unrelated to the strength of the study, e.g., high quality studies with few or no effects would be cited less frequently than studies of lesser quality that reported effects. To investigate this, we examined a subset of literature around the herbicide atrazine. We found that papers reporting an effect had significantly more citations per year than those that did not ($p<0.05$). There was no significant relationship between the strength of the study and number of citations, but a general trend for weaker studies to have greater number of citations. The impact factor of journals was not positively correlated with the strength of the study methods, but studies that reported effects were published in journals with a greater mean impact factor than those that reported no effects ($p<0.05$). This analysis reveals evidence of citation bias within the pesticide ecotoxicology literature, as well as bias by journals to publish studies that report effects, regardless of study quality. This study is currently being expanded to examine all research articles studying the effects of pesticides that have been published in the journal Environmental Toxicology and Chemistry since its inaugural issue in 1982.

Acute oral toxicity and risks of potential neonicotinoid replacements to the Common Eastern Bumble Bee (*Bombus impatiens* Cresson)

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Key Words: bumblebee, acute oral toxicity, systemic insecticide, risk assessment

The Common Eastern Bumblebee (*Bombus impatiens*) is native to North America with an expanding range across Eastern Canada and the United States. This bumblebee is relied upon for greenhouse produce production and makes up a substantial part of the wild bumble bee fauna found within agricultural, suburban and urban landscapes. However, there is a dearth of pesticide toxicity information about this species. We determine the acute oral toxicity (LD_{50}) of three potential neonicotinoid replacements, cyantraniliprole (>0.54 µg/bee), flupyradifurone (>1.7 µg/bee) and sulfoxaflor (0.0194 µg/bee) as well as a neonicotinoid, thiamethoxam (0.0012 µg/bee). A comparison to the European honeybee (*Apis mellifera*) LD_{50} demonstrates that sulfoxaflor and thiamethoxam are more acutely toxic to *B. impatiens*, whereas cyantraniliprole and flupyradifurone are more acutely toxic to *A. mellifera*. A comparison of three risk assessment equations demonstrated that the European Plant Protection Organization's (EPPO) Hazard Quotient (HQ) was the most broad classifier of risk whereas the Standard Risk Assessment (SRA) and Fixed Dose Risk Assessment (FDRA) provided more nuanced levels of risk based upon pollen and nectar residues. This work suggests that a one-species and one-model risk assessment may not produce the most accurate risk characterization for all species. More work should be completed on comparative toxicities and risk assessment models to encapsulate the diversity of wild pollinators.

Poster Presentations
Atrium

Toxicity of novel fire suppression gels to aquatic and terrestrial organisms

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Key Words: fire suppression gels, plant toxicity, zooplankton

Previous research has shown that fire suppression additives containing perfluorinated compounds negatively affect the environment through persistent contamination and bioaccumulation. Manufacturers have introduced 'environmentally-friendly' alternatives, but limited studies on their fate and effect in the environment have been completed. A two-part study will be completed to investigate the toxicity of six fire suppression gels: Eco-Gel™, Thermo Gel 200L™, Fire Aid 2000™, Solberg Fire Foam™, Novacool Foam™, and F-500™.

The first part of the study focused on aquatic organisms, as fire suppression gels can enter water systems through run-off or aerial application. Toxicity to *Daphnia magna,* an aquatic invertebrate, was investigated through static acute tests. The second part of the study focused on terrestrial organisms, as soil can be contaminated through direct application of fire suppression gels. A root elongation assay was conducted with crop species *Fagopyrum esculentum* and *Raphanus raphanistrum* ssp. *sativus,* as well as flowering plant species, *Rudbeckia hirta. Rudbeckia hirta* was chosen at it is commonly found within the boreal forest where fire suppression gels may be used to control wildfires.

Survival, growth and/or immobility will be documented after each test, and the concentration-response relationship determined, allowing the EC_{50}/LC_{50} to be estimated. With the knowledge gained from this study, a better understanding of the potential fate and effect of fire suppression gels in the environment can be developed.

Developing multigenerational exposure of the earthworm *Eisenia andrei* to neonicotinoid pesticides

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Key Words: earthworms, multigenerational exposure, neonicotinoids, soil toxicology,

Concerns about the effects of neonicotinoid pesticides to non-target organisms have been mounting based on emerging evidence of their toxicity to pollinators such as honeybees. At present, the focus of neonicotinoid ecotoxicology has expanded to include aquatic and terrestrial invertebrates. Neonicotinoids enter agricultural soils via the sowing of treated seeds and through foliar spraying, resulting in the potential for multiple applications throughout a growing season. With half-lives up to thousands of days reported in soil, there is potential for these substances to accumulate in soil. Soil invertebrates such as earthworms are sensitive to exposure to neonicotinoids, however the levels at which mortality or inhibition of reproduction occur have not been measured in Ontario soils. Based on neonicotinoid persistence, soil invertebrates will be exposed to low concentrations of neonicotinoids over long periods of time, considerably longer than the 56-day duration of standardized tests involving this species. These tests will allow for the observation of multiple generations of the earthworm *Eisenia andrei* exposed to single treatments of the neonicotinoids thiamethoxam and clothianidin over 196 days at concentrations significantly below those which have been reported to have deleterious effects during relatively short exposure durations.

The influence of sediment composition on the toxicity of naphthalene sulfonates to benthic invertebrates *Tubifex tubifex* and *Hyalella Azteca*

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Keywords: aquatic toxicology, benthos, bioavailability, sediment exposure

Naphthalene sulfonic acids (NSAs) are extensively used in Canada for a variety of applications (e.g., dispersant in dyes, rubbers, pesticides or anti-corrosive agent in coatings, gels, sealants), despite the significant knowledge gap surrounding how they may affect aquatic biota upon their eventual entry into the environment. This study examined the toxicity of three priority NSA congeners; dinonylnaphthalene disulfonic acid (DNDS), barium dinonylnaphthalene sulfonate (BaDNS), and calcium dinonylnaphthalene sulfonate (CaDNS). Toxicity of these NSAs was evaluated using mortality, growth, and the production of biomass endpoints for the epibenthic amphipod *Hyalella azteca* and by using mortality and reproduction for the endobenthic *Tubifex tubifex*. Organisms were exposed via spiked substrates to emulate relevant environmental exposure routes for these chemicals of relatively large affinity for organic carbon (log Koc). The 28-d LC50s for juvenile *H. azteca* in sand were >500, 113, and 69 µg/g dry weight (dw) and in sediment were >2000, 832, and 648 µg/g dw for DNDS, BaDNS, and CaDNS, respectively. Alternatively, the most sensitive endpoint for *T. tubifex* in both substrates was the production of juveniles with EC50 values in sand of 638, <20, and <20 µg/g dw and 2336, 398, and 205 µg/g dw in sediment for DNDS, BaDNS, and CaDNS, respectively. All endpoints, from every exposure scenario, indicate that the examined NSAs are significantly more toxic to aquatic biota when present in substrates of lower organic carbon (e.g., sand); the organic carbon content of the sediment acts as a natural sink for NSAs to accumulate and thusly reduces the bioavailability. Interspecies differences in toxicity may be the result of differences in benthic zone occupancy as well as diet. This study will, in part, support risk assessment efforts for the continued use of this family of chemical in Canada.

Overview of draft Canadian Water Quality Guidelines for the protection of aquatic life for manganese

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Key Words: manganese, guidelines, aquatic life, metals

Manganese (Mn) is an essential trace element that is naturally occurring, is abundant in the environment, and is the fourth most widely used metal in the world. Draft Canadian Water Quality Guidelines (CWQG) for the protection of freshwater aquatic life for manganese are being developed through the Canadian Council of Ministers of the Environment (CCME) and include both a short-term benchmark and a long-term guideline. CWQGs are nationally endorsed, science-based recommendations of levels of substances that pose negligible risk to aquatic biota and aquatic ecosystem health. These guidelines serve as benchmarks of environmental quality that can be used nationally for the protection, evaluation, and enhancement of the Canadian environment. Development of the draft manganese CWQGs involved compiling and interpreting aquatic toxicity data, incorporating bioavailability and toxicity modifying factors, using a species sensitivity distribution (SSD) method to derive guideline values, and assessing the protectiveness of the guidelines against CCME guiding principles. The draft manganese CWQGs are expected to be posted for public review this year.

Deriving predicted no-effect concentrations for ecological risk assessments (ERAs) conducted under the *Canadian Environmental Protection Act* using a new assessment factor (AF) approach

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Keywords: risk assessment, assessment factor

Quantitative risk assessments include the derivation of predicted no-effect concentrations (PNECs), which represent the concentration of a substance in an environmental medium that is unlikely to cause adverse effects to populations in that medium, typically following chronic or long-term exposure. The PNEC is compared with a predicted environmental concentration (PEC) to calculate a risk quotient (RQ). For small toxicity datasets (e.g., data from less than seven species) that do not meet the requirements for a species sensitivity distribution, an assessment factor (AF) approach is used, where a PNEC is calculated by dividing the critical toxicity value (CTV) by an AF. The CTV is typically the lowest concentration of a substance, from the acceptable available data, at which an adverse effect was observed in a given environmental medium.

AF approaches are not new, and many – if not all – regulatory jurisdictions have been using such approaches in ERAs for years. However, existing methods to derive AFs are prone to inconsistent application and have not incorporated advances in risk assessment methods, such as using analogue and read-across approaches, Quantitative Structure-Activity Relationship (QSAR) modeling, and consideration of specific modes of action. Consequently, the Ecological Assessment Division of ECCC has developed an approach for deriving AFs that accommodates alternative data described above and strives for increased consistency in application. This new approach for deriving AFs will be presented.

The influence of physicochemical parameters on bioaccessibility-adjusted hazard quotients for copper, lead and zinc of urban street dusts and soils

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Key Words: Bioaccessibility, SBET, Size fractionation, Hazard quotient

When the hazard quotient for ingestion (HQI) of a trace element in soil and dust particles is adjusted for the element's bioaccessibility, the HQI is typically reduced as compared to its calculation using pseudo-total element concentration. However, those studies have mostly used bulk particles and the reduction in HQI when expressed as bioaccessible metal may not be similar among particle size fractions. This possibility is probed by the present study of street dusts and soils collected in Tehran. The highest Cu, Pb and Zn near-total concentrations occurred in the finest particles of dusts and soils. Bioaccessible concentrations of Cu, Pb and Zn in the particles (mg kg^{-1}) were obtained using simple bioaccessibility extraction test (SBET).

In the bulk (<250 µm) sample, the bioaccessible concentration of Cu and Pb increased as the pH of sample increased, while Zn bioaccessibility (%) in the bulk particles was influenced by organic matter and cation exchange capacity. X-ray diffraction identified sulfide and sulfate minerals in all of the size-fractionated particles, which are insoluble to slightly soluble in acidic conditions and included most of the Cu and Pb in the samples. The only Zn-bearing mineral identified was hemimorphite, which would be highly soluble in the SBET conditions. The calculated HQI suggested potential noncarcinogenic health risk to children and adults from ingestion of soils and dusts regardless of particle size consideration, in the order of Zn>Pb≥Cu. The bioaccessibility percent-adjusted HQI for Pb was higher for the smaller particles than the bulk. This work is novel in its approach to compare HQI for a bulk sample of particles with its composite particle size fractions.

Time-dependent *Daphnia magna* metabolomic monitoring of exposure to propranolol

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Key Words: metabolomics, time-course monitoring, *Daphnia magna*, propranolol

Propranolol is an emerging pollutant with high bioreactivity in freshwater aquatic species. Time-course monitoring of metabolomic regulation was performed to investigate propranolol exposure at sub-lethal concentrations. In addition to propranolol exposures, the baseline metabolomic profile of *Daphnia magna* was monitored on different days under non-stressed conditions and was compared to evaluate its stability and periodicity. We targeted and monitored 26 metabolites using liquid chromatography with tandem mass spectrometry (LC-MS/MS). As a result, it was detected that metabolomic regulation was significantly differentiated by propranolol exposures. Particualy, an increase of branched-chain amino acids (BCAAs) was observed. Among the days monitored under non-stressed conditions, metabolite dependent periodicity and stability were observed. Hourly monitoring results indicate the time-dependent metabolomic regulation was tightly organized between individuals. In the present study, the metabolic perturbation of propranolol exposure to the *Daphnia* metabolome and the potential of time-course metabolomic monitoring as a water pollution monitoring tool were confirmed.

Toxicity of diluted bitumen to rainbow trout (*Oncorhynchus mykiss*) alevins

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Key Words: diluted bitumen, toxicity, CEWAF

Production of diluted bitumen (dilbit) in Western Canada may soon exceed the capacity of existing pipeline infrastructure, which has resulted in proposals for pipeline expansions or new pipelines to transport dilbit across Canada. Comprehensive reports by the Royal Society of Canada and the US National Academy of Sciences have highlighted knowledge gaps in the chemical and toxicological characterization of dilbit products. Although the number of publications on the toxicity of dilbit products have increased the last five years, there are still unknowns about how toxicity test methods alter the composition of test solutions and observed toxicity and the relative toxicity of dilbit products to other oils.

The toxicity of Access Western Blend (AWB) and Cold Lake Blend (CLB) dilbit to rainbow trout alevins was measured with chemically-enhanced water accommodated fractions (CEWAF). Alevins were exposed for 23 or 25 d from hatch to swim-up to daily renewal of dilutions of CEWAF, and cumulative mortality, signs of blue sac disease, and molecular responses were assessed at the end of the exposure. Toxicity was expressed in terms of measured concentrations of oil in water using fluorescence spectrometry (FS) and gas chromatography-mass spectroscopy (GC-MS). The FS method allowed for the immediate analysis of test solutions and for more frequent chemical characterization.

Dilbits had similar toxicity to developing alevins with signs of toxicity similar to those of alevins exposed to conventional crude oils. This research characterized the relative toxicity of two dilbit products, AWB and CLB, to rainbow trout alevins and provides insight into the relative risk of dilbit spills to fish recruitment.