



# Cooperative Freshwater Ecology Unit Annual Report 2013







### **Awards and Recognition**

- Dr. Nathan Basiliko, our new Canada Research Chair in Environmental Microbiology arrived in June 2013. Nathan was awarded a 5 year NSERC Discovery grant (The functional role of microbial diversity in terrestrial ecosystems; \$110k) and a CFI grant (Infrastructure funding for an advanced laboratory in microbial ecology and biogeochemistry; \$110k) to start his program at VLWLC. Nathan also successfully recruited a new PhD student, Michael Carson of Colorado, as our first PhD student to win a full Ontario Trillium Scholarship (\$40k/year)
- Dr. Nadia Mykytczuk received the “Young Researcher Award” from her colleagues at the Polar and Alpine Microbiology Conference in Montana, Sept. 8-13, 2013. This capped off an exciting year which included receipt of her first 5 year NSERC Discovery grant, publication in Nature Group Journal (ISMEJ Feb. 2013), an interview on Quirks & Quarks (May 25, 2013) and selection of her paper on bacterial growth at -15°C as an “Editor’s Choice” article by the Journal Science. Quite a year!
- Chantal Barriault joined the Laurentian faculty team in September 2013 after a quarter century career at Science North where she was most recently Senior Scientist, Research and Evaluation. She is currently completing her Ph.D. in Science Communication through Curtin University in Western Australia. Chantal’s arrival will make it possible to offer undergraduate courses and the first, SCOM 4006 Presenting and Communicating Research, will be offered in the fall of 2014. Science Communication will be a unit in the new School of the Environment. David Pearson and Chantal Barriault will be full members of the school’s faculty.
- Dr. David Kreuzweiser was the recipient of the Canadian Forest Service Merit Award, Outstanding Achievement. 2013 and the Departmental Achievement Award: Fighting

the invasion of the emerald ash borer to protect our resources. Natural Resources Canada, 2013

- Dr. Bjorn Rosseland served as a visiting scholar in residence and guest lecturer during our OUPFB field course in August, 2013. He conducted the ICP Waters Certification Course on fish dissection and contaminant sampling and 13 students were certified.
- Dr. John Gunn and Dr. Nadia Mykytczuk were successful co-applicants in 2013 of an \$1.65M NSERC CREATE program entitled “Mine of Knowledge” (science in support of sustainable development of the mining industry). This program provides scholarships (max. \$20K) and industrial internships and involves researchers from the Univ. of Montreal, INRS, McMaster and Laurentian. The first PhD student at Laurentian to receive support from this program is Varun Gupta, who will be working on the Falconbridge wetland site, in cooperation with GlencoreXstrata Ltd.
- Dr. Tom Johnston gave one of the plenary addresses at the joint CCFR meeting in Yellowknife on January 5, 2014 entitled “Climate Warming Effects in Subarctic Rivers: Building on Traditional Knowledge”
- Dr. Heidi Swanson of Waterloo University joined the Co-op Unit in 2013 as an external member and will serve on the thesis supervising committee of two of our students (Alexandra Sumner, Gretchen Lescord). In October 2013 she was approved by the Board of Directors of the Canadian Network for Ecosystem Services to join CNAES as a principal investigator, adding to our team on the Attawapiskat Watershed study.
- Dr. Andrew Tanentzap, our Banting Post-Doctoral Fellow (co-supervised by Drs. Norm Yan and John Gunn) was selected for a faculty position at Cambridge University as head of the Ecosystems and Global Change Group in the Department of Plant Sciences. He joined Cambridge in October, 2013 but returned to Canada to marry Fallon Kirkey of Sudbury on December 21, 2013. Congratulations and Best Wishes!
- Dr. Graeme Spiers became an official member of the Cooperative Freshwater Ecology Unit in September, 2013. Graeme has been a wonderful part of our team for many years, but now that he is no longer dividing his time with MIRARCO we are pleased that we can have him all to our own. Like many other members, his office and labs are elsewhere, but he is seen frequently on site nonetheless.
- Dr. Norman Yan was the Special Recognition Recipient at York University’s Research Gala in February 2013.
- The Vale Living with Lakes Centre was officially certified as a LEED (Leadership in Environmental Energy Design) Platinum building in January 2014.

### Student Scholarships, Fellowships, Bursaries

- Kyle Artym, MSc. Candidate. NSERC CGSM – Kyle is investigating Arctic Grayling movement and habitat use in barrenland streams (Waterloo)
- Shakira Azan, MSc Candidate. E.G. Bauman Fellowship (Queen's)
- Michael Carson, PhD Candidate. Trillium Award. \$40,000/year 2014 through 2017.
- Kendra Driscoll, MSc Candidate. Tom Peters Award, CLRA
- Sarah Hasnain, MSc Candidate. Ontario Graduate Scholarship (Queen's)
- Brian Kielstra, MSc Candidate. NSERC (Queen's)
- Kim Lemmen, MSc Candidate. TD Fellowship in Arctic Environmental Issues and OGS (Queen's)
- Michele Nicholson, MSc Candidate. NSERC (Queen's)
- Caroline Sadlier, MSc Candidate. Fisheries and Oceans Canada Habitat and Restoration Bursary, January 2013. (Laurentian)
- Ashley Stasko, PhD Candidate. NSERC CGSD (Waterloo)
- Alexandra Sumner, MSc Candidate. W. Garfield Weston Graduate Fellowship to fund field work, \$10,000, 15 May 2013
- Karrah Watkins, BSc. Honours Student. 2013 Winner of Ecology Award at Ontario Biology Day, McMaster University, Hamilton, ON. 16-17 March 2013. (Laurentian)

### Community Outreach

- **Dr. Peter Beckett is the Outreach Coordinator with the VLWLC. He served in the following Capacities in 2013:**
  - **VETAC:** Chair
  - **Bioski and Snowshoe Club:** Executive member.
  - **Canadian Land Reclamation Association (National):** Director
  - **Canadian Land Reclamation Association (Ontario Chapter):** Director
  - **Greenspace Advisory Panel:** Technical member assisting in defining conservation areas in Sudbury.
  - **Junction Creek Stewardship Committee:** Technical advisor
  - **Rainbow Routes:** Environmental Advisor and Board Member

- **Sudbury Naturalists:** Co-chair
- Dr. Charles Ramcharan sat on the policy panels for the City of Sudbury Food Policy Council, The City of Sudbury Food Hub Network and the City of Sudbury Community Gardens Network
- **City of Lakes Advisory Panel:** John Bailey and Charles Ramcharan served as members of the City of Sudbury Lakes Advisory Panel (LAP).
- **Foundation Hubert Lemire:** Dr. Peter Beckett was in Haiti over reading week 2013 where he was working with the Foundation Hubert Lemire and visiting Haitian Universities and local restoration and agriculture groups in southern Haiti in an effort to apply how the lessons of regreening Sudbury could be applied to re-afforestation and mountain landscape restoration. Dr. Graeme Spiers, Kabwe Knongolo and Dan Archambault are also involved in the potential projects.
- **Picture our Lakes Photography Contest:** The Co-op Unit again took a lead role with Artists on Elgin, in a contest to celebrate the more than 330 lakes in the city's boundaries. Over 300 photos were submitted. The awards presentation was held at the VLWLC. The Co-op Unit continues to work toward its goal of promoting lake stewardship within the general public through this contest related education.
- **VETAC:** Dr. Graeme Spiers serves as a member of VETAC
- Dr. Shelley Arnott, made a public presentation at the Kingston Pumphouse Museum:
  - ~ Aquatic Invasive Species: Their impact on aquatic ecosystems and how to prevent their spread. July 2013.
- Dr. Daniel Campbell participated in approximately 8 interviews on Radio Canada radio in 2013. He also made an appearance on Radio Canada television.
- Dr. Nathan Basiliko participated in the following public outreach initiatives in 2013:
  - ~ Public lecture for the Sudbury Naturalists monthly meeting (Nov 2013) "The dirt on the soil"
  - ~ Contributed to ongoing content development and promotion of the award-winning Soil-4-Youth educational portal bringing exciting soil science educational resources to high school teachers and students to promote the important discipline of Soil Science: <http://soilweb.landfood.ubc.ca/promo/raising-awareness/soil-4-youth>
- Dr. David Kreutzweiser participated in the following news stories in 2013:
  - ~ Destructive emerald ash borer could leave loss of tree life along North Shore. Sault Star Article. October 2013.

- ~ How is the emerald ash borer jeopardizing the role of ash-dominated forests? Canadian Forest Service Web Story, June 2013.
- ~ Helping Forests Thrive at the Waters Edge. Sault Star Article. February 2013.
- ~ Helping Forests Thrive at the Waters Edge. NRCan Web Story, February 2013.
- Dr. Nadia Mykytczuk participated in the following news stories in 2013
  - ~ Interview on CBC Radio with Bob McDonald: Quirks and Quarks, , 25 May, 2013
  - ~ Interview on CBC News with Emily Chung: *Arctic bacteria found multiplying at record – 15 C, Microbes offer clues about possible life on Mars*, 22 May 2013.
- Dr. Charles Ramcharan participated in the following public presentations in 2013:
  - ~ Science North Science Cafe - How we do science. April 2013
  - ~ CBC interview on the new Living With Lakes Centre, May 2013
  - ~ Presentation to Sudbury Power Squadron on issues affecting our waterways, May 2013
- Dr. Heidi Swanson participated in the following public presentations in 2013:
  - ~ Workshops for Dehcho youth in Northwest Territories. Dr. Swanson collaborated with several others to deliver two days of workshops to over 50 youth from Jean Marie River First Nation, Sambaa Ke First Nation, Ft. Providence, Jean Marie River First Nation, and Kakisa First Nation. Youth learned to collect fish and invertebrates, and participated in many activities related to climate change and environmental change in the North.
  - ~ Invited presentation for First Nations leadership at Kakisa First Nation Workshop – ‘A Return to Country Food’ August 27-29, 2013.
  - ~ Organized a public lecture and panel discussion on the science and politics of pipeline development (at University of Waterloo)
- Dr. Norm Yan gave the following lectures to the general public:
  - ~ “Lessons learned from environmental good news stories” Muskoka Watershed Council summer environmental lecture series, Port Carling, ON, 15 August 2013.
  - ~ “Good news stories about the Muskoka Environment”, invited presentation Muskoka Lakes Association Annual General Meeting, Bala Community Centre, Bala, ON, 26 July, 2013.
  - ~ “Emerging issues for Muskoka Lakes” invited presentation at Muskoka Stewardship Conference, Nipissing University, Bracebridge, ON, 27 April, 2013.
  - ~ “Changes in the animal plankton, including a spiny invader, in Muskoka lakes: a naturalist’s perspective” invited presentation to the Muskoka Field Naturalists, 7 Feb 2013, Gravenhurst, ON

### **Community Support**

The Living with Lakes Centre continues to be a much loved community space. Some of the special events that occurred in 2013 included the monthly Lunch by the Lake music concerts,



the Margaret Atwood birthday party, Art Impact, a juried art show, and a wide variety of community meetings and gatherings.

Even though this report covers only 9 months since the last report, our stats indicate that our building received heavy use:

- Approximately **110** groups have held events in our building representing over **7,000** users
- **6** fundraising events through the Office of the President or Advancement Department
- **74** external community group users
- **70** other Laurentian University group users

### Living with Lakes Centre Design Awards

We were officially certified as a LEED Platinum building in January, 2014.

### 2013 Watershed Lecture and "Lunch and Learn with Dr. Smol"

Dec. 4th was a very special day at the Lake Centre as we were honoured to have Dr. John Smol, one of Canada's best known environmental scientists, and recipient of the 2013 Order of Canada award, present the 2013 Watershed Lecture. In fact he presented two lectures-addressing his two passions (Teaching and Research). The first "Bringing the Joy of Discovery into the Classroom", was presented at VLWLC to an audience of over a 100 and live streamed to many others. The second "Paleolimnology: Windows into the Past of a Changing Arctic", was presented to a full house at the Vale Cavern at Science North. In addition to the lectures we had an exciting "Lunch and Learn Event with Dr. Smol" and this was an opportunity to meet with students and staff and see some of the exciting Science Communication projects underway at VLWLC. Dr. Nadia Mykytczuk hosted Dr. Smol for a session describing some of the student research in the Far north and her own work from the High Arctic. Dave Pearson and Chantal Barriault described some of their recent work in Fort Hope with a whole community science literacy and engagement event. Patrick Moldowan, a M.S. student with Jackie Litzgus, gave a fabulous lunch time talk about the making of his "Eagles Award" video. Altogether a great day.

THE VALE LIVING WITH LAKES CENTRE PROUDLY PRESENTS THE  
**2013 Watershed Lecture**

**Dr. John Smol**  
Queen's University - Office of the Order of Canada  
Canada Research Chair in Environmental Change

Winner of the 2014 OSCEI Honorary Gold Medal as Canada's top scientist, he has also won 25 teaching, mentoring and service awards, including a 2008 National Teaching Fellowship, and was chosen by Nature Magazine (London, UK) following a nation-wide search, to be Canada's Top Mid-Career Scientist. Member, In 2011, the Governor General of Canada named John an Officer of the Order of Canada.

**Tuesday, December 10, 2013**  
**1 - 2 p.m. - Vale Living with Lakes Centre**  
"Environmental Research and Bringing The Joy of Discovery into the Classroom"

**7 p.m. - Free Public Lecture**  
**Vale Cavern, Science North**  
"Paleolimnology: Windows into the Past of a Changing Arctic"

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### **Key Science and Science Engagement Events**

- *TÅLER – NSERC CRD meetings* (see below for details)
- *Science Unmuzzled*: Nearly 100 people attended this event on March 8, 2013 organized by the Biology Society. A panel of scientists, media, and politicians shed light on the current status of science and explored questions like “is there a war on science”, and “who owns the information generated by public money and what happens to it.” Dr. John Gunn and Dr. Dave Pearson were panelists for this event.
- *Russian Delegation*: March 10 - 12, 2013. Nine Russian delegates from The National Mineral Resources University - University of Mines, St Petersburg, Russia, hosted by the Goodman School of Mines, visited Laurentian University including the VLWLC to discuss potential collaborations. Their university has the oldest school of mines in the world and can be a great model for our new initiatives. The focus of the Goodman School of Mines on sustainable mining has created a pivotal role for the Living with Lakes Centre sparking new areas of collaboration.
- *Bioremediation workshop (March 27, 2013)*: The Living with Lakes Centre and the Goodman School of Mines held a workshop on Mar 27 titled “Completing the Mining Cycle: Bioremediation and Reclamation of Mine Waste Areas”. Presentations illustrated how lessons learned in Sudbury may be applied to developments in the Ring of Fire area to avoid some of the environmental damage experienced in the previous century. ( see below for details)
- *Canadian Network for Aquatic Ecosystems Services (CNAES) April 29-30, 2013*: (see details about the network below) held its first Annual Network Meeting. The meeting provided an excellent opportunity for networking and information sharing among Network members from across Canada. Attendees included researchers from 11 universities, Canadian government scientists, industrial partners and environmental and technology associations. The meeting facilitated the exchange of project ideas within and across research themes, promoted discussion of the various approaches being considered in different regions, and enhanced collaboration amongst researchers. Highly-Qualified Personnel (HQP) had the opportunity to present their work to other Network members. In addition, each Theme was provided the opportunity to meet and discuss their research.

### **Aurora Trout Physiology Study 2013**

Through its Visiting Scholar in Residence program, the Cooperative Freshwater Ecology program at the Vale Living with Lakes Centre at Laurentian University was able to involve Dr. Bjorn Olav Rosseland from the Norwegian University of Life Sciences, Norway, in a physiological and contaminant study to assess the effect of Ca decline and contaminant deposition. This internationally recognized expert applied the international ICP-Waters protocols to this study, allowing us to compare findings with many of the most sensitive lakes in the world. John Gunn, Jocelyne Heneberry, Matt Heerschap and Bjorn Rosseland participated in the study on Sept. 3-

6, 2013. The team collected the 20 specimen of aurora trout needed for a full analyses within an effective 48 hours of sampling.



Dr. Bjorn Rosseland processing an Aurora Trout.

### **NSERC CRD Program TĀLER 2010-2015**

*“Terrestrial Aquatic Linkages for Ecosystem Recovery”*

The TĀLER project funded by NSERC, Vale Ltd. and GlencoreXstrata Ltd. was designed to address the concerns identified through the Ecological Risk Assessment as part of the Sudbury Soils Study. The ERA concluded that Sudbury’s terrestrial ecosystems exhibited persistent problems because of the continuing soil erosion, elevation of metal contaminants and the lack of organic matter. The degraded nature of the land in turn appeared to adversely affect the recovery of diverse communities of invertebrates at the interface of terrestrial and aquatic ecosystems (i.e. littoral zones, riparian areas). The initial research team for this project consisted of J. Gunn and W. Keller (Laurentian), D. Kreuzweiser (Can. For. Serv.) S. Watmough (Trent), N. Yan (York) and J. McGeer (Wilfrid Laurier) and their students and post-docs. In 2011 S. Arnott (Queen’s) joined the project to support a M.Sc. project by B. Kielstra. In 2012, A. Yates (Western) and J. Bailey (VLWLC) joined to support a PDF project by David Armanini.

TĀLER addresses the following questions:

- 1) How does disturbance type (fire, logging, mining) affect benthic invertebrate recovery? (D. Kreuzweiser, J. Gunn, S. Arnott)
- 2) What controls the quantity and quality of organic matter entering lakes? (S. Watmough, J. Gunn)
- 3) How do organic matter and base cations interact to influence the toxicity of residual metals? (J. McGeer, N. Yan, M. Celis-Salgado)
- 4) What habitat characteristics are associated with healthy invertebrate communities? (A. Yates, J. Bailey, W. Keller)

The TĀLER projects make use of study sites and facilities at the:

- 1) CFS experimental watershed sites in White River, Ontario
- 2) Catchment sites associated with many key long-term study lakes (e.g. Clearwater, Daisy, Laurentian) in Sudbury
- 3) FLAMES lab and long-term catchment study sites in Dorset

Extensive data from over 300 sites from the Freshwater Invertebrate Reference Network of Northern Ontario (FIRNNO) located across mining regions of Ontario are also being used.

The TĀLER group held its first workshop at the Copper Cliff Club on Oct. 27, 2010 hosted by Vale Ltd. A special guest at the meeting was Dr. Sandra Clinton, a microbial ecologist from N. Carolina State. Representatives for the City (S. Monet) and the OMOE (P. Welch) also participated. The second TĀLER workshop was held on Aug. 31, 2011 at the Lakes Centre. A unique aspect of the meeting was the participation of 12 OUPFB (Ontario University Program in Field Biology) students from 7 participating universities. The 3<sup>rd</sup> and 4<sup>th</sup> TALER meetings were held in 2012 and the agendas were as follows. The 2013 TĀLER meeting was held on Aug. 29-30, again with OUPFB student participation.

### **TĀLER Meeting 2013**

#### **Thursday, August 29, 2013**

- Introduction from Andrew Tanentzap (AJT) Preliminary model structure
- Working Groups Aim: Accept model structure  
Discussion topics include: 1) Model structure 2) Modeling approaches 3) Feasibility/knowledge gaps
- Group Session Aim: Groups acceptance of final model structure
- Working Groups re-convene and work on estimating relationships  
Aim: Produce first regression relationship
- Working Groups re-convene to continue modeling  
Aim: Produce second regression relationship
- Closing group session with AJT. Identify leaders and next steps.  
Aim: Format timeline and deliverables

#### **Friday, August 30, 2013**

- E. Szkokan-Emilson, Metal geochemistry of wetlands in watersheds recovering from historical metal and sulphur deposition
- Paul Pennington - Spatial and Temporal Variations in Peatland Geochemistry in Sudbury, Ontario
- Sophie Barrett - Characterizing the impact of a historical industrial deposition gradient on peatland vegetation and peat near Sudbury, Ontario
- Brian Kielsta - Multiple scales of amphipod recovery
- Christine Geiger -Aromatic-Rich Natural Organic Matter Increases Growth and Reduces Nickel Toxicity in a Wild Daphnia Hybrid
- Intro to OUPFB contributions to TALER (N. Mykytczuk) followed by group presentations and discussion:  
Tribe 1 Veg – Leaders: P. Beckett, G. Spiers and A. Watkinson  
Tribe 2 Bug – Leaders: A Tanentzap and J. Gunn  
Tribe 3 Microbe – Leaders: N.Mykytczuk and C. Sadlier

### **Aquatic Restoration Group - Sudbury Environmental Study Lakes**

In 2013, the Ministry of the Environment at the Cooperative Freshwater Ecology Unit continued sampling lakes for the Sudbury Environmental Study (SES) under 2 main programs which complement each other: SES Extensive and SES Intensive. The SES Extensive program includes a set of 44 lakes, located within a 100 km zone around Sudbury. These lakes were all acidified to below pH 5.5 in the early 80s, but are now in various stages of recovery. They were sampled once annually during the period late June through early July. The data are intended to provide information on regional patterns in water quality and lake recovery in the lakes near Sudbury. During 2013 all 44 lakes in the SES Extensive lake set were sampled once for a set of standard water chemistry parameters and zooplankton samples were also collected. The SES Intensive program is a set of lakes sampled monthly or twice-monthly through the ice-free season for a wide range of physical, biological and chemical parameters (water chemistry, Secchi disc transparency, oxygen/temperature profiles, zooplankton, phytoplankton), therefore giving a larger and more varied amount of data on a smaller group of lakes. In 2013 there were 16 lakes sampled monthly (May - October) and 1 lake sampled twice-monthly (Swan lake) under the SES Intensive program.

Beginning in 2012, the SES sampling was expanded to include lakes in the Serpent River watershed that were acidified through the effects of acid mine drainage from Elliot Lake uranium mines and are now recovering. Zooplankton, phytoplankton and standard water chemistry data were collected for comparison to Sudbury-area recovering lakes to compare the rate and nature of their recoveries. In 2013, two of the lakes (Whiskey and Whitefish) were sampled monthly from May through October. *Daphnia mendotae* bioassays were also conducted at the York University FLAMES laboratory using water from select Serpent River watershed lakes compared to similar bioassays using water from two Sudbury area lakes (Clearwater Lake, Whitepine McLeod, Aurora Whitepine) as part of an Honours BSc project undertaken by Matt Heerschap. This component of the programme is expected to provide further insight to the recovery of Sudbury lakes.

Sampling was also expanded to include visits to 4 lakes in the vicinity of the proposed chromite smelter north of Capreol. This additional sampling was undertaken in order that we are better positioned to distinguish any new effects from the construction and operation of the chromite smelter from historical and ongoing effects from the Sudbury smelting operations.

Finally, in July-August of 2013, the lake sampling programme was expanded to include lakes in the Ring of Fire Region as part of an initiative by MOE to collect baseline environmental data in the area. Twenty lakes were sampled for zooplankton, benthic invertebrates, water chemistry and phytoplankton.

The zooplankton taxonomy lab continued to process samples collected under the SES program, but also processed samples for various partners and collaborators including the Severn Sound Environmental Association, Dorset Environmental Science Centre (DESC) and the Climate Change and Multiple Stressor Research Programme.

Database management during 2013 included updating the several databases that house data produced from our programs. In addition, numerous data requests were addressed from partners and collaborators. Support for other projects, including graduate student projects was also provided (data, expertise and logistics).

These Sudbury area monitoring programs continue to be a very important component of Canadian and international efforts to assess the effects of acid deposition and the responses of lakes to sulphur emission controls. In recent years these studies have also figured prominently in large-scale collaborations investigating the effects of other major environmental stressors including climate change, UV-B irradiation, changes in DOC concentrations and declines in calcium. Results from these sampling programs have been presented and interpreted by ARG partners and numerous collaborators. Most of these publications were prepared for peer reviewed journals for widespread dissemination. A list of recent publications arising from this program can be found within the publication section of this report.

### **Climate Change and Multiple Stressor Aquatic Research Program**

#### **Science Advancement and Science Transfer:**

To promote and facilitate climate change and multiple stressor research in Ontario, partial funding support has been provided for 12 projects at 8 universities (Queen's, Ottawa, Toronto, Wilfrid Laurier, UQAM, York, Trent, Laurentian). These projects are now yielding valuable results that are advancing the scientific understanding of climate change and multiple stressor effects on aquatic ecosystems. Products include B. Sc. and M. Sc. theses, and a number of journal papers have recently been submitted from these projects; many more will be submitted during the coming year.

Much progress has been made in networking and collaborating with northern researchers. A special issue of the journal Arctic, Antarctic and Alpine Research is scheduled for February 2014, which will feature science from the Hudson/James Bay drainage of Ontario as well as studies from Manitoba and Quebec. W. Keller is a guest associate editor for this special issue.

Working relationships have been maintained with First Nations residents in several communities in the Far North in order to conduct science-related collaborations. Following up on previous studies, W. Keller coordinated work by Albert Chookomolin (Peawanuck resident) and Timothy Miles (Fort Severn resident) for installation of recording thermistors in sea run brook charr rivers to document thermal conditions during spawning runs.

#### **Field Project Updates:**

##### **Hawley Lake Area**

In August 2013, Laurentian University continued sampling aquatic ecosystems in the Hawley Lake area near the Hudson Bay Coast. This work followed on studies conducted in the summers of 2009 to 2012. These studies involve collaborators from MNR, University of Ottawa, Queens University, Trent University and Wilfred Laurier University. During 2013, work focused on continuing to collect water quality and temperature data from Hawley Lake and from various locations along the Sutton River. A status report summarizing all the work done in the Hawley

Lake area was prepared and distributed during winter 2013. All information generated from the studies is being made available to stakeholders involved with managing and protecting water resources in the far north of Ontario.

#### “Ring of Fire” Area Surveys

Previously, In August 2011, in collaboration with the Ontario Geological Survey (OGS), 98 lakes were sampled in a block running through the “Ring of Fire” area, near the community of Webequie. Lakes were sampled through the transition between the Hudson Bay Lowlands and the Boreal Shield. During 2012, Geochemical analyses of water samples from that survey were completed by OGS, additional water analyses were conducted by MOE, and paleolimnological (diatoms, cladocerans) analyses of recent and old sediments were conducted by Queens University. A data sharing agreement has been developed between the Cooperative Freshwater Ecology Unit and OGS. Data analyses are in progress for all aspects of this project. Additional chemical and biological lake surveys were completed on 29 lakes in north-western Ontario around the Ring of Fire area in July 2012, by Laurentian and Queen’s Universities. This study was developed in collaboration with the First Nation communities at Fort Hope, Neskantaga and Webequie. Data from the 2011 and 2012 lake surveys are currently being analysed by M. Sc. candidate Josef MacLeod as part of his research project – Analysis of lakes in the Far North of Ontario: Regional Contrasts and Comparisons.

During 2013, field work continued in the Ring of Fire area, and more broadly throughout northern Ontario. W. Keller participated in sampling of 20 lakes around the Cliffs mining camp in the Ring of Fire area (chemistry, plankton, benthic invertebrates). Chantal Sarrazin-Delay, based out of the Debeers Victor Mine sampled 40 stream sites (chemistry and benthic invertebrates) flowing into the Attawapiskat River, from the confluence with the Muketei River to the mouth. She also conducted science activities in the community of Fort Hope (Eabametoong First Nation) instructing community members in OBBN invertebrate identification, engaging children from the community in science based activities, and conducting sampling of area streams using the CABIN protocol.

#### Northern Rivers

In follow up to previous work, during 2013 recording thermistors were again placed at various locations in the Sutton (Albert Chookomolin, Peawanuck, Weenusk First Nation), and Pipowatin Rivers (Timothy Miles, Fort Severn, Washaho First Nation). These thermistors were retrieved in the fall, after tracking water temperatures during the brook charr runs. Samples for water chemistry analyses were also collected from both these rivers at multiple sites, to add to our knowledge of baseline chemical characteristics of northern rivers.

#### Northern Fisheries Research Program

This program improves our understanding and aids the management of the fish populations that support the recreational, commercial and subsistence fisheries of northern Ontario. The program is led by Tom Johnston (OMNR) and has included a variety of projects examining the biology, ecology, and ecotoxicology of northern fish populations. Work on this program in 2013

was primarily directed at two fields of research: **i) Mercury bioaccumulation and food web structure in northern fish populations.** This work is funded by the OMNR Far North Branch, the OMNR Aquatic Research and Monitoring Section, the OMOE Environmental Monitoring and Reporting Branch, and the NSERC CNAES. The geographic focus of this work continues to shift towards aquatic ecosystems of Ontario's Far North. Fish sampling at six sites along the Attawapiskat River was completed in summer 2013 as part of the CNAES program. A graduate student research project was initiated on the potential effect of climate change on bioaccumulation and biomagnification of mercury in fishes of the boreal shield (Sumner, MSc). **ii) Reproductive ecology of northern fishes.** This research is funded by the OMNR Aquatic Research and Monitoring Section and the NSERC Discovery Grants Program. Research on Lake Nipissing continues to explore the effects of multiple stressors (spawning stock decline, food web disruption) on energy allocation and reproductive ecology of its walleye and white sucker populations (Elsasser, BSc). Graduate research on reproductive ecology of burbot was completed (Cott, PhD).

### **The Freshwater Invertebrate Reference Network of Northern Ontario (FIRNNO)**

Biological indicators such as benthic macroinvertebrates (BMI) are useful in gauging the degree of impact due to anthropogenic activities. The simplest approach involves the collection of BMI data prior to the activity at paired control and impact areas and the comparison to BMI data after the activity. The traditional before-after/ upstream-downstream (BACI) study design is not always feasible due to confounding issues and geographical limitations, hence alternative designs have been proposed. The Reference Condition Approach (RCA) to bioassessment is based on the premise that when a site is to be assessed, its BMI community is compared to that of many minimally impacted reference sites with similar habitat characteristics. The implementation of the RCA design generally requires a large network of reference site encompassing many habitat types from which to match a site of interest. Such a network is currently maintained by Co-op Unit.

The Freshwater Invertebrate Reference Network of Northern Ontario (FIRNNO) was designed to assist the metal mining industry in locating suitable reference sites to meet the Environmental Effects Monitoring (EEM) requirements of the Fisheries Act. The objectives of this project are

- to develop and maintain a large network of reference sites to define the normal range of Northern Ontario benthic macroinvertebrate (BMI) communities
- to maintain an accessible database of BMI abundance and chemical/physical habitat characteristics for Northern Ontario lakes and streams
- to assess and monitor mining and other anthropogenic effects on surface waters by detecting any change in BMI community structure.

Since FIRNNO's establishment in 2003, BMI data for over 400 sites have been collected in the vicinity of 4 mining centers including Red Lake, Hemlo, Sudbury and Timmins along with accompanying water chemistry as well as site, channel and watershed level habitat data. Various modeling strategies have been explored including the Nearest Neighbour technique



(NN). Here the BMI community of a discharge site is compared to the BMIs at the reference sites that most resemble the discharge site in habitat using ordination techniques

The core program is complemented by work being done to understand the impact of various sources of variability on the assessment of a discharge site. We are investigating the effects of temporal, spatial, replication and methodological factors, confounding anthropogenic effects, as well as various statistical approaches. In 2013, fall sampling continued with 50+ benthic samples collected from a mixture of long term and new sites. These included sites on and around Ramsey Lake, sampled as part of a collaboration with the City of Greater Sudbury wherein MOE will seek to determine “reference condition” for urban aquatic systems.

The addition of another year of data for a number of sites will help gain a better understanding of inter-annual temporal variation as it pertains to the assessment of an affected site. Some new sites were sampled in the area north of Capreol where a chromite smelter facility may be constructed. Adding reference sites in this area will better prepare us to evaluate potential effects from the construction and operation of that smelter. This work was carried out in collaboration with Wahnapiatae First Nation and included sites of interest to that First Nation. A joint crew carried out the sampling and MOE will be providing sample processing and data analysis assistance to WFN as part of this collaboration.

Benthic invertebrate sampling was also carried out on Attawapiskat River Basin streams in the summer of 2013, partly through the NSERC CNAES and also through an MOE initiative to gather baseline environmental data in the Ring of Fire Region. Two crews worked on the Attawapiskat River and included participation by Attawapiskat and Marten Falls residents as well as a crew member from Matawa Tribal Council. These crews sampled 72 wadeable stream sites in the Basin.

We were invited to participate in the publication of a special issue of Freshwater Science wherein the performance of several benthic invertebrate data analysis techniques are compared. We are among several international contributors who were invited to apply their analysis techniques to three common data sets and write up the results. A manuscript for this collection was submitted in 2013 and the Special Issue is expected to be published in 2014.

### **Mine of Knowledge Program: Finding Microbial Solutions to Ecosystems Problems**

The Mine of Knowledge program is 5 year \$1.65 NSERC funded CREATE program designed to train students in a multi-disciplinary research to provide the mining industry with highly qualified personnel in environmental management and restoration of ecosystem services at mining locations around the world. Laurentian University joins with University of Montreal, INRS, McMaster, and Ottawa universities in this bilingual Quebec/Ontario program. Bacterial metabolism represents the root cause of deleterious mine drainage, but also a significant untapped opportunity to enhance mine sustainability through strategic characterization of its roles in these ecosystems. In addition to providing students with hands-on experience, the SMART-MINE initiative will provide them with training in analytical and environmental

chemistry, mine waste mineralogy, biogeochemistry, ecotoxicology, environmental genomics and molecular microbiology using state-of-the-art instrumentation and modeling approaches. Graduate projects will range from fundamental laboratory-based projects on membrane protein transport to large-scale field studies on the bioremediation of mine drainage. This bilingual Quebec/Ontario training program will form a new generation of environmental scientists who understand the needs of mining industries and are prepared to propose innovative solutions to improve the environmental sustainability of this key Canadian economic sector. With the increasing overlap associated with expansion of mining activities into the Canadian north between Canadian mining activities and First Nations communities, this mine of Knowledge will emphasize First Nations representation and involvement.

### **Biomremediation Workshop**

A new series of workshops on bioremediation has been established at VLWLC in partnership with the Goodman School of Mines. The agenda from the 2013 meeting was:

*March 27<sup>th</sup>, 2013*

*Completing the Mining Cycle: Bioremediation and the Restoration of Ecosystem Services*

- John Gunn (VLWLC) Welcome
- Daniel Campbell(MIRARCO) Reclamation of Mine Wastes in the Far North
- Graeme Spiers(ELRFS / LU Dept. of Chemistry) Biogeochemical Impacts on Minerals Industry Materials – From rocks to anthrosols
- Nadia Mykytczuk (VLWLC) Microbial bioleaching : Metal recovery and remediation of Sudbury tailings
- Mairi Best (VLWLC)Submarine Tailings: Overview and Global Examples
- Roberta Pedlar-Hobbs (Denison Env. Serv.) Denison Tailings Management Program
- John Bailey (OMOE / VLWLC) Recovery of Contaminated Lakes: Sudbury vs. Elliot Lake comparison
- Peter Beckett (VLWLC) From Waste to Biofuels
- Bruce Jago (Goodman School of Mines) Wrap Up

### **Canadian Network for Aquatic Ecosystems Services (CNAES)**

#### **Networks Lead Scientist**

Dr. Don Jackson, University of Toronto

#### **Theme I Co-Leaders:**

Dr. Brian Branfireun, Western University

Dr. John Gunn, Laurentian University

#### ***LU/CFEU participants:***

J. Bailey, D. Campbell, J. Gunn, T. Johnston, B. Keller, D. Pearson, H. Swanson

## Summary

Aquatic ecosystems are recognized for the many direct ecological, social and economic benefits they provide (e.g. fisheries, drinking water) but they also provide many services not well recognized, including hydrologic and nutrient regulation, and waste processing. Increasingly the importance and associated economic value of these ecosystems are being recognized (e.g. Canada's Roundtable on the Economy and the Environment), including most recently by the United Nations General Assembly in creating the Inter-governmental Panel on Biodiversity and Ecosystem Services (IPBES 2011). This, and related conventions and agreements, require Canada to develop detailed knowledge and policy to address issues specific to ecosystem services. Furthermore, there are plans for extensive development of remote northern areas throughout Canada (e.g. Quebec's Plan Nord, Ontario's Far North Act) for mineral, petroleum and hydroelectric resources. However we have limited knowledge about how these developments may impact these ecosystems, and how to manage these ecosystems to allow enhanced development. The Canadian Network on Aquatic Ecosystem Services (CNAES) will provide the collaboration from academia, industry and government to develop knowledge about, and provide training on, the relationship between these ecosystem services and stressors (e.g. development, climate change). Research will lead to the production of necessary tools to detect impacts on these systems, appropriate restoration targets, and the understanding essential for policy and management development. Canada's aquatic ecosystems are tremendously varied, so CNAES takes a watershed-based approach to address under studied systems (northern wetlands), knowledge gaps associated with forest-stream and lake ecosystems, and linkages across these systems. CNAES will determine how properties of ecosystem services from these systems vary due to spatial and temporal scale in order to provide results that have general applicability, rather than being size or site specific. We will develop understanding and management tools for government and industry through the study of predominant Canadian landscapes.

*NSERC funding:* Total of \$4,416,625.00 over 5 years (2012-16)

*Participating Universities:* Toronto, Laurentian, UBC, UQAM, Western, Guelph, Trent, UNB, Waterloo, McGill, Nipissing

*CNAES Graduate Students at LU (to date):*

*Project 1.3 Characterize the structure and function of aquatic ecosystems*

1.3(a) RCA invertebrate surveys – M.Sc. Nicole Novodvorsky (PI John Bailey)

1.3(b) Zooplankton and Phytoplankton – M.Sc. Josef MacLeod (PI Bill Keller)

*Project 1.5 Characterize the distribution of Hg and MeHg in surface water and freshwater biota*

1.5(a.1) Headwater to Coast Hg Survey – Ph.D. Gretchen Lescord (PI Tom Johnston/John Gunn)

1.5(a.2) Stable Isotopes and Hg – M.Sc. Alexandra Sumner (PI John Gunn/Tom Johnston)

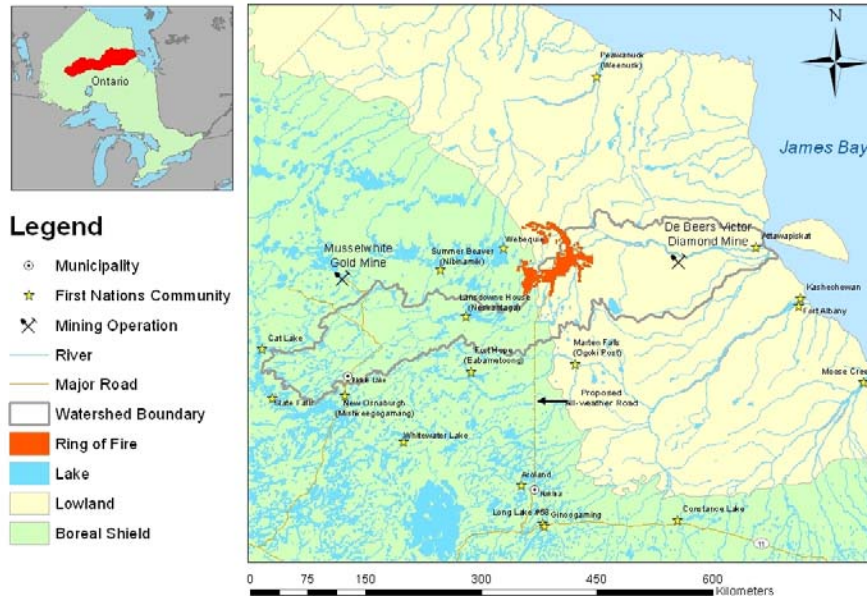
1.5(c) Anadromy and Hg – T.B.A. (PI Heidi Swanson, Waterloo)

*Partnering agencies:* Ontario Ministry of the Environment, Ontario Ministry of Natural Resources, Canadian Forest Service, Natural Resources Canada, Parks Canada, Fisheries and

Oceans Canada, Central & Arctic Region, Le Ministère des Ressources naturelles et de la Faune du Québec

*Partnering Industries and Foundations:* Debeers Canada, Alberta Innovation Technology, Kongsberg Maritime, David Suzuki Foundation

### The Attawapiskat River Watershed



The Attawapiskat watershed is one of the principal study sites for the LU/CFEU scientists and students participating in the Canadian Network for Aquatic Ecosystem Services (CNAES).

### **A New Model for Upper Level Student Engagement and E-learning through Social Online Course Environments with a Global Reach: the Laurentian University SOLE Model**

A team of people including Nadia Mykytczuk (project lead), John Gunn, Bruce Jago (Goodman School of Mines), in collaboration with several LU departments, faculty, staff and external city and industry collaborators are working to develop, test, and deliver an innovative new learning model for e-learning courses. The model and first production will lead to the establishment of a signature course for Laurentian on “Bioremediation; Global Lessons from the Sudbury Restoration Story.” Such a course will be key to Laurentian’s provincial, national and international student recruitment efforts. The interactive experimental model that we will develop and test will guide future developments of not only our own distance education programs, but is also designed to lead to major improvements in on-line course at other institutions in Ontario.

## **Science Communication**

### ***Graduate Diploma***

The one year Graduate Diploma remains the focus of the teaching program. Enrolment in 2013-2014 would have been 15 students but for the strike by visa staff in Canadian Embassies. Unfortunately two international students were prevented from enrolling. As usual, all of this year's students have science degrees from universities across Canada; several have a Masters degrees and one has a Ph.D.

### ***Video stories with Biology graduate students***

A major activity in the winter semester continues to be producing 4 to 6 minute video stories of the research projects of Biology M.Sc. students. This culminates in the Eagle Awards Gala in early April. Patrick Moldowan's "Secret Life of Painted Turtles", produced by Sabrina Doyle (now working for Canadian Geographic) was awarded Best Picture for 2013. Autumn Watkinson's "Manufactured Soils" produced by Grace Hunter, won an Honourable Mention in the Best Picture category. Grace Hunter was also the producer for Caroline Sadlier's captivating stop animation "Aquatic Microbes", which ran away with the award for Most Original Picture. As well as the fun of the Grand (Pot Luck) Gala with John Gunn and David Pearson in black ties and dinner jackets, the learning experience for about 40 students is second to none. The camera and editing equipment, purchased three years with a donation from Vale, will be supplemented to include a small audio recording and editing corner, as well as another video editing station, as donations are found.

### ***Far North Outreach – the Far North Ontario Youth in Science Opportunity Program***

A team of five went to the fly-in community of Fort Hope near the south edge of the "Ring of Fire" region for a week in November to visit all the JK to Grade 9 classes in the Eabametoong First Nation's community school. Three science communication students took two telescopes, including a Hydrogen alpha solar telescope, moose bones, butterfly specimens (expired residents of the Butterfly Gallery at Science North), Attawapiskat area tree cookies with immensely tight growth rings, sea shells, fossils of types found in the Hudson Bay Lowland, as well as wifi hand held microscopes and ipods along with traditional lab microscopes and aquatic invertebrate specimens, house flies and lichen, and, not least, laptops loaded with astronomy apps. The purpose was not to teach curriculum but to engage and motivate the students to be more interested in science.

One student doubled as a videographer and Chantal Sarrazin-Delay from the Lake Centre's field and lab team, doubled as a class room demonstrator of water monitoring equipment and trainer in invertebrate identification for three band members. We took part in a public open house and spent time with Eabametoong's data gatherer for the Land Use Planning exercise currently underway. This outreach activity is almost entirely supported by private donations. Long term support is being sought to enable 6 communities to be involved in the program and for two or three visits to be made during the school year when working relationships can be established with teachers within a whole community relationship.

### ***Canadian Science Policy Conference and Field Trips***

We were selected from many proposals to present a workshop on 'Making Science Communication Effective, along with two communication colleagues and friends of the program from Ottawa, at the annual Canadian Science Policy Conference in Toronto. We made it the first stop on a student field trip that went on to include the Discovery Channel and the Daily Planet crew, the Perimeter Institute (where two graduates from the program are working), the Waterloo Institute for Quantum Computing, and the Royal Ontario Museum for the opening of the Wildlife Photographer of the Year Exhibition.

Dark Matter and Dark Energy experiments at SNOLab were the talking points on another field trip where we were again met by one of our science communication graduates, Samantha Kuula, who is the Communications Officer for SNOLab.

### ***Work experience placements and graduates***

Our 80 graduates since 2006 are slowly spreading around the world. James Baxter-Gilbert is carrying the flag, along with his very newly minted Biology M.Sc., to Australia. Closer to home Sarah Wendorf has recently been appointed the Social Media and Web Specialist at Health Sciences North. There is much to say on another day about our other graduates and the mark they are making. For the moment we can add that work experience placements during the program have taken students to CERN in Switzerland, the Canada-France-Hawaii Telescope in Hawaii, the Experimentarium in Copenhagen, and the *Science Times* in Beijing among many other fascinating and rewarding places. Instead of searching for placements we are now fielding more requests from prospective hosts than we have students.

### **Climate Change Adaptation**

Four reports on planning for climate change adaptation were completed in 2013 for Fort Hope and the Eabametoong First Nation, Constance Lake First Nation, Fort Severn First Nation, and Webequie First Nation. This work will continue with other Far North communities.

### **Academic Programs and Modular Courses**

The teaching facilities at the VLWLC were well used in 2012 with both undergraduate (BIO 3377, 4386, 4756, 4907) and graduate (BIO 5056) courses in Biology as well as the following Science Communication courses offered here:

SCOM 5016- Audiences and Issues

SCOM 5036 – Theory and Principles of Science Communication

SCOM 5056 – Design Theory in Science Communication

SCOM 5066 - Science Communication Practice

SCOM 5096 – Communicating Science through Information Technology

SCOM 5106 – Communicating Science through Mass Media

The Ontario University Program in Field Biology (OUPFB) as well as the PhD in Boreal Ecology also call the Lake Centre home in 2013. A unique course involving First Nation engagement was held in 2013 that made extensive use of the VLWLC video conferencing facility. This course

(BIO 4907 – Fisheries Science for Stressed Ecosystems) was created in consultation with Matawa Tribal Council staff and was designed to address the science needs of the Far North communities to answer fisheries questions related to industrial development and climate change in their traditional areas. Each student took a questions posed by community members and addressed it during a March 21, 2013 video conference presentation to First Nation Community representatives gathered in Thunder Bay. The student presentations were much appreciated.



**4<sup>th</sup> year Biology Students in BIO 4907 present to First Nation Community Representatives.**

### **Conference Organizing, Program Coordination and Editorial Activities**

Arnott, S. Associate Editor of the Journal of Applied Ecology 2010-present

Arnott, S. Served as Session Chair, Multiple Stressors, Society of Canadian Limnologist/CCFFR, Windsor, ON, 2013

Arnott, S. Served as Chair of Meeting Committee, the American Society of Limnology and Oceanography

Basiliko, N. Served as Associate Editor, Canadian Journal of Soil Science (2013-)

Basiliko, N. Served as Review Editor, Frontiers in Microbiology (2011-)

Beckett, P. Served on the Organizing Committee for the Ontario CLRA/OMA Annual Reclamation Symposium

Beckett, P. Served on the Steering Committee for the CLRA/Mirarco Lunch-time Reclamation Discussion Group

Belzile, N. Served as Associate Editor for the Journal of Geochemical Exploration

Belzile, N. Served on the Editorial Board of ISRN Environmental Chemistry

Belzile, N. Served on the Editorial Board of Green and Sustainable Chemistry



Gunn, J. Served as Programme Co-Chair for the Organizing of the 2013 CCFFR/SCL Conference held in Windsor, ON. 3-5 January 2013

Gunn, J. Served as Coordinator for the Boreal Ecology PhD Program.

Kreutzweiser, D. Served as Associate Editor, Canadian Journal of Forest Research

Spiers, G. is serving as Chair for the Sudbury 2015 Organizing Committee

Spiers, G. Served as Session Chair for EnviroAnalysis 2013

Spiers, G. Served as Treasurer of the Canadian Society for Analytical Sciences and Spectroscopy 2013-2015

### **Partners and Collaborators**

#### **Industry**

Vale Ltd.

GlencoreXstrata

DeBeers Canada

#### **Government Funding Partners**

City of Greater Sudbury

Can. Wildlife Service

CFI/OIT

Environment Canada

FedNor/MNDM

Fisheries and Oceans Canada

Great Lakes Fishery Commission

Great Lakes Forestry Centre, NRCAN-CFS

Industry Canada

NSERC

#### **Scientist Collaborators**

Laurentian University

Queen's University

University of Lethbridge

Centre for Ecology and Hydrology, UK

University of New Brunswick

L'Université du Québec à Montréal

L'Université du Québec à Rimouski

Western University

Cambrian College

University of Guelph

University of Waterloo

Wilfrid Laurier University

University of Turku, FI

University of Alberta

Univ. of British Columbia

Univ. of Windsor

York University

University of Toronto

Indiana University

University of Ottawa

Univ. of Montreal

Trent University

Univ. of Canberra

McGill University

Cornell University  
Appalachian State University  
Mt. Holyoke College  
University of Winnipeg

Cambridge University  
Michigan Tech U  
University of Colorado  
University of Waikato

Lakehead University  
University of Munster  
University of Kansas

#### Others

Agriculture Canada  
Barrick Gold  
Canada-Ontario Invasive Species Centre  
Dehcho First Nations  
Denison Environmental Services  
Forest Ecosystem Science Cooperative  
Friends of Killarney Park  
Haliburton Forest and Wildlife Reserve  
Hemlo  
Holden Arboretum

Irving Pulp and Paper  
Matawa Tribal Council  
Ontario Power Generation  
MIRARCO  
Resolute Forest Products  
Severn Sound Environmental Association  
Tembec  
United States Fish and Wildlife Service  
United States Geological Survey  
Wahnapiatae First Nation

#### Book Chapters

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### **Publications**

Co-op Unit Members authored or co-authored numerous publications:

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Stackhouse, B.T., T.A. Vishnivetskaya, A. Layton, S. Pfiffner, N.C.S. Mykytczuk, L.G. Whyte, L. Hedin, N. Saad and T.C. Onstott. 201X. Vertical gas fluxes, geochemical characteristics, and

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Symons, C.C., and S.E. Arnott. 2013. Regional zooplankton dispersal provides spatial insurance for ecosystem function. *Global Change Biology* 19: 1610-1619.

Symons, C.C. and S.E. Arnott. Timing is everything: priority effects alter post-disturbance invisibility. *Ecology and Evolution*. In press.

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Tran, A., K.K. Nkongolo, M. Mehes-Smith, R. Narendrula, G.A. Spiers and P.J. Beckett. 201X. Genetic and metal analyses of Red oak (*Quercus rubra*) populations from a mining region in Northern Ontario (Canada): effect of liming on population sustainability. *Environmental Monitoring and Assessment*. In review.

Truong, H.Y.T., Y.-W. Chen and N. Belzile. 2013. Effect of sulfide, selenite and mercuric mercury on the growth and methylation capacity of the sulfate reducing bacterium *Desulfovibrio desulfuricans*. *Science of the Total Environment*. 449, 373-384.

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Wang, J.M., J.G. Murphy, J.A. Geddes, C.L. Winsborough, N. Basiliko and S.C. Thomas. 2013. Methane fluxes measured by eddy covariance and static chamber techniques at a temperate forest in central Ontario, Canada. *Biogeosciences* 10:4371-4382

Webster, N.I., W. Keller and C. Ramcharan. 2013. Restoration of zooplankton communities in industrially damaged lakes: influences of residual metal contamination and the recovery of fish communities. *Restoration Ecology* 21: 785-792.

Williamson, A.W., F. Caron and G.A. Spiers. 201X. Radionuclide Release from Simulated Waste Material after Biogeochemical Leaching of Uraniferous Mineral Samples. *Environmental Radioactivity*. In review.

Zimmerman, C.E., H.K. Swanson, E.C. Volk and A.J.R. Kent. 2013. Species and life-history affects the utility of using otolith chemical composition to determine natal stream-of-origin in Pacific salmon. *Transactions of the American Fisheries Society* 142:1370–1380.

Ziolkowski, L., N.C.S. Mykytchuk, C.R. Omelon, G. Southam, L.G. Whyte and G. Slater. 2013. Arctic Gypsum Endoliths: a biogeochemical characterization of a viable and active microbial community. *Biogeosciences Discussions* 10:7661-7675.

### **Conference Presentations**

Alarie, Y. 2013. Généalogie des insectes aquatiques: histoire d'un poil qui a changé ma vie. Université du Troisième Âge. Sudbury, Ontario. 3 November, 2013. Invited.

Brekke, L.J., T.A. Johnston, and J.M. Gunn. 2013. Comparison of two standardized gill-netting protocols for assessing fish community structure in boreal lakes. Poster presentation at the Canadian Conference for Fisheries Research, Windsor, ON, Canada, 3-5 January 2013.

Arnott, S.E. Dispersal mediates zooplankton response to environmental change. Canadian Society of Zoology, Guelph, ON, May 2013. Invited.

Arnott, S.E., T. Johnson, M. Yuille, M. King, and K. McDonald. Is the latest Great Lake invader, *Hemimysis anomala*, a threat to inland lakes? SCL/CCFFR joint meeting, Windsor, ON, Canada, 3-5 January 2013. Invited.

Åtland, Å., Liltved, H., Powell, M., Rosseland, B.O., Salbu, B., Teien, H-C, Kristensen, T. 2013. Vannkvalitet i akvakultur. Tilbakeblikk på noen viktige samarbeidsprosjekter NIVA, UMB og

Nofima – videre muligheter? ("*Water quality in aquaculture. Historical view on cooperative projects between NIVA, UMB and Nofima- future possibilities?*"). Forskersamling akvakultur, Quality hotel Expo, Fornebu, Oslo, 9 January, 2013.

Auld, R., N. Mykytczuk, L. Leduc and T. Merritt. Seasonal Variation of the Acid Mine Drainage Microbial Community. Science for a Changing North III 2013 Sudbury Restoration Workshop. Sudbury, Ontario, 1 May, 2013. Poster.

Azan, S., S. Arnott and N. D. Yan. The effects of *Bythotrephes longimanus* and calcium poor environments on zooplankton communities. Canadian Aquatic Invasive Species Network (CAISN) Annual General Meeting, Kananaskis, Alberta, 2 May 2013. Poster.

Bailey, J.L. MOE/Laurentian University Partnership Far North Lake and Stream Sampling. EMRB Talks Series, Rexdale, ON. September, 2013.

Bailey, J.L., M.P. Celis-Salgado, J. Heneberry and N.D. Yan. Using zooplankton community structure and Daphnid bioassays to compare recovering acidified and contaminated lakes in northern Ontario. CLRA/OMA Reclamation Symposium. Cobalt, ON. June, 2013.

Bailey, J.L. and M.P. Celis-Salgado. Using Daphnid bioassays to compare recovering acidified and contaminated lakes in northern Ontario. Tailings Workshop, VLWLC, Sudbury, ON. March 2013.

Bailey, J.L., M.P. Celis-Salgado, J. Heneberry and N.D. Yan. Using zooplankton community structure and Daphnid bioassays to compare recovering acidified and contaminated lakes in northern Ontario. ASLO, New Orleans, LA. February, 2013.

Basiliko, N. Microbial feedbacks in northern peatlands. Third annual Science for a Changing North meeting, Sudbury, Canada, May 2013

Basiliko, N. Can Ontario's forests supply additional bioenergy feedstock sustainably? A soils perspective. Lakehead University's 8th annual "Research and Innovation Week", Thunder Bay, Canada, May 2013

Beall F, K. Webster, I. Creed and D. Kreuzweiser Impacts and prognosis of natural resource development on water and wetlands in Canada's boreal forest. 16<sup>th</sup> International Boreal Forest Association Conference, Edmonton, Alberta, 7-10 October 2013.

Campbell, D. 2013. The Development of Mine Revegetation Protocols for the Hudson Bay Lowlands. Proceedings of the 23rd World Mining Congress. Montreal.

Cott, P.A., A.D. Hawkins, D. Zeddies, B. Martin, T.A. Johnston, J.D. Reist, J.M. Gunn and D.M. Higgs. Sound Production by *Lota lota*. Presentation. NWT Environmental Monitoring Annual Results Workshop Yellowknife, NWT. 21-23 January 2013.

Cott, P.A., A.M. Muir, C.C. Krueger, T.A. Johnston, M.M. Guzzo, P.J. Blanchfield, and J.M. Gunn. 2013. Buoyancy control mechanisms of fishes in deepwater Nearctic lakes. Oral presentation at the Canadian Conference for Fisheries Research, Windsor, ON, Canada, 3-5 January 2013.

Creed, I., D. Kreuzweiser, M. Weber, J. Buttle, S. Gergel, K. Kidd, J. Richardson and P. Sibley. Managing forests – the not so secret services of aquatic ecosystems. Canadian Network for Aquatic Ecosystem Services Annual Meeting, Sudbury, Ontario, 29-30 April 2013.

Driscoll, K. and G.A. Spiers. Migration of Calcitic and Dolomitic Limestone through Contaminated Soil. Ontario Chapter, Canadian Land Reclamation Association Annual Workshop, Cobalt, Ontario. June 2013. Invited.

Goto, S., A. Jokela\*, and S.E. Arnott. Behavioural responses of *Daphnia* to native and exotic predators. SCL/CCFFR joint meeting, Windsor, ON, Canada, 3-5 January 2013.

Gunn, J.M. 2013. Modern Mining: Protecting and restoring ecosystems and their services. Aquatic Toxicity Workshop, Moncton, NB, 6-9 October 2013.

Gupta, V., K. Smemo, J.B. Yavitt, B. Branfireun, D. Fowel and N. Basiliko. Widespread anaerobic methane oxidation in northern peatlands. Poster presentation at the third annual Science for a Changing North meeting, Sudbury, Canada, May 2013

Johnston, T.A., P.A. Cott, H.K. Swanson, A.D. Stasko, R.W.-K. Tang and J.M. Gunn. 2013. Ontogenetic patterns in isotopic composition of northern fishes. Oral presentation at 98th Annual Meeting of the Ecological Society of America, Minneapolis, MN, USA, 4-9 August 2013.

Hasnain S.S. and S.E. Arnott. The role of dispersal in mediating the effects of multiple stressors in zooplankton communities. Annual Meeting of the Canadian Aquatic Invasive Species Network. 2013. Poster: National

Heier, L.S., Mariussen, E., Teien, H-C., Salbu, B. and Rosseland, B.O. 2013. Trace element bioaccumulation and effects in indigenous brown trout (*Salmo trutta*) and caged brown trout eggs exposed to shooting range run off. SETAC Europe 23<sup>rd</sup> Annual Meeting, Glasgow, UK, 12-16 May, 2013.

Heneberry, J., L. Witty and J.L. Bailey. Comparison of Lakes Recovering from acidification from mine tailings and lakes recovering from the effects of acid precipitation. SCL-CCFFR Windsor, ON, Canada, 3-5 January 2013. Poster.

Jokela, A., S.E. Arnott and B.E. Beisner. Biotic resistance of an introduced predator's impact via niche contraction. Canadian Society of Zoology, Guelph, ON, May 2013.

Kielstra, B., S.E. Arnott and J.M. Gunn. Landscape-level effects on a freshwater amphipod at the

land-water interface. SCL/Canadian Conference for Fisheries Research, Windsor, ON, Canada, 3-5 January, 2013.

Kielstra, B. Local and regional recovery of freshwater amphipods in a degraded and complex landscape. Water Research Centre Student Symposium, Kingston, ON, January 2013.

Kreutzweiser, D. Alternatives to imidacloprid for control of invasive forest insect pests. International Union for the Conservation of Nature, Task Force on Systemic Insecticides, Padova, Italy, 4-9 November, 2013.

Kreutzweiser, D., F. Beall, K. Webster, D. Thompson and I. Creed. Risks to aquatic biodiversity from natural resource development in Canada's boreal forest. 16<sup>th</sup> International Boreal Forest Association Conference, Edmonton, Alberta, 7-10 October 2013.

Kreutzweiser, D., S. Capell, D. Nisbet, P. Sibley, P. Hazlett and T. Scarr. Invasive forest insects pose risks to fisheries habitat: an emerald ash borer case study. Aquatic Ecosystem Health Management Society, 11<sup>th</sup> General Meeting, Victoria, BC, 17-21 June 2013.

Kreutzweiser, D., S. Capell, D. Nisbet, P. Sibley, P. Hazlett and T. Scarr. When pests pose greater risks to ecosystem services than pesticides: a case study. Society of Environmental Toxicology and Chemistry Annual Meeting, Glasgow, UK, 12-16 May 2013.

Kreutzweiser, D., K. Good, D. Chartrand, D. Thompson and T. Scarr. Determining ecological risk of systemic insecticides in trees. International Union for the Conservation of Nature Task Force on Systemic Insecticides, Louvain-La-Neuve, Belgium, 16-19 April 2013.

Kreutzweiser, D. Ecological impacts of invasive forest insects and their control products: which are worse? Departmental Seminar, Department of Biology, Wilfrid Laurier University, Waterloo, Ontario, 23 January 2013.

Kristensen, T., Åtland, Å., Urke, H, Kroglund, F. og Rosseland, B.O. 2013. Vannmiljø i settefiskanlegg. ("Water environment in hatcheries"). Foredrag. EWOS Microteket, Hotel Grand Terminus, Bergen 12 November, 2013.

Kristensen, T., Åtland, Å., Urke, H, Kroglund, F. og Rosseland, B.O. 2013. Vannmiljø i settefiskanlegg. ("Water environment in hatcheries"). Foredrag. EEWOS Microteket, Clarion Hotel og Congress, Brattøra, Trondheim 5 November, 2013.

Lemmen, K.D. and S.E. Arnott. Does rapid environmental change promote local adaptation in a Subarctic *Daphnia* population? Canadian Society for Ecology and Evolution, Kelowna, BC, May 2013

Lemmen, K.D. and S.E. Arnott. Investigation of adaptation in a *Daphnia* population to rapid environmental change. Society of Canadian Limnologists, Windsor, ON, Canada, 3-5 January 2013.

Livingstone, K., F. Lester, D. Kreuzweiser, S. Smith and J. McGeer. Influence of dissolved organic matter source in mitigating the acute and chronic toxicity of Cu to *Hyalella azteca*. Environment Canada Risk Assessment Session, Burlington, Ontario, 20 June 2013.

Meland, S., Johansen, S.L., Jensen, K.A., Rosseland, B.O. and Heier, L.S. Time-dependent uptake of trace metals in larvae of European common frog (*Rana temporaria*). SETAC Europe 23<sup>rd</sup> Annual Meeting, Glasgow, UK, 12-16 May, 2013.

Michat, M.C. and Alarie, Y. 2013. Higher-level Phylogeny of diving beetles (Dytiscidae) based on larval characters. Symposium: When a Blind Beetle Crawls over the Surface of the Globe...or under the Water: Biodiversity and Systematics of Aquatic Beetles. Entomological Society of America, Annual meeting. Austin, Texas, USA. 10-13 November, 2013. Invited.

Mykytczuk, N.C.S., B. Stackhouse, T. Vishnivetskaya, J. Allan, C.Y.M. Lau, K. Chourey, R. Hettich, A. Layton, T.J. Phelps, S. Pfiffner, J. Ronholm, A. Chauhan, D. Williams, G. S. Saarunya, R. Sanders, S. Myneni, G. Lamarche-Gagnon, L. Ziolkowski, P. Bennett, L. Whyte, and T.C. Onstott. Microbial carbon cycling in high Arctic permafrost polygons: responses to a warming climate. 5<sup>th</sup> Polar and Alpine Microbiology Conference, BigSky Montana, 8-12 September, 2013. Invited. Recipient of Early Career Researcher Award

Mykytczuk, N., R. Auld, L.G. Leduc and T.J. Merritt. Seasonal Variation of the Acid Mine Drainage Microbial Community. 63rd General Meeting, Canadian Society of Microbiologists, Ottawa, Ontario, 17-20 June, 2013. Poster.

Mykytczuk, N.C.S. and J. Hamr. The Potential for Bioleaching of Mine Wastes in Sudbury and Other Cold Boreal Climates. Science for a Changing North III 2013 Sudbury Restoration Workshop. Sudbury, Ontario, 1 May, 2013. Poster.

Myreng, H., Heier, L.S., Haugen, T., Heier, O-H., Salbu,, B. and Rosseland, B.O. 2013. Bioaccumulation and biomagnification of mercury (Hg) to "at risk levels " in the fish community in the humic Lake Øvre Sandvannet, SE Norway. SETAC Europe 23<sup>rd</sup> Annual Meeting, Glasgow, UK, 12-16 May 2013. Poster.

Novodvorsky, N., J.L. Bailey and J.M. Gunn. Concordance of Benthic Invertebrate Communities from the Attawapiskat and other Northern Watersheds. Theme 1. Project 1.3a. NSERC CNAES Annual Meeting, VLWLC. Sudbury, ON. May, 2013. Poster.

Oshier, R., F. Beall, P. Dale, R. Parfett, B. Pinno, R. Krygier, D. Kreuzweiser, K. Webster, D. Kuhnke and A. Ghebremichael. Responsible development of natural resources in Canada's boreal zone: advancing reclamation of disturbed forest landscapes. 16<sup>th</sup> International Boreal Forest Association Conference, Edmonton, Alberta, 7-10 October 2013.



Preston, M. and N. Basiliko. Carbon mineralization in peatlands: does the microbial community composition matter? Oral presentation at the British Ecological Society and INTERCOL meeting in London, UK, August 2013

Preston, M. and N Basiliko. Do microbial communities matter in peatland carbon mineralization? Poster presentation at the third annual Science for a Changing North meeting, Sudbury, Canada, May 2013 \*\*\*Winner of the student presentation award

Ramcharan, C.W. 2013. The ecological and sociological factors in deciding endpoints for ecosystem recovery. Society of Canadian Limnologists /Canadian Conference for Fisheries Research, Windsor, ON. 3-5 January 2013.

Rosseland, B.O., Terjesen, B.F. og Hess-Erga, O-K. Konflikten mellom villaks og fiskeoppdrett – kan den løses gjennom endret produksjonsform? (*Conflict between wild and farmed Atlantic salmon – can it be solved by through change in production schemes?*) Foredrag; Skretting Aqua Training Settefisk, H10 Playa Meloneras Palace, Meloneras, Grand Canaria, Spania, 2-16 November 2013.

Rosseland, B.O. og Hess-Erga, O-K. Generell resirkulering (RAS) Problemstillinger og vannkvalitet. (*Recirculation Aquaculture Systems (RAS). Problems and water quality issues*). Foredrag; Skretting Aqua Training Settefisk, H10 Playa Meloneras Palace, Meloneras, Grand Canaria, Spania, 2-16 November 2013.

Rosseland, B.O. A near 40 years search to explain the sensitivity of Atlantic salmon smolt to acid waters. 29<sup>th</sup> Task Force Meeting, UN-ICP Waters, Cesky Krumlov, Czeck Republic, October 1-3, 2013.

Rosseland, B.O. Sensitivity of salmon smolts to water quality. Pharmaq Academy, Inverness, Scotland, UK, 24 September, 2013.

Rosseland, B.O. O<sub>2</sub>/CO<sub>2</sub> Impact in Fish Farming. Pharmaq Academy, Inverness, Scotland, UK, 23 September, 2013.

Rosseland, B.O. A near 40 years search to explain the sensitivity of Atlantic salmon smolt to acid waters. The 9<sup>th</sup> International Workshop on Salmonid Smoltification, Iceland. Reykjarvik – Holar, 12-17 August, 2013.

Rosseland, B.O. 2013. Gas in supersaturation. Society of Fish Veterinarians. Norton House Hotel, Edinburgh, Scotland, 14 March, 2013.

Rosseland, B.O. Sensitivity of Atlantic salmon smolts to water quality problems. Society of Fish Veterinarians. Norton House Hotel, Edinburgh, Scotland, 13 March, 2013.

Rosseland, B.O. 2013. Via Frankrike og USA til Sudbury i Ontario, Canada - en ekstremt forurenset by som har gått fra månelandskap til grønne skoger. (*"Through France and USA to Sudbury in Ontario Canada – Sudbury, a former extreme polluted town changed from "moon landscape" to green forests"*). Landstormen, Kolben, 15 March, 2013.

Rosseland, B.O. 2013. Sudbury i Canada. En ekstremt forurenset by. Fra måne landskap til grønne skoger. (*"Sudbury in Canada – a former extreme polluted tow. From moon landscape to green forests"*). Gjersjøen Rotary, Kolben, Kolbotn, 13 January, 2013. UMB

Rosseland, B.O. 2013. Vitenskapelig kvalitet og forsøkgjennomføring. (*"Scientific quality and project management"*). Prosjektmøte Landsmolt; Bergen, 13 January, 2013.

Sadlier, C., N. Mykytczuk, D. Kreutzweiser and J. Gunn. The role of stream microbial communities in the recovery of aquatic ecosystems from natural and industrial watershed disturbance. Aquatic Toxicity Workshop, Moncton, New Brunswick, 6-9 October 2013.

Sadlier, C., N. Mykytczuk, D. Kreutzweiser and J. Gunn. The role of stream microbial communities in the recovery of aquatic ecosystems from natural and industrial watershed disturbance. Canadian Society of Microbiologists, 63<sup>rd</sup> Annual Conference, Ottawa, ON, 17-20 June 2013.

Sadlier, C., N.C.S. Mykytczuk, D. Kreutzweiser and J. Gunn. The Role of Stream Microbial Communities in the Recovery of Aquatic Ecosystems from Natural and Industrial Watershed Disturbance. Science for a Changing North III 2013 Sudbury Restoration Workshop. Sudbury, Ontario, 1 May, 2013. Poster.

Sadlier, C., N.C.S. Mykytczuk, D. Kreutzweiser and J.M. Gunn. The role of stream microbial communities in the recovery of aquatic systems from natural and industrial damage. Canadian Conference for Fisheries Science, Windsor, Ontario, 3-5 January, 2013. Poster.

Shabaga, J., N. Basiliko, T. Jones and J. Caspersen. Exploring the heterogeneity and spatial distribution of critical nutrients and carbon in acid-sensitive managed mixed-deciduous forest soils. Poster presentation at the 12th North American Forest Soils Meeting in Whitefish Montana, USA June 2013

Sinclair, J.S. and S.E. Arnott. Combined effects of zebra mussel (*Dreissena polymorpha*) invasion and nutrient loading on zooplankton. 66th Canadian Conference for Fisheries Research/Society of Canadian Limnologists, Windsor, ON, 3-5 January 2013.

Sinclair, J.S. and S.E. Arnott. Interactive effects of multiple stressors on zooplankton. Water Research Centre Student Symposium, Kingston, ON. January 2013.

Sinclair, J.S. and S.E. Arnott, S.E. Zebra mussel effects on zooplankton communities are unaltered by nutrient inputs. Canadian Aquatic Invasive Species Network (CAISN) II Annual

General Meeting, Kananaskis, AB. May 2013.

Smenderovac, E., K. Webster, J. Caspersen and N. Basiliko. Microbial communities and functioning in boreal forest soil and coarse woody debris under intensified biomass harvests. Poster presentation at the third annual Science for a Changing North meeting, Sudbury, Canada, May 2013

Song, Y., Salbu, B., Teien, H-C., Heier, L.S., Oughton, D., Lind, O-K., Rosseland, B.O., Høgåsen, T. and Tollefsen, K.E. Use of gene expression responses to evaluation combined effect of low dose gamma radiation and uranium on Atlantic salmon (*Salmo salar*). SETAC North America 34<sup>th</sup> Annual Meeting, Nashville, Tennessee, United States, 17-21 November 2013

Spiers, G.A. 2013. Impact of mining waste materials – from rocks to anthrosols. Symposium on Tailings Management, Living With Lakes Centre, Laurentian University, Sudbury, ON. March 2013. Invited.

Stasko, A.D., T.A. Johnston, G.L. Hamilton, B.K. Nugent, P.A. Cott, and J.M. Gunn. 2013. Sharing the top of the bottom: influences on isotopic niche dimensions and overlap of large benthivores. Poster presentation at the Canadian Conference for Fisheries Research, Windsor, ON, Canada, 3-5 January 2013.

Stasko, A.D., T.A. Johnston, and J.M. Gunn. 2013. Environmental influences on niche overlap between native walleye and smallmouth bass, with special emphasis on water clarity. Oral presentation at the Canadian Conference for Fisheries Research, Windsor, ON, Canada, 3-5 January 2013.

Swanson, H.K., M. Lysy, J.D., Reist, W.M. Tonn, J. Johnson, L. Loseto, and M. Power. 2013. Trophic ecology of coastal fishes from Phillips Bay, Yukon Territory. Oral presentation at: Canadian Conference for Fisheries Research, January 3-5, 2014.

Swanson, H.K., G. Low, M. Low, E. Hardisty, A. Sanguéz, L. Sanguéz, V. Jumbo, B. Laird, and E. Reyes. 2013. Understanding and predicting fish mercury levels in the Dehcho region using models of bioaccumulation and biomagnification. Oral presentation at: 2<sup>nd</sup> Northwest Territories Environmental Monitoring Results Workshop, Yellowknife, NT, 10-12 December, 2013.

Swanson, H.K. 2013. Contaminants and ecology in northern fishes. Invited presentation at: Evolution and Ecology Seminar Series, Université du Québec à Montreal, 27 November, 2013. Invited.

Swanson, H.K. 2013. Science and Innovation Policy Case Study: The experimental Lakes Area. Invited speaker and panelist at: Science Policy: Nuts and Bolts, Canadian Science Policy Conference, Toronto, ON, 20 November, 2013. Invited.

Swanson, H.K. 2013. The life, times, and mercury concentrations of northern fishes. Invited presentation at Department of Biology Seminar Series, 4 October, 2013. Invited.

Swanson, H.K. 2013. The life, times, and mercury concentrations of northern fishes. Invited presentation at Colloquium Series, Department of Geography, 24 September, 2013. Invited.

Swanson, H.K. 2013. Eating the Fish: Understanding Mercury Levels in a Changing North. Invited presentation at: Ka'a'gee Tu "A Return to Country Food - Kakisa" Meeting and Workshop, Kakisa, NT, 27-29 August, 2013. Invited.

Swanson, H.K. 2013. We Want to Drink the Water and Eat the Fish: Science in a Changing North. Invited keynote presentation at: Science for a Changing North, Sudbury Restoration Workshop 2013, Laurentian University, Sudbury, ON, 1 May, 2013. Invited.

Swanson, H.K. 2013. Being a Good Guest: Lessons Learned from Scientific Outreach and Education in the Canadian Arctic. Invited presentation at: NSERC Canadian Network for Aquatic Ecosystem Services 1<sup>st</sup> Annual Meeting, Sudbury, ON, 30 April, 2013. Invited.

Swanson, H.K. 2013. Importance of long-term research stations to Canada's scientific future. Invited presenter and panel member at: Science Café series, Science North, Sudbury, ON, 5 February, 2013. Invited.

Swanson, H.K., W.M. Tonn, M. Power, T.A. Johnston and J.D. Reist. 2013. Life and times of anadromous lake trout (*Salvelinus namaycush*) in the Canadian Arctic. Oral presentation at the Canadian Conference for Fisheries Research, Windsor, ON, Canada, 3-5 January 2013.

Vishnivetskaya, T., N. Mykytczuk, J. Allan, K. Cheng, K. Chourey, R. Hettich, A. Layton, X. Liu, J. Murphy, T.J. Phelps, S. Pfiffner, G. Saarunya, B. Stackhouse, C.Y.M. Lau, R. Sanders, S. Myneni, L. Whyte, R. Wilhem, G. Lamarche-Gagnon, P. Hatcher, R.L. Sleigher, P. Bennett, L. Ziolkowski and T.C. Onstott. Carbon Cycling by Microbial Communities in High Arctic Active Layers and Permafrost: Evidence from a Combined Geochemical, Genomic and Proteomic Approach. DOE Genomic Science Joint Meeting, February 2013

Watkinson, A., G.A. Spiers, P.J. Beckett, A. Lock and S. Hayes. Monitoring Impact and Closure Planning at Gold Mines on the Northern Shield Margins. Ontario Chapter, Canadian Land Reclamation Association Meetings, Cobalt, Ontario. June 2013.

Wiegand, M.D., M. Elsasser, T.A. Johnston, L.R. Porteous, R.L. Szmadyła, M.D. Moles, and W.C. Leggett. 2013. Changes in walleye ova fatty acid profiles in Lake Nipissing (Ontario, Canada) following the invasion of spiny water flea. Oral presentation at Association for the Sciences of Limnology and Oceanography, Aquatic Sciences Meeting, New Orleans, LA, USA, 17-22 February 2013.

Williamson, A., F. Caron and G.A. Spiers. Radionuclide release from simulated waste material after biogeochemical leaching of uraniferous mineral samples. EnviroAnalysis 2013. Toronto, Ontario, 15-18 September, 2013.

Williamson, A., G.A. Spiers, F. Caron, F and M. Schindler. 2013. Biogeochemical Mineral Dissolution of Rare Earth Elements from Low Grade Ore - An Overview. Rare Earth Elements Research Workshop, Ottawa, 25-26 June, 2013. Invited.

Winsborough, C. and N. Basiliko. Biochar as a soil amendment in Canada's temperate forests. Nordic Associate of Agricultural Scientists (NJF) Biochar Seminar, Helsinki, Finland, February 2013

Yan, N. Local vs. regional regulation of recovery of zooplankton from historical acid and metal pollution in Sudbury, Canada. Departmental lecture, Department of Bioscience, University of Birmingham, Birmingham, UK, 6 December, 2013. Invited.

Yan, N. Limits to classical environmental management in a multi-stressor world: the role of daphniid genomics. Bioscience lecture series, Department of Bioscience, University of Birmingham, Birmingham, UK, 13 November, 2013.

Yan, N. Local vs. regional regulation of recovery of zooplankton from historical acid and metal pollution of Sudbury, Ontario, lakes. Departmental lecture, Department of Environmental Engineering, Michigan Technical University, Houghton, MI, USA, 9 Sept, 2013. Invited.

Yan, N. Widespread threat of calcium decline in Canadian Shield lakes. Departmental lecture, Department of Biology, Michigan Technical University, Houghton, MI, USA, 13 September, 2013. Invited.

Yan, N. Local vs. regional regulation of recovery of zooplankton from acid and metal pollution in Sudbury's urban lakes. Waterloo Summit Centre for the Environment, Symposium on Rebuilding the Natural System, Huntsville, ON, 3 July, 2013. Invited.

Yan, N. Advice for natural resource managers in an increasingly complicated, multi-stressor world. Plenary talk at the annual meeting of the Great Lakes Fishery Commission, 29 May, 2013, Montreal, QC. Invited.

Yan, N. Local vs. regional regulation of recovery of zooplankton from acid and metal pollution in Sudbury's urban lakes. Department of Biology, McGill University, Montreal, Qc, 17 April, 2013. Invited.

Yan, N. Emerging issues for northern lakes: the increasing threat of multiple stressors at a time of reduced oversight in Canada. Plenary lectures at the McGill School of the Environment Research Symposium 2013, McGill University, Montreal, QC. 16 April, 2013. Invited.

Yan, N. Emerging issues for northern lakes. Plenary lecture at the 10<sup>th</sup> annual Lake of the Woods Water Quality Forum, International Falls, MN, 13-14 March, 2013. Invited.

Yan, N. Widespread calcium decline in Canadian Shield lakes: causes, and consequences for crustacean zooplankton. Departmental lecture series, Department of Integrative Biology, University of Guelph, Guelph ON, 12 February, 2013.

Yan, N. Advice to young aquatic ecologists in an increasingly complicated, multi-stressor world. Introductory plenary session, 2013 conference of the Canadian Conference for Fisheries Research, Society of Canadian Limnologists and Society of Wetland Scientists, 3-5 January, 2013, Windsor, ON

### **Research Grants**

#### **Alarie, Y**

- NSERC Discovery

#### **Arnott, S**

- NSERC Strategic Network NSERC Network on Aquatic Invasive Species (29 PIs, Lead: Hugh MacIsaac)
- NSERC Discovery, The influence of dispersal on ecosystem response to environmental change, 2010-2014

#### **Bailey, J**

- NSERC Canadian Network for Aquatic Ecosystem Services (2011-2016)
- Vale Ltd., Aquatic Restoration Group
- GlencoreXstrata, Aquatic Restoration Group
- Ministry of the Environment, Aquatic Restoration Group
- Ministry of the Environment, Ring of Fire Baseline Data Collection Programme

#### **Basiliko, N**

- NSERC Discovery Grant: The functional role of microbial diversity in terrestrial ecosystems.
- Canada Research Chair (CRC): Environmental Microbiology (to be held at Laurentian University, Sudbury Ontario).
- Canada Foundation for Innovation and Ontario Research Fund infrastructure funding for an advanced laboratory in microbial ecology and biogeochemistry.
- NSERC Research Tools and Instruments (RTI): Multi-gas surface area and pore size analysis system for characterization of micro- and nano-porosity of biochar and other biomaterials. Sean Thomas PI (University of Toronto Forestry), Basiliko, and 3 others

- NSERC Strategic Projects Grant: Biochar as a soil amendment in northern forests: ecology, biogeochemistry, and bioenergy tradeoffs. Sean Thomas, PI, Basiliko, and 3 others
- NSERC Strategic Grant Biomass harvests in boreal forests: minimizing environmental impacts and maximizing benefits. Han Chen (Lakehead University), PI, Basiliko and 4 others
- NSERC Collaborative Research and Development Grant (CRD) Fundamental studies of drying, combustion and ash properties of biomass, and impacts on boiler and pulp and paper mill operations. Honghi Tran (University of Toronto Chemical Engineering and Applied Chemistry) PI, Basiliko (1 of 4 project leaders), and 8 others.
- NSERC Collaborative Research and Development Grant (CRD) An integrated multi-trophic assessment of the impact of biomass harvesting on forest sustainability. Partners are Ontario Power Generation and Tembec. Christian Messier PI, Basiliko, and 3 others
- NSERC Collaborative Research and Development Grant Intensifying forest biomass utilization for energy production. John Caspersen PI (University of Toronto Forestry) and Basiliko
- US Department of Energy, Joint Genome Initiative. Fungal, bacterial, and archaeal communities mediating C cycling and trace gas flux in peatland ecosystems subject to climate change. E Lilleskov (USFS) PI, Basiliko, and 3 others

#### **Belzile, N**

- VALE Canada, Investigation on nanoparticles to remove metals from mine waters (with Chen and Mercier)
- CORFO Chile, Cleaning of mine waters using recycled waste materials and nanoparticles (with Pizarro, Chen and Mercier)
- NSERC CRD, Preparation of an adsorbent matrix modified with nanomaterials for the removal and recovery of metals and selected anions from mine waters. (with Mercier and Chen)

#### **Campbell, D**

- The Development of Rehabilitation Protocols for the Hudson Bay Lowland after Mining: Phase. De Beers Canada. Research contract 2012-2013.
- The Measurement of Canola and Sunflower Productivity along a Thickness Gradient of Compost Covers over Ni-Cu Tailings and a Preliminary Assessment of Metal Uptake in Plants. Sudbury Integrated Nickel Operations, Glencore. Research contract 2012-2013.

#### **Gunn, J**

- NSERC CRC Tier 1 for Stressed Aquatic Systems
- NSERC Discovery, Terrestrial/aquatic linkages in the recovery of disturbed ecosystems
- NSERC Industrial CRD with Vale Ltd. and GlencoreXstrata Ltd. Terrestrial Aquatic Linkages for Ecosystem Recovery
- NSERC Canadian Network for Aquatic Ecosystem Services (2011-2016)
- OMOE, Mercury Contamination of Fish in Ontario's Boreal Shield (with T. Johnston)

- OMOE, Mercury Bioavailability after Small Reservoir Development
- City of Greater Sudbury, Urban Lakes Restoration
- Far North Information and Knowledge Management (FNIKM), OMNR Mercury in Far North Fish Populations (with Johnston/Keller)
- Canadian Water Network, monitoring cumulative effects in the Muskoka River Watershed (with Bailey/ Jones)

#### **Johnston, T**

- NSERC Canadian Network for Aquatic Ecosystem Services (2011-2016)
- Aquatic Research and Development Section ,Ontario Ministry of Natural Resources, Northern fisheries research
- NSERC Discovery Grants Program, Reproductive ecology of boreal fishes
- Far North Information and Knowledge Management Program, Ontario Ministry of Natural Resources, Mercury in fish communities of Ontario’s Far North. (with Gunn/Keller)

#### **Keller, B**

- NSERC Canadian Network for Aquatic Ecosystem Services (2011-2016)
- Ontario Ministry of the Environment, Climate Change and Multiple Stressor Research Support
- FNIKM, OMNR Mercury in Far North Fish Populations (with Johnston/Gunn)

#### **Kreutzweiser, D**

- NSERC SNG - Canadian Network for Aquatic Ecosystem Services, Theme II Healthy Forests and Health Aquatic Ecosystems (partner)
- Forest Ecosystem Science Cooperative and the Sustainable Forestry Initiative Conservation and Community Partnership Grant – Landscape scale effects of disturbance on aquatic systems
- Invasive Species Centre Partnership Fund, Ecological impacts of forest invasive insect pests on Ontario’s landscape

#### **Mykytczuk, N**

- NSERC CRD- Role of Terrestrial Carbon and Base Cations in the Recovery of Damaged Aquatic Systems \$1 million. Co-Investigator (2010-2015)
- NSERC Discovery- Ecology and molecular biology of the effects of cold temperatures on acid mine drainage microbial communities. \$130,000 (2013-2018)
- NSERC CREATE- Mine of Knowledge: Scientific Mentoring, Applied Research and Training for sustainable Mines. \$1,650,000. Collaborator (2013-2018)

#### **Spiers, G**

- Barrick Hemlo Operations, Manufacturing Viable Soil Covers for Mine Rock
- Dennison Environmental, Elliot Lake, Analysis of Waters from Serpent River Basin



- Pele Mountain Resources, Simulated Uranium Surface Heap Leaching - Geochemical Monitoring of a Biological Extraction Process
- Ontario Research Fund, Productivity Enhancement and Risk Management in Mining. Ontario Research Fund (2008 - 2013). (G. Spiers, Co-Investigator, with P.I. Kaiser)

#### **Swanson, H**

- Cumulative Impact Monitoring Program, Aboriginal Affairs and Northern Development Canada. Understanding and predicting fish mercury levels in the Dehcho region using models of biomagnification and bioaccumulation. Funded by (with Low and Low)
- Health Canada Climate Adaptation Program. A Return to Country Food; Examining Risks and Benefits and Contaminant Perceptions on the Safety of the Traditional Diet (with Low and Laird)
- Northern Contaminants Program, Community-Based Monitoring and Knowledge Integration. Mercury Levels in Food Fish Species in Lakes used by Dehcho Community Members with a focus on Choice and Risk Perception of eating Traditional Country Food. (with Low and Low)
- DeBeers Canada. Movement and habitat use of Arctic grayling (*Thymallus arcticus*) near a diamond mine development, Gahcho Kue, NT.
- Arctic Land Conservation Cooperative. Biological Responses to Increasing Water Temperatures in Lakes of the Barrow/Atqasuk Focus Watershed: An Interdisciplinary Bioenergetics and Contaminants Study. (with Zimmerman, Koch, Carey and Schmutz) 2013-2016

#### **Yan, N**

- NSERC Discovery Grant: Transforming daphniid ecotoxicology for softwater lakes in a warming, multi-stressor world (2012-2017)
- NSERC CREATE Training Program in Aquatic Ecosystem Health: integrative approaches for studying multiple stressors (ERAMUS) (Yan is one of 11 co-PI's in this CREATE grant) (2011-2016)
- Canadian Water Network Muskoka River Watershed Consortium Grant (2012-2014) Yan is one of 8 co-PIs)
- NSERC Network on Aquatic Invasive Species (Yan is one of 26 co-PI's in this network grant (2011-2016)

#### **Theses Completed**

##### Graduate

Cott, Pete, PhD in Boreal Ecology. Life history and reproductive ecology of a mid-winter spawner: the Burbot (*Lota lota*). Laurentian University, Sudbury, ON (Gunn/Johnston)

Jokela, Anneli. PhD. Factors mediating the distribution and impact of the non-native invertebrate predator *Bythotrephes longimanus* Queen's University, Kingston, ON. (Arnott/Beisner)

Preston, Michael. PhD. Microbial community composition and activities across northern peatlands: University of Toronto, Toronto, ON. (Basiliko).

Alzharani, A. M.Sc. Determination and Speciation of Tellurium in Environmental Samples Using Hydride Generation Atomic Fluorescence Spectroscopy (HG-AFS). Laurentian University, Sudbury, ON (Belzile)

Driscoll, K. 2013. M.Sc. Chemical Sciences. Fate of Limestone Dissolution Products In Acidic Metal-Contaminated Soil Mesocosms. 451 pp. Laurentian University, Sudbury, ON (Spiers)

Geiger, Christine. MSc. with Distinction. Aromatic-rich natural organic matter increases growth and reduces nickel toxicity in a wild *Daphnia* hybrid. York University, Toronto, ON. (Yan)

Gillespie, Michelle. MSc. Effect of Experimental Thermocline Deepening on Fish Community Dynamics and Trophy Ecology in a Small Boreal Lake. Laurentian University, Sudbury, ON (Gunn)

Lemmen, Kimberley. MSc. Local Adaptation in Subarctic *Daphnia* Populations due to Rapid Environmental Change. Queen's University, Kingston, ON. (Arnott)

Sinclair, James. MSc. Interactive effects of nutrient loading and dreissenid invasion on plankton communities. Queen's University, Kingston, ON. (Arnott)

### Undergraduate

Deshpande, Prachi, BSc Honours. Effects of hexavalent chromium on native daphniids in hard and soft water. York University, Toronto, ON. (Yan)

Elsasser, McKenna, BSc Honours. Energetic and reproductive changes in Lake Nipissing walleye following ecosystem disruption from multiple stressors. Laurentian University, Sudbury, ON (Johnston)

Furlanetto, Katrina, BSc Honours. Regional dispersal: a potential resistance mechanism of zooplankton communities against the effects of *Dreissena polymorpha*. Queen's University, Kingston, ON. (Arnott)

King, Meagan. BSc Honours. The influence of predator cues on the functional response of an invasive mysid shrimp, *Hemimysis anomala*, and its potential inland transport by recreational boaters in the Rideau Canal. Queen's University, Kingston, ON. (Arnott/ Cumming)

McDonald, Kent. BSc Honours. Quantifying the thermal and chemical tolerances of the aquatic invasive invertebrates *Dreissena polymorpha*, *Bythotrephes longimanus*, and *Hemimysis anomala*. Queen's University, Kingston, ON. (Arnott/Johnston)

Moore, Kelly-Anne. 2013. BSc Honours. Biofuel Crop Production on Compost Covers of Varying Thickness over Cu/Ni Mine Tailings at the Tailings Facility in Onaping, Ontario. Laurentian University, Sudbury, ON (Campbell)

Sardelis, Stephanie. BSc Honours. Mortality rate of the cladoceran *Daphnia pulex* as an indicator of water quality in the presence of three different types of antifouling paint. Queen's University, Kingston, ON. (Arnott)

Sprott, Adam. BSc Honours. Do larval water mites attached to the same host odonate compete with their neighbours as they engorge? Queen's University, Kingston, ON. (Arnott/Nagel)

Watkins, Karrah, BSc Honours. Response of nearshore benthic macroinvertebrate communities to artificial deepening of the thermocline. Laurentian University, Sudbury, ON (Gunn)

Wilcox, Eric. 2013. BSc Honours. Survival and Growth of Willows on Biosolid Covers Over Ni-Cu Tailings. Laurentian University, Sudbury, ON (Campbell)

### **HQP Supervised**

Baumann, Ryan, BSc Honours. In progress (Swanson)

Borland, Meghan, BSc Honours. In progress (Arnott)

Corrigan, Amelia, BSc Honours. In progress (Arnott)

Heerschap, Matthew, BSc Honours. In progress (Bailey)

Rivest, Maxime, BSc Honours. In progress (Poulain/Mykytczuk)

Snetsinger, Megan, BSc Honours. In progress (Arnott)

Vaillancourt, Kevin, BSc Honours. In progress (Spiers)

Valiquette, Nicole, BSc Honours. In progress (Merrit/Mykytczuk)

Witterick, Lauren, BSc Honours. In progress (Arnott)

Aguilera, Liudmila Aleaga, MSc Candidate, Queen's University (Arnott)

Artym, Kyle, MSc. Candidate, University of Waterloo (Swanson)

Brekke, Lorraine (Sawdon), MSc Candidate, Laurentian (Gunn/Johnston)

Doran, Marney. MSc Candidate, Laurentian University (Merrit/Mykytczuk)

Dutkiewicz, David, MSc Candidate, University of Guelph (Sibley/Kreutzweiser)

Gorgolewski, Adam, MSc-F Candidate, University of Toronto (Basiliko)

Guo, Galen, MSc Candidate, Laurentian University (Basiliko)

Kielstra, Brian, MSc Candidate, Queen's University (Arnott/Gunn)

Lahnalampi, Tamsen, MSc Candidate, Laurentian (Johnston/Gunn) withdrew May 2013

MacLeod, Josef, MSc Candidate, Laurentian University (Gunn/Keller)

Musetta, Jordan, PhD Candidate, University of Guelph (Sibley/Kreutzweiser)

Nicholson, Michele, MSc Candidate, Queen's University (Arnott /Johnson), Jan. 2014  
Nisbett, David, MSc Candidate, University of Guelph (Sibley/Kreutzweiser)  
Novodvorsky, Nicole, MSc Candidate, Laurentian University (Bailey/Gunn)  
Potter, Alex, MSc Candidate, Trent University (Buttle/ Kreutzweiser/ Sibley)  
Ross, Alex, MSc Candidate, Queen's University (Arnott)  
Sadlier, Caroline, MSc. Candidate, Laurentian University (Mykytczuk/Gunn/Kreutzweiser)  
Smenderovac, Emily, MSc-F Candidate, University of Toronto (Basiliko)  
Sumner, Alexandra, MSc Candidate, Laurentian University (Gunn/Johnston)  
Wallace, Kylie, MSc Candidate, Laurentian University (Gunn/Kreutzweiser)  
Watkinson, Autumn, MSc Candidate, Laurentian University (Beckett/Spiers)  
Yucel, Cagdas (Kera), MSc Candidate, Laurentian University (Mykytczuk/Ryser)

Appiah-Hagan, Emmanuel, Ph.D. Candidate Material Sciences ( Belzile)  
Azan, Shakira, PhD Candidate, Queen's University (Arnott/Yan)  
Carson, Michael, PhD Candidate, Laurentian University (Basiliko)  
Erdozain, Maitane, PhD Candidate, University of New Brunswick (Kidd/Sibley/Kreutzweiser)  
Hasnain, Sarah, PhD student, Queen's University (Arnott/Day)  
Jones, Chris, PhD Candidate, Laurentian (Bailey/Gunn)  
Noyce, Genevieve, PhD Candidate, University of Toronto (Basiliko)  
Shabaga, Jason, PhD Candidate, University of Toronto (Basiliko)  
Sinclair, James, PhD Candidate, Queen's University (Arnott)  
Stasko, Ashley, PhD Candidate University of Waterloo (Swanson)  
Szkokan-Emilson, Erik, PhD Candidate, Laurentian (Gunn/Watmough)  
Winsborough, Carolyn, PhD Candidate, University of Toronto (Basiliko)

Celis-Salgado, Martha, PDF, York University (Yan)  
Kelly, Noreen, PDF, York University (Yan)  
Smith, Andrea, PDF, York University (Yan)  
Tanentzap, Andrew, Banting PDF, York and Laurentian Universities (Yan/Gunn)

Brown, Arran, Research technician, York University (Yan)  
Geiger, Christine, Research technician, York University (Yan)  
Servida, Paulina, Co-op Student, University of Waterloo (Swanson)  
Stasko, Ashley, Research Associate, Laurentian University (Johnston)

## **Staff**

### Laurentian University Science Building

Alarie, Yves – Biosystematics  
Belzile, Nelson - Environmental Chemistry  
Dirszowsky, Randy – Geomorphology/Paleolimnology  
Ramcharan, Charles - Aquatic Ecologist  
Spiers, Graeme – Chemistry, Science and Engineering

Canadian Forest Services, Sault Ste. Marie  
Kreutzweiser, David – Land Water Linkages

Norwegian University of Life Sciences  
Rosseland, Bjorn

Queens University  
Arnott, Shelley

University of Waterloo  
Swanson, Heidi

York University  
Yan, Norman

Living with Lakes Centre

Bailey, John – MOE Research Scientist/ LU Adjunct  
Bamberger, Elizabeth – Business Manager, LU  
Barriault, Chantal – Science Communication  
Beckett, Peter - Education and Outreach, Faculty LU  
Campbell, Daniel –Research Scientist MIRARCO/Lakes Centre  
Corston, Andrew – Fisheries Technician  
Fram, Kim - Invertebrate Taxonomist  
Gillespie, Michelle – Lab Manager, Living with Lakes Centre  
Greene, Stacey – Field Assistant, MOE  
Gunn, John – Canada Research Chair in Stressed Aquatic Systems, LU  
Haslam, Lee – Senior Fisheries Technician, MNR  
Heneberry, Jocelyne - Monitoring Coordinator, MOE  
Jackson, Vicky – Data Management, MNR  
Johnston, Tom – MNR Senior Research Scientist/LU Adjunct  
Keller, Bill – Director, Climate Change and Multiple Stressor Aquatic Research, LU  
McCourt, Jason – Environmental Officer, MOE  
Mykytczuk, Nadia – Research Scientist, VLWLC  
Oman, Karen – Research and Administration, LU  
Pearson, David - Urban Lakes Coordinator/Science Communication, Faculty LU  
Sarrazin-Delay, Chantal - Biomonitoring Biologist  
Witty, Lynne – Invertebrate Taxonomist

Field Technicians and Research Assistants

Aelick, Miranda, Grade 12 Co-op student, Ecole secondaire MacDonald-Cartier  
Heerschap, Matthew, Summer Research Assistant  
Hunt, Sarah, Summer Research Assistant

Visiting Scientists

Best, Mairi - School of Earth and Ocean Sciences, University of Victoria

Rosseland, Bjorn – Norwegian University of Life Sciences

Whittington, Pete – University of Waterloo