Science For a Changing North IV

"Northern Watersheds and Ring of Fire Studies"

Highlighting Research by Theme 1 Participants in the
NSERC Canadian Network for Aquatic Ecosystems Services

Wednesday, February 18th, 2015
Vale Living with Lakes Centre
Laurentian University
Sudbury, ON.

Agenda

8:00-8:30	**Coffee & muffins**
8:30 -8:45	John Gunn (Laurentian), Brian Branfireun (Western) Introduction to the CNAES Theme 1 Workshop
8:45-9:15	Bill Keller (Laurentian) Lakes in the Far North of Ontario: status and changes
9:15-9:45	Cheryl Chetkiewicz (Wildlife Conservation Society Canada) Getting it Right in the Ring of Fire: The case for regional environmental planning and how to get there
9:45-10:15	Brian Steinback (DeBeers Ltd) Mining Industry Science Needs
10:15-10:30	**Break**
10:30-11:00	Brian Branfireun (Western) Climate & Land Use Change Impacts in Far North Peatlands: Implications for Carbon and Mercury Cycling
11:00-11:30	April James (Nipissing) Watershed Classification Studies in the Attawapiskat Watershed
11:30-12:00	John Bailey (OMOECC) Far North Stream Baseline Data Collections and Research
12:00-13:00	**Lunch**
13:00-13:30	Daniel Campbell (Laurentian) Mitigation of Mining Activities in the Hudson bay Lowlands
13:30-14:00	Tom Johnston (OMNRF) Mercury in fish communities of the Attawapiskat River drainage
14:00-14:30	Rachel DeJong (Waterloo) Interactions of life history and mercury accumulation in northern rivers
14:30-14:45	**Break**
14:45-15:15	John Gunn (Laurentian) 30 Years of Fisheries Research in the Sutton River Watershed: Building on Traditional Knowledge
15:15-15:45	David Pearson (Laurentian) Science Communication and First Nations Engagement
15:45-16:00	John Gunn (Laurentian), Brian Branfireun (Western) Wrap Up and Summary

Proceedings available at: http://www3.laurentian.ca/livingwithlakes/research/workshop-conferences/

Speaker Biographies

John Bailey received his B.Sc. in Zoology from the University of Guelph and his Ph.D. in Biology from the Western University. He is currently the Ontario Ministry of Environment and Climate Change Research Scientist and Adjunct Professor with the Cooperative Freshwater Ecology Unit at Laurentian University. He oversees the Sudbury lake recovery monitoring programme and the Freshwater Invertebrate Reference Network for Northern Ontario (FIRNNO) and is also involved in freshwater ecotoxicology and metabolomics research related to the effects of multiple stressors. Prior to moving to Sudbury in 2011, Bailey spent 30 years in the Yukon, Northwest Territories and Nunavut, specializing in aquatic biomonitoring programme design, implementation, data analysis, GIS and training, as well as environmental assessment, policy, legislation and management and Aboriginal land claim negotiations and implementation. John began his career in renewable resource management and research with the Ontario Ministry of Natural Resources in the mid-1970s.

Brian Branfireun is an Associate Professor and the Canada Research Chair in Environment and Sustainability in the Department of Biology and Centre for Environment and Sustainability at the University of Western Ontario. Since his first appointment in 1998 at the University of Toronto, he has developed an internationally recognized trans-disciplinary research program focussing on hydrology, wetland ecosystems and mercury in the environment. He is involved in international research initiatives in Mexico, Sweden and the UK, and serves on several international scientific advisory boards. In addition to serving as the President of the Canadian Geophysical Union, Dr. Branfireun currently serves as the Director of the Biotron Centre for Experimental Climate Change Research at Western, and is the Co-Lead of Theme 1 of the NSERC Canadian Network for Aquatic Ecosystem Services, along with Dr. John Gunn.

Daniel Campbell is an assistant professor in the School of the Environment and a researcher at the Vale Living with Lakes Centre. His has expertise in plant ecology, wetland ecosystems, restoration ecology especially mined landscapes, and methods of ecological analysis. He has worked in boreal, subtropical and subarctic ecosystems. He now conducts research in the rehabilitation of mined landscapes and on applications of wetlands around Sudbury and in the Hudson Bay Lowland.

Cheryl Chetkiewicz has been a conservation scientist and the leader of WCS Canada's conservation program in the Far North of Ontario since 2009. She is focused on cumulative effects assessment, regional environmental assessment, monitoring, and infrastructure scenarios. Through environmental planning she works with partners to deliver conservation outcomes for species such as caribou, wolverine and freshwater fish, ecosystems, including peatlands and wetlands, and traditional resource use by First Nations.
She received a PhD from the University of Alberta in 2008 to help identify wildlife corridors for cougars and grizzly bears across fragmented landscapes in the Alberta Rockies. Cheryl has worked with large mammals in both Arctic and tropical systems including Alaska and the Northwest Territories as well as Peru and Brazil. Cheryl grew up in Zambia, England and Alberta as her father pursued jobs in mining, specifically copper mining and the oilsands.
Contact Cheryl Chetkiewicz at **cchetkiewicz@wcs.org** or 807-472-1440

Rachel DeJong is a Master's student under the supervision of Dr. Heidi Swanson at the University of Waterloo. She completed her undergraduate degree in Biology also at the University of Waterloo. She is currently investigating the influence of fish life history on fish mercury concentration in coastal rivers of the Hudson Bay Lowlands. Rachel enjoyed her time at the Living with Lakes Centre conducting fish community surveys throughout the summer.

John Gunn is the Canada Research Chair in Stressed Aquatic Systems and the founding Director of the ale Living with Lakes Centre at Laurentian University. He was a biologist and scientist with the Ontario Ministry of Natural Resources for over 25years before joining Laurentian in 2003. He was a founding member of the Cooperative Freshwater Ecology Unit formed in 1989. John's current research focuses on the effects of multiple stressors on aquatic ecosystems with a particular interest in the factors that affect recovery from disturbance. He is the Co-Lead of Theme 1 of the NSERC Canadian Network for Aquatic Ecosystem Services, along with Dr. Brian Branfireun.

April James is an Associate Professor and Canadian Research Chair Tier II in Watershed Analysis and Modeling in the Department of Geography at Nipissing University. April received her undergraduate degree in Engineering Physics at the Royal Military College of Canada, her MSc. in Hydrogeology at Clemson University, and her Ph.D in Geography at McGill University. Her work experience includes subsurface flow and transport modeling while a researcher associate at the Lawrence Berkeley National Laboratory, in Berkeley California, and the study of headwater watersheds in southern Quebec, the Oregon Cascades and the North Carolina Piedmont region. Her current research includes experimental and modeling studies of streamflow generation, groundwater-surface water interactions, and applications of water isotopes to understanding hydrological processes in northern and central Ontario.

Tom Johnston is a Research Scientist with the Aquatic Research and Monitoring Section of the Ontario Ministry of Natural Resources and Forestry, and an Adjunct Professor of Biology at Laurentian University. His research program explores various aspects of fish ecology and fisheries in northern freshwater ecosystems.

Bill Keller is currently the Director of Climate Change and Multiple Stressor Aquatic Research at Laurentian University. He is a founder and a principal scientist of the Cooperative Freshwater Ecology Unit at Laurentian University. As leader of a research team, he has conducted studies on the effects of various anthropogenic stressors on northern Ontario lakes and rivers for over four decades. Much of this work centered on determining the effects of contaminants (acid, metals, nutrients) on aquatic ecosystems. Over the last two decades, his studies have increasingly focused on documenting and understanding recovery processes in damaged systems, and on investigating the combined effects of multiple stressors (eg. acidification, climate change, UV-B irradiance) on aquatic ecosystems. Much of his current research focuses on the Far North of Ontario.

David Pearson was the Project Director and then founding Director of Science North from 1980 to 1986 and is currently Senior Science Advisor to the centre. He has hosted two science television series: "Understanding the Earth" for TV Ontario, and "Down to Earth" for Mid-Canada Television, as well as a weekly radio spot, "Radio Lab", on CBC Northern Ontario Radio. He received the Ward Neale Medal from the Geological Association of Canada for promotion of the Earth Sciences in Canada in 2001 and the McNeil medal for science communication from the Royal Society of Canada in 2003. David chaired the Ontario office of the Canadian Climate Impacts and Adaptation Research Network from 2002 to 2007; co-chaired the Ontario Expert Panel on Climate Change Adaptation, and chaired the Far North Science Advisory Panel for the Ontario Government that released its report “Science for a Changing Far North” in 2010. David is currently Science Advisor to the Ontario Centre for Climate Impacts and Adaptation Resources at Laurentian and is working with Far North Ontario First Nation communities on climate change adaptation plans.

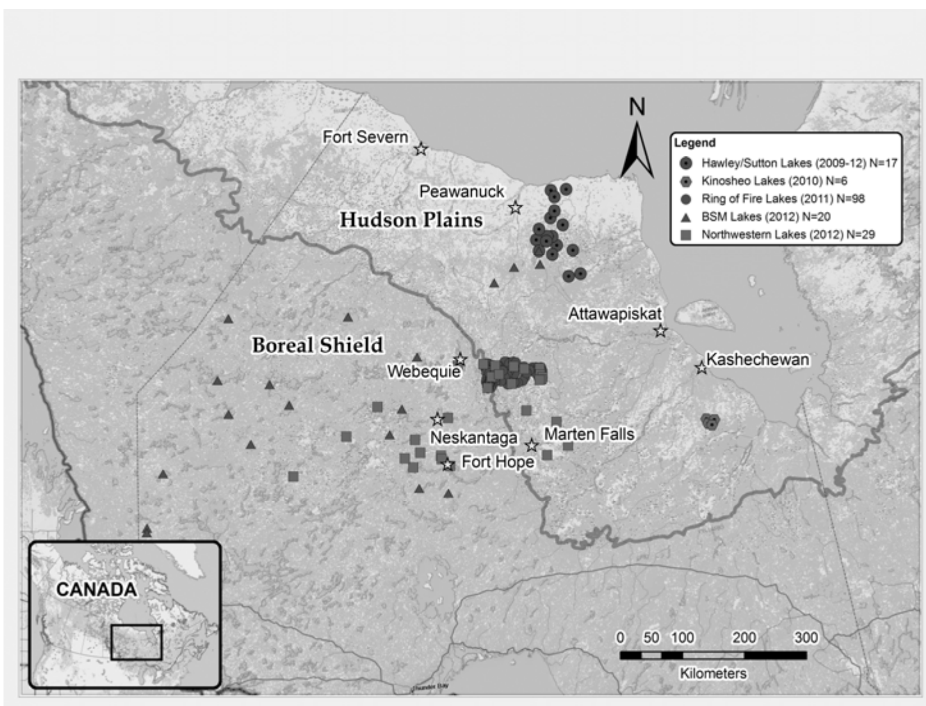
Chantal Sarrazin-Delay M.Sc is an aquatic biologist specializing in water monitoring and aquatic invertebrates. Having worked at the Vale Living with Lakes Centre for 11 years, she is a certified trainer in field collection and in the identification of aquatic invertebrates. She is also a sessional lecturer at Laurentian University and has participated in the Lake Centre’s Far North field work since 2010. Chantal is now the Coordinator of First Nation Relationship Building leading the development and delivery of science activities in various Far North communities.

Brian Steinback is currently senior environmental engineer at De Beers Canada. He has managed environmental monitoring and compliance programs at the Victor diamond mine in the James Bay region for more than 11 years, including involvement in a range of environmental research programs. Brian has worked closely with representatives of the Attawapiskat First Nation on environmental issues throughout this period. Environmental protection is a personal passion which has been expressed through more than 35 years of environmental management experience across five provinces, in the mining, pulp and paper, and nuclear power industries. Brian is a registered Professional Engineer in Ontario, and a graduate of the University of Guelph.

Lakes in the Far North of Ontario: Status and Changes

W. (Bill) Keller
Cooperative Freshwater Ecology Unit, Vale Living with Lakes Centre
Laurentian University

Changes are coming to the far north of Ontario that will affect aquatic ecosystems, including large-scale mining development and rapid climate change. However, until very recently there has been little study of waters in this vast, remote area. To address the pressing need for limnological data for this understudied region, lake chemistry surveys were conducted during 2009-2012, to help better understand the nature of remote northern Ontario lakes which span the Precambrian Shield and Hudson Bay Lowlands physiographic regions, and occupy two Ecozones, the Boreal Shield and Boreal Plains. Not surprisingly there was large variation in the chemical nature of northern lakes, reflecting the heterogenous nature of the landscape. Important watershed factors related to this lake chemistry variability include the extent of permafrost development, the extent and type of peatland cover, and the degree of interaction with glacial moraine and lacustrine deposits. Northern lakes support highly diverse zooplankton and phytoplankton communities that will be sensitive to the future effects of climate change. In fact, paleolimnological studies indicate that biological changes in northern lakes are already occurring due to climate warming.



Lakes sampled in the Far North of Ontario, Climate Change and Multiple Stressor Research Program, 2009-2012 (BSM lakes sampled by Ontario Ministry of Natural Resources).

Getting it Right in the Ring of Fire: The Case for Regional Environmental Planning and How to Get There

Cheryl Chetkiewicz
Wildlife Conservation Society Canada

The Far North of Ontario region is globally unique. This vast area is one of the world's largest, most intact ecological systems. Globally significant ecosystems, dynamic processes (such as fire, and fish and wildlife) still shape the region and provide ecosystem services beyond the Far North planning area. Limited scientific research, climate change, and a lack of conservation planning make conserving this unique landscape challenging.

The region is also the homeland of 34, 000 First Nations living in 34 remote communities. First Nations depend on the region's diversity and the richness of its fish, wildlife and plants for food and medicines, sustenance of cultural and spiritual values, and livelihoods. But they also face a number of pressing social concerns – from erosion of cultural integrity and health, to inadequate housing and education, to unemployment. First Nations consider industrial development on their traditional territories as one way of addressing these issues. Development in the Far North—such as mining and infrastructure proposals being considered in the Ring of Fire—is currently tied to the rich mineral resources that are found in the region

Inviting new industrial development in the Far North will impact ecological systems that exist there and requires proactive regional planning to address the complexity of cumulative effects, the remoteness of the region, and the biophysical significance of the region. Similarly, the ability of new development to meet socio-economic interests of First Nations will also require more explicit attention to the legacy effects of mining and long-term sustainability as well as the capacity of First Nations to address the pace and scale of development.

Despite a commitment by the Ontario government to "get it right" in the Far North, however, individual project-based environmental assessments and community-based land-use planning under the *Far North Act, 2010* cannot adequately evaluate the impact of industrial activities on the region-wide ecological and social integrity. To address these shortcomings, scientists, stakeholders, and the Environmental Commissioner of Ontario recommend a proactive region-wide planning approach, particularly in the Ring of Fire.

Together with Dr. Anastasia Lintner (Lintner Law), I examined the current legal tools for environmental planning in the Far North of Ontario to understand how current processes might deliver on the ambitious objectives in the *Far North Act, 2010*. To support a more regional and comprehensive approach to planning and monitoring, we recommended a regional strategic environmental assessment (R-SEA). We provided a possible framework for R-SEA in the Far North and identified a number of case studies to illustrate the benefits of R-SEA.

Mining Industry Science Needs

Brian Steinback
De Beers Canada Inc.

Two mines now operate within the Far North region of Ontario; the Musselwhite gold mine in the Shield ecozone and the Victor diamond mine in the James Bay Lowlands. Other mines operate in similar ecosystems near the southern boundary of the region, and mineral exploration has identified a number of potentially viable mine developments in the region, particularly in the "Ring of Fire" camp centred 250 km west of James Bay in the Attawapiskat River watershed.

Proposed mines must undertake extensive baseline environmental studies to support rigorous environmental assessments, under federal and/or provincial regulations. These include extensive consultation with First Nations communities to understand traditional ecological knowledge of the area, and to seek community permission to operate. Formal agreements with these First Nations then define how the project will support financial, business, employment and other objectives of the communities. This includes protocols for ongoing environmental monitoring programs, information sharing and consultation.

Through project-specific studies and discussions many issues of environmental interest or concern come to light. While these can often be incorporated into site-specific environmental programs, new issues and perspectives are frequently raised which are less specific or may be regional in scale rather than local. The CNAES research partnership (sponsored in part by the mining industry) is intended to address specific information gaps at a regional and watershed scale in this enormous and logistically challenging region.

This presentation will identify topics of potential research interest relating to aquatic and wetland ecosystems in the Far North that may not yet be included in the CNAES program. These have been identified by mining companies in the region based on dialogue with communities, ongoing monitoring programs, developing regulatory issues, and concerns expressed by environmental groups. Categories of interest include:

- Development effects of access road / rail corridors and ice roads;
- Site development implications on micro-scale muskeg watersheds;
- Assimilation of nutrients, minerals and trace contaminants in wetland treatment systems and the muskeg environment;
- Background conditions and environmental dynamics of naturally occurring elements in mine ores and waste rock; and
- Regional-scale loadings of contaminants introduced through long-range atmospheric transport from sources far outside the region, and how these affect fish and other aquatic indicator species in the Far North.

This industry perspective is intended to spark discussion amongst the CNAES research team

Climate and Land Use Change Impacts in Far North Peatlands: Implications for Carbon and Mercury Cycling

Brian A. Branfireun
Department of Biology and Centre for Environment and Sustainability
Western University, London, Ontario, Canada.

Far North peatlands are a globally important carbon (C) store, sequestering C due to slow decomposition rates under high water table, low temperature and low nutrient conditions. They are also important modifiers of downstream water quality, with both dissolved organic carbon and methylmercury (MeHg) being notable and intensely studied solutes of interest. As a result of future climate change, which is anticipated to be the most extreme in northern high latitudes, changes in peatland temperature and moisture regimes are expected to directly alter decomposition rates, above and below ground floral and faunal diversity and activity, and subsequent downstream water quality. Superimposed on these climate changes are land-use modifications such as roads, resource extraction operations, and industrial and municipal infrastructures that will influence hydrological and biogeochemical function. In this presentation, I will provide an overview of three lines of research that are related to Theme 1 of the Canadian Network for Aquatic Ecosystem Services that seek to address some uncertainties associated with these anticipated future changes.

To evaluate the effects of climate change factors on dissolved organic carbon (DOC) dynamics and Hg, we subjected intact, vegetated peat monoliths to a range of elevated temperatures, increased atmospheric CO_2, and two water table levels over 18 months in a factorial design. Our results show that despite elevated temperature effects on plant community composition, decomposition, and DOC concentrations, MeHg concentrations were only related (inversely) to water table position, with mean %MeHg significantly and consistently 2-3x higher than high water table treatments. This suggests that climate change-induced water table lowering in northern peatlands could be the primary driver of increased methylation of Hg, not warmer soil conditions, as might be expected.

We have also investigated DOC, THg and MeHg in peatland surface and pore waters across a range of peatland types in the central James Bay Lowland and have found that, unlike other Hg studies in more southerly peatlands, MeHg concentrations are extremely low in peatland surface and pore waters, and that there is no difference in %MeHg among peatland types. We have found that elevated MeHg concentrations are only found in sites of highly localized groundwater discharge in the riparian zone of stream channels. Similarly, zones of high %MeHg could be induced through the addition of water and nutrients (sulphate) in simulated effluent discharge in a recent field-scale experiment, with some pore water concentrations exceeding 80% MeHg. These data provide the basis for more effective monitoring and land-use management in a changing future environment.

Catchment classification studies in the Attawapiskat Watershed

April James[1], Krystopher Chutko[1], Brian Branfireun[2], Brittany Rundle[1]
[1]Nipissing University, [2]Western University

The Attawapiskat watershed represents one of the Far North watersheds in Ontario that extend from Precambrian Shield headwaters through the Hudson Bays Lowlands (HBL) to the coast. The ultimate goals of our project are to evaluate the ability of a catchment classification to characterize similar hydrologic landscape regions, and to evaluate the relative contributions of groundwater to streamflow across a range of stream orders and watershed positions. In this talk, contemporary studies of catchment classification and key concepts will be reviewed. As part of these studies, tracer-derived measures of hydrologic response are increasingly of interest in the evaluation of catchment similarity, and include estimation of mean transit times (MTT) and relative contributions of surface vs. subsurface water to streamflow. This talk will explore a comparison of stable water isotope (SWI) tracer analyses for mesoscale sub-watersheds from the HBL and a representative Shield region. The HBL is represented by the De Beers Victor Mine sub-watersheds (30 - 2000 km^2) for which recent analysis has shown increasing relative contributions of bedrock-derived groundwater to streamflow with increasing catchment area. A suite of catchments (14) from the Sturgeon River – Lake Nipissing – French River (SNF) basin (35 to 6,875 km^2) are presented as representative of the Shield region where two years of SWI data are allowing for estimates of MTT. Preliminary results from the SNF suggest decreasing MTT with catchment size, inferring smaller relative contributions of groundwater with increasing catchment size (i.e. increasing surface water contributions), in contrast to the HBL. Results will be discussed in the context of differences in Quaternary and bedrock geology, fundamental components of contemporary catchment classification frameworks.

Far North Stream Baseline Data Collections and Research

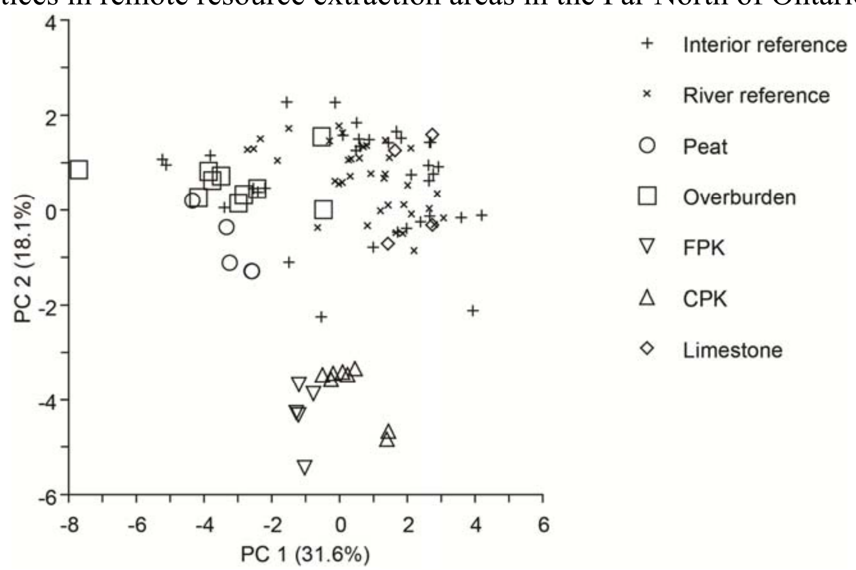
John L. Bailey[1], Aaron Todd[2]
[1]Ontario Ministry of Environment and Climate Change, CFEU, Laurentian University, (jbailey@laurentian.ca), [2]Provincial Water Quality Monitoring Network, Ontario Ministry of Environment and Climate Change, 125 Resources Road, Etobicoke, Ontario

The Ring of Fire in the Far North of Ontario is considered be one of the most promising mineral development opportunities in Ontario in almost a century. Covering an area of about 5,000 km², recent estimates suggest that the Ring of Fire holds significant potential production of nickel, copper and platinum as well as potential for world-class multi-generational production of chromite. In advance of significant development in this region, we collected baseline benthic invertebrate and environmental data at more than a hundred stream sites in the Attawapiskat River basin in 2013 and 2014 to initiate a set of reference sites using consistent field and laboratory protocols. Many of these sites have or will also be sampled for a comprehensive suite of water chemistry indicators under the Ontario Provincial Water Quality Monitoring Network. These data are intended to be used in the future for the detection and assessment of the effects of development activities, including cumulative effects. In this presentation, we provide an overview of Far North stream sampling efforts in 2013 and 2014, preliminary results and describe research projects under the NSERC Canadian Network Aquatic Ecosystem Services that has and will be undertaken.

Mitigation of Mining Activities in the Hudson Bay Lowland

Daniel Campbell
Vale Living with Lakes Centre and the School of the Environment, Laurentian University

The Hudson Bay Lowland (HBL) is becoming a centre of Canadian mining activity, with active mining at the De Beers Canada Victor Mine and extensive exploration and advanced permitting in the vicinity of the Ring of Fire. Sound protocols for mine reclamation and mitigation of environmental impacts are required in this subarctic peatland-dominated region. My students and I have conducted research on (i) the restoration of disturbed peatlands areas; (ii) reference conditions to determine mine waste reclamation targets; (iii) upland substrate mixes from mine wastes and organic materials; and (iv) best upland species to reclaim upland sites. We are continuing with the second phase of the research with three main projects. 1) We have set-up a large factorial field experiment of test plots to examine how different soil mixes perform to support native plant species. 2) We will be determining best protocols for seed collection and the valuation of seed to help build a regional program for local seed collection. 3) This research project will focus on the reaction of vegetation to simulated waste water polishing by string fens. These peatlands dominate the HBL and they are currently used to polish camp and mine waters, but little is known on their efficiency or resilience to enrichment nutrient loading along string fen gradients. An experimental string fen has been studied over the past two years by collaborators at the University of Waterloo. We will be conducting research on the impacts on plant productivity and nutrient relations and the capacity of vegetation to act as a sink for nutrients along the string fen gradient. These studies together will continue to act to design sound environmental mitigation practices in remote resource extraction areas in the Far North of Ontario.

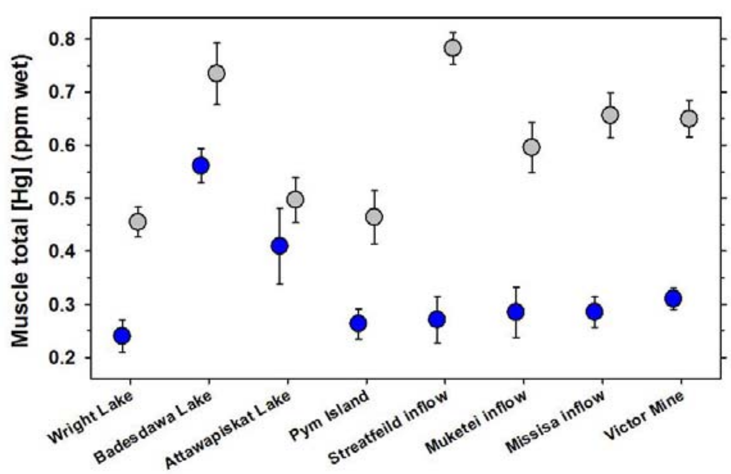


Principal component analysis of the bioavailable elements in waste materials from the Victor Mine (n = 32) as compared to reference sites in isolated interior uplands (n = 35) and on uplands along the Attawapiskat River (n = 37).

Mercury in fish communities of the Far North

Tom Johnston[1], John Gunn[2], and Bill Keller[2]
[1]Ontario Ministry of Natural Resources and Forestry, and [2] Laurentian University Cooperative Freshwater Ecology Unit

Mercury is the primary contaminant limiting the food quality of wild fish in northern Ontario. All Far North communities are situated on water and per capita consumption of wild fish is high. But, mercury data for many fish populations in the Far North is either lacking or out-dated. Furthermore, landscape disturbances from climate warming or industrial development could alter the mercury cycle in northern waters, leading to changes in fish mercury concentrations. Recent sampling of Far North fish populations is providing data to refine consumption guidelines, establish pre-development conditions, and improve our understanding of the spatio-temporal patterns in fish mercury across this vast region. Our research program is sampling fish populations from a diversity of lakes and rivers across both the Boreal Shield and Boreal Plains ecozones, with recent emphasis on the Attawapiskat River drainage basin. This is supporting research projects that assess variation in fish mercury concentrations with respect to time, with respect to climate, limnological and ecological conditions, and with respect to their utilization of marine ecosystems. Recent progress on all of these fronts will be discussed.



Mercury concentrations (mean ± SE) of 1 kg walleye (grey) and northern pike (blue) sampled at various sites along the Attawapiskat River drainage system

Interactions of life history and mercury accumulation in northern rivers

Heidi Swanson and Rachel De Jong
University of Waterloo

Mercury concentrations in fish respond to a number of abiotic and biotic variables, including water chemistry and temperature, fish trophic position and food source, and fish growth rates. Previous research has shown that anadromous (i.e., sea-run) fish can have lower concentrations of mercury than freshwater-resident fish. This is especially interesting in systems where anadromous and resident individuals of the same species exist in sympatry – that is, when the population is partially anadromous.

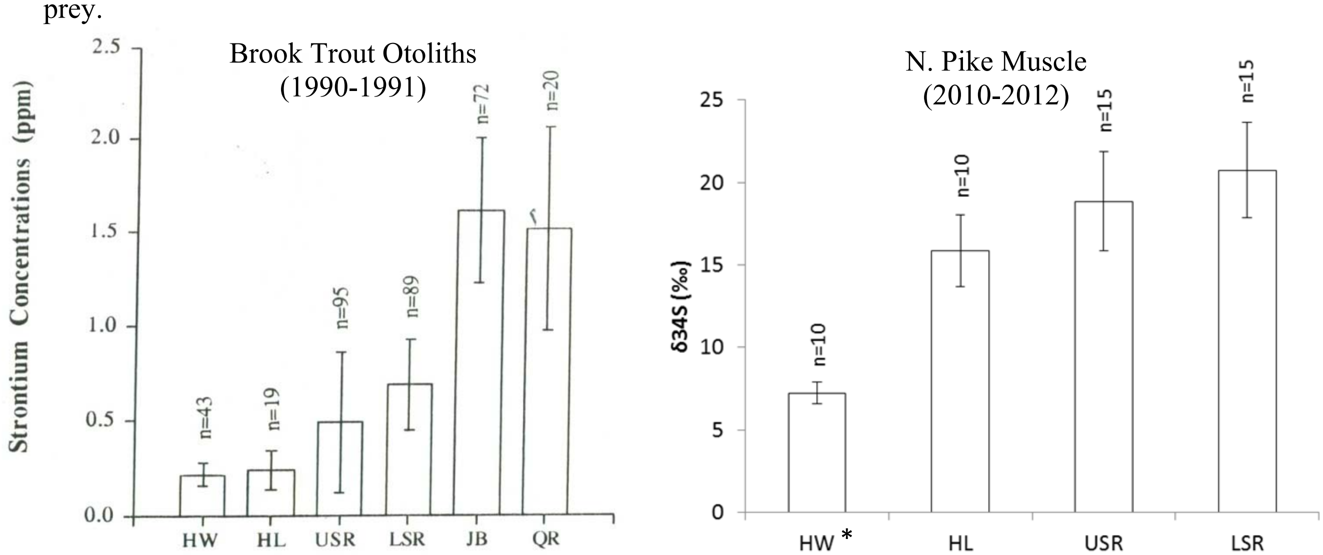
Subsistence food fish species in the Hudson Bay Lowlands are of significant cultural and nutritional importance. Fish are an important source of omega-3 fatty acids and micronutrients and are of irreplaceable cultural value. They are also, however, a source of mercury (Hg). Globally, fish are the most important source of Hg to humans.

In this study, we are investigating: 1) the presence or absence of anadromy/semi-anadromy in three fish species (Lake Whitefish, Cisco, and Northern Pike); 2) the contribution of marine-derived production to anadromous fishes; and, 3) the relationship between fish Hg concentrations and life history. Samples are being collected from the Winisk, Severn, and Attawapiskat Rivers, as well as from coastal marine areas. Results will help indicate the safest sources of subsistence fish.

30 Years of Fisheries Research in the Sutton River Watershed: Building on Traditional Knowledge

J.M. Gunn[1], W. Keller[1], A. Chookomolin[2], and T. Johnston[1]*
[1]*Cooperative Freshwater Ecology Unit, Laurentian University (jgunn@laurentian.ca)*
[2] *Weenusk First Nation*

The Hudson Bay rivers are important sources of food for coastal First Nations communities in the form of anadromous stocks of whitefish and brook trout. These migratory fish feed heavily in the marine environment before returning to freshwater to reproduce and overwinter (??). Anadromous fish are not only a highly nutritious food source but they also tend to have lower levels of Hg and other contaminants than do freshwater resident forms. Current climate models suggest that these northern ecosystems are particularly vulnerable to extreme temperature changes through rapidly rising air temperatures related to the loss of the moderating effects of sea ice. Expected increases in evaporation and a shift to more rain in winter and earlier spring runoff, as well as the potential release of Hg from melting permafrost and drying wetlands, all combine to create uncertainty about the future of these valuable anadromous stocks. However, the precision of model predictions in such complex systems can be very low and there is a pressing need for more direct survey data. Here, traditional knowledge (TK) can provide the important starting points for such studies, and local observations can also profoundly change the questions ecologists ask. For example, in the Sutton River, local community members identified warming and drying trends that have been associated with recent mortality impacts on migratory trout (Gunn and Snucins 2010, Hydrobiologia 650:79-84), but they also suggested that the habitat in the river was changing (more weed growth) and that northern pike were now abundant in this famous brook trout river. The arrival or expansion of pike, with a wider thermal tolerance than trout, represents a phenomenon much like the northern movement of warm water smallmouth bass into coldwater lake trout lakes. This presentation provides an overview of past work beginning with the P. Steele (1986) thesis describing growth and migration of the trout. It continued with a system wide sampling of brook trout in the 90's by M. Malette (1993) using an analysis of Sr in otoliths to assess timing and extent of anadromy. Stable isotopes of S were measured on northern pike sampled in 2010/2012 to assess their use of anadromous prey.



Evidence of anadromy in brook trout from whole otoliths strontium concentration (ppm) in various locations in the Sutton R. watershed as well as sites in James Bay and Quebec rivers. (HW=Headwaters (Gorge and Raft Creek); HL= Hawley lake; USR= Upper Sutton River; LSR= Lower Sutton River; JB=James Bay; QR=Quebec Rivers). Pike muscle tissue was collected for analysis of δ34S(‰) at similar sites to assess increased use of marine resources at downstream sites. *Samples collected in North Raft L.

Science Communication and First Nations Engagement

David Pearson[1], *Chantal Sarrazin-Delay*[2]
[1]*Science Communication, School for the Environment,*
[2]*Cooperative Freshwater Ecology Unit, Vale Living with Lakes Centre*

Much of our research in the Lake Centre involves field work in the homelands of northern First Nations. Bands are consulted and Band members are hired to work in summer field crews. The initiatives we describe here are being designed and undertaken to complement and extend those important practices by taking our science into communities - to summer festivals, Open Houses, and especially into classrooms. We are doing this in hands-on ways we hope will engage and motivate First Nation children to imagine that they too might become scientists. And we hope, as well, to encourage the support of parents and Elders whose own experience of education held no such vision. Furthermore, we are able to act as ambassadors for the science involved in the projects, not delivering results but explaining the science and the research questions underlying the field work.

Over a third of the 24,000 people living in remote Far North communities are 16 years old or younger. It is the fastest growing segment of Ontario's population. Very few of them will graduate with high school science credits let alone study science at college or university. We may be the only scientists they've ever seen. They are the future of their communities.

In 2010 one of our Science Communication students, James Baxter-Gilbert, spent his 6 week internship in Eabametoong (Fort Hope) taking children out to look for frogs in wetlands, spotting birds, watching ants, and generally being a story-telling, endlessly knowledgeable naturalist for dozens of children. Since then, four Sci Com students have been part of several visits to Eabametoong with hand held wifi microscopes and iPads, optical microscopes and freshly collected – usually by the children - benthic invertebrates, otoliths, Paleozoic fossil corals, lichens, feathers, and much more. We have a simple experiment the children do themselves that shows how stratification happens in lakes and then they use infrared sensors to measure the temperature of the water - as well as the walls and windows of the classroom.

We have built a strong working relationship with Four Rivers, the Environmental Program Unit of Matawa First Nations Management, and put on workshops for Environmental Monitors in Thunder Bay and Eabametoong. We have begun visiting coastal, Mushkegowuk communities.

Graduate students from NSERC Network projects will soon participate in community and school visits led by Chantal Sarrazin-Delay, who is now our Coordinator of First Nation Relationship Building with funding from the Network and others. They will be ambassadors for the science of the Network at the same time as they raise the sights of young people and their parents.

Poster

Warmer and drier northern peats are not subject to runaway decomposition under future climate conditions

Catherine Dieleman[1], Zoë Lindo[1], James W. McLaughlin[2], & Brian A. Branfireun[1]*
[1] Department of Biology, Western University
[2]Ontario Forest Research Institute, Ontario Ministry of Natural Resources

It is estimated that northern peatlands currently store approximately 30% of the Earth's terrestrial carbon. Phenolic carbon compounds are an important part of the peat biogeochemistry, as they limit decomposition through microbial inhibition. Enzymes known as phenol oxidases are able to break down phenols into more labile compounds however, the activity of these enzymes is generally presumed to be limited by anaerobic and cold conditions in northern peatlands. Climate change conditions will likely lead to the warming of peats and the lower water tables, theoretically removing some of the limits on phenol oxidase activity and enhancing peat decomposition. This is sometimes referred to 'runaway decomposition', and has been suggested by observations and experimental manipulations of water table level and measurements of carbon loss. To test whether peat drying combined with warming will lead to an increase in phenol oxidase activity, a decrease in phenolic compound concentrations, and increased carbon loss, 84 mesocosms containing an undisturbed peat profile and a living plant community were placed in a state-of-the-art experimental climate change facility under a full-factorial experimental design of temperature (ambient, +4, +8˚C), atmospheric carbon dioxide (ambient, 2x), and water table level (saturated, lowered). Phenolic compound concentration, soil respiration, and non-phenolic dissolved organic carbon concentration all significantly increased with warming, indicating enhanced decomposition despite the purported inhibitory effects of phenolic compounds. We found no evidence of a water table effect on phenol oxidase activity under elevated temperatures, suggesting that previously published work demonstrating increases in phenol oxidase activity under these conditions may have missed important ecological or biogeochemical interactions that only a full-factorial experiment such as this can reveal. As such, the "runaway decomposition" hypothesis that has been posited in the literature may be somewhat overstated.

Poster

Hydrogeomorphic Classification Approach for the Hudson Bay Lowlands in the Attawapiskat Watershed

Brittany Germain[1], April James[1], Brian Branfireun[2]*
[1]Nipissing University, [2]Western University

The Hudson Bay Lowlands (HBL) in the Far North of Ontario is a peatland dominated ecoregion where wetland types (e.g. bogs, fens and riparian areas) form patterns of hydrologic features with complex interactions that regulate the general hydrology of the region. The hydrological response of this wet organic terrain is not well understood, and variations in peatland processes and functions across different terrains are as yet under-represented in most distributed models used for hydrologic predictions. Recent hydrologic or catchment classification studies aim to assess broad-scale hydrologic systems in terms of the smaller hydrologic 'building blocks' that make up the larger picture to help develop hypotheses of how hydrologic systems function within specific terrains, but few if any have focused on low gradient, peatland dominated systems like the HBL.

The Attawapiskat watershed represents one of the Far North watersheds in Ontario that extend from headwaters in the shield/lowland transition to the coast. The ultimate goals of our project are to evaluate the ability of a catchment classification to characterise similar hydrologic landscape regions across the HBL, and to evaluate the relative contributions of groundwater to streamflow across a range of stream orders and watershed positions. This poster will: 1. Describe a hydrogeomorphic classification approach, and 2. Identify and report on preliminary generation of similarity metrics (e.g. climatic, hydrologic, hydro-climatic, and physical variables) for the HBL using DeBeers Victor Mine sub-watersheds. Discussion will address feasibility of metric generation using given datasets (e.g. MNR Ring of Fire and Victor Mine sub-watersheds), tools available (e.g. Ontario Flow Assessment Tool III) and unique landscape-related issues (e.g. permafrost, hydrologic connectivity and water storage).

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