NSERC
Canadian
Network for
Aquatic
Ecosystem
Services

3rd Annual Meeting

April 29th - 30th, 2015

Sault College

Sault Ste Marie, ON

Sault College, Essar Hall

Contents

Acknowledgements

Our deepest appreciation is extended to Sault College for the use of meeting space for this year's Annual Meeting. Special thanks to Lisa Bagnall, Lua Turcotte, Nora Simm, and the staff at NR Canada, Canadian Forest Service for their extensive help in the organization and facilitation of the Meeting. Thank you!

Locations and Directions

Sault College
M-Wing, Essar Hall
443 Northern Avenue, Sault Ste Marie, Ontario
Toll free: 1-800-461-2260
http://www.saultcollege.ca/services/Recruitment/HowToGetHere.asp

Algoma Water Tower Inn & Suites
360 Great Northern Road, Sault Ste Marie, Ontario
Telephone: 705-949-8111
Toll free: 1-888-461-7077
http://www.watertowerinn.com/about/index.aspx?l=0,21,50,52

Casey's Grill & Bar (attached to the Algoma Water Tower Inn & Suites)
http://www.watertowerinn.com/index.aspx?l=0,21,35,388

General Map of Sault Ste Marie http://www.watertowerinn.com/Userfiles/File/WTI-VisitorMap.pdf

Traveling from the Sault Airport to the Algoma Water Tower Inn:
The Sault Airport is a ~20 minute drive from both Sault College and the Algoma Water Tower Inn. It is highly recommended that you book a cab to go to and from the airport **IN ADVANCE** of your arrival/departure.
There are 3 options:

- **Soo Taxi** (metered fare)
  705-942-0005

- **Hollywood Limo** (flat rate, $39.00)
  705-941-0477

- **Algoma Water Tower Inn shuttle** (flat rate; cheaper rate for groups. Call the hotel for details)
  Telephone: 705-949-8111
  Toll free: 1-888-461-7077

Walking from the Algoma Water Tower Inn to Sault College, M-Wing, Essar Hall:
Exit the Algoma Water Tower Inn and walk along the Hub Trail to Northern Avenue. This is a ~5-minute walk. You will be able to see Sault College from the trail. Ask at the reception desk of Algoma Water Tower Inn for directions to the Hub Trail and refer to the googlemap on the next page.

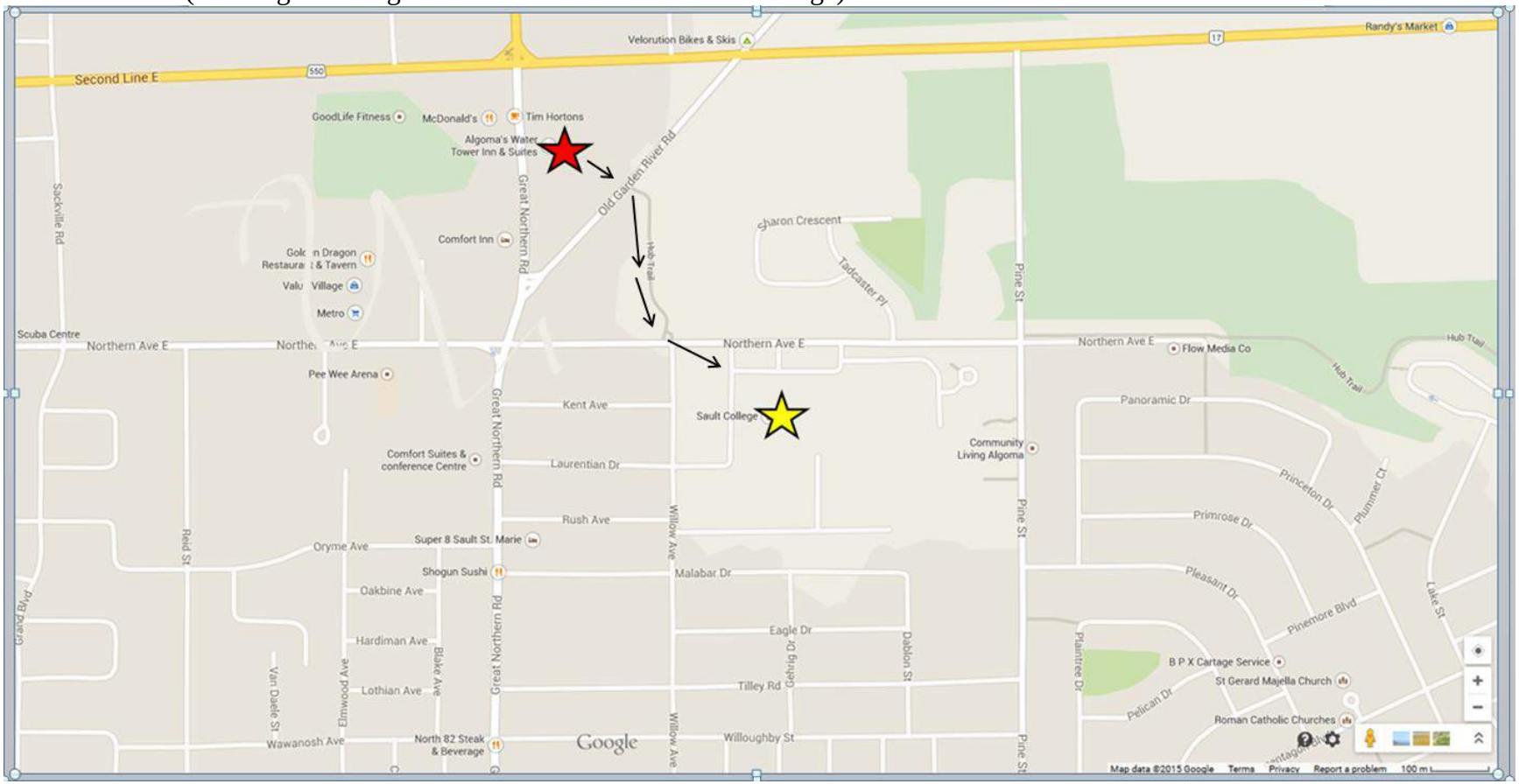
Parking at the Algoma Water Tower Inn:
Parking is included in the cost of the hotel room.

Parking at Sault College:
Day-parking is available in the lot beside F-wing ("Visitor/Student/Employee Daily Parking, $3.00 upon exit"). Please note that there is metered parking beside M-wing, but you would have to refill the meter multiple times throughout the course of the day, as that lot is geared towards short-term parking.
There is an indoor path from F-Wing to M-Wing. (~5-minute walk).

NSERC Canadian Network for Aquatic Ecosystem Services

3rd Annual Meeting & Workshop
Sault College, Sault Ste. Marie, Ontario
April 29-30, 2015

The Hub Trail (Walking from Algoma Water Tower Inn to Sault College)



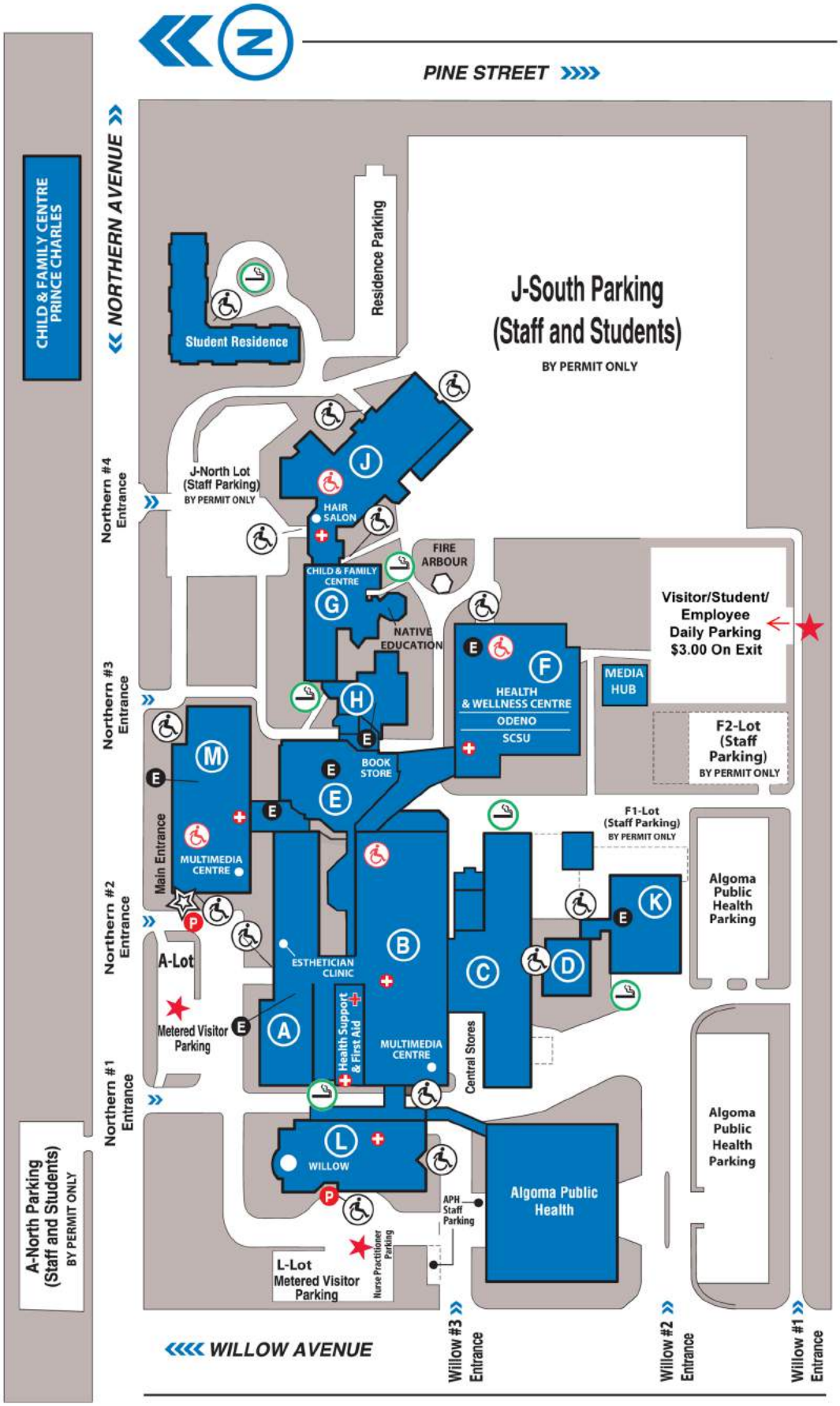
<u>Legend:</u>

Algoma Water Tower Inn, 360 Great Northern Road

Sault College, 443 Northern Avenue

The Hub Trail (~ 5 minute walk)

Welcome to Sault College



Legend

Directory

Academic Upgrading	E Wing
Athletics	B Wing
Bookstore	E Wing
Cafeteria	B Wing
Child & Family Centre	G Wing
Contact North	J Wing
Continuing Education	B Wing
Contract Training	B Wing
Employment Services	A Wing
Essar Hall	M Wing
Esthetician Clinic	A Wing
External Relations	B Wing
Financial Assistance	M Wing
Financial Services	M Wing
Health Support & First Aid	A Wing
Hair Salon	J Wing
Health & Wellness Centre	F Wing
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Library	H Wing
Multi Media Centre (B1170)	B Wing
Multi Media Centre (M1030)	M Wing
Native Education	G Wing
Odeno	F Wing
Physical Resources	B Wing
President's Office	A Wing
Registrar's Office	M Wing
SCSU	F Wing
Security	M Wing
Student Services	E Wing
Willow	L Wing
Tim Horton's	E Wing

- Elevator
- Accessible Entrance
- Accessible Washroom (All Genders)
- Main Entrance
- Para Bus drop off
- Visitor Parking
- Health Support & First Aid
- Designated Smoking Area (Look for sign)
- Automatic External Defibrillators (AED)

NSERC Canadian Network for Aquatic Ecosystem Services

3rd Annual Meeting & Workshop
Sault College, Sault Ste. Marie, Ontario
April 29-30, 2015

Agenda Overview, April 29-30

3rd Annual Meeting, Wednesday April 29, 2015		
Time	**Program**	**Room #**
8:30	**Sign-in, Poster set-up, Coffee & Tea available**	**M1220**
9:00	**Welcome & Introduction** **Donald Jackson** **David Nanang,** Director General, NR Canada, Canadian Forest Service **Brian Antess,** Coordinator and Faculty, Natural Environment and Outdoor Studies Program, Sault College	**M1030**
9:30	**Ecosystem Service Analyses: Federal Needs & Current Activities** **Marlene Doyle,** Wildlife and Landscape Science Directorate, Environment Canada	
10:15	**Interactions of life history and mercury accumulation in northern rivers** **Heidi Swanson,** University of Waterloo, CNAES Theme I	
10:35	**Break**	**M1220**
10:55	**Toward mapping Aquatic Ecosystem Services of Canadian rivers at large-scale** **Camille Ouellet Dallaire,** McGill University, CNAES Theme III	**M1030**
11:10	**Lightning Talks** Presented by CNAES students & Post-docs	
12:10	**Lunch**	**M1220**
1:10	**Assessing the dynamics of Aquatic Ecosystem Services in a multi-use watershed** **Stephanie Tomscha,** University of British Columbia, CNAES Theme II	**M1030**
1:30	**Geographic Extension of Benthic Invertebrate RCA Bioassessments: How Far Can We Go?** **Nicole Novodvorsky,** Laurentian University, CNAES Theme I	
1:50	**Size-based Approaches in Aquatic Ecology and Fisheries Science: A Symposium in Honour of Rob Peters** **Henrique Giacomini,** University of Toronto, CNAES Theme III	
2:10	**Next steps for Ecosystem Services research: a call to action** **Elena Bennett,** McGill University, CNAES Theme III	
2:30	**Break**	**M1220**

2:45	**CNAES Networking Survey** **Stephanie Tomscha,** University of British Columbia, CNAES Theme II	
3:00	**Lightning Talks** Presented by CNAES students & Post-docs	
4:00 – 6:00	**Poster Session** *Appetizers, cash bar*	**Common Link**
7:00	**Network Dinner** Hosted at the **Algoma Water Tower Inn & Suites,** **360 Great Northern Rd** *Dinner and cash bar* *Presentation of awards for Best Lightning Talk, Best Poster, & Best Video*	**The Pavilion**

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3rd Annual Meeting , Thursday April 30, 2015		
Time	**Program**	**Room #**
8:50	**Sign-in, Coffee & Tea available**	**M1220**
9:00	**Introduction & Updates** **Donald Jackson**	**M1030**
9:10	**Land/Water Linkages in Ecosystem Recovery** **John Gunn,** Laurentian University, CNAES Theme I	
9:30	**More is different - emergent questions in aquatic ecosystem services** **Marian Weber,** Alberta Innovates – Technology Futures Environmental Economics and Planning Program, CNAES Theme II	
10:10	**Contaminant transport in peatlands: Challenges and opportunities** **Jonathan Price,** University of Waterloo, CNAES Theme I	
10:30	**Break** ***HQP Committee Elections***	**M1220** **M2020**
11:00	**HQP Committee Update** Presented by the HQP Committee	**M1030**
11:15	**Cross-Collaboration Workshop Updates** **Donald Jackson,** Conceptualizing Framework Workshop **John Richardson,** POM Workshop **Stephanie Melles,** Watershed Classification Workshop	
11:45	**Closing Remarks** **Donald Jackson**	
12:00	**Lunch**	**M1220**
1:00-5:00	**Theme I Meeting**	**M2020**
	Theme II Meeting	**M2030**
	Theme III Meeting	**M2140**
	Board of Directors Meeting	**A1050**

Wednesday, April 29th, Abstracts

9:30 Ecosystem Service Analyses: Federal Needs & Current Activities

Marlene Doyle, Wildlife and Landscape Science Directorate, Environment Canada

This presentation will identify key drivers for federal interest in ecosystem service assessment and management. Several federal activities and initiatives related to Ecosystem Services assessment will be introduced including tools and data development, the creation of models and assessment metrics and ecosystem service valuation. I will highlight efforts to quantify and map the potential of ecosystems to purify water in support of national scale indicators and reporting. An overview of identified gaps where additional research could support on-going federal efforts to understand, model and assess ecosystem services will be presented.

Marlene Doyle is an Integrated Ecosystem Assessment Officer with the Wildlife and Landscape Science Directorate of Environment Canada. She has worked on collaborative approaches to environmental monitoring and assessment with Environment Canada for over 10 years. She currently focuses on supporting coordinated Arctic terrestrial biodiversity monitoring through participating as Canada's representative on the Circumpolar Biodiversity Monitoring Program Terrestrial Steering Group. She also leads research into mechanisms to spatially assess the biophysical relationships and functions which affect ecosystem service provision and participates on the federal Measuring Ecosystem Goods and Service Working Committee.

10:15 Interactions of life history and mercury accumulation in northern rivers

Heidi Swanson, University of Waterloo, CNAES Theme I

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 subsistence food fish species (Lake Whitefish, Cisco, and Northern Pike); 2) the contribution of marine-derived production to anadromous fishes; and, 3) the relationship between fish mercury 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.

Heidi Swanson is an Assistant Professor at University of Waterloo. Her research interests and expertise lie in accumulation of mercury through freshwater food webs, northern fish ecology and life history, and tracing fish migrations using otolith chemistry. She has had the opportunity to train under several great mentors, including Dr. Bill Tonn (Postdoc), Dr. Karen Kidd (Ph.D and Dr. Dave

Schindler (M.Sc.). Heidi has spent the last 10 years conducting ecological and ecotoxicological research in Nunavut, the Northwest Territories, Alaska, and northern Ontario. She has worked on joint traditional knowledge-western science studies, trained Inuit and First Nations youth in environmental science, and partnered with government, industry, and aboriginal groups to conduct whole ecosystem research in remote lakes and rivers and on the Beaufort Sea. Heidi's current research portfolio includes studies of Arctic grayling and Lake Trout ecology, ecological drivers of fish mercury concentrations, and effects of climate warming on thermokarst lakes.

10:55 Toward mapping Aquatic Ecosystem Services of Canadian rivers at large-scale
Camille Ouellet Dallaire, B Lehner , McGill University, CNAES Theme III

Mapping Aquatic Ecosystem Services (AES) is one of the first steps to understand their distribution and availability. For AES, capacity and demand might be separated by long distances as a result of the directional and accumulative nature of river systems; for instance, upland areas provide often services to, often more populous, lowland areas. My project aims at understanding the impact of the directional nature of river systems on the availability of AES from a large-scale perspective. Proxies are needed to represent both bio-physical and anthropogenic characteristics of river systems so that different components of ecosystem service delivery can be mapped. For Canada, these proxies are currently developed as part of a river reach classification geared toward sustainable management practices of freshwater systems such as recommendations of environmental flow requirements. The classification relies on the GloRiC framework that promotes a multi-disciplinary approach using various sub-classifications based on indicators from different discipline such as Hydrology, Physiography and Climatology. Using these proxies, spatial distribution of capacity and demand will be analyzed to identify key providing areas for AES of Canadian rivers, which can be used to inform sustainable management of river systems and insure the lasting provision of AES.

Camille Ouellet Dallaire is a PhD candidate under the supervisor of Dr. Bernhard Lehner. Her research interests are geared toward large-scale classifications of river systems to better understand the relationship between geo-physical characteristics, biodiversity and human alteration. For her PhD, she is focusing on Canada to develop tools and datasets to inform sustainable management of large river systems. Using HydroSHEDS, a suite of hydrologically relevant datasets, she is developing methods to apply concepts such as environmental flow requirements and aquatic ecosystem services at large-scales. During her master degree, she developed a global river classification framework and applied it on river reaches at the global scale at the 500 meter resolution. She is currently involved with the Sustainable Research Symposium that aims at fostering collaborations across disciplines at McGill.

11:10 Lightning Talks

Poster #	Name, Title , CNAES Project ID
8	**Alexandra Sumner**, Potential effects of climate on the bioaccumulation of mercury in two large-bodied fish species in northern Ontario, Project I-5a
27	**Lauren Barth**, Calibrating the zooplankton body-size spectrum to serve as an indicator of environmental perturbations in lakes, Project III-3
12	**Junting Guo,** Analysis relationships between sreamflow regime with hydrological Classification zones, Project II-1
2	**Vanessa Bourne,** Seasonal Variability of Water Chemistry, and Benthic Invertebrate and Periphyton Communities in the Attawapiskat Watershed, Project I-3a
17	**Alexander Potter,** Effects of operational harvesting practices on hydrological and biological indicators of aquatic ecosystem services in northern hardwoods, central Ontario, Project II-2
5	**Catherine Dieleman**, The effect of climate change on peatland ecosystem stable state and services, Project I-4
22	**Jason Igras,** Managing cumulative ecosystem risk in Lake Erie from nutrient contributing stressors in the Grand River watershed, Project II-4,5
7	**Rachel DeJong,** The Influence of Life History on Tissue Mercury Concentration in Fish from Coastal Rivers of the Hudson Bay Lowlands, Project I-5c
19	**Óscar E.Senar,** Dissolved organic matter quality as a key factor determining major energy source in lakes, Project II-3
	Amanda Lavalle, *Introduction, incoming MSc candidate, Project I-4*
14	**Kristin Daoust,** Assessing the Impacts of Forest Disturbance on Aquatic Ecosystem Services through Predictive Modeling of Benthic Community Composition and Hydrological Indicators, Project II-2
26	**Lifei Wang,** Size spectrum and environmental characteristics in relation to patterns in fish mercury concentrations in Ontario lakes, Project III-2
6	**Colin McCarter,** Transport and Hydrological Response of Simulated Wastewater from a Continuous Point Source in a Northern Ribbed Fen, Project I-4
31	**Julia Linke**, High-resolution global maps of 21st-century forest loss: validation and application in the Miramichi river basin, Project III-5

1:10 Assessing the dynamics of Aquatic Ecosystem Services in a multi-use watershed
Stephanie Tomscha, University of British Columbia, CNAES Theme II

Truly understanding and managing aquatic ecosystem services (AES) requires measuring an area's biophysical capacity for AES as well as human demand for AES. Furthermore, it requires understanding AES interactions and dynamics. Yet, most research into ecosystem services takes a static, one-time approach that is poorly suited to understanding AES interactions. To better understand AES dynamics, we synthesize a suite of approaches, asking two main questions: (1) How dynamic and interrelated are AES along river-floodplain gradients? We integrate GIS and aerial photography to capture relationships among floodplain connectivity (e.g., lateral, longitudinal) and the capacity of an area to provide AES (fish habitat, waterfowl habitat, beaver habitat, paddle routes, timber, etc.). Long-term spatial dynamics will be addressed using historical imagery. (2) How do AES capacity and demand differ in river-floodplain systems? Using participatory approaches, we engage with communities to map both the benefits provided by and demand for AES (fishing, hunting, trapping, canoeing, harvesting, etc.). We integrate this information to understand the community's priorities and behaviors with respect to management of AES and the benefits they confer. Pairing spatially-explicit approaches with long-term datasets provides a unique opportunity to explore interactions and dynamics among AES across river-floodplain gradients, key for managing valuable AES.

Stephanie Tomscha is a PhD. candidate in the department of Forest and Conservation Sciences at the University of British Columbia, transitioning to a Postdoctoral Fellowship with the Canadian Network for Aquatic Ecosystem Services. She received an undergraduate degree in biology at Luther College, Decorah IA, USA in 2003, where she became interested in long-term ecosystem dynamics working in a paleoecology lab. Stephanie has worked on six major research projects in ecosystem conservation in Wisconsin, Iowa, Hawaii, North Carolina, Washington State, and British Columbia. She is interested in management's impacts to ecosystem services and natural capital, especially the impacts of their losses for diverse user groups and future generations. After her postdoc, she hopes to continue her research on mapping and managing ecosystem services.

1:30 Geographic Extension of Benthic Invertebrate RCA Bioassessments: How Far Can We Go?
Nicole Novodvorsky, Laurentian University, CNAES Theme I

Benthic invertebrate RCA bioassessments are generally developed using reference sites within a localized area such as a watershed or ecoregion. If such reference data can be used to assess test sites that lie outside their geographic scope, it would reduce the need to collect time-consuming and costly reference site data. In this study, we examined invertebrate and environmental data to assess concordance of benthic communities and develop predictive models using data from three areas in Canada: the Attawapiskat watershed in northern Ontario, the Fraser River watershed in British Columbia, and the Yukon River watershed. RCA bioassessments were developed based on reference sites from the individual watersheds and on pooled data from the three. The effectiveness of assessments was evaluated using a common set of artificially impaired sites. The results of this study reveal that assessments using reference sites from other watersheds perform similarly to those using only local reference data, suggesting that reference sites sampled in one watershed could be "exported" for effective bioassessment in other adjacent or more distant watersheds. These findings enables us to protect and monitor Canadian aquatic ecosystem services that are important to us as a society such as clean water and fish resources.

Nicole Novodvorsky completed her BSc in Environmental Sciences at the University of Guelph in 2010, where she developed my interest in aquatic ecosystems, specifically in the use of benthic invertebrates as ecological indicators. In 2012, Nicole was involved with an interesting research project with Trent University assessing the effects of nanosilver on aquatic ecosystems at the Experimental Lakes Area. This experience piqued her interest in academia/research and inspired her to pursue my Masters in Biology at Laurentian University in Sudbury. Nicole successfully defended in January 2015, and she is currently working on other research projects at the Vale Living with Lakes Centre

1:50 Size-based Approaches in Aquatic Ecology and Fisheries Science: A Symposium in Honour of Rob Peters

Henrique C. Giacomini, University of Toronto, CNAES Theme III

Size-based models of aquatic ecosystems have been increasingly used in ecology and fisheries to describe, manage and forecast the behaviour of both marine and freshwater systems. In order to assess the state of the art in this field and to start up a collaborative network, a CNAES-sponsored symposium on size-based approaches was held during the 144th Annual Meeting of the American Fisheries Society in Quebec City, August 2014, bringing together a group of 26 scientists from Europe, North and South America. Topics covered in the symposium include: (i) theory underlying model structure and behaviour – links to the macroecology literature and the pioneering work of Rob Peters; (ii) applications to exploitation management at both the population and the community level; (iii) new methods for estimating size distributions in the field; (iv) empirical studies of size structure variation along several environmental gradients. The symposium contributions will be published together as a Special Issue in the Canadian Journal of Fisheries and Aquatic Sciences, which is already in progress with all papers submitted, including four from CNAES members. This talk will provide a synthesis of these contributions and discuss future directions.

Henrique Giacomini is a biologist with a Ph.D. in Zoology from the São Paulo State University (UNESP, Brazil). He is interested in theoretical ecology and quantitative methods, including the development of simulation models and theory-driven indices for biological conservation. His research is concerned with the link between variation in traits of individual organisms and the dynamics and assembly of ecological communities. Currently, his work involves the use of optimal resource allocation models to explain intraspecific variation of life history traits and bioenergetics in fish, particularly as a function of climate and prey community structure. This knowledge can in turn be used to extend population or ecosystem models that are dependent on these traits (e.g., size-spectrum models, individual-based models), and that can benefit from the inclusion of more realistic species' responses to fluctuations in the environment and food web configurations.

2:10 Next steps for Ecosystem Services research: a call to action

Elena Bennett, McGill University, CNAES Theme III

2:45 CNAES Networking Survey

Stephanie Tomscha, CNAES Theme II

3:00 Lightning Talks

Poster#	Name, Title , CNAES Project ID
18	**Alex Yeung,** Tracking the long-term responses of headwater ecosystems to logging disturbance: in-stream litter decomposition recovered within 15 years after forest harvesting, Project II-2
13	**Aleksey Paltsev,** Remotely sensed changes in trophic status of lakes in a temperate forest, Project II-1
1	**Brittany Germain,** Hydrogeomorphic Classification Approach for the Hudson Bay Lowlands in the Attawapiskat Watershed, Project I-2
	Dalal Hana, *Introduction, incoming PhD Candidate, Project III-6*
16	**Jordan Musetta-Lambert,** Conserving Aquatic Ecosystem Services through the Emulation of Natural Disturbance Paradigm for Sustainable Forest Management, Project II-2
21	**Francesco Accatino,** Average wetland functions under the Alberta Wetland policy – scenario analyses assessed with an agent-based model, Project II-4,5
4	**Nicole Balliston,** Subsurface Flow Behaviour of a Continuous Solute Release in a Sub-Arctic Bog, Project I-4
30	**Andrew Chin,** Resilience of fish functional groups to global change in watersheds, Project III-5
15	**Maitane Erdozain**, Effect of forest condition on food web structure in headwater streams in different regions of Canada, Project II-2
29	**Karl Lamothe**, Evaluating Ecosystem Condition by Quantifying Ecological Resilience**,** Project III-4
	Matthew Heerschap, Fatty acid analysis of primary food fishes from Ontario's Far North rivers, Project I-3
23	**Jacqueline Serran**, New mapping and wetland loss estimation techniques to examine the preferential loss of small wetlands on prairie landscapes, Project II-4,5
10	**Chantal Sarrazin-Delay**, Building relationships with Far North First Nation communities, Project I-6
32	**Ira Sutherland**, Longterm recovery of ecosystem services reveals non-linear tradeoffs following forest harvest in BC coastal forests, Project III-6

Thursday, April 30th, Abstracts

9:10 Land -Water Linkages in the Recovery of Severely Damaged Ecosystems

John M. Gunn[1], E Szkokan-Emilson[2], B Kielstra[3], and A Tanentzap[2]
[1]Vale Living with Lakes Centre, Laurentian University, Sudbury, ON
[2]Department of Plant Sciences, University of Cambridge, Cambridge, UK
[3]Stream and Riparian Research Laboratory, University of British Columbia, Vancouver, BC

The spatial gradients in forest cover, soil conditions and stream water chemistry that have evolved in the Sudbury area following emission reductions or experimental treatments, have created unique study sites to assess the services that terrestrial ecosystems provide to downstream aquatic systems. For example, the experimental liming of a 39ha catchment in one of the study lakes sustained improved stream water quality for 20 years after the initial aerial treatment and created a littoral zone "hot spot" for the recolonization of a sensitive benthic invertebrate, *Hyalella Azteca,* and an overall increase in benthic diversity. Inputs of terrestrial DOM and fine particulate organic matter at various sub-catchment delta areas in a single study lake initiated an "energy upsurge" that enhanced littoral zone productivity including increased growth rates of larval perch associated with individual sites. The early recovery ecosystems (i.e. carbon starved) in Sudbury represent good model systems of the important role of terrestrial subsidies of DOM in fueling aquatic food webs in nutrient poor systems. Recent findings of the potential limiting role (i.e. shading) of DOM on in-lake production as "brownification" proceeds will also be discussed.

Dr. John Gunn is a Canada Research Chair in Stressed Aquatic Systems at Laurentian University. He is the founding Director of the Vale Living with Lakes Centre and Co-Leader of Theme I for the CNAES.

9:30 More is different - emergent questions in aquatic ecosystem services

Marian Weber, Alberta Innovates – Technology Futures Environmental Economics and Planning Program, CNAES Theme II

Ecosystem services (ES) are the benefits of natural ecosystems that support human well-being. They are the result of complex socio-ecological systems which are determined by the co-evolution of ecosystem processes and functions on the one hand and social, economic, and governance relationships on the other. It is manifest that ES research requires a multi-disciplinary approach to conceptualize complex phenomena and identify relevant hypotheses. The CNAES faces a daunting challenge for integrating knowledge across the range of themes and disciplines brought together within the network in order to understand aquatic ecosystem services. Elinor Ostrom's Social-Ecological-Systems Framework (SESF) is a meta-framework that can be applied in a transparent and structured way to develop a common understanding between researchers about the underlying behaviors, institutions, and ecosystem functions that drive the sustainability of ecosystem services. The SESF allows researchers to conceptualize emergent questions that are hidden when looking at the elements themselves. I show how this approach can be applied to understanding forest aquatic ecosystem services. In particular I will highlight some of the common variables and relationships that have been identified in the Theme II project Healthy Forests Healthy Aquatic Ecosystems and use this framework to highlight important uncertainties and research questions for developing robust strategies for sustaining aquatic ES in forests.

Marian Weber has a PhD in economics and leads Alberta Innovates – Technology Futures Environmental Economics and Planning program. AITF supports research and innovation that addresses grand challenges facing Alberta's resource and environment sectors. Marian's research focuses on the development and testing of incentives and policies for managing land and water resources, and the evaluation of policies for stewardship and conservation on private and public working landscapes. Marian has worked with government and industry on the design and evaluation of biodiversity offsets, tradable disturbance rights, transferable development credits, water trading, and water quality trading. She is Adjunct Professor at the University of Alberta.

10:10 Contaminant transport in peatlands: Challenges and opportunities

Jonathan S. Price, Geography and Environmental Management
CPR McCarter, University of Waterloo
BA Branfireun, Biology, Western University, London, ON
M Kompanizare, Geography and Environmental Management

Resource developments within peatlands can impact ecosystem health, but peatlands can also provide important ecosystem services of value to developers. They can retard the transport of solutes including nutrients, and sequester most heavy metals; however their highly reducing environments can liberate toxic species like methylmercury. This research evaluates the capacity of peatlands to uptake, immobilize, liberate or transport contaminants associated with treated wastewater from a mine-camp in the James Bay Lowland. Wastewater is high in sulfate (SO4), phosphorus and nitrogen, which can cause structural changes in the peatland that impact transport. High loading rates increased connectivity, hence transport, because it raised water tables into more hydraulically conductive layers and preferential flow paths. In an experimental fen, simulated wastewater was transported 117 m in 38 days, which represents a contaminant transport rate up to 2.2 times lower than water transport. Higher water levels and nutrient inputs (specifically SO4) dramatically enhance mercury methylation and potentially its transport to aquatic systems. Careful management of wastewater discharge rates could better control the hydrological regime, thus limit contaminant migration, and regulate the formation and transport of methylmercury. Mine dewatering changed the connectivity between bogs and fens, hence their ability to transport solutes.

Professor Price is a wetland hydrologist with interests on the impacts of resource development. He has over two decades of experience dealing with peatland restoration associated with horticultural peat extraction. More recently this has evolved into peatland reclamation on post-mined oil sands leases; he initiated the concept, assisted with the design and now leads the research into one of the first constructed fen watershed systems. Professor Price also has experience in contaminant transport in peatlands, based on studies of conservative tracers, reactive metals and nutrients, and most recently immiscible fluids (hydrocarbon).

Poster Session List

Wednesday April 29th, 4:00pm-6:00pm

1	**Hydrogeomorphic Classification Approach for the Hudson Bay Lowlands in the Attawapiskat Watershed** *CNAES Theme I, Project I-2* **Brittany Germain**[1], April James[1], Brian Branfireun[2] *[1]Nipissing University, [2]Western University*
2	**Seasonal Variability of Water Chemistry, and Benthic Invertebrate and Periphyton Communities in the Attawapiskat Watershed.** *CNAES Theme I, Project I-3a* **Vanessa Bourne[1]**, JL Bailey, A Todd and JM Gunn *1Laurentian University, Ontario Ministry of Environment and Climate Change, Cooperative Freshwater Ecology Unit, Laurentian University, Sudbury, Ontario*
3	**Geographic Extension of Benthic Invertebrate RCA Bioassessments: How Far Can We Go?** *CNAES Theme I, Project I-3a* **Nicole-Marie Novodvorsky[1]**, JL Bailey[1,2], TB Reynoldson[3] *[1]Cooperative Freshwater Ecology Unit, Laurentian University, [2]Ontario Ministry of the Environment and Climate Change, [3]GHOST Environmental Consulting*
4	**Subsurface Flow Behaviour of a Continuous Solute Release in a Sub-Arctic Bog** *CNAES Theme I, Project 1-4* **Nicole Balliston,** J Price, C McCarter *University of Waterloo*
5	**Warmer and drier northern peats are not subject to runaway decomposition under future climate conditions** *CNAES Theme I, Project I-4* **Catherine Dieleman**[1], B Branfireun[1,] JW McLaughlin[2], Z Lindo[1] *[1]University of Western Ontario, [2]Ontario Forest Research Institute*
6	**Transport and Hydrological Response of Simulated Wastewater from a Continuous Point Source in a Northern Ribbed Fen** *CNAES Theme I, Project I-4* **Colin McCarter[1]**, J Price[1]. *[1]University of Waterloo*
7	**The Influence of Life History on Tissue Mercury Concentration in Fish from Coastal Rivers of the Hudson Bay Lowlands** *CNAES Theme I, Project 1-5c* **Rachel DeJong[1]**, H Swanson[1], B Branfireun[2], J Gunn[3], T Johnston[3, 4], B Keller[3] *[1]University of Waterloo, [2]University of Western Ontario, [3]Living with Lakes Centre, Laurentian University, [4]Ontario Ministry of Natural Resources and Forestry*
8	**Potential effects of climate on the bioaccumulation of mercury in two large-bodied fish species in northern Ontario** *CNAES Theme I, Project I-5* **Alexandra Sumner[1]**, TA. Johnston[2], JM. Gunn[1] *[1]Laurentian University, [2]Ontario Ministry of Natural Resources and Forestry*

9	**Assessing spatial and seasonal variability in mercury and other water chemistry parameters in remote freshwater systems across the Attawapiskat watershed in northern Canada.** *CNAES Theme I, Project I-5* **Gretchen L. Lescord**[1], M Gillespie[1], TA. Johnston[1], JM Gunn[1] [1]*Vale Living with Lakes Center, Laurentian University, Sudbury ON*
10	**Project I-6: Building relationships with Far North First Nation communities.** David Pearson and Chantal Sarrazin-Delay *Laurentian University*
11	**Climate change effects on water export from temperate forests of eastern North America** *CNAES Theme II, Project II-1* **Chris Brimacombe**[1], IF Creed[1] [1]*University of Western Ontario*
12	**Analysis relationships between sreamflow regime with hydrological Classification zones** *CNAES ThemeII, Project II-1* **Junting Guo**[1], Irena F.Creed[1] [1]*Western University*
13	**Remotely sensed changes in trophic status of lakes in a temperate forest** *CNAES Theme II, Project II-1* **Aleksey Paltsev**[1], IF Creed[1] [1]*Western University*
14	**Assessing the Impacts of Forest Disturbance on Aquatic Ecosystem Services through Predictive Modeling of Benthic Community Composition and Hydrological Indicators** *CNAES Theme II, Project II-2* **Kristin Daoust**[1], D Kreutzweiser[2], IF Creed[3], P Sibley[1] [1]*University of Guelph,* [2]*Canadian Forest Service,* [3]*Western University*
15	**Effect of forest condition on food web structure in headwater streams in different regions of Canada.** *CNAES ThemeII, Project II-2* **Maitane Erdozain**[1,2], K Kidd[1,2], D Kreutzweiser[3], P Sibley[4]. [1]*University of New Brunswick,* [2] *Canadian Rivers Institute,* [3]*Canadian Forest Service,* [4]*University of Guelph.*
16	**Conserving Aquatic Ecosystem Services through the Emulation of Natural Disturbance Paradigm for Sustainable Forest Management** *CNAES Theme II, Project II-2* **Jordan Musetta-Lambert**[1], DP Kreutzweiser[2], EA Muto, and PK Sibley[1] [1]*University of Guelph,* [2]*NR Canada, Canadian Forest Service*
17	**Effects of operational harvesting practices on hydrological and biological indicators of aquatic ecosystem services in northern hardwoods, central Ontario** *CNAES Theme II, Project II-2* **Alexander Potter**[1], J Buttle[1], D Kreutzweiser[2], P Sibley[3] [1]*Trent University,*[2]*NR Canada, Canadian Forest Service,* [3]*University of Guelph*
18	**Tracking the long-term responses of headwater ecosystems to logging disturbance: in-stream litter decomposition recovered within 15 years after forest harvesting** *CNAES Theme II, Project II-2* **Alex C. Y. Yeung**[1], JS. Richardson[1] [1] *Department of Forest and Conservation Sciences, University of British Columbia*

19	**Dissolved organic matter quality as a key factor determining major energy source in lakes** *CNAES Theme II, Project II-3* **Óscar E.Senar[1]**, IF Creed[1], K Kidd[2] *[1]Western University, [2]University of New Brunswick*
20	**Assessing the dynamics of Aquatic Ecosystem Services in a multi-use watershed** *CNAES Theme II, Project II-3* **Stephanie Tomscha,** *University of British Columbia*
21	**Average wetland functions under the Alberta Wetland policy – scenario analyses assessed with an agent-based model** *CNAES Theme II, Project II-4,5* **Francesco Accatino**[1], M Weber[2], IF Creed[1] *[1]University of Western Ontario, [2]Alberta Innovates*
22	**Managing cumulative ecosystem risk in Lake Erie from nutrient contributing stressors in the Grand River watershed** *CNAES Theme II, Project II-4,5* **Jason Igras[1]**, IF Creed[1] *[1]Western University*
23	**New mapping and wetland loss estimation techniques to examine the preferential loss of small wetlands on prairie landscapes** *CNAES THEME II, Project II-4,5* **Jacqueline Serran**, IF Creed *Western University*
24	**Identifying Restorable Wetlands and their Anticipated Functions in the Prairie Pothole Region** *CNAES Theme II, Project II-4,5* **Anna Waz[1]**, IF Creed *[1]Western University*
25	**Multi-disciplinary classification of river reaches at high spatial resolution** *CNAES Theme III, Project III-1* **Camille Ouellet Dallaire**, Bernhard Lehner *McGill University*
26	**Size spectrum and environmental characteristics in relation to patterns in fish mercury concentrations in Ontario lakes** *CNAES Theme III, Project III-2* **Lifei Wang[1],** Stephanie J. Melles[2], Donald A. Jackson[1], Cindy Chu[1], Henrique C. Giacomini[1], Brian J. Shuter[3,1] *[1]University of Toronto, [2]Ryerson University, [3]Ontario Ministry of Natural Resources and Forestry*
27	**Calibrating the zooplankton body-size spectrum to serve as an indicator of environmental perturbations in lakes** *CNAES Theme III, Project III-3* **Lauren Emily Barth**[1], BJ Shuter[1], G Sprules[1] *[1]University of Toronto*
28	**Responses of fish size spectra to a river impoundment** *CNAES Theme III, Project III-3.3* **Mateus Ferrareze[1]**, HC Giacomini[1], BJ Shuter[1], DA Jackson[1] *[1]University of Toronto*

29	**Evaluating Ecosystem Condition by Quantifying Ecological Resilience** *CNAES Theme III, Project III-4* **Karl A. Lamothe**[1], DA Jackson[1], KM Somers[2] *[1]University of Toronto, [2]Dorset Environmental Science Centre*
30	**Resilience of fish functional groups to global change in watersheds** *CNAES Theme III, Project III-5* **Andrew Chin**[1], M-J Fortin[1], J Linke[1], S Courtenay[2], R Cormier[3], M Boudreau[4], C Godin[4], M-H Thériault[4], K Somers[5], N Lester[6] *[1]University of Toronto,* *[2]Canadian Water Network, University of Waterloo,* *[3]Eco-Risk Management,* *[4]Fisheries and Oceans Canada* *[5]Ontario Ministry of Environment,* *[6]Ontario Ministry of Natural Resources,*
31	**High-resolution global maps of 21st-century forest loss: validation and application in the Miramichi river basin** *CNAES Theme III, Project III-5* **Julia Linke**[1], M-J Fortin[1], S Courtenay[2], R Cormier[3] *[1]University of Toronto, [2]Canadian Water Network, [3]Eco-Risk Management*
32	**Longterm recovery of ecosystem services reveals non-linear tradeoffs following forest harvest in BC coastal forests** *Project Theme III, III-6* **Ira Sutherland**[1], E Bennett[1,2], S Gergel[3] *[1]Department of Natural Resource Sciences, McGill University, Montreal, QC, Canada, [2]School of the Environment, McGill, University, Montreal. QC, Canada,* *[3]Department of Forest and Conservation Sciences, UBC, Vancouver, BC, Canada*
33	**How is my zone doing? A landscape approach to management of Ontario's inland lake resources** **Nigel Lester**, H Ball, T Dunkley *Ontario Ministry of Natural Resources and Forestry*
34	**Enhancing our understanding of risks to freshwater ecosystem services from a changing climate and multiple stressors via gradient analysis: a pan-American watershed approach** **James A. Rusak**[3], TC Harmon[1], SR Villamizar[1], D Conde[2], , B Reid[4], Astorga[4], G M. Perillo[5], MC Piccolo[5], F Scordo[5], M Zilio[6], S Londón[6], MI Velez[7], N Hoyos[8], J H. Escobar[8], and B Wemple[9] *[1]School of Engineering & Sierra Nevada Research Institute, University of California, Merced, USA;[2]Universidad de la República, Uruguay;[3]Queen's University and the Ontario Ministry of the Environment and Climate Change, Canada;[4]Centro de Investigaciones en Ecosistemas de la Patagonia, Universidad Austral de Chile, Chile;[5]Instituto Argentino de Oceanografía, CONICET & Universidad Nacional del Sur, Argentina;[6]Instituto de Investigaciones Económicas y Sociales del Sur – CONICET, Argentina;[7]University of Regina, Canada;[8]Universidad del Norte, Colombia* *[9]University of Vermont, USA*
35	**Sault College Natural Environment and Outdoor Studies** **Brian Anstess** , Coordinator and Faculty Natural Environment and Outdoor Studies, Sault College http://www.saultcollege.ca

Poster Session Abstracts

1	**Hydrogeomorphic Classification Approach for the Hudson Bay Lowlands in the Attawapiskat Watershed** *CNAES Theme I, Project I-2: 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 Attawapiskat watershed makes up a ~57,000 sq. km area in Ontario's Far North and extends from Precambrian Shield headwaters through the Hudson Bay Lowlands (HBL) to the coast. The region is peatland dominated and these low gradient, large expanses require further analysis and study to address uncertainties about their variations in hydrologic response. Recent hydrologic or catchment classification studies aim to assess broad-scale hydrologic systems in terms of the smaller '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. This study aims to evaluate the hydrology of the region across physiographic provinces within the Attawapiskat watershed, through the application of a catchment classification approach to compare select study sub-watersheds in a catchment scale analysis. The proposed study will involve generation and collection of physical, climatic and hydrologic characteristics/metrics of interest for the sub-watersheds across the Attawapiskat watershed from 2008 - 2014. These metrics will then be used in a statistical analysis (Principle Component Analysis) to assess the similarities between the hydrologic landscape units (sub-watersheds) and help make comments about the generalized hydrologic responses across the region.
2	**Seasonal Variability of Water Chemistry, and Benthic Invertebrate and Periphyton Communities in the Attawapiskat Watershed.** *CNAES Theme I, Project I-3a* **Vanessa Bourne**[1], JL Bailey, A Todd and JM Gunn *1Laurentian University, Ontario Ministry of Environment and Climate Change, Cooperative Freshwater Ecology Unit, Laurentian University, Sudbury, Ontario* Many regions of Canada's subarctic have recently been targeted for natural resource development. Baseline data on the area will be imperative to monitoring these developments as natural resource extraction progresses. This data can be used to observe changes in biotic communities as well as provide signs of ecosystem impairment. Additional factors, such as seasonal variability could influence evaluation of bio assessment and other monitoring data of biotic communities. The impact of seasonal variation on biotic communities may differ between the Hudson's Bay Lowlands (HBL) and Boreal Eco-Zones. The objective of this project is to determine and quantify seasonal variability in stream water chemistry parameters, invertebrate communities and Periphyton communities. The variability will also be compared between HBL and Boreal Eco-Zones. Sampling will occur at 20 sites in each eco- zone being studied. These sites will be sampled three times in the 2015 season: 1) post- breakup (late June); mid summer (late July/early August) and fall (late September/early October). Field collection and lab processing will follow standard Ministry of Environment and Climate Change and Canadian Aquatic Biomonitoring Network (CABIN) protocols. Data will be compared among the three seasons and between the two Eco- zones.

3 **Geographic Extension of Benthic Invertebrate RCA Bioassessments: How Far Can We Go?**

CNAES Project I-3a: Characterize the structure and function of aquatic ecosystems of the Hudson Bay Lowlands

Nicole-Marie Novodvorsky[1], JL Bailey[1,2], TB Reynoldson[3]
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Benthic invertebrate RCA bioassessments are generally developed using reference sites within a localized area such as a watershed or ecoregion. If such reference data can be used to assess test sites that lie outside their geographic scope, it would reduce the need to collect time-consuming and costly reference site data. In this study, we examined invertebrate and environmental data to assess concordance of benthic communities and develop predictive models using data from three areas in Canada: the Attawapiskat watershed in northern Ontario, the Fraser River watershed in British Columbia, and the Yukon River watershed. RCA bioassessments were developed based on reference sites from the individual watersheds and on pooled data from the three. The effectiveness of assessments was evaluated using a common set of artificially impaired sites. The results of this study reveal that assessments using reference sites from other watersheds perform similarly to those using only local reference data, suggesting that reference sites sampled in one watershed could be "exported" for effective bioassessment in other adjacent or more distant watersheds. These findings enables us to protect and monitor Canadian aquatic ecosystem services that are important to us as a society such as clean water and fish resources.

4 **Subsurface Flow Behaviour of a Continuous Solute Release in a Sub-Arctic Bog**

CNAES Project 1-4: Identify the impacts of climate and land-use changes on peatland biogeochemical function in the Hudson Bay Lowlands

Nicole Balliston, J Price, C McCarter
University of Waterloo

Resource extraction activities in the Canadian subarctic can result in the unintentional release of contaminants in the surrounding peatlands and subsequently the aquatic ecosystems. An understanding of flow within the variably saturated peatlands is necessary to predict both the behaviour of a contaminant plume and the potential for release into aquatic ecosystems. The goal of this study is to better understand how the hydrophysical structure of a bog controls contaminant transport under field conditions. The objectives are to 1) determine the spatial and temporal evolution of a developing contaminant plume, and 2) relate the hydrophysical structure of the peat to the plume's dispersal throughout the peat profile and peatland. A continuous solute release (NaCl) on a bog peatland near the De Beers Victor diamond mine will occur and the plume development will be documented. Both saturated and unsaturated plume behaviour will be monitored using an adaptive monitoring piezometer network and soil moisture/ electrical conductivity sensors. Relationships developed in the field will be tested in the lab through the execution of capillary rise peat core experiments. Results obtained from this experiment can be used to predict real-world contaminant spill behaviour and aid in spill mitigation efforts.

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

CNAES Project I-4: Identify the impacts of climate and land-use changes on peatland biogeochemical function in the Hudson Bay Lowlands

Catherine Dieleman[1], B Branfireun[1,] JW McLaughlin[2], Z Lindo[1]
[1]*University of Western Ontario,* [2]*Ontario Forest Research Institute*

Northern peatlands are a globally significant terrestrial carbon store. Phenolic carbon compounds are central to this carbon store as they limit microbial decomposition. Enzymes known as phenol oxidases break down phenols into labile compounds; however, the activity of these enzymes is limited by the cold and anaerobic 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 prompting 'runaway decomposition' of peat. To test this hypothesis 84 intact peat mesocosms were placed 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. The water table treatment had no effect on phenol oxidase activity under elevated temperatures, suggesting that 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 can reveal. As such, the 'runaway decomposition' hypothesis that has been posited in the literature may be somewhat overstated.

6 **Transport and Hydrological Response of Simulated Wastewater from a Continuous Point Source in a Northern Ribbed Fen**

CNAES Project I-4: Identify the impacts of climate and land-use changes on peatland biogeochemical function in the Hudson Bay Lowlands

Colin McCarter[1], J Price[1].
[1]*University of Waterloo*

Peatlands have been successfully used to treat primary and tertiary wastewater that minimizes the discharge of contaminants from remote northern communities and mining camps into surrounding aquatic ecosystems. However, there is a limited understanding of contaminant transport in fen peatlands, particularly in sub-arctic Canada. To better characterize contaminant transport in these systems, approximately 43 m^3 day^{-1} of simulated wastewater (concentrated custom-blend fertilizer) was pumped into a small 0.5 ha sub-arctic northern ribbed fen continuously for 47 days (July 15th –August 31st 2015). Water table increased quickly (~0.16 m in 6 days) nearest the point source (8 m down-gradient), resulting in rapid solute transport, as measured by specific conductance (SC) (0.35 – 2.88 m day^{-1}). This rapid transport was due to the large increase of hydraulic conductivity (~2 to 82 m day^{-1}) as the water table rose. After 38 days, the water table had risen on average 0.16 m across the site but SC breakthrough was limited to 117 m (in peat ~44 m; 1.16 m day^{-1}). Northern ribbed fens have a large capacity to detain wastewater from as illustrated by the high retardation factors (1.1 – 2.2) and have the potential to significantly decrease wastewater contamination in northern aquatic environments.

7 **The Influence of Life History on Tissue Mercury Concentration in Fish from Coastal Rivers of the Hudson Bay Lowlands**

CNAES Project 1-5c: Characterize the distribution of mercury and methyl-mercury in surface waters and freshwater biota of the Hudson Bay Lowlands

Rachel DeJong[1], H Swanson[1], B Branfireun[2], J Gunn[3], T Johnston[3, 4], B Keller[3]
[1]*University of Waterloo,* [2]*University of Western Ontario,* [3]*Living with Lakes Centre, Laurentian University,* [4]*Ontario Ministry of Natural Resources and Forestry*

Mercury (Hg) is a bioaccumulative neurotoxin to which humans are largely exposed through fish consumption. Many factors influence fish Hg concentration. Previous research in the North has shown anadromous life history types of Arctic Charr (*Salvelinus alpinus*) and Lake Trout (*Salvelinus namaycush)* to have lower Hg concentrations than resident types. The Hudson Bay Lowlands region is home to many Aboriginal communities that rely on subsistence fisheries; people in these communities are at elevated risk of Hg exposure due to fish consumption. Proposed developments in the Hudson Bay Lowlands (i.e. the Ring of Fire) and a changing climate could cause changes in Hg dynamics and fish movement; it is therefore important to establish regional baseline data. Using a combination of stable isotope, mercury, and otolith microchemistry analyses we aim to: 1) determine the relative importance of freshwater and marine-derived prey in anadromous life history types of Lake Whitefish (*Coregonus clupeaformis*) and Cisco (*Coregonus spp.*), 2) investigate possible use of brackish and estuarine habitats by Northern Pike (*Esox lucius*), and 3) compare fish Hg concentrations among species and life history types. Study results will be used to inform guidance provided to communities regarding safety and security of subsistence fisheries in northern coastal communities.

8 **Potential effects of climate on the bioaccumulation of mercury in two large-bodied fish species in northern Ontario**

CNAES Project I-5: Characterize the distribution of mercury and methyl-mercury in surface waters and freshwater biota of the Hudson Bay Lowlands

Alexandra Sumner[1], TA. Johnston[2], JM. Gunn[1]
[1]*Laurentian University,* [2]*Ontario Ministry of Natural Resources and Forestry*

Increasing temperatures in Canada's subarctic region are expected to alter many components of aquatic ecosystems, including mercury bioaccumulation in fish. It is important to understand how current climate trends influence the concentration of this neurotoxin in fish in order to assess the future impacts that climate change might have on the safety of consuming wild fish in Ontario. To better understand how climate influences mercury bioaccumulation, I am investigating patterns of fish mercury concentrations across a climatic gradient in Ontario. Two species of large-bodied fish, walleye and white sucker, have been sampled from 75 lakes throughout the Near and Far North of Ontario. These lakes are distributed over 9.0° of latitude and represent a range of climatic conditions (annual growing degree days 604-1599). Additionally, fish mercury concentrations are being analyzed with respect to chemical, physical, and biological variables known to be influential. The results of this study will address important gaps in our current understanding of how climate affects fish mercury, and will be useful in assessing reference conditions in advance of further climate change.

9

Assessing spatial and seasonal variability in mercury and other water chemistry parameters in remote freshwater systems across the Attawapiskat watershed in northern Canada.

CNAES Project I-5: Characterize the distribution of mercury and methyl-mercury in surface waters and freshwater biota of the Hudson Bay Lowlands

Gretchen L. Lescord[1], M Gillespie[1], TA. Johnston[1], JM Gunn[1]
[1]*Vale Living with Lakes Center, Laurentian University, Sudbury ON*

In northern Canada, the majority of Hg is atmospherically transported from point sources and deposited into freshwater systems, where it can be methylated by anaerobic bacteria. In aquatic systems, methylation of aqueous Hg can be enhanced or limited by complex cycling of various chemical factors in water (e.g. sulfate, nitrates, organic carbon; OC). While many studies have examined these relationships in natural systems during summer months, less is known about biogeochemical profiles of lakes during the winter months. Furthermore, while methylation is known to occur in profundal sediments, it is unclear if the biogeochemical properties of lakes remain consistent across basins. This study investigated the seasonal and spatial variability in concentrations of total Hg, MeHg, and 40 additional chemical parameters (e.g. OC, pH, nitrogen, and ions) in waters across the Attawapiskat watershed in Northern Ontario. This dynamic watershed begins as deep headwater lakes in the Boreal Shield and transitions into shallow lakes and the Attawapiskat River in the Hudson Bay lowlands. It also includes the area known as the "Ring of Fire," where extensive chromium and nickel mining is expected in the next decade. In 2013-2014, three water samples were taken from the deepest basins of 12 shield lakes and 9 lowland lakes/river sites during the winter and summer months. Preliminary results show no spatial differences in chemical parameters between basins within a lake. However, differences were found between chemical concentrations in summer and winter months; filtered (but not unfiltered) MeHg and THg concentrations were higher in summer months when compared to winter samples within the shield lakes ($p = 0.013$ and 0.029, respectively). Understanding how the other chemical factors change from winter to summer within a lake will hold significant implications for predicting climate related impacts on Hg cycling in these systems. According to the preliminary data, increased temperature and summer-like conditions will mean lower nitrate/nitrite (92±59 mg/L higher in winter; $p < 0.001$) and ion (4.7±2.7 mg/L higher in winter; $p = 0.006$) concentrations, as well as higher OC (7.9±4.5 mg/L higher in summer; $p = 0.006$) concentrations, all factors that have been shown to increase MeHg production in Boreal systems. We further predict that these impacts will be greater in the lowland lakes, which are smaller and more influence by weather events. These seasonal and spatial data will also be particularly useful in planning the sampling locations and timing for future monitoring programs for the ROF region.

10

Project I-6: Building relationships with Far North First Nation communities.

David Pearson and Chantal Sarrazin-Delay
Laurentian University

The purpose of Project I-6 is to engage and build respectful and trusting relationships with the First Nations in Far North Ontario in whose traditional territories Theme 1 field work is taking place. Their reserves and small communities are remote and accessible only by air or winter road. We are currently focussed on the First Nations of the inland Matawa and coastal Mushkegowuk Tribal Councils, and Fort Severn. Relationship building is emphasized in Tri-Council guidelines. Treaties are the basis of sharing the land and establish the context for engaging and sharing scientific knowledge of the land as it emerges from field work and research.

	Visits include getting to know the Chief and Council members; meeting community members in Open Houses; initiating in-community environmental training in aquatic invertebrate identification; and visiting schools with science activities for class and field. We speak about the overall objectives of Theme 1 and have begun specifically involving researchers and HQP in raising understanding of mercury issues in coastal communities. We also participate in Tribal Council workshops. It is very rare for a young person from a Far North First Nation to earn sufficient science credits to enter a post secondary science program. CNAES cannot change that but our research can help stimulate the imagination of young people as well as show the relevance and value of science and build bridges with the science community.
11	**Climate change effects on water export from temperate forests of eastern North America** *CNAES Project II-1: Physical, chemical and biological indicators of aquatic ecosystem services from headwaters of forested landscapes.* **Chris Brimacombe**[1], IF Creed[1] [1]*University of Western Ontario* Forests are important source areas of water for society, particularly those living in lower reaches of the watershed. Forests not only provide natural habitats but also provide important ecosystem services including flood control, sediment control, and water availability. Although it is already understood that climate influences forest ecological and hydrological processes, it remains unknown which climate effects are driven by naturally occurring climate oscillations (i.e. stationary oscillatory signals) vs. anthropogenically driven climate change (i.e. linear trends). We focus on eighteen headwater catchments which are 'sentinels' for climate change because of their ability to collect most water from adjacent terrestrial ecosystems, have high topographic positioning, and thin soil layers to reduce noise caused by soil absorption. Specifically, we use statistical techniques of regression and wavelets transform to test hypothesized climate forcings on water export from headwater catchments and, if there is a climate-water response, to discriminate between the stationary vs. non-stationary climate signals in the water export.
12	**Analysis relationships between sreamflow regime with hydrological Classification zones** *CNAES Project II-1: Physical, chemical and biological indicators of aquatic ecosystem services from headwaters of forested landscapes* **Junting Guo**[1], Irena F.Creed[1] [1]*Western University* Based on soils, climate, land use and topography, we can classify a specific area into different hydrological zones which are useful for data organization, model parameters set and prediction of hydrological response to climate change. And stremflow generation is also based on same factors as hydrological classification used. Therefore we can infer that hydrological classification can be used to predict streamflow regimes. It is very important that we can predict streamflow regimes in ungauged area using hydrological classification as a predictor. In this study we will finish hydrological classification and streamflow regimes calculation, then relate relationships between them for gauged streams in Ontario. Furthermore we can apply this relationship as a tool to predict streamflow variety of whole country, especially ungauged area following climate change.

13 **Remotely sensed changes in trophic status of lakes in a temperate forest**

CNAES Project II-1: Physical, chemical and biological indicators of aquatic ecosystem services from headwaters of forested landscapes

Aleksey Paltsev[1], IF Creed[1]
Western University

Oligotrophic lakes in the temperate forests of eastern North America appear to be experiencing an increase in the frequency and duration of algal blooms. This has been the focus of numerous public and government reports, resulting in heightened concern for reporting of algal blooms. There is a vital need for detailed historical survey of numerous lakes, covering large spatial scales (>100 km^2) and temporal scales (decades) to determine if public observations are accurate. In this study remote sensing was used to: (1) develop a regression model that relates chlorophyll a (chl-a) as a proxy of lake phytoplankton biomass to Landsat TM and ETM+ optical reflectance; and (2) apply this regression model to estimate chl-a in lakes within the Temperate Forest Biome in Ontario over a 28-year period. Reflectance in Landsat band 3 (red) showed the strongest correlation with *in situ* data explaining 85% of the variance in chl-a ($p<0.001$). Application of the regression model revealed a spatial pattern of relatively low chl-a (oligotrophic) in headwater lakes to higher chl-a (eutrophic) in lower reaches of watersheds, and a temporal shift between the time periods of 1985-1994 to 1995-2004, providing an "early warning" that lakes within the region are changing towards eutrophication.

14 **Assessing the Impacts of Forest Disturbance on Aquatic Ecosystem Services through Predictive Modeling of Benthic Community Composition and Hydrological Indicators**

*CNAES Project II-2**:** Experimental manipulations to test the effects of forest management activities on physical, chemical and biological indicators of aquatic ecosystem services from headwaters of forested landscapes* .

Kristin Daoust[1], D Kreutzweiser[2], IF Creed[3], P Sibley[1]
[1]University of Guelph, [2]Canadian Forest Service, [3]Western University

Our present understanding of the effects of natural and anthropogenic disturbance in forested landscapes is largely based on watershed physical, chemical and biological indicators that have been developed independently of any knowledge of the relationship between them, and rarely in the context of the aquatic ecosystem services (AES) to which they are linked (e.g., water quality). In this study, we will use a combination of field measurements and modelling to develop predictive relationships between physical (e.g., discharge, peak/low flow) and chemical (e.g., pH, conductivity, major nutrients) properties and benthic invertebrate community composition (BICC) of forested headwater streams, as indicators of AES. Initially, we will focus on the Batchawana watershed in north central Ontario which contains a gradient of disturbance ranging from undisturbed (reference) to intensively harvested and a long history of research focusing on ecohydrological questions that has generated an excellent dataset of ecohydrological measurements. In the second phase, working with NRCAN-CFS and Parks Canada, we will apply the resulting model(s) to explore relationships between physicochemical indicators and biological responses across watersheds for which information on BICC has been collected. By defining the relationships between physicochemical and biological indicators of AES, we hope to provide forest managers/policy makers with the information required for making effective monitoring and forest management decisions aimed at ensuring sustainability of forest-based AES.

15 **Effect of forest condition on food web structure in headwater streams in different regions of Canada.**

CNAES Project II-2: Experimental manipulations to test the effects of forest management activities on physical, chemical and biological indicators of aquatic ecosystem services from headwaters of forested landscapes.

Maitane Erdozain[1,2], K Kidd[1,2], D Kreutzweiser[3], P Sibley[4].
[1]*University of New Brunswick,* [2] *Canadian Rivers Institute,* [3]*Canadian Forest Service,* [4]*University of Guelph.*

An important ecosystem service provided to headwater stream communities by forests is the provision of allochthonous energy to support biodiversity. Forest disturbance can significantly affect this subsidization, and ultimately affect the delivery of aquatic ecosystem services by streams, but the mechanisms are poorly understood. To address this we are studying how forest management affects food web structure (via stable isotopes and ecological stoichiometry of macroinvertebrates and their food resources) in headwater streams differing in degree of disturbance and consequent forest condition across Canada. Streams with a range in watershed disturbance were sampled in Ontario (3 logged, 3 burned, 3 reference), British Columbia (6 clearcut, 1 thinned, 3 reference) and New Brunswick (15 with 0 to 69% of the watershed planted). Nitrogen isotope data from Ontario indicate longer food webs in streams with burned and logged watersheds compared to reference streams (33 and 17% longer, respectively). Carbon isotope data indicate that shredders feed on leaves, but that scrapers are not feeding on biofilm as anticipated. This study will improve our understanding of the linkage between forests and stream ecosystem services across different forest types, and provide information that could be used by the forestry industry to ensure the sustainability of practices.

16 **Conserving Aquatic Ecosystem Services through the Emulation of Natural Disturbance Paradigm for Sustainable Forest Management**

CNAES Project II-2: Experimental manipulations to test the effects of forest management activities on physical, chemical and biological indicators of aquatic ecosystem services from headwaters of forested landscapes.

Jordan Musetta-Lambert[1], DP Kreutzweiser[2], EA Muto, and PK Sibley[1]
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Applying the emerging paradigm of emulation of natural disturbances (END) to forest management requires understanding how the riparian-aquatic interface responds to forest disturbances. A comparison of riparian forest condition and stream characteristics was conducted by assessing vegetation communities, litter inputs to streams, in-stream litter decomposition, and associated aquatic invertebrate communities in low-order boreal streams in catchments with disturbance histories including forest fire, logging with riparian buffers, and undisturbed. Shrub and juvenile woody-stem densities and richness were higher at fire than logged and reference sites. Mature tree densities at reference sites were 2x and 30x higher than at logged and fire sites, respectively. Litter decomposition rates were slightly higher at fire and lower at logged than reference sites. Invertebrate communities were distinctly characterized by unique shredder taxa, and leaf litter input composition was greater and communities dissimilar at fire than at logged and reference sites. Detectable differences in riparian forest condition and in-stream processes suggest that riparian management to emulate fire disturbance under END could promote ecosystem services by inducing forest succession and enhancing biodiversity, organic matter processing and habitat complexity.

17 **Effects of operational harvesting practices on hydrological and biological indicators of aquatic ecosystem services in northern hardwoods, central Ontario**

CNAES Project II-2: Healthy Forest, Healthy Aquatic Ecosystems

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Aquatic insect communities and watershed hydrology were examined over a 5-year study period in headwater catchments of a northern hardwood forest in central Ontario. Insect communities and streamflow response from four treatment catchments (14 - 69% harvest, selection-cut) were compared to four reference catchments (no harvest) over a two year pre- and three year post-harvest period using a paired-catchment approach. Treatment catchments were arranged in a nested fashion, such that harvesting impacts could be examined with changing catchment scale. Harvesting was conducted in compliance with a riparian code of practice and other best management practices. The following research questions are being addressed:

1. Does operational selective-harvesting impact aquatic ecosystem services (AES) based on hydrologic and biologic indicators?
2. Can benthic community structure be used as an indicator of selective-harvesting impacts on AES in northern hardwoods? and
3. Does the response of benthic community structure to selective-harvesting change with harvesting intensity and catchment scale in this landscape?

This poster presents information on the study methodology as well as data analysis and interpretation of streamflow and benthic invertebrate community structure in reference and treatment catchments. The results of this project will assist forest managers in designing operational harvesting strategies in order to minimize impacts on AES in northern hardwood forest landscapes.

18 **Tracking the long-term responses of headwater ecosystems to logging disturbance: in-stream litter decomposition recovered within 15 years after forest harvesting**

CNAES Project II-2: Experimental manipulations to test the effects of forest management activities on physical, chemical and biological indicators of aquatic ecosystem services from headwaters of forested landscapes

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Litter decomposition rates in headwater streams regulate the supply of organic matter as a basal resource to macroinvertebrates and microbes throughout the entire watershed. This process is considered a key determinant of habitat productivity, and hence provisioning ecosystem services. Litter breakdown is usually used to detect short-term effects of human disturbances on stream health, but less so for their legacy effects when compared to ecosystem structure such as macroinvertebrate abundance and richness. For instance, the recovery of litter breakdown after timber harvesting likely depends on the habitat template mediated by forest regeneration, which requires long-term studies. Following up on a 2006 study which detected impacts of harvesting practices on stream conditions in a coastal temperate rainforest, litter decomposition and shredder abundance and richness were re-determined in fall, 2013 (15 years after clearcutting with/without streamside buffers, and 8 years after thinning). Provisional data showed similar litter breakdown among sites receiving different harvesting practices, indicating its recovery in clear-cut (with/without buffers) and thinned sites to pre-logging levels, within 15 years after harvest. This study thus provides information on the resilience of headwater ecosystems impacted by logging, and

	recommends a target timeframe for the monitoring of logged sites in the Pacific Northwest region.
19	**Dissolved organic matter quality as a key factor determining major energy source in lakes** *CNAES Project II-3: Cumulative effects of catchment disturbances on downstream ecosystem services in forested landscapes* **Óscar E.Senar[1]**, IF Creed[1], K Kidd[2] *[1]Western University, [2]University of New Brunswick* Dissolved organic matter (DOM) in lakes influences nutrient availability, metal cycles and pollutant transport. Furthermore, depending on its degradation susceptibility (ranging from refractory; difficult to decompose– to labile; easily consumed by microorganisms), dissolved organic matter can form the major energy source in ecosystems' food webs. In this project, we aim to describe the reliance of food chains on autochthonous (algae) and allochthonous (degradation of forest organic matter) energy sources as a function of the type of organic matter and concentrations of phosphorus and dissolved organic carbon. And because a large fraction of the organic matter in lakes is originated in forests, the results from this study will expand our knowledge about connectivity between terrestrial and aquatic ecosystems.
20	**Assessing the dynamics of Aquatic Ecosystem Services in a multi-use watershed** *CNAES Project II-3: Cumulative effects of catchment disturbances on downstream ecosystem services in forested landscapes* **Stephanie Tomscha,** *University of British Columbia* Truly understanding and managing aquatic ecosystem services (AES) requires measuring an area's biophysical capacity for AES as well as human demand for AES. Furthermore, it requires understanding AES interactions and dynamics. Yet, most research into ecosystem services takes a static, one-time approach that is poorly suited to understanding AES interactions. To better understand AES dynamics, we synthesize a suite of approaches, asking two main questions: (1) How dynamic and interrelated are AES along river-floodplain gradients? We integrate GIS and aerial photography to capture relationships among floodplain connectivity (e.g., lateral, longitudinal) and the capacity of an area to provide AES (fish habitat, waterfowl habitat, beaver habitat, paddle routes, timber, etc.). Long-term spatial dynamics will be addressed using historical imagery. (2) How do AES capacity and demand differ in river-floodplain systems? Using participatory approaches, we engage with communities to map both the benefits provided by and demand for AES (fishing, hunting, trapping, canoeing, harvesting, etc.). We integrate this information to understand the community's priorities and behaviors with respect to management of AES and the benefits they confer. Pairing spatially-explicit approaches with long-term datasets provides a unique opportunity to explore interactions and dynamics among AES across river-floodplain gradients, key for managing valuable AES.

21 **Average wetland functions under the Alberta Wetland policy – scenario analyses assessed with an agent-based model**

CNAES Project II-4,5: Identifying desired social, economic, and aquatic ecosystem services futures and policy implementation needed to sustainably manage forest ecosystems

Francesco Accatino[1], M Weber[2], IF Creed[1]
[1]*University of Western Ontario,* [2]*Alberta Innovates*

Increasing urban pressure caused a progressive loss of wetland ecosystem services in the last decades. The Alberta wetland policy provides rules for wetland drainage and restoration. According to this policy, wetlands are scored (A, B, C, or D, in decreasing importance), and, when drained, they must be replaced with other wetlands following precise aerial ratios dependent on the scores. Scores are obtained bundling wetland functions that represent ecosystem services provided by the wetlands. However, different techniques of bundling wetland functions may lead to different scores, and, ultimately, to different scenarios of wetland drainage and restoration. We developed an agent-based model for simulating urban expansion (emergent from interaction land demand and offer) and its impact on wetland drainage and restoration. We tested a prototype of the model on the Strathcona County, a part of the BHI Initiative in Alberta. We developed simple proof-of-concept indicators for biodiversity preservation, water purification, flood reduction, and human use. We ran simulations with different bundling techniques (weighted average, minimum and maximum bundling) and tracked the average of the wetland functions of the whole county. Results showed that different bundling techniques improve different wetland functions and highlight synergies and conflicts between ecosystem services.

22 **Managing cumulative ecosystem risk in Lake Erie from nutrient contributing stressors in the Grand River watershed**

CNAES Project II-4,5: Identifying desired social, economic, and aquatic ecosystem services futures and policy implementation needed to sustainably manage forest ecosystems

Jason Igras[1], IF Creed[1]
[1]*Western University*

The Great Lakes Water Quality Agreement has played a significant role in the management of nutrient contributing stressors within the Great Lakes basin. However, recent and recurrent nuisance algal blooms pose an increased risk to human health and aquatic ecosystem services in Lake Erie, presenting a unique opportunity to evaluate the current regulatory framework from an integrated science and management perspective. In this study, we are applying an Ecosystem Risk Management framework along with Bow-tie risk assessment and Bayesian Network Analysis (BNA) methodologies to identify areas for enhancement within the current regulatory measures managing nutrient contributing stressors and their consequences in the Grand River watershed. The Bow-tie approach provides a simple yet qualitative way of assessing risk while also considering the regulatory control measures around that risk. BNA, which quantitatively models the cause and effect relationships of different management decisions and ecosystem responses, will be nested within the Bow-tie approach and involve the Soil and Water Assessment Tool, as well as a review of the literature and expert elicitation for indicator dynamics and network design. We anticipate the research will identify gaps and vulnerabilities in the current regulatory framework in addition to opportunities improvement, providing a science-policy integrated approach to environmental management.

23 **New mapping and wetland loss estimation techniques to examine the preferential loss of small wetlands on prairie landscapes**

CNAES Project II-4,5: Identifying desired social, economic, and aquatic ecosystem service futures and policy implementation needed to sustainably manage forest ecosystems

Jacqueline Serran, IF Creed
Western University

Reliable estimates of wetland loss require improved wetland inventories and methods to estimate wetland loss. The Prairie Pothole Region of North America is experiencing rapid development placing wetlands at risk. Wetland loss is concomitant with a loss of ecosystem services. To improve upon current wetland inventories, a method for mapping wetlands using an automated object-based approach based on Light Detection and Ranging (LiDAR) data was developed for a watershed in Alberta. Applying this method, we identified 130,157 wetlands. Wetland loss estimates (% number and % area) were then obtained by applying a wetland area vs. frequency power-law function to the wetland inventory. We estimated a 69.3% loss of wetland number and a 9.96% loss of wetland area, with the size of these lost wetlands < 0.04 ha. We also examined wetland loss rates over time and since different policies were implemented by applying the power-law to historical wetland inventories. An historical rate of loss of 0.34% number and 0.05% area per year from 1962 to 1993 was estimated and a 0.78% number and 0.4% area per year wetland loss occurred from 1993 to 2009. Despite the introduction of a "no net area loss" interim wetland policy in Alberta in 1993, by 2009 6.4% of the total area of wetlands in 1993 had been lost. Results of this study can be used to better manage wetlands on prairie landscapes.

24 **Identifying Restorable Wetlands and their Anticipated Functions in the Prairie Pothole Region**

CNAES Project II-4,5: Identifying desired social, economic, and aquatic ecosystem service futures and policy implementation needed to sustainably manage forest ecosystems

Anna Waz[1], I Creed
[1]*Western University*

Prairie potholes, depressional wetlands formed from past glaciation, provide many ecosystem functions including water storage and nutrient abatement and serve as biodiversity hotspots. Unfortunately, with land use change, prairie pothole numbers have been significantly reduced which subsequently alters the variation and distribution of wetland functions and associated ecosystem services over the landscape. While progress has been made in automating wetland identification and delineating small wetlands, the identification of lost wetlands remains a persistent challenge as historic imagery is coarse in resolution and drainage is often not documented. This study will use high-resolution LiDAR imagery to delineate drained wetlands on the landscape, representing opportunities for wetland restoration. To better target wetland restoration, remotely sensed imagery and GIS, in combination with function-based indicators will be used to estimate the potential functions of these drained wetlands, if restored. A technique which identifies drained wetlands as well as their potential functions would provide a new vital tool to guide restoration efforts to ensure the potentially high-functioning wetlands are prioritized for restoration and conservation.

25 **Multi-disciplinary classification of river reaches at high spatial resolution**

CNAES Project III-1: Quantitative Indicators & Metrics of Ecosystems Services, Health & Function

Camille Ouellet Dallaire, Bernhard Lehner
McGill University

River classifications have been used in various large-scale assessments of river health and environmental flow requirements to define either reference sites or management units. These tractable units can later be the basis of further research to define specific manageable practices such as ecosystem services. A major challenge for large-scale assessments is that consistent data across the entire study region is often lacking. This is certainly true for Canada, where ecosystem data and understanding is scarce and often incomplete in remote areas. To overcome this problem and to facilitate eco-hydrological modelling, the HydroSHEDS database can be used (Lehner et al. 2008), a framework that provides consistent data and tools relevant to hydrological analysis at multiple spatial scales. This project further develops the Global River Classification (GloRiC) framework , which will aim to derive functional ecosystem classifications based on physical and biological parameters at global and regional scales in order to better understand and recognize the various characteristics of habitats and their inter-connections, and apply it to Canadian rivers. Preliminary results based on two sub-classifications (Hydrological and Physio-climatic) are presented.

26 **Size spectrum and environmental characteristics in relation to patterns in fish mercury concentrations in Ontario lakes**

CNAES Project III-2: Can watershed-based classification help explain patterns in fish mercury concentrations across Ontario and Quebec?

Lifei Wang[1], Stephanie J. Melles[2], Donald A. Jackson[1], Cindy Chu[1], Henrique C. Giacomini[1], Brian J. Shuter[3,1]
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Understanding what factors can help explain the patterns in fish mercury concentrations in Ontario lakes is important for the health of aquatic ecosystems and human. Mercury bioaccumulation in fish is strongly related to species metabolism and the flux of energy and matter in aquatic ecosystems. These relationships could be considered by using size spectrum approach based on the size distributions of individual organisms within each ecosystem. Size spectrum slope can indicate how quickly species density declines as size increases, energy transfer efficiency, and the size ratio between prey and predators. In this study, we examine the relationships between fish mercury concentrations in Ontario lakes and fish size spectrum when accounting for environmental and watershed variables. We use fish size spectrum, lake environmental and watershed information, and mercury concentrations in walleye, northern pike, lake trout, and smallmouth bass from Ontario lakes. Principal component analysis and generalized linear model are used to examine whether the patterns in fish mercury concentrations in Ontario lakes could be explained by the physical, chemical, or biological characteristics of aquatic ecosystems. Results indicate that mercury concentrations in the four fish species are higher in shallower lakes with higher fish size spectrum slope and lower conductivity and pH.

27 **Calibrating the zooplankton body-size spectrum to serve as an indicator of environmental perturbations in lakes**

CNAES Project III-3: Calibrating the community size spectrum to serve as an indicator of the health of aquatic ecosystems

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The size spectrum is the distribution of organism abundance across a range of organism size. Its shape reflects size-dependent ecological and physiological processes that govern the energy flow and biomass distribution in aquatic ecosystems. Perturbations (overharvesting fish populations and eutrophication) which alter the flow of energy within a community should be captured by the parameters that describe the shape of the community size spectrum. Zooplankton are an important link between primary phytoplankton production and fish in lakes, and changes in abundance or composition of higher or lower trophic levels should be reflected in the zooplankton community size spectrum. Using zooplankton and lake characteristic data collected from 73 lakes across Ontario I will present preliminary results showing which model, linear or quadratic, best captures the shape of zooplankton community size spectra and the sensitivity of model parameters to lake characteristics such as lake depth and the presence/absence of cisco and invasive Bythotrephes. If the model parameters are sensitive enough to respond to lake characteristics in a consistent manner then zooplankton size spectra can potentially reflect environmental perturbations that disrupt the delivery of ecosystem services. Thus, the zooplankton size spectrum may be a useful tool to monitor the health of aquatic ecosystems.

28 **Responses of fish size spectra to a river impoundment**

CNAES Project III-3.3: Size spectra of fish assemblages: longitudinal and temporal variation in Neotropical reservoirs

Mateus Ferrareze[1], HC Giacomini[1], BJ Shuter[1], DA Jackson[1]
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Habitat fragmentation has been identified as one of the greatest threats to freshwater environments. In the Neotropical region, dam construction is one of the main causes of aquatic habitat fragmentation. Reservoir construction can result in a restructuring of the aquatic communities, including fish. Many attributes of fish are related to body size. Therefore, size spectrum approaches have been increasingly used as an indicator of aquatic ecosystem structure. In this study, we estimated the size spectrum slopes of fish assemblages at one reservoir in Southeastern Brazil, at two different points in time: before and after the reservoir' filling. The size spectrum slope, given by the maximum likelihood estimator of the Pareto type I distribution, showed a steeper size distribution after the damming, implying in relatively higher dominance by small fish. After impoundment, the lotic zone was characterized as the most preserved region, while the lentic zone was the most altered. The transition zone showed intermediate trends in slope. These results can be explained by concomitant changes in phytoplankton production, water transparency and higher occurrence of piscivorous fish observed after the reservoir' filling. The results also suggested that the fish size distribution can readily track changes in environmental conditions following major perturbations.

29 **Evaluating Ecosystem Condition by Quantifying Ecological Resilience**

CNAES Project III-4: Evaluating Ecosystem Health by Quantifying Resilience

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[1]*University of Toronto,* [2]*Dorset Environmental Science Centre*

Aquatic ecosystems provide essential services that society relies on. With recent projections of climate change, these systems are vulnerable to an increased frequency of environmental disturbances. Ecological resilience is a term often used to describe the response of an ecosystem to disturbance. Although the term 'resilience' is commonly cited, being able to measure or quantify this in nature remains a challenge. Therefore, my research involves developing methods for quantifying ecological resilience, specifically for freshwater biotic communities. To develop this metric, I first use multivariate techniques on simulated biotic communities subjected to artificial disturbances. Using this metric, I will describe the relative resilience of lake zooplankton communities in Ontario, which have been subjected to various anthropogenic disturbances. Additionally, I assess how particular characteristics of biota relating to ecosystem function, also known as functional traits, can be used to describe the resilience of Ontario freshwater fish communities across environmental gradients. Lastly, I show how the ecosystem services that aid in the regulation of environmental processes, such as water purification or nutrient retention, are instrumental for maintaining the resilience of ecosystems to disturbance. Overall, ecological resilience and ecosystem services approaches present a cohesive perspective for managing natural ecosystems.

30 **Resilience of fish functional groups to global change in watersheds**

CNAES Project III-5: Geospatial risk mapping of aquatic system across Canada: Determining regional generalities and local specificities

Andrew Chin[1], M-J Fortin[1], J Linke[1], S Courtenay[2], R Cormier[3], M Boudreau[4], C Godin[4], M-H Thériault[4], K Somers[5], N Lester[6]
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Ecological resilience is necessary for the provisioning of aquatic ecosystem services. While resilience can be affected by both natural dynamics and human pressures, increased infrastructure development and land-use changes further exacerbate these adverse effects on aquatic ecosystems globally. Yet watersheds are also spatially and temporally complex ecosystems. Chin PhD's thesis is comprised of three chapters that will use a functional group-based approach to investigate fish community responses to stressors at key scales to better understand the effects of natural and human pressures on ecological resilience. (1) Fish functional groups that respond to environmental changes in estuaries will be determined to improve predictions of aquatic ecosystem responses to stressors. (2) Once the functional groups are identified, the impact from the cumulative effects of culverts streams for the diadromous functional group due to reduced overall connectivity among streams will be investigated. (3) Then the key spatio-temporal scales at which a species within the migratory functional group of communities respond to changes at the watershed level will be assessed. A community-based analysis to a species-specific approach using functional group responses will be critical to manage aquatic ecosystem integrity by determining areas vulnerable to anthropogenic impact.

31 **High-resolution global maps of 21st-century forest loss: validation and application in the Miramichi river basin**

CNAES Project III-5: Geospatial risk mapping of aquatic system across Canada: Determining regional generalities and local specificities

Julia Linke[1], M-J Fortin[1], S Courtenay[2], R Cormier[3]
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Monitoring forested watersheds require accurate, up-to-date information on the type and extent of forest depletion. While these data may be available for public lands, its attributes or quality vary across jurisdictions, and they may be completely inaccessible for private forests land where the owners may be reluctant to publicly share information on their harvesting operations. An opportunity to tackle this situation could be provided by a new Landsat-based global dataset of forest change developed by Hansen et al. (2013). The dataset contains year-by-year forest changes for the period 2000 to 2012, with annual updates planned. Here we report on the methodology and preliminary findings of our accuracy assessment of this dataset in the basin of the Miramichi river (NB). We vectorised the portion of the dataset corresponding to public lands in the Miramichi basin (8678 polygons, MMU 1ha), for which we had a complete provincial inventory of harvest cutblocks, and compared both datasets through GIS overlays. We present 1) thematic accuracy (harvested or not, year); 2) detectability of various harvest types (stand-replacing versus selective); and 3) annual trends of forest loss. Our results corroborate the usefulness of this global map of forest loss for local and regional forest monitoring.

32 **Longterm recovery of ecosystem services reveals non-linear tradeoffs following forest harvest in BC coastal forests**

Project III-6: Understanding the trade-offs among multiple ecosystem services along disturbance gradients

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Management of ecosystem services (ES) requires understanding the interactions among multiple services and how both services and their interactions change over time. Timber harvesting provides near-term services (such as wood products), but can be responsible for lagged reductions in other services such as regulation of fish habitat quality or the large red-cedar used traditionally by First Nations for carving totem poles. We used a 250-year forest chronosequence dataset to estimate long-term post-harvest recovery trajectories of eight ecosystem services on Vancouver Island, BC, Canada. We observed that ES recovered at markedly different rates and along varying non-linear trajectories. For example, timber volume, snags, and carbon storage recovered along sigmoidal trajectories mostly within 100 years. In contrast, the large red-cedar trees used by First Nations recovered much more slowly. We then used field sampling to contrast ES recovery in riparian forests and in sloped mountain forests, with particular focus on aquatic services and cultural services important to First Nations communities. Preliminary results show that riparian forests provide greater levels of ecosystem services than the sloped forests of equal age. Recognizing these ES interactions can help inform silvicultural or restoration treatments needed to support the provision of multiple ES valued by society.

33 **How is my zone doing? A landscape approach to management of Ontario's inland lake resources**

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Ontario's large and diverse landscape provides a wide range of aquatic ecosystems that support the highest freshwater fish diversity in Canada. These fishery resources support Aboriginal, commercial food and bait, and recreational fisheries. The over 250,000 lakes and thousands of km of rivers and streams span a north-south climatic gradient of about 1000 to 2400 Growing Degree Days and exhibit variable morpho-edaphic characteristics, both of which influence fish production. Approaches to managing this resource have evolved in response to economic, social and environmental drivers, as well as fishery development through time. In 2005, Ontario launched a new ecological framework for managing recreational fisheries which shifted the emphasis from individual lakes to management zones. This approach includes (1) enhanced engagement of the public in setting goals for zones and evaluating success; (2) commitment to a monitoring program focussed on indicators linked to goals; (3) an adaptive management cycle in which data not only guide management but also support science development.

34 **Enhancing our understanding of risks to freshwater ecosystem services from a changing climate and multiple stressors via gradient analysis: a pan-American watershed approach**

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The objective of this work is to identify and understand how climate change and multiple anthropogenic stressors may impact aquatic ecosystems, and translate these changes into a risk of ecosystem service loss (or gain). A secondary objective is to communicate risk, and pose risk mitigation strategies, in a manner acceptable to a broad spectrum of stakeholders. Quantifying the nature and timing of the risk is difficult because (1) we often fail to understand the connection between anthropogenic pressures and the timing and extent of ecosystem changes; and (2) the concept of risk is inherently coupled to human perception, which generally differs with cultural and socio-economic conditions. In this study, we endeavor to assess aquatic ecosystem risks across an international array of six study sites. We have constructed a methodology capable of capturing the marked biogeographical, socioeconomic, and cultural differences among the sites, which include: (1) Muskoka River watershed in humid continental Ontario, Canada; (2) Lower San Joaquin River, an impounded snow-fed river in semi-arid Central California; (3) Cienaga Grande de Santa Marta, a tropical coastal lagoon in Colombia; (4) Senguer River basin in a semi-arid region of Argentina; (5) Laguna de Rocha watershed in humid subtropical Uruguay; and (6) Palomas Lake complex in oceanic Chilean Patagonia. Preliminary results demonstrate the power of this methodology given our ability to characterize risk across our "experimental" gradients over the six sites and suggest that risk scales with various social, economic, and environmental indices important to watershed management and mitigation efforts.

35	**Sault College Natural Environment and Outdoor Studies** **Brian Anstess** , Coordinator and Faculty Natural Environment and Outdoor Studies, Sault College http://www.saultcollege.ca The Natural Environment and Outdoor Studies (NEOS) Department of Sault College has a long history of graduating top field Technicians and Technologists. There are 4 core diploma programs: Forest Conservation, Fish and Wildlife Conservation, Adventure Recreation and Parks, and Natural Environment Technician / Technologist. As the anchor Department in the number one ranked College in the province of Ontario, NEOS can support your research or business with capable students and graduates.