WASTEWATERS

MANY PIPES MANY SOLUTIONS

SETAC

PRAIRIE NORTHERN

WINNIPEG

JUNE 17 2016

A MESSAGE FROM THE PRESIDENT

Welcome!

On behalf of the organizing committee and the Board of the Prairie Northern Chapter of the Society of Environmental Toxicology and Chemistry, it is my pleasure to welcome you to our 7th annual meeting. We hope you will enjoy both the science and the social side of things while you are with us in Winnipeg. A quick thank you to our generous sponsors without whom this event—in both scope and scale—would not be possible.

The PNC is geographically the largest of SETAC's regional chapters and we do a great job at representing all the regions as best we can through our science and outreach. Our diversity brings a wealth of expertise, issues, and viewpoints from which to draw on and promote strong, sound science. We are all striving to protect the environment in a sustainable manner, and regardless of whether a student or professor emeritus, industry, academic, or government we do this best when we work together. This has always been the aim of SETAC, and this approach has been a powerful tool in our common goal of a sustainable society.

As always, if you are looking to help guide the chapter, or have ideas for how we can grow and be more engaged, please do contact me. The Board and I have many ideas about how we can go about this, but we have no doubt that you each have a unique vision as well and would love to hear them. Remember, this is your PNC! We are especially interested in student-driven initiatives and opportunities to expand training and interactions amongst all sectors.

Again, many thanks to the tireless volunteers who helped bring this event together, and we look forward to seeing you all next year in Saskatoon for our 8th annual meeting.

Mark Hanson, Ph.D.
President, PNC

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The 7th Annual Chapter Meeting of SETAC Prairie-Northern | June 17 2016 | Winnipeg

WASTEWATERS | MANY PIPES MANY SOLUTIONS

7:30 - 8:25	REGISTRATION TABLE OPEN	SCHULTZ THEATRE
8:30	Opening Remarks from Dr. Mark Hanson (UofM) and greetings from SETAC Board of Directors' Dr. Karsten Liber (UofS)
8:45	Plenary: Microplastic pollution in inland waters	Dr. Mike Rennie, Canada Research Chair in Freshwater Ecology and Fisheries, Lakehead University.
9:25	Prevalence of microplastics in water and gastrointestinal tracts of fish from Wascana Creek	S. Campbell (UofR)
9:40	The effect of hydropeaking on energy stores and mercury concentrations in shoreline dwelling spottail shiner (Notropis hudsonius)	D. Green (UofS)
9:55	Identifying physicochemical mechanisms affecting internal phosphorus loading in Buffalo Pound Lake, SK, using sediment fractionation extractions and in situ water chemistry	L. D'Silva (UofS)
10:10	The effect of changes in Hg deposition on Hg accumulation by zooplankton and fish: an update on the METAALICUS project	M.J. Paterson (IISD-ELA)
10:15 - 10:35	COFFEE BREAK AND POSTER VIEWING	OUTSIDE SCHULTZ THEATRE
10:40	Physiological changes in fathead minnows in relation to natural vs. anthropogenic sources of bituminous toxicants: adaptation in the oil sands?	S. Chow (UofL)
10:55	Effects of water accommodated fractions of a hydraulic lubricating oil on aquatic organisms	Z. Currie (UofS)
11:10	Cardiac and metabolic effects of benzo-a-pyrene in juvenile rainbow trout (Oncorhynchus mykiss)	F. Leal (UofS)
11:25	A proposed whole ecosystem study to examine fate, behavior, and toxicity of a diluted bitumen spill in a Canadian boreal lake catchment	V. Palace (IISD-ELA)
11:40	Monitoring PAHs with deep-sea archaebacteria surface proteins	M. McDougall (UofM)
12:00 - 13:00	LUNCH	CROSS COMMON ROOM
12:15	SETAC PNC BOARD of DIRECTORS MEETING	ROOM 111
12:30	NASAC MEETING	ROOM 119
13:10	Plenary: Male fishes and estrogens in municipal wastewaters: What do we know and where should we go?	Dr. Karen Kidd, Canada Research Chair in Chemical Contamination of Food Webs, University of New Brunswick.
13:50	Effects of thyroid hormones and thyroid hormone disruptors on olfaction in North American bullfrog (Lithobates catesbeianus) tadpoles	J. Heerema (UofL)
14:05	Reproductive health assessment of fathead minnow populations inhabiting an effluent-dominated stream, Wascana Creek, SK, Canada	S. Hanson (UofS)
14:20	Effects of lighting intensity and ammonia concentration on nitrogen removal efficiency using algae - bacteria consortia	J. Huijun (UofM)
14:35	Quantification of human pharmaceutical conjugates in municipal wastewaters	A. Brown (UofM)
14:40 - 15:00	COFFEE BREAK AND POSTER VIEWING	OUTSIDE SCHULTZ THEATRE
15:05	Reducing nutrients and organic micropollutants in a rural wastewater effluent with subsurface filtration treatment technology	L. Chaves-Barquero (UofM)
15:20	Development, calibration, and modelling of an organic-DGT passive sampler for a diverse suite of polar organic contaminants in aquatic systems	J. Challis (UofM)
15:35	Making your ecotoxicology stand out in an increasingly crowded world	M.Hanson (UofM)
15:50	Plenary: Global Wastewaters: ACWA provides opportunities to create local solutions with application to global problems	Dr. Leland J. Jackson, Scientific Director, Advancing Canadian Wastewater Assets, University of Calgary.
16:30	Closing remarks: Dr. Mark Hanson (UofM)	
16:30 - 17:45	POSTER SOCIAL WINE & CHEESE	OUTSIDE SCHULTZ THEATRE
18:30	BANQUET & AWARDS CEREMONY	CLAY OVEN RESTAURANT

CONFERENCE INFORMATION

TOX ON TAP | AN INFORMAL CONVERSATION ABOUT SCIENCE

WITH DR KAREN KIDD | UNIVERSITY OF NEW BRUNSWICK
THURSDAY JUNE 16TH | 6-9 PM | THE BLACK RABBIT | 135 OSBORNE ST.

ARE EMERGING CONTAMINANTS A CONCERN IN WASTEWATER?

Municipal wastewater operators want to know whether contaminants of emerging concern, including endocrine disrupters, are of sufficient concern that they should spend resources on expensive chemical analyses or advanced waste treatment systems. The Canadian Water Network and the Water Environment Research Foundation have recently developed programs to understand the risks and detectable impacts of these chemicals on downstream organisms. Producing actionable research results for end user communities is an ongoing challenge. This lively discussion will include the approaches that were used to generate the relevant science, the successes, the challenges of these programs, and the future needs for this sector.

POSTER SOCIAL | WINE & CHEESE & PRIZES

FRIDAY JUNE 17TH | 4:30 - 5:45 | ATRIUM OUTSIDE SCHULTZ THEATRE

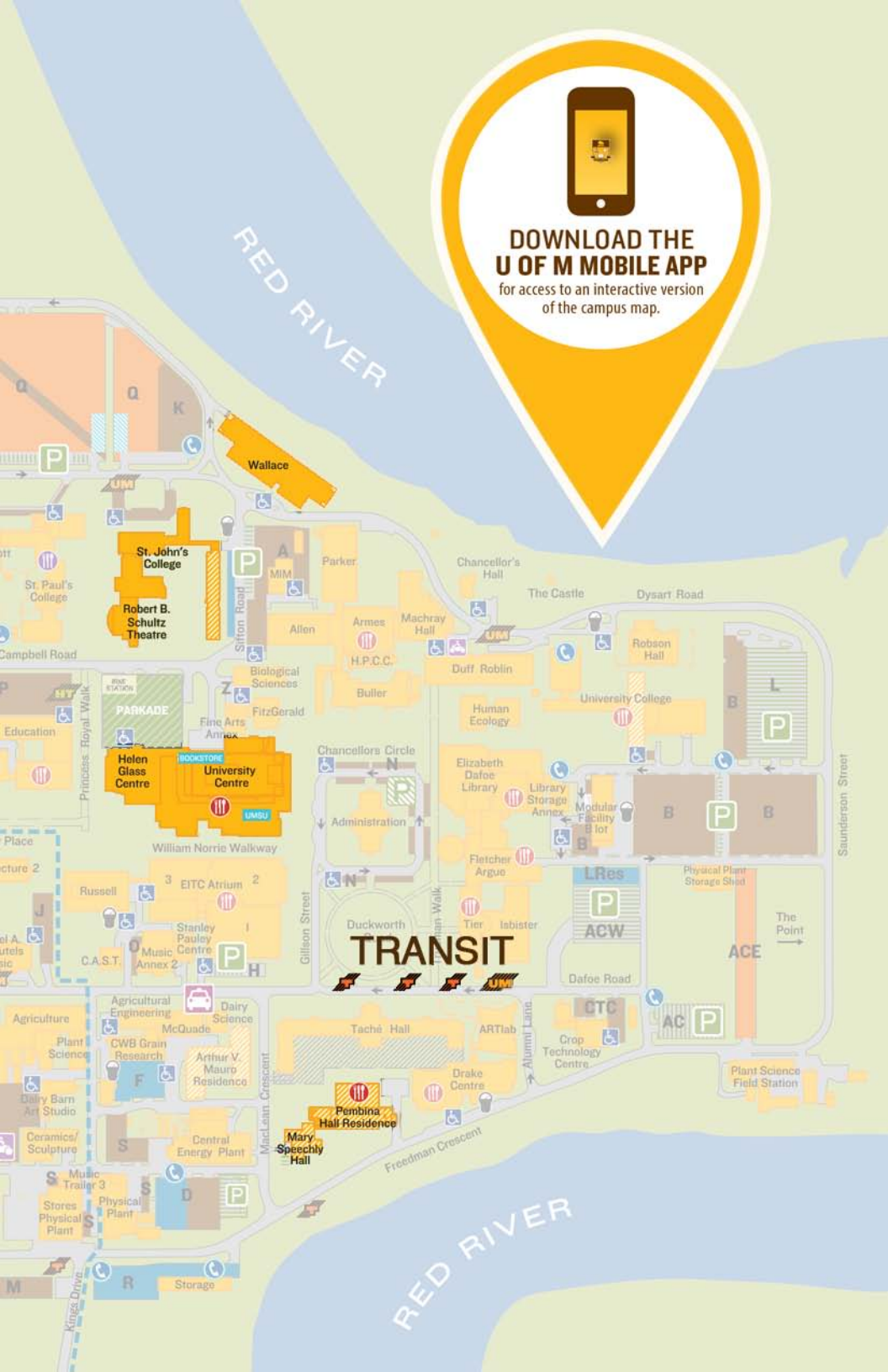
This year's PNC Poster Social will feature a prize raffle with tons of great prizes. Prizes will be on display throughout the conference and tickets available from our volunteers:

3 tickets for $5
8 tickets for $10
20 tickets for $20

BANQUET | WINNIPEG GOLDEYES at SHAW PARK

FRIDAY JUNE 17TH | 6:45 - GAME'S END | SHAW BALL PARK, 1 PORTAGE AVE E.

Celebrate a successful conference at the Shaw Ball Park in the heart of Winnipeg's Historic Forks site. An elevated Hakka/ East Indian buffet with customized wine and drinks on our own private covered patio overlooking the Goldeyes vs the St. Paul Saints.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Biological Sciences
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University College
PARKADE
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FitzGerald
Human Ecology
Education
Princess Royal Walk
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Plant Science Field Station
Drake Centre
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Ceramics/ Sculpture
Central Energy Plant
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Freedman Crescent
Music Trailer 3
Stores Physical Plant
Physical Plant
Storage
King's Drive
RED RIVER

PLENARY SPEAKERS

MICROPLASTIC POLLUTION IN INLAND WATERS

8:45 AM

Dr. Michael Rennie *is the Canada Research Chair in Freshwater Ecology and Fisheries and is based out of Lakehead University in Thunder Bay, Ontario.*

MALE FISHES AND ESTROGENS IN MUNICIPAL WASTEWATERS: WHAT DO WE KNOW AND WHERE SHOULD WE GO?

1:10 PM

Dr Karen Kidd *is the Canada Research Chair for Chemical Contamination of Food Webs and is based out of the University of New Brunswick in Fredericton, New Brunswick.*

CREATING LOCAL WASTEWATER SOLUTIONS THAT ARE APPLICABLE TO GLOBAL PROBLEMS

3:50 PM

Dr. Lee Jackson *is the Executive Director of Advancing Canadian Wastewater Assets (ACWA) at the University of Calgary in Calgary, Alberta.*

SETAC PNC 2016 | SCIENCE PROGRAM

PLATFORM PRESENTATIONS

Platform presentations are 12 minutes, followed by a 3-minute question/discussion and transition period.

PowerPoint or PDF presentations may be emailed to pncabstracts2016@gmail.com prior to the meeting or submitted on site via USB flash drive at the Registration Desk. All presentations must be received by 8:20 am on June 17.

Please title files as: last name_first initial
e.g. Mark Hanson's PDF: Hanson_M.pdf

SPECIAL THANKS TO OUR VOLUNTEER STUDENT PLATFORM JUDGES!

9:25 I Prevalence of microplastics in water and gastrointestinal tracts of fish from Wascana Creek

S. Campbell[1,*] and B. Hall[1]
[1]*University of Regina.* [*]*samantha.hope.campbell@hotmail.com*

The contamination of both marine and freshwater environments with microplastics, as well as ingestion by freshwater organisms, is a growing concern. Microplastics can be defined as any plastic that has a diameter of 5mm or less. When they are ingested problems such as pseudo satiation, blockage of the intestine, endocrine disruption through leached plasticizers, and contamination by adhered persistent organic pollutants can arise. Our study quantifies the amount of microplastics in a prairie creek immediately north of Regina, Saskatchewan. Sample sites were selected upstream and downstream of a waste water treatment plant in summer 2015. Water samples were collected using a net (80 μm mesh size), sieved, digested in an $Fe(II)/H_2O_2$ solution, and observed under a microscope. Plastics present were enumerated and colour and type was noted. A series of blanks helped clarify the source of plastics observed in water samples. Five species of fish were also collected using gillnets, seine nets, minnow traps, and conventional tackle. Gastrointestinal tracts were digested in a NaOCl solution which was filtered after which microplastics in stomachs were counted and categorized under a microscope. Results of this study will provide baseline conditions on the presence of plastics in the creek prior to a major upgrade of the waste water treatment plant.

Keywords: *microplastics, fish, ingestion*

9:40 I The effect of hydropeaking on energy stores and mercury concentrations in shoreline dwelling spottail shiner (*Notropis hudsonius*)

D. Green[1], D. Janz[1,2], and T. Jardine[1,3]
[1]*Department of Toxicology, University of Saskatchewan.* [2]*Western College of Veterinary Medicine, University of Saskatchewan.* [3]*School of Environment and Sustainability, University of Saskatchewan.* [*]*d.green@usask.ca*

Hydroelectric reservoir construction induces chemical and physical changes that can affect impounded and downstream ecosystems. MeHg produced in reservoirs rapidly bioaccumulates in reservoir-impounded and downstream foodwebs, as evidenced by significant post-dam decline (1970 to 2013) in Hg concentrations ([Hg]) of commercial fishes (pike, walleye, sauger, and goldeye) from the Tobin Lake Reservoir and a downstream fishery in Cumberland Lake. Further analyses reveal significantly delayed Hg decline from downstream walleye and goldeye populations relative to those in the reservoir ($P<0.001$). These latter effects could be related to stress imparted by daily dam-induced water level fluctuations. Observed fish kills and strandings on low-pitched shorelines below the dam suggest that the irregular and highly variable water levels observed below this peaking hydro-electric facility may act as a chronic physical stressor, causing increased retention of [Hg] in downstream fish. Analysis of triglyceride concentrations in young of the year spottail shiner (*Notropis hudsonius*) collected from affected habitats reveal reduced energy accumulation in young of the year fishes ($P<0.05$) and relatively greater [Hg] ($P<0.05$) relative to upstream counterparts, suggesting that hydro-electric facilities may induce an energetic bottleneck that exacerbates [Hg] in downstream fishes. Additional analyses of the glycogen and cortisol concentrations in these fish are underway to determine if populations from affected habitats show physiological signs of chronic stress.

Keywords: *reservoirs, mercury, bioaccumulation, fisheries*

9:55 I Identifying physicochemical mechanisms affecting internal phosphorus loading in Buffalo Pound Lake, SK, using sediment fractionation extractions and in situ water chemistry

L. D'Silva[1,*], K. Liber[1,2], H. Baulch[2], L. Doig[1]
[1]*Toxicology Centre, University of Saskatchewan.* [2]*School of Environment and Sustainability, University of Saskatchewan.* [*]*Lawrence.dsilva@usask.ca*

Buffalo Pound Lake, SK, Canada, is a shallow eutrophic reservoir. It has experienced an increased frequency and severity of algal blooms in recent years, causing management issues for the local water treatment plant. Lake sediments can naturally contain and release large quantities of phosphorus (P) to associated overlying waters, thus stimulating algal blooms. Previous laboratory experiments have demonstrated that environmentally relevant warm temperatures, low dissolved oxygen (DO) concentrations, and alkaline pH (9.3) in lake water significantly increase sediment-associated P efflux. To assess mechanisms affecting *in situ* P remobilization from sediments, water column and sediment pore water samples were collected and analyzed for various forms of aqueous P and supporting water

chemistry. Phosphorus-speciation, aluminum (Al), and iron content in surficial sediments were analyzed using a sequential extraction method to help understand influencing geochemistry. Generally, periods of warm temperatures and low DO concentrations were associated with greater total P and soluble reactive P in bottom waters. Total P in sediments was similar among sites, but P-speciation significantly differed. One site displaying lower sediment P-efflux had significantly greater sediment Al content. Aluminum can act as a redox-insensitive P-sorbent, which can modify redox-induced P-release. Further research should investigate effectiveness of alum dosing within the lake as a means to limit P-remobilization from sediment, and decrease algal bloom severity.

Keywords: *eutrophic, pore water, anoxia, aluminum*

10:10 | The effect of changes in Hg deposition on Hg accumulation by zooplankton and fish: an update on the METAALICUS project

M. Paterson[1,*], L. Hrenchuk[1], P. Blanchfield[2], and H. Hintelmann[3]
[1]*IISD-Experimental Lakes Area.* [2]*Fisheries & Oceans Canada.* [3]*Trent University.* [*]*mpaterson@iisd-ela.org*

Fish from many lakes in North America and Europe have concentrations of mercury (Hg) that exceed consumption guidelines, leading to proposals in Canada and the United States to restrict Hg emissions from coal-fired power plants at a potential cost of billions of dollars. Because of the complexity of the Hg cycle, it has proven difficult to demonstrate the efficacy of proposed emission reductions and there are many questions about how quickly ecosystems will respond. To answer these questions, Hg deposition to a lake and its watershed at the IISD-Experimental Lakes Area (ELA) was experimentally increased for 7 years (2001-2007) using enriched Hg stable isotopes. Different stable isotopes were added to the lake and the surrounding catchment using a boat and an airplane, respectively. During the addition phase, Hg isotopes added directly to the lake rapidly increased in fish and zooplankton, but only small changes were observed for isotopes added to the terrestrial system. After the cessation of experimental Hg additions in 2007, concentrations in zooplankton of isotopic methyl Hg declined steadily for 3 years and then leveled off. Concentrations in fish also declined, but more slowly. Eight years after isotopic Hg additions were ended, detectable isotopes were observed in all biota, indicating that some deposited Hg remains biologically available for many years.

Keywords: *Experimental Lakes Area, mercury, fish, zooplankton*

10:40 | Physiological changes in fathead minnows (*Pimephales promelas*) in relation to natural versus anthropogenic sources of bituminous toxicants: adaptation in the oil sands?

S. Chow[1,*] and G. Pyle[1]
[1]*Department of Biological Sciences, University of Lethbridge.* [*]*sylvia.chow@uleth.ca*

The lower Athabasca River basin is home to indigenous fish species that reside within bituminous rich deposits. However, the potential and extent of local adaptation of these fish species to natural and anthropogenic bituminous sources are not well known. Following a reciprocal cross transplant between sites containing natural bitumen and a site downstream of industry, a 28 day chronic exposure experiment was conducted using a small indigenous forage fish, the fathead minnow (*Pimephales promelas*). Pre- and post-exposure neurophysiological, metabolic, and contaminant exposure endpoints were measured. Impairment of olfaction and respiration was observed in pre-exposure fish residing in bituminous-containing waters when compared to upstream reference fish. After exposure, olfaction, respiration, and hematocrit levels did not change in the case of natural bitumen and downstream fish. Reference fish exhibited impairment of olfaction, respiration, and hematocrit levels to levels comparable to the resident bituminous fish. Fish did not exhibit local adaptation. Physiologic scope of fish from natural bitumen and downstream waters may be limited when comparing olfaction, respiration, and hematocrit endpoints to the high mortality rates observed in these populations during exposure. Data in this current study show that field-based physiological data equate to that of lab-based toxicological studies: toxicological data, regardless of origin, may be implemented directly into remediation efforts and environmental risk assessment in the field.

Keywords: *physiology, toxicology, olfaction, adaptation*

10:55 | Effects of water accommodated fractions of a hydraulic lubricating oil on aquatic organisms

Z. Currie[1,*], D.L. McPhee[1], K. Bresee[2], C. Semper[3], S. Siciliano[1], and N. Hogan[1]
[1] *Toxicology Center, University of Saskatchewan.* [2] *Intrinsik Environmental Sciences Ltd.* [3] *TransCanada.*
[*]*Zac660@mail.usask.ca*

Oil and gas transport depends on pipeline networks and compressor stations, where actuator valves pressurize and control flow of the oil and gas. These valve actuators use hydraulic fluid as a lubricant,

and leakage of the fluids has caused soil staining around the valves. Direct toxicity risks of this lubricating oil to aquatic organisms from groundwater infiltration as well as spring runoff are uncertain. Therefore, we assessed the acute toxicity of pure lubricating oil UNIVIS J 13 in *Vibrio fischeri, Daphnia magna,* and embryo-larval stages of two amphibian species, *Xenopus laevis* and wood frog (*Rana sylvatica*). Aquatic organisms were exposed to a range of percentages (3, 6, 12, 25, 50, 100%) of 1:1 loadings of UNIVIS J 13 water accommodated fractions (WAF). Dose-response relationships were established and lethal loading 50 (LL_{50}) values were determined. The 5-minute LL_{50} in *Vibrio fischeri* was 33.4%, and the 48-h LL_{50} in *Daphnia magna* was 24%. For *Xenopus laevis*, there were no significant differences in mortality among treatment groups, but total length, tail length, and snout-vent length were significantly decreased in the 100%, 50%, and 25% treatment groups. For wood frogs, there was no mortality and no significant differences in growth.

Keywords: *aquatic organisms, hazard assessment, water accommodated fraction*

11:10 | Cardiac and metabolic effects of benzo-a-pyrene in juvenile rainbow trout (*Oncorhynchus mykiss*).

F. Leal[1,*] and L. Weber[2,3]
[1]*NSERC CREATE HERA.* [2]*Western College of Veterinary Medicine, University of Saskatchewan.* [3]*Toxicology Center, University of Saskatchewan.* [*]*Fred.Leal@usask.ca*

Benzo-a-pyrene (BaP) is a ubiquitous environmental contaminant rapidly metabolized but that exerts acute cardiotoxicity and persistent cardiac and metabolic effects in fish. Juvenile rainbow trout were injected once daily for 2 days with corn oil (control) or BaP (0.1 and 1 mg/kg). Cardiac ultrasound was performed on days 4 or 7 (n=10 fish/group/time) followed by fish euthanasia and collection of liver, heart and red muscle for analysis of glycogen (GLY) and triglycerides (TG) stores, activity of citrate synthase (CS), lipoprotein lipase (LPL), 3-hydroxyacyl coenzyme A dehydrogenase (HOAD). At day 4 there was a decrease in duration of blood flow through the ventriculobulbar valve and aorta with BaP. All cardiac function returned to control values at day 7 except peak aortic blood velocity, which was increased by BaP. At day 4, TG was increased in the heart and muscle; activity of CS and HOAD were increased in the liver; HOAD activity was decreased in muscle. At day 7, liver GLY and TG were decreased consistent with liver CS and HOAD activities remaining elevated, while muscle GLY was decreased with BaP treatment. Taken together, although most cardiac effects were transient, trout exposed to BaP underwent a persistent shift towards more glycolytic metabolism 7 days after exposure. Greater reliance on glycogen as an energy source may threaten fish survival since utilization of TG is more metabolically advantageous for long-distance swimming.

Keywords: *benzo-a-pyrene, rainbow trout, metabolism, cardiotoxicity*

11:25 | A proposed whole ecosystem study to examine fate, behavior, and toxicity of a diluted bitumen spill in a Canadian boreal lake catchment

V. Palace[1], J. Blais[2], B. Hollebone[3], M. Hanson[4], and M. Paterson[1]
[1]*IISD –Experimental Lakes Area (IISD-ELA).* [2]*University of Ottawa.* [3]*Environment and Climate Change Canada.* [4]*University of Manitoba.* [*]*vpalace@iisd-ela.org*

Despite constantly improving safety measures when transporting petroleum products, whether by pipelines, rail, or truck, there will always exist the possibility of accidental releases (spills). In North America, recent reviews by the Royal Society of Canada and the National Academies of Science have highlighted knowledge gaps regarding the fate and behaviour of oil in freshwater environments. These reports also identified the need for ecosystem-level studies to examine the efficacy of first response strategies, clean-up procedures, and the effects of residual oil on the ecosystem following completion of spill recovery efforts. The feasibility of conducting controlled oil release experiments at the Experimental Lakes Area (IISD-ELA) field station in Northwestern Ontario, Canada will be presented and model scenarios for examining responses related to a dilbit (diluted bitumen) release proposed. The authors are soliciting input from the research community regarding, but not limited to, the most significant knowledge gaps to address, experimental design options, and effects endpoint identification as they relate to oil entering boreal ecosystems, aquatic and terrestrial.

Keywords: *diluted bitumen, Whole Ecosystem, IISD-Experimental Lakes Area*

11:40 | Monitoring PAHs with deep-sea archaebacteria surface proteins

M. McDougall[1,*], O. Francisco[1], J. Leslie[2], L. Bestvater[1], T. Halldorson[1], M. Hanson[2], V. Palace[3], G. Tomy[1], and J. Stetefeld[1]
[1]*Department of Chemistry, University of Manitoba.* [2]*Department of Environment and Geography, University of Manitoba.* [3]*International Institute for Sustainable Development- Experimental Lakes Area.*
[*]*ummcdou8@myumanitoba.ca*

Present as pollutants in water, air, and land, polycyclic aromatic hydrocarbons (PAHs) have the potential to be mutagenic, teratogenic, and carcinogenic; so much so that in the 1970s the EPA defined a set of 16

priority PAHs which is currently being updated to include rings with alkylation and other modifications. These compounds have been the focus of numerous studies, but detecting them in the environment continues to be problematic. Though hydrophobic, these small, rigid molecules retain high diffusivity in traditional fatty acid passive sample devices (PSDs), such that monitoring the concentrations of these compounds near oil extraction sites and after spills is done through the collection of biological samples. Our work has focussed on developing a PSD using a proteinaceous matrix derived from the surface layer protein of *S. marinus*, a deep-sea archaeon. The physiological role of this protein, RHCC, is to capture elemental sulfur, which is commonly found in its ring state with a similar diameter to many of the priority PAHs. Here we will present the binding capabilities and equilibration times of RHCC with the 16 priority PAHs.

13:50 | **Effects of thyroid hormones and thyroid hormone disruptors on olfaction in North American bullfrog (*Lithobates catesbeianus*) tadpoles**

J. Heerema[1], C. Helbing[2], and G. Pyle[1]
*[1]Department of Biological Sciences, University of Lethbridge. [2]Department of Biochemistry and Microbiology, University of Victoria. *jody.heerema@uleth.ca*

Endocrine disrupting compounds (EDCs) from anthropogenic sources are deposited into wastewater and are not fully removed by treatment processes. Consequently, low concentrations of EDCs persist in treated effluent receiving waters. Some EDCs are thyroid active, and therefore can disrupt the normal functioning of the thyroid hormone (TH) in vertebrates. Since TH drives amphibian metamorphosis, tadpoles are valuable sentinels for studying TH disruption. During metamorphosis, the tadpole olfactory system is completely remodeled and consequently, TH disruption has the potential to disrupt olfaction in tadpoles. In this study, premetamorphic *Lithobates catesbeianus* tadpoles were exposed to environmentally relevant concentrations of one of thyroxine (T4), triiodothyronine (T3), a cocktail of known EDCs, or treated wastewater. After exposures, avoidance responses to a chemosensory stimulus were measured using a behavioural assay. Our findings show T3 impairs the avoidance response to the chemosensory stimulus in tadpoles, but T4 does not have an effect. Avoidance responses were also impaired after exposure to treated wastewater, but exposure to the cocktail of known EDCs had no effect on behaviour. Studying changes in olfactory acuity as a result of TH disruption can serve as a strong link between the presence of EDCs in receiving waters and their ecological significance.

Keywords: *wastewater, behaviour, endocrinology*

14:05 | **Reproductive health assessment of fathead minnow (*Pimephales promelas)* populations inhabiting an effluent-dominated stream, Wascana Creek, SK, Canada.**

S. Hanson[1,*], T. Bagatim[2], K. Steeves[1], S. Wiseman[1], N. Hogan[1,3], A. Hontela[4], P. Jones[1,2], J. Giesy[1,5] and M. Hecker[1,2]
*[1]Toxicology Centre, University of Saskatchewan. [2]School of the Environment and Sustainability, University of Saskatchewan. [3]Department of Animal and Poultry Science, University of Saskatchewan. [4]Department of Biological Science, University of Lethbridge. [5]Department of Veterinary Biomedical Sciences, University of Saskatchewan. *sara.hanson@usask.ca*

Waterbodies in the southern Canadian Prairies may be at an elevated risk to contaminants released within municipal waste-water effluents (MWWEs), particularly endocrine disrupting compounds (EDCs), due to the uniqueness of prairie surface water systems. During low flow periods, Wascana Creek, SK can be up to 100% treated effluent downstream of the City of Regina's outdated lagoon based treatment facility. The aim of this study was to characterize the potential endocrine disrupting effects of municipal waste-water effluents on wild fathead minnow (Pimephales promelas; FHM) populations in an effluent dominated stream, Wascana Creek, SK. Field studies were conducted on spawning FHMs (2014 and 2015) to assess responses in terms of overall health (condition factor, ovosomatic indices), reproduction (secondary sexual characteristics, gonad histopathology, PCR array), and sex ratios. FHMs downstream of the effluent fallout had lower gonadosomatic indices and significantly greater hepatosomatic indices compared to upstream. There was significant disruption of regulation of key genes associated with reproductive processes. Additionally, in both male and female FHMs gonadal degradation and delayed maturation was observed histologically. Exposed males displayed lower scores of secondary sexual characteristics. This case study highlights the current ecological risks of EDCs associated with MWWEs, and the need for implementing more effective and affordable measures to remove them at wastewater treatment plants.

Keywords: endocrine disruption, municipal wastewater, Wascana Creek, fathead minnow

14:20 | Effects of lighting intensity and ammonia concentration on nitrogen removal efficiency using algae - bacteria consortia

J. Huijun[1,*] and Y. Qiuyan[1]
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Activated sludge treatment is the most commonly used method in wastewater treatment plants. This process requires extensive aeration which translates into significantly energy consumption and operational cost. As photosynthetic organism, algae play a role as "tiny aeration devices" producing O_2 for other microorganisms in natural aquatic systems. The objective of this research is 1) to exam the performance of an algae-bacteria consortia on nitrogen removal from the wastewater, and 2) to explore the effects of lighting intensity and ammonia concentration on the algae-bacteria consortia's performance. The bacteria was the activated sludge that obtained from a wastewater treatment plant in Winnipeg, and the algae was a pure culture of *Chlorella Vulgaris*. The wastewater treatment reactors were inoculated with the mixture of bacteria and algae. Three different sets of lighting intensity, 1000 lx, 1500 lx, 2500 lx, were test. Synthetic wastewaters with different ammonia concentration, 50 mg/L, 250 mg/L, 430 mg/L, were also studied. It was found that at the lowest lighting intensity of 1000 lx, the ammonia removal efficiency was approximately 83 mg/L/d, which was up to 75% faster than that of the light intensity of 3000 lx; In terms of ammonia concentration, the highest ammonia concentration (430 mg/L) in the influent resulted in highest ammonia removal rate of 117 mg/L/d, which was two times faster than the one with low ammonia concentration (40 mg/L). It was therefore concluded that the low lighting intensity and high ammonia concentration could be used as a strategy to promote the performance of the algae-bacteria consortia.

Keywords: *algae—bacteria consortium, nitrogen removal, light intensity, ammonia concentration*

14:35 | Quantification of Human Pharmaceutical Conjugates in Municipal Wastewaters

A. Brown[1,*] and C. Wong[1,2]
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Recent data suggests there are non-trivial amounts of human pharmaceutical conjugates potentially entering environmental surface waters. These compounds could contribute to eliciting toxic effects either directly or indirectly (via de-conjugation) on aquatic biota. The need for developing a single method for quantifying both parents and conjugates is necessary. Propranolol (PRO), sulfamethoxazole (SMX), and their respective major conjugates 4-OH-propranolol sulfate (PRO-Sul) and sulfamethoxazole-β-glucuronide (SMX-Glc) were successfully simultaneously extracted through weak anion exchange solid phase extraction cartridges from primary and secondary clarification wastewaters from the North End Winnipeg Water Pollution Treatment Plant in Winnipeg, Canada. Subsequent separation and quantification was achieved by reversed-phase C_{18} chromatography coupled to positive electrospray ionisation tandem mass spectrometry. Linearity was > 0.99, and recovery RSD ranges across all matrices for PRO, SMX, PRO-Sul, and SMX-Glc were 2.14-13.21%, 2.32- 10.18%, 9.79- 19.22%, and 2.01-10.32% respectively. Primary and secondary filtrates respectively showed a significant increase of PRO from 0.039 to 0.045 µg/L ($P = 0.0457$); SMX showed a significant decrease from 1.56 to 0.58 µg/L ($P < 0.0001$); PRO-Sul showed a significant decrease of 0.050 to 0.020 µg/L ($P = 0.0172$); and SMX-Glc showed a significant decrease from 0.41 to 0.019 µg/L ($P < 0.0001$). To the best of our knowledge this is first study that simultaneously separated and quantified two different classes of parent compounds and two different kinds of human metabolite conjugates (glucuronide and sulfate) from a major urban wastewater treatment plant.

Keywords: *pharmaceuticals, wastewater, metabolite, conjugate*

15:05 | Reducing nutrients and organic micropollutants in a rural wastewater effluent with subsurface filtration treatment technology

L. Chaves-Barquero[1,3,*], K. Luong[2], M. Hanson[1], and C. Wong[1,2,3]
[1]*Department of Environment and Geography, University of Manitoba.* [2]*Department of Chemistry and Environmental Studies, University of Winnipeg.* [3]*Department of Chemistry, Costa Rica Institute of Technology.*
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To better understand the efficacy of wastewater treatment in rural Canada, we characterized the occurrence of wastewater contaminants (i.e. pharmaceuticals and nutrients) from lagoon to release at a treatment facility in Dunnottar, Manitoba. Wastewater treatment in this community is performed by the use of a two-lagoon system with subsequent subsurface filtration and ultraviolet treatment. A smaller pilot-scale is also available in the site, for which the removal capacity was studied under a fixed input flow of wastewater. Significant attenuation was observed for nutrients between the input and the output of the full-scale filter, whereas lesser attenuation was detected for the pilot-scale system at the time of the study. A total of five pharmaceuticals were consistently detected on the system: atenolol, sulfamethoxazole,

metoprolol, propranolol and carbamazepine. Of these five them were efficiently removed between the primary and secondary lagoons, with some attenuation being observed for these compounds at both the full- and the pilot-scale systems. Our results suggest that the constructed sub-surface treatment filtration system can provide a low-cost and low-maintenance means to reduce nutrients and attenuate pharmaceutical residues commonly found in wastewaters.

Keywords: *wastewater lagoons, pharmaceuticals, subsurface filtration*

15:20 | **Development, calibration, and modelling of an organic-DGT passive sampler for a diverse suite of polar organic contaminants in aquatic systems.**

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A unique configuration of the diffusive gradients in thin films sampler for polar organics (o-DGT) was developed with an 'uptake-limiting' agarose diffusive gel as the outer membrane. Diffusion coefficients (D) through the agarose gels were measured for 34 pharmaceuticals and pesticides at three temperatures (5, 13, 23 °C). Analyte-specific diffusion-temperature plots produced empirical relationships ($R^2 > 0.85$) whereby D could be determined at any temperature (i.e., matched to *in-situ* water conditions). Calibration of o-DGT was conducted using a flowing static-renewal system. Eight time points over the 25 day experiment showed linear uptake for all analytes except three macrolide antibiotics. Experimental sampling rates ranged from 8.8–16.1 mL/d and were successfully estimated with measured and modelled D to within 19 and 30% average relative errors, respectively. *In-situ* boundary layer experiments under slow flowing (2.4 cm/s) conditions showed that o-DGT uptake was minimally (< 20%) affected by water flow. Field evaluation in a wastewater treatment plant showed good agreement between o-DGT, POCIS and grab samples. The o-DGT sampler presents a promising monitoring tool that is 1) largely insensitive to typical flow conditions and 2) significantly reduces the need for calibration through measured/modelled diffusion-based sampling rates – two issues greatly affecting the applicability of current polar passive samplers.

Keywords: *passive sampling, pharmaceuticals and pesticides, surface waters*

15:35 | **Making your ecotoxicology stand out in an increasingly crowded world**

M. Hanson[1,*], J. Sumpter[2], J. Green[3], M. Kivi[4], G. Panter[5], M. Warne[6], B. Wolff[7], and M. Ågerstrand[8]

[1]Department of Environment and Geography, University of Manitoba. [2]Institute for the Environment, Health and Societies, Brunel University London. [3]DuPont. [4]Health Canada. [5]Syngenta LLC. [6]Queensland Department of Science, Information Technology and Innovation. [7]Department of Fish, Wildlife and Conservation Biology, Colorado State University. [8]Department of Environmental Science and Analytical Chemistry (ACES), Stockholm University. [*]mark.hanson@umanitoba.ca

There is increasing awareness that the quality (i.e., reliability) of peer-reviewed scientific literature is uneven, and there is a growing desire to improve the practice and reporting of studies. This is especially important in the field of ecotoxicology where regulatory decisions can include data from the peer-reviewed literature, with wide reaching implications for environmental protection. Our objective is to improve the reporting of ecotoxicology studies so that they can be appropriately utilized in a fair and transparent fashion. We propose a series of nine reporting requirements and recommendations for adoption by the ecotoxicology community. Reporting requirements are clarity around experimental design and conditions, chemical identification, test organisms, exposure confirmation, data presentation and availability, statistical analysis, and endpoints. Specific details that allow for a full assessment of the reliability and relevance of the studies, including limitations, are needed. Recommendations for their implementation are provided herein for practitioners, journals, regulators, stakeholders, funders, and professional societies. If applied, this will help to improve ecotoxicology and its value to environmental protection.

SETAC PNC 2016 | SCIENCE PROGRAM

POSTER PRESENTATIONS

Poster set up will take place in the atrium outside of the Schultz theater (inside St. John's College) from 7:30 to 8:20 a.m. on June 17th, prior to the meeting. Presenters should set up their posters on the board corresponding to the number assigned to their poster in the program.

Materials to set up posters will be provided on site.

Presenters are encouraged to attend their posters during conference breaks.

Posters should be a maximum 4' tall and 3' wide.

SPECIAL THANKS TO OUR VOLUNTEER STUDENT POSTER JUDGES!

The ARGs were quantified in the 14-day treatment and 7-day depuration and hibernation systems. By day 14, treated jars had 6.6% of resistance genes, but where 7-day hibernation and depuration should have been 0% the jars had an average of 3.9% and 1.4%, respectively, of SMX resistant genes. Findings suggest that ARGs could be transferred to new environments from snails excreting gut flora in their feces. If snails are a vector, many other invertebrate species could be vectors for ARGs as well, fundamentally increasing the threat of antibiotic resistance globally.

Keywords: *antibiotics, resistance, sulfamethoxazole, vector*

Impacts of climate change on seasonal watershed flow patterns in the Canadian boreal forest

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Streams and lakes in the Canadian boreal forest are important resources which face many pressures, including climate change. Water quality in these systems is sensitive to parameters such as the amount of precipitation and the timing of snow melt. We used a 33 year record of meteorological and hydrological data from a long-term research site in northwestern Ontario (the Experimental Lakes Area) to assess trends in precipitation, temperature and streamflow, and identify relationships between climatic and hydrological variables. Relationships were developed between total spring stream discharge, the peak date of stream discharge and stream nitrate concentrations, and climatic indices. The Akaike Information Criterion was used to determine the best models to describe the relationships. Results of this analysis shows that the best models predicting total spring discharge and the peak date of discharge include May climatic variables and the North Atlantic Oscillation as predictors. Understanding these climate-streamflow relationships provides a framework for understanding the implications of changes in climate on water quality and the timing of stream discharge.

Keywords: *climate, hydrology, stream chemistry, nitrate*

Determination of acute and sub-chronic toxicity of emerging contaminants in early life stages of rainbow trout (*Oncorhynchus mykiss*)

D. Schultz[1,*], S. Tang[1], S. Beitel[1], B. Eisner[1], J. Alcaraz[1], D. Janz[1], S. Wiseman[1], P. Jones[1], J. Giesy[1], and M. Hecker[1]
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Emerging contaminants have recently gained notoriety due to their ubiquity in the aquatic environment as well as the lack of data available regarding their toxicity. This is particularly relevant in northern climates where various factors may lead to inaccurate extrapolation from standard laboratory species to native species. Emerging chemicals (ECs) of concern such as hexabromocyclododecane (HBCD), silver nanoparticles (AgNPs), short-chain chlorinated paraffins (SCCP), 17α-ethynylestradiol (EE2), and Fluoxetine/Prozac™ (FLX) primarily enter the aquatic environment as mixtures through municipal wastewater effluent (MWWE), which is often released into receiving waters with little to no treatment. In this study, *Oncorhynchus mykiss* gametes were fertilized in and exposed to six waterborne concentrations of EE2, FLX, MWWE, and Ag nanoparticles where the lowest doses were selected based on environmental relevance and increased incrementally thereafter. Exposures were continuous flow-through and subsamples were collected at critical developmental stages to assess acute and sub-chronic toxicity of all test chemicals. Main findings include a significant effect on degree days in the AgNP, MWWE, and Prozac treatments as well as increased mortalities in AgNP and Prozac treatments. However, further sample analysis is required to fully elucidate histological anomalies associated with FLX, MWWE, and AgNP exposures, as well as potential impacts of MWWE and its associated contaminants and further characterize the effects.

Keywords: *emerging contaminants, wastewater, fish*

The effects of oil sands processed water on *Daphnia magna*

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Current production and growth in oil sands extraction has raised concerns of its prospective influences on the surrounding environment. This study has demonstrated that *Daphnia magna* exposed to oil sands process-affected water (OSPW) with and without suspended particulate matter (SPM), have a reduced feeding rate compared to those unexposed. This study also

matter (SPM), have a reduced feeding rate compared to those unexposed. This study also examined different mechanisms of action to explain the observed feeding rate. There was no significant change in the major digestive enzymes trypsin or amylase when exposed to OSPW or SPM, however, tandem exposure (as normally found in tailings ponds) reduced the total trypsin activity. Mandible rolling or post-abdominal rejections, which are behaviours used in feeding did not see a change in any exposure. Thoracic limb movements, used to provide water flow toward the feeding grove, were reduced in all SPM treatments, but not OSPW alone. Peristaltic movements were reduced resulting in a reduction of digestion time in all OSPW treatments. EDX analysis detected both aluminum and silicon in both SPM treatments. All exposures showed an increase in the number of intact algae cells after excretion demonstrating the reduction in feeding rates is partly caused by improper digestion.

Keywords: *oil sands process-affected water*

Constructing species sensitivity distributions for lead (Pb) from the ECOTOX database: lessons and limitations for reliability and relevance

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Species sensitivity distributions (SSDs) are generated to establish water quality guidelines and in ecological risk assessment. Community sensitivity is extrapolated from single species toxicity values typically derived from the laboratory setting, usually in the form of E/LC50 or NOEC values for acute or chronic exposures, respectively. A common method for obtaining large quantities of toxicity data for a multitude of aquatic species in an efficient manner is via the United States Environmental Protection Agencies ECOTOX database. It is often assumed by users that the data are accurate and contain sufficient content and context to create SSDs. As an exercise, we accessed ECOTOX and acquired data for lead (Pb) in order to construct SSDs for the purpose of calculating a hazard concentration at the 5th centile of the distribution (HC5) for freshwater fish. Through the process of constructing SSDs to account for various physic-chemical scenarios, various limitations of ECOTOX were identified. Many of these relate to the way in which the data are reported, and the ability to identified reliable and relevant studies. We recommend that more of the available water quality and experimental design information found within the articles cited in the database should be included in the database for ease of access, to make possible a simplified summary database as a first screen that focuses on major indicators of data reliability and relevance, and to improve the screening process for the acceptance of literature into the database and reduce transcription errors.

Keywords: *data quality, extrapolation, hazard concentration, risk assessment, lead*

Untargeted screening of brominated disinfection by-products in drinking water by DIPIC-frag method

C. Watts[1,*], H. Peng[1], P. Jones[1,2], S. Wiseman[1], and J. Giesy[1,3,4,5]

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Disinfection byproducts (DBPs) are produced during the treatment process of drinking water as a result of the reaction of disinfectants with natural organic matter (NOM). Brominated DBPs (Br-DBPs) are well documented to be more toxic than chlorinated DBPs, but most of the Br-DBPs in drinking water have remained unidentified. Identification of Br-DBPs in drinking water is challenging due to the occurrence of interferences, extremely low concentrations of Br-DBPs and their chemical diversity. To overcome these challenges, we developed a data independent precursor isolation and characteristic fragment (DIPIC-Frag) method for the untargeted screening of Br-DBPs in drinking water. Analytical conditions were optimized including sample pretreatment methods (SPE and freeze-drying), ionization modes (APCI and ESI) and HPLC columns (C18 and Amide columns) to expand the coverage of Br-DBPs detected. 4793 Br-DBPs were robustly detected by the DIPIC-Frag method. Precursor ions and compound formulae for 1653 Br-DBPs were predicted and structures were proposed for the 50 most abundant peaks. This represents the largest mass spectrometry library of Br-DBPs established to date, and most of these Br-DBPs have not been previously reported. Distribution of these Br-DBPs across different treatment processes including raw water, chlorinated water, sedimentation water and finished water after activated carbon was determined and toxicity testing of water extracts initiated.

Keywords: *disinfection byproducts*

Annual changes in surface water quality of an oil sands end-pit lake have reduced the toxicological risk to initial aquatic ecosystem colonizers

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In order to manage growing inventories of fluid fine tailings (FFT) and oil sands process-affected water (OSPW), Alberta oil sands mine operators have proposed end-pit lakes (EPLs) as a method for the long-term storage and reclamation of tailings. In December of 2012, Syncrude began the industry's first large-scale demonstration of EPLs with the creation of Base Mine Lake (BML), an artificial lake containing FFT capped with OSPW and fresh water. However, tailings contain a complex mixture of dissolved organics, salts and metals which have adverse effects on phytoplankton and zooplankton – aquatic organisms essential for early ecosystem development. The initial elevated salinity of BML decreased rapidly during 2013 and 2014, but has since slowed; chloride (415 mg/L) is now within a tolerable range for most freshwater organisms, but will still cause stress. From October 2014 to August 2015, most metals concentrations decreased an average of 60%; Cu and Zn were the only metals that increased (>300% and >200%, respectively). As of August 2015, Cu and Hg are the only metals that exceed Canadian Water Quality Guidelines (As, Cd and Cr exceeded in 2014) although some metals remain highly elevated above background levels (Mo is 45x higher in BML than in the Athabasca River). Comparisons to chronic toxicity values yield Cu and Ni hazard quotients >0.1 for *Ceriodaphnia dubia*, as well as Cr and Cu for *Pseudokirchneriella subcapitata*. Cr, Cu, Ni, Mo and Zn are therefore of potential concern to initial aquatic colonizers in BML and are the focus of current toxicity testing.

Keywords: *tailings, salinity, metals, reclamation*

Methods used to analyze the cardiorespiratory and metabolic effects of acute naphthalene and pyrene exposure in adult zebrafish (*Danio rerio*)

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It is hypothesized that acute exposure (48-hours) to petrogenic polycyclic aromatic hydrocarbons (PAH) naphthalene (NAP) and pyrene (PYR) will cause similar sublethal cardiorespiratory and metabolic impairment observed in previous studies after acute benzo-a-pyrene (BaP) exposure to adult zebrafish (*Danio rerio*), but by different mechanisms than BaP. Experiments will be performed using adult zebrafish aqueously exposed to NAP (0, 3.7, 370, and 3700 μg/L) and PYR (0, 0.025, 2.5, and 25 μg/L) using static renewal conditions. Post 48h exposure, half of the fish (n=16/group) will be subjected to the high frequency cardiovascular ultrasound to determine stroke volume, heart rate, cardiac output and blood flow characteristics of blood through the ventral aorta. The second half of the fish will undergo swimming tests, simultaneously measuring oxygen consumption to determine swimming endurance (critical swimming speed; U_{crit}), standard metabolic rate, maximum metabolic rate and aerobic scope. The expression of important metabolic enzymes (citrate synthase, lipoprotein lipase and 3-hydroxacyl-CoA dehydrogenase), antioxidant enzymes (glutathione peroxidase, catalase, superoxide dismutase) and aryl hydrocarbon receptor-controlled genes (cytochrome P450-1A) will be analyzed using real time fluorescence qRT-PCR in heart, skeletal muscle and liver from these same zebrafish to determine the mechanistic links to observed cardiorespiratory and swimming effects. Cardiorespiratory and gene expression changes will be compared to whole body levels of NAP or PYR residues to better determine mechanisms of effect and dose-response of these toxicants.

Keywords: *naphthalene, pyrene, zebrafish*

PROGRAM I SCIENTIFIC POSTERS 2016

Poster abstracts listed following program

ECOTOXICOLOGY of FOSSIL FUELS

1 Investigating the phototoxicity of polycyclic aromatic hydrocarbons and a petroleum-based lubricating oil in larval amphibians

Z. Currie and N. Hogan

Keywords: *polycyclic aromatic hydrocarbons, phototoxicity, amphibians, ultraviolet light*

2 Exploring the mechanistic influence of water chemistry on vanadium toxicity to Daphnia spp.

E. Gillio-Meina, S. Niyogi, and K. Liber

Keywords: *vanadium, oil sands, OSPW, water chemistry*

3 A mesocosm study to explore the utility of a new passive sampler for PAHs based on RHCC protein

J. Leslie, T. Halldorson, G. Tomy, J. Stetefeld, M. McDougall, M. Hanson, and V. Palace

Keywords: *passive sampler, right hand coiled coil protein, polycyclic aromatic hydrocarbons*

4 The effects of oil sands processed water on *Daphnia magna*

D. Steinkey, E. Lari, and G. Pyle

Keywords: *oil sands process-affected water*

5 Annual changes in surface water quality of an oil sands end-pit lake have reduced the toxicological risk to initial aquatic ecosystem colonizers

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C. Yeung and L. Weber

Keywords: *naphthalene, pyrene, zebrafish*

ECOTOXICOLOGY of METALS

7 Metabolic and cardiovascular effects of dietary selenomethionine exposure in adult zebrafish (*Danio rerio*)

C. Pettem, L. Weber, and D. Janz

Keywords: *selenium, cardiovascular, metabolism, zebrafish*

8 Validation of *in ovo* embryo microinjections using selenomethionine to simulate maternal transfer in the fathead minnow (*Pimephales promelas*)

T. Lane, D. Janz, K. Liber, and M. Hecker

Keywords: *selenium, development, maternal transfer, early life stages*

9 Constructing species sensitivity distributions for lead (Pb) from the ECOTOX database: lessons and limitations for reliability and relevance

A. Vanderpont and M. Hanson

Keywords: *data quality, extrapolation, hazard concentration, risk assessment, lead*

10 Influence of revegetation choices on plant community and soil development on a reclaimed coal waste rock pile in the Shanxi mining area, China

S. Li and K. Liber

Keywords: *coal gob pile, revegetation efforts, ecological restoration effect, soil quality*

NOVEL RESEARCH of EMERGING CONTAMINANTS

11 **Aquatic insects as a mechanism of dispersal for antibiotic resistance genes in the environment**
C. Lobson and M. Hanson
Keywords: *antibiotic resistance, aquatic insects, sulfamethoxazole, wastewater*

12 **Are aquatic snails vectors of microbes bearing antibiotic resistance genes?**
A. Reeves, D. Moore, C. Lobson, and M. Hanson
Keywords: *antibiotics, resistance, sulfamethoxazole, vector*

13 **Progesterone and testosterone concentrations in northern elephant seal (*Mirounga angustirostris)* vibrissae**
A. Hodgson, L. Kapronczai, and D. Janz
Keywords: *endocrine disruption non-invasive biomarker, northern elephant seal*

14 **The effects of multiple stressors (diltiazem, temperature, and hypoxia) on the cardiovascular function of rainbow trout**
A. Keller, A. Manek, B. Brooks, G. Pyle, and A. Hontela
Keywords: *diltiazem, hypoxia, rainbow trout, multiple stressors*

15 **Determination of acute and sub-chronic toxicity of emerging contaminants in early life stages of rainbow trout (*Oncorhynchus mykiss*)**
D. Schultz, S. Tang, S. Beitel, B. Eisner, J. Alcaraz, D. Janz, S. Wiseman, P. Jones, J. Giesy, and M. Hecker
Keywords: *emerging contaminants, wastewater, fish*

CANADIAN FRESHWATERS and WATER QUALITY MONITORING

16 **The state of the science for toxicity testing with Arctic algae**
O. Daly, C.J. Mundy, C. Wong, and M. Hanson

17 **When you assume...: the limitations of standard tests and regulatory monitoring methods in unique Arctic environments**
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18 **Recovery of *Lemna minor* from atrazine following various exposure durations**
C. Lau, D. Moore, and M. Hanson

19 **Lake Manitoba and its watershed: knowledge gaps and next steps**
M. Peterson, N. Casson, P. Badiou, S. Forbes, G. Goldsborough, S. Higgins, D. Orihel, and E. Watchorn
Keywords: *Lake Manitoba, water quality*

20 **Monitoring chitobiase in freshwater aquatic mesocosms**
M. Randell and M. Hanson
Keywords: *chitobiase, arthropods, mesocosms*

21 **Impacts of climate change on seasonal watershed flow patterns in the Canadian boreal forest**
H. Robichaud and N. Casson
Keywords: *climate, hydrology, stream chemistry, nitrate*

WATER QUALITY for HUMAN USE

22 Simultaneous biological nutrient removal from wastewater using aerobic granular sludge

A. Jafari Kang and Q. Yuan

Keywords: *aerobic granulation, SBR, simultaneous nutrient removal, wastewater, biological treatment*

23 Untargeted screening of brominated disinfection by-products in drinking water by DIPIC-frag method

C. Watts, H. Peng, P. Jones, S. Wiseman, and J. Giesy

Keywords: *disinfection byproducts*

POSTER ABSTRACTS I ALPHABETICAL BY LEAD AUTHOR

Investigating the phototoxicity of polycyclic aromatic hydrocarbons and a petroleum-based lubricating oil in larval amphibians

Z. Currie[1,*] and N. Hogan[1]

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Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous environmental contaminants derived primarily from the incomplete combustion of organic matter. PAHs are generally not acutely toxic to aquatic organisms; however, in the presence of ecologically relevant intensities of UV light, the acute toxicity of PAHs increases substantially. Early life-stage amphibians may be particularly susceptible to PAH photo-induced toxicity as they are translucent, have permeable skin and undergo embryo and larval development in shallow ponds. Limited studies have investigated the potential photo-induced toxicity of PAHs in amphibian species making it difficult to predict the impact of individual PAHs and complex mixtures containing PAHs. The objective of the present study was to evaluate and compare the sensitivity of a model organism (Xenopus laevis) and an ecologically native species (wood frog, Lithobates sylvaticus) to photo-enhanced toxicity of PAHs as well as a petroleum-based lubricating oil containing a mixture of PAHs (UNIVIS J13). Tadpoles will be co-exposed to UV light and individual PAHs (anthracene, naphthalene, acridine) or UNIVIS J13 and results will be compared using mortality, growth, malformations, body burden, and whole body transcriptomic responses. This research will determine if UV modifies the toxicity of PAHs for amphibians and whether responses in Xenopus are protective of ecologically relevant amphibian species.

Keywords: *polycyclic aromatic hydrocarbons, phototoxicity, amphibians, ultraviolet light*

The state of the science for toxicity testing with Arctic algae

O. Daly[1,2,*], C.J. Mundy[1,2], C. Wong[3], and M. Hanson[1]

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Phytoplankton and ice algae spring blooms are important to the structure and function of Arctic ecosystems, accounting for the majority of primary production in this region. With expanding development and human settlement in the North, there is increased likelihood of direct entry of contaminants to Arctic aquatic ecosystems, e.g., pharmaceuticals in wastewater that are known to impair nontarget organisms. We conducted a literature review in order to understand what, if anything, has been done as it relates to characterizing responses in Arctic phytoplankton, and reviewed what protocols were currently available for culturing Arctic phytoplankton and sea-ice algae. Robust toxicity data for temperate marine species are accessible, however currently little to no toxicity data exist for primary producers in the Arctic, nor is there a standard test for algae that could be applied for ecological risk assessment in Subarctic and Arctic specific assessments. The need for such protocols is imperative as there are vast differences in physiological characteristics of Arctic organisms, and environmental parameters in these regions. We recommend the development and validation of protocols for screening the toxicity of contaminants on Subarctic and Arctic algae. Standard culturing techniques suggested by the Phycological Society of America can be used and parameters adjusted to suit the Arctic environment. Candidate species include: Fragilariopsis cylindrus, Nitszchia spp., Navicula spp., Chaetoceros spp., and

Thalassiosira spp. as they may have both ease of culture and applicability. The creation of repeatable and field-validated bioassays will help agencies globally to begin to address concerns around non-target effects in Subarctic and Arctic systems.

Exploring the mechanistic influence of water chemistry on vanadium toxicity to Daphnia spp.

E. Gillio-Meina[1,*], S. Niyogi[1,2] and K. Liber[1]
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Insufficient data are available to understand how common water quality variables representative of Alberta's oil sands region can affect toxicity of vanadium (V) to aquatic organisms and how this effect could be explained through an understanding of the toxic mechanisms of action of V. There is on-going research to mitigate oil sands process water (OSPW) toxicity using petroleum coke to reduce organic toxicants. However, vanadium is released from petroleum coke to "coke-treated" OPSW increasing the aqueous concentration from negligible to up to 7 mg/L. Results to date indicate that some water chemistry variables can mitigate or exacerbate V toxicity to aquatic organisms — including alkalinity, sulphate, and sodium concentration. These contrasting trends could indicate that the mechanism of V uptake and toxicity in *Daphnia* could be through anion carriers, and that V may subsequently be affecting the internal sodium ion balance, potentially causing a respiratory disruption within the organism. Here, a mechanistic investigations of V toxicity using *D. magna* is described. Initial results indicate that there is no significant effect of V on whole body sodium concentration or on sodium influx in *Daphnia magna*, suggesting that the inhibition of the Na/K pump is not the most probable mechanism of toxicity. Further research will be initiated focused on lipid peroxidation and reactive oxygen species generation to corroborate if oxidative stress is the predominant mechanism of action.

Keywords: *vanadium, oil sands, OSPW, water chemistry*

Progesterone and testosterone concentrations in northern elephant seal (*Mirounga angustirostris)* vibrissae

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There is need to develop tools to assist wildlife managers to understand wildlife health. Hair cortisol analysis is a new approach that is being used as one such tool. The analysis of hair cortisol concentrations is being used as a biomarker of long-term stress in terrestrial mammals. It is thought that other hormones, such as sex steroid hormones, could also be useful tools to assess the health status of wildlife. By developing knowledge of the average concentrations of progesterone and testosterone in vibrissae of elephant seals at different times of the year, it would allow for future comparisons. The breeding cycle of northern elephant seals consists of one breeding period per year. As such, there are differences in sex steroid hormone levels at different times. By dividing the vibrissae into small sections and analyzing hormone content, we are able to observe differences corresponding to different times of the year. Further, if an animal was observed with significantly different hormone levels, it could be a possible indicator of endocrine disruption, as a result of exposure to xenobiotics. Vibrissae from 50 adults (40 female, 10 male), 31 sub-adults (16 female, 15 male) and 15 pups were obtained from northern elephant seals on the central California coast in 2012. Vibrissae were cut into 52 mm segments and analyzed for their progesterone and testosterone content. Hormone concentrations among different vibrissae sections were compared statistically using one way-ANOVAs. Significantly lower progesterone concentrations were observed in the adult male groups, however there were no significant differences between the female adult and the juvenile groups.

Keywords: *endocrine disruption non-invasive biomarker, northern elephant seal*

Simultaneous biological nutrient removal from wastewater using aerobic granular sludge

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The unique characteristics of aerobic granular sludge such as high settling velocity, compact structure, and simultaneous nutrient removal capability provide the opportunity to design a compact wastewater treatment process. In the present study, aerobic granulation strategy was studied. The aerobic granular sludge was first cultivated from the anaerobic/aerobic sequencing

batch reactors fed with high strength synthetic wastewater with COD of 1300 mg/l (COD_{load} of 2.6kg/m^3d). After 64 days, stable granules (indicated by Settling Velocity Index of SVI_{5min} = $SVI_{30min} \approx$ 41 ml/mgVSS and $d_{0.9}$=1.2mm) with COD, ammonia and phosphorus removal greater than 90% was achieved. In the second stage, COD of the feed (wastewater) was reduced to 700 mg/l (COD_{load} of 1.4kg/m^3.d). The decrease in COD initially affected settling properties and phosphorus removal efficiency. However, gradual improved settling property was observed (SVI_{5min}=SVI_{30min}≈43ml/mgVSS at day 111) and 95% phosphorus removal was achieved. Finally, at day 168, the reactors were fed with low-strength municipal wastewater (COD of 400mg/l and COD_{load} of 0.8 kg/m^3d). The decrease in sludge concentration (MLSS decreased from 5 to 2.5 g/l), the granules size ($d_{0.9}$ decreased from 1.1 to 0.6mm) and phosphorus removal was observed. However, at day 217, stable granules (SVI_{5min} = $SVI_{30min} \approx$ 50 ml/mgVSS) with 99%, 95% and 70% of COD, ammonia and phosphorous removal was achieved, respectively.

Keywords: *aerobic granulation, SBR, simultaneous nutrient removal, biological treatment*

The effects of multiple stressors (diltiazem, temperature, and hypoxia) on the cardiovascular function of rainbow trout

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The aquatic environment has been affected by anthropogenic threats such as the disposal of pharmaceuticals and their metabolites in surface waters since early 19th century. The global warming effect, hypoxia of surface waters, and other stressors in the aquatic environment, are recent concerns generated by the modern civilization. However, very little is still known about the impacts of multiple stressors, concomitantly, in the aquatic environment. Diltiazem is a calcium channel blocker commonly prescribed in the treatment of hypertension, angina pectoris, and some types of arrhythmia in humans. It reduces the heart rate and causes systemic and peripheral vasodilation. The results of previous studies have shown that diltiazem causes the same effects in dogs as what it is seen in humans. However, very limited information is available on the effects of diltiazem in the aquatic environment. The current study investigated the effects of diltiazem in rainbow trout (*Oncorhynchus mykiss*) under controlled laboratory temperatures (4 °C, 10 °C and 18 °C) and oxygen saturation (40% and >90%). Rainbow trout were exposed to diltiazem (0, 1 μg/L and 10 μg/L), to characterize the effects of diltiazem in fish, and determine the modulation capacity of different temperatures and different concentrations of dissolved oxygen in water. Diltiazem induced effects on the cardiovascular function of fish as those observed in humans and dogs. (Funded by Alberta Innovates – Energy and Environment Solutions – AI-EES)

Keywords: *diltiazem, hypoxia, rainbow trout, multiple stressors*

Validation of *in ovo* embryo microinjections using selenomethionine to simulate maternal transfer in the fathead minnow (*Pimephales promelas*)

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Selenium (Se) is a developmental toxicant of great concern because it can be released into the aquatic environment in significant amounts through industrial and natural processes. Inorganic Se released into surface water is biotransformed by microorganisms to selenomethionine (SeM) that has the ability to bioaccumulate at higher trophic levels. Early life-stages of fish are most sensitive to exposure with SeM and are primarily exposed via maternal transfer. Developmental deformities (e.g. spinal curvature, craniofacial, edema) may occur as a result of embryo exposure to maternally transferred SeM, however, this is difficult to study in long-lived species of concern in local Canadian ecosystems. The objective of this study will be to investigate developmental effects of SeM in fathead minnow early life stages by using embryo microinjection to mimic maternal transfer. Fathead minnows are a relevant model species based on their wide distribution throughout Canada. Specifically, fathead minnow embryos will be injected with graded concentrations of SeM (9μg/g, 18μg/g, 36μg/g). Developmental endpoints will be compared with a parallel maternal transfer study. Establishing an embryo injection model for predicting toxicity of SeM through maternal transfer will make testing a broader range of species more feasible, particularly in long-lived native species. Future research using this model will strive to determine Se sensitivity in early life stages for native species of concern (e.g. white sturgeon and rainbow trout).

Keywords: *selenium, development, maternal transfer, early life stages*

Recovery of *Lemna minor* from atrazine following various exposure durations

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Observing the increase in frond number, plant number, dry mass and the respective growth rates of each, we examined the ability of the duckweed *Lemna minor* to recover following exposure to the herbicide atrazine. 7-, 14-, 21- and 28-day static renewal assays were performed (with an exposure series of 0, 10, 20, 40, 80, 160 and 320 µg/L atrazine),and followed by a 7-day recovery period in clean media. We observed full recovery for all of our endpoints from observed EC50s, regardless of the exposure duration. The USEPA currently regulates atrazine on an aquatic plant Concentration Equivalent Level of Concern of 10 µg/L (60-day average concentration). Our data support this decision, as we predict any effects observed during this window would be rapidly attenuated upon the removal of atrazine from the system.

Keywords: *duckweed, atrazine, recovery, growth rate*

A mesocosm study to explore the utility of a new passive sampler for PAHs based on RHCC protein

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Transportation of petroleum products allows the possibility for spills to occur, necessitating monitoring efforts to determine baseline conditions prior to a spill and targets for cleanup activity. Passive samplers are increasingly used in place of chemical analysis of abiotic and biotic ecosystem components. Current PSDs have relatively long times associated with reaching equilibrium which becomes problematic when volatile compounds are present.
This new passive sampling device (PSD) contains the RHCC protein which is isolated from bacteria that reside in deep sea hydrothermal vents. The protein is thermally stable, resistant to a wide range of salinity, pH and sulfide concentrations and can be custom synthesized in the laboratory in a variety of polymeric forms. We hypothesized that a PSD based on the RHCC protein will bind priority PAHs from a model ecosystem enclosure treated with diluted bitumen more effectively than the traditional PSD media, triolein and there will be a statistical relationship between uptake of the 16 priority PAHs in the RHCC PSD and in tissues of fish. To test this we conducted a mesocosm study in 2015 to characterize the performance of the Right Hand Coiled Coil (RHCC) protein under controlled field conditions. Preliminary results show uptake of PAHs by the RHCC however comparison of the SPMDs and fish tissue has not yet been completed. Once these comparisons have been completed, future research needs can be identified.

Keywords: *passive sampler, right hand coiled coil protein, polycyclic aromatic hydrocarbons*

Influence of revegetation choices on plant community and soil development on a reclaimed coal waste rock pile in the Shanxi mining area, China

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In order to identify pioneer plant species suitable for revegetation of coal waste rock piles, a field survey was conducted to assess the colonization success of different planted species and their influence on soil development nine years after planting on a reclaimed coal waste rock pile in the Yangquan mining area of Shanxi province, China. Data were analyzed using a quantitative classification method (TWINSPAN), ordination techniques (DCA and DCCA) and Principal Component Analysis. Poor soil nutrient status and low soil moisture content were the major limiting factors affecting plant community development on the coal waste rock pile, not chemical toxicity. The metals of greatest concern were Pb, Cr, Cd, Cu, As and Hg, but all were present in soil at levels below predicted levels of adverse effects. The plant communities that developed had improved the topsoil (0-10 cm) quality on the reclaimed coal waste rock pile nine years after initial planting, but the degree of improvement varied greatly with different planted species. Revegetation types comprised of the planted leguminous species, *Medicago sativa*, the non-leguminous species, *Populus tomentosa* and *Salix babylonica*, and the mixed species, *Amorpha fruticosa - Festuca elata*, had the best ecological restoration effects on the reclaimed coal waste rock pile. Revegetation using these species is therefore strongly recommended for future reclamation of abandoned coal waste rock piles in this region.

Keywords: *coal gob pile, revegetation efforts, ecological restoration effect, soil quality*

Aquatic insects as a mechanism of dispersal for antibiotic resistance genes in the environment

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Human-use antibiotics are commonly released into aquatic ecosystems from wastewater effluents emanating from open lagoons on the Canadian Prairies. This can lead to extensive antibiotic resistant gene-bearing bacteria (ARGs) in these environments (both lagoons and receiving waters). We hypothesize that as aquatic insects emerge from these systems they could be a vector for ARGs into surrounding environments. To test this, we deployed emergence traps in three wastewater lagoons and the receiving creek at Dunnottar, MB. The ARGs were measured on emerged insects, in the water and were quantified using qPCR. The antibiotic resistance genes targeted were *sul1*, *sul2*, and *sul3* and were compared to *16S-rRNA* to calculate the proportion of resistant genes relative to total bacterial genes. Our results will be presented.

Keywords: *antibiotic resistance, aquatic insects, sulfamethoxazole, wastewater*

When you assume...: the limitations of standard tests and regulatory monitoring methods in unique Arctic environments

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Canadian Environmental Effects Monitoring programs mandated by the Fisheries Act ensure continual oversight and regulation of industrial projects in Canada. However, increasing development in remote locales has created new challenges for community stakeholders and regulators, as standard approaches to monitoring that have been developed for use in the country — including the use of surrogate species as representatives of local organisms — may not be appropriate for application in unique landscapes and Arctic conditions. Using the example site of the now-closed Snap Lake Mine alongside 350+ 96 h cold-water fish lethality tests, this study examines the limitations of the surrogate cold-water fish test species (rainbow trout) to capture the effects of 17 industrial contaminants as exhibited by five local species (arctic char, arctic grayling, lake trout, lake whitefish, and round whitefish) with respect to the modifying effects of temperature, water hardness, pH, and exposure duration. Additional meta analysis of the Maximal Toxic Effect (the proportion of tests achieving maximum toxicity prior to test termination) was conducted and reveals that, although often similar in sensitivity, many cold-water fish species exhibit the effects of toxic exposures much earlier than the time reported as prescribed by the standard test duration. This may potentially overestimate the 'safe' exposure durations or concentrations interpolated from the results of such standard test methods.

Keywords: *surrogate species, EEM, maximal toxic effect, standard testing, cold-water fis*

Lake Manitoba and its watershed: knowledge gaps and next steps

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Lake Manitoba is a large, shallow, prairie lake located in central Manitoba. The lake and its watershed consist of complex ecosystems connected to the landscape and other waterbodies, including Lake Winnipeg. These ecosystems are subject to many environmental pressures such as climate change, land use change, and water level regulation. Substantial gaps in our scientific understanding of Lake Manitoba ecosystem functioning impedes our ability to make informed management decisions. This poster summarizes the findings and recommendations of a recent workshop convened on identifying these knowledge gaps and determining steps to address them. Several critical data gaps were identified; these must be filled before progress can be made on understanding Lake Manitoba water quality and ecosystem health. These gaps include physical data (e.g. bathymetric and LiDAR data), water quality data (e.g. tributary nutrient loading), and ecological data (e.g. characterization of algal, zooplankton, and invertebrate communities). Furthermore, the extent of spatial and temporal heterogeneity in the Lake Manitoba system is not fully understood because there is a lack of offshore monitoring and winter data. Lastly, there is an

urgent need to coordinate research activities across disciplines and agencies within the watershed.

Keywords: *Lake Manitoba, water quality*

Metabolic and cardiovascular effects of dietary selenomethionine exposure in adult zebrafish (*Danio rerio*)

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Selenium (Se) is an essential micronutrient involved in important metabolic functions for all vertebrate species. As Se is reported to have a narrow margin between deficiency and toxicity, there is growing concern surrounding the adverse effects of elevated Se exposure caused by anthropogenic activities. It is well known that oviparous vertebrate species, especially fish, are highly susceptible to elevated dietary Se exposure. Recent studies have reported that elevated dietary exposure of fish to selenomethionine (Se-Met), the primary form of Se in the diet, can alter metabolic capacity, energy homeostasis, swimming performance and cause a greater incidence of early life stage deformities and mortality. This study aims to further investigate mechanisms of Se-Met toxicity, particularly potential underlying cardiovascular implications of chronic exposure to environmentally relevant concentrations of dietary Se-Met in adult zebrafish (*Danio rerio).* Adult zebrafish were fed either control food or Se-Met spiked food with nominal concentrations of 10 and 30 µg Se/g, dry weight for 90 days at 5% body weight per day. Following exposure, high resolution B-mode and Doppler ultrasound was used to characterize cardiac and vascular function. Metabolic endpoints investigated include muscle glycogen and triglyceride stores, and oxidative stress genes of interest are currently being examined using Real-Time Quantitative PCR. The results of this study will help further characterize sublethal physiological responses in fish inhabiting Se-contaminated aquatic ecosystems.

Keywords: *selenium, cardiovascular, metabolism, zebrafish*

Monitoring chitobiase in freshwater aquatic mesocosms

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There is potential for the use of an enzymatic technique to assess and monitor the status of arthropod communities, both rapidly and cheaply. The proposed technique is the measurement of free chitobiase, an arthropod molting enzyme, present in aquatic ecosystems. Chitobiase present in the aquatic ecosystem should be directly related to the status of arthropod populations, reflecting factors such as number of organisms, growth/development rate and size of the organisms. Chitobiase activity can also be used as an indicator that represents response of organisms to disturbances, such as chemical stressors, in aquatic systems. In 2015, we conducted two wetland mesocosm studies examining the fate and effects of the antibiotic sulfamethoxazole and diluted bitumen. The use of mesocosms allows for the monitoring of chitobiase and the response of complex arthropod communities in the face of contaminant pressure. The half-life, rate of production, and standing concentrations of chitobiase were measured and zooplankton and emergent insects communities were characterized. No distinct differences were observed amongst our chitobiase measurements between treatments and controls. Our data indicate that sulfamethoxazole and diluted bitumen, at the concentrations tested, resulted in a lack of significant impacts on secondary productivity in our model wetlands.

Keywords: *chitobiase, arthropods, mesocosms*

Are aquatic snails vectors of microbes bearing antibiotic resistance genes?

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The role of *Stagnicola elodes*, a freshwater species, as a reservoir and vector for transporting antibiotic resistance genes (ARGs) within their gut microbe was explored with a 21-day laboratory study. ARGs are considered a global threat to human and ecological health and are of particular concern in sewage effluents because resistance develops in the guts of organisms. A 14-day exposure period allowed snails in jars to graze on biofilms with resistance to sulfamethoxazole (SMX), after snails were transferred to fresh media with no SMX for either a 7-day hibernation or depuration period. Methods of extracting and analyzing feces and tissue samples for DNA were unsuccessful. This was attributed to snails having large amounts of mucus sugars that interfere with the extraction process. Water samples from the exposure jars were successfully analyzed.

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