Cooperative
Freshwater Ecology Unit
Unité Conjointe
D'écologie D'eau Douce

Cooperative Freshwater Ecology Unit Annual Report 2011

Awards and Recognition

- Dr. John Bailey joined the Cooperative Freshwater Ecology Unit and started as MOE Scientist June 6, 2011. He quickly became an adjunct at Laurentian and is already co-supervising PhD student Chris Jones (Jan. 2012). Chris will be working on multiple stressor and cumulative effects on benthic macroinvertebrate communities as well as refining benthos biocriteria and impact assessment modeling techniques.

- Mike White, a PDF with Bill Keller, left the Co-op Unit to take up a scientist position with Minnow Environmental in Georgetown.

- Dr. Norm Yan co-authored the lead article in a special issue of Biological Invasions, on *Bythotrephes*. See: Yan, N.D., B. Leung, M.A. Lewis and S.D. Peacor. 2011. The spread, establishment and impacts of the spiny water flea, *Bythotrephes longimanus*, in temperate North America: a synopsis of the special issue. Biol. Invasions 13: 2423-2432. DOI: 10.1007/s10530-011-0069-9.

Student Scholarships, Fellowships and Bursaries

- Michelle Gillespie. MSc Candidate. February 17, 2012. Fisheries and Oceans Canada Habitat and Restoration Bursary. $3900.

- Michelle Gillespie. MSc Candidate. February 17, 2012. Sudbury Game and Fish Protective Association Scholarship. $1000.

- Brian Kielstra. MSc Candidate. April 2012. Recipient of a CGS-M NSERC scholarship for his next year of studies. $17,500.

- Josef MacLeod. MSc Candidate. March 18, 2012. W. Garfield Weston Foundation Fellowship for Northern Conservation administered by Wildlife Conservation Society of Canada. $20,000

- Janel Sauder. BSc Honours. February 14, 2012. ESRI Student Scholarship. $1500

- Ashley Stasko. MSc Candidate. Dec., 2011. Watson Family Graduate Award. $1,000.

- Ashley Stasko. MSc Candidate. Jan., 2012. Department of Fisheries and Oceans Habitat and Restoration Scholarship. $2,200.

- Erik Szkokan-Emilson. PhD Candidate. 2011-2012. Ontario Graduate Scholarship. $15,000

Community Outreach

- **Bioski and Snowshoe Club:** Peter Becket serves as an executive member of this club.

- **Canadian Land Reclamation Association (National)**: Peter Becket served as the Director of this organization.

- **Canadian Land Reclamation Association (Ontario Chapter)** - Peter Becket served as the Director of this organization.

- **CBC Radio Interviews:** Dr. Charles Ramcharan represented the Co-op Unit and Laurentian University on numerous occasions throughout 2011 providing information and education on a wide range of subjects from milfoil and cyanobacteria to the effects of snowmobiles on lakes when they fall through the ice.

- **Central Algoma Freshwater Coalition:** Dave Kreutzweiser served as an advisor on development of their lake monitoring program.

- **EarthDay:** The Co-op Unit participated once again in the Sudbury Earth Day Festival organized by the Greater Sudbury Environmental Network.

- **City of Lakes Advisory Panel:** Charles Ramcharan and Shannon MacPhee served as members of the City of Sudbury Lakes Advisory Panel (LAP) in 2011. Shannon was succeeded by John Bailey in December, 2011.

- **Greenspace Advisory Panel:** Peter Beckett served as a technical member assisting in defining conservation areas in Sudbury.

- **Greater Sudbury Watershed Alliance:** Charles Ramcharan served as an environmental advisor.

- **Junction Creek Stewardship Committee:** Peter Beckett and John Gunn, among others, provided considerable technical advice and other resources to this committee.

- **Laurentian University President's Action Committee on the Environment:** Charles Ramcharan served on the action committee.

- **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. At the awards presentation at City Hall, the Co-op Unit was represented by Dr. Charles Ramcharan who delivered a presentation on the status of City Lakes. The Co-op Unit continues to work toward its goal of promoting lake stewardship within the general public through this contest related education.

- **Rainbow Routes:** Peter Beckett is an Environmental Advisor and Board Member for Rainbow Routes and has led field trips and contributed to the development of curriculum for schools called "Learning with Trails".

- **Source Water Protection Program**: Charles Ramcharan provided environmental advice to the panel.

- **Stewardship Committees:** Charles Ramcharan served as a member of both the Long Lake and Ramsey Lake Stewardship Committees. Both of these lakes had blue green algae blooms in 2011.

- **Sudbury Naturalists:** Peter Beckett co-chaired this group

- **VETAC:** Peter Beckett chaired this committee and participated in various subcommittees.

Vale Living with Lakes Update

Unbelievable may be the best way to describe the past year that has whizzed by in a blur.

The building was completed and we moved in April 11, 2011. The move was very smooth thanks to the competent coordination by Michelle Gillespie. Roger Trottier, our contact at Physical Plant, complimented Michelle with "this is the best-organized move I have ever seen". Roger is not given to hyperbole.

Overall, the building is as beautiful and functional as we had hoped. There are some small so-called deficiencies that we continue to work through, but our biggest problem now is that we already need to renovate to accommodate the many new members who will join us within a few months.

Our Official Opening took place on August 25, accompanied by much pomp complete with fanfare provided by the Northern Brass Quartet. Nearly 200 VIP's and others crowded into our magnificent lobby. We couldn't have received a more fitting house-warming gift than the prize winning painting "Killarney" - by Frank Danielson. We are grateful to Vale for this and for their ongoing support.

Community Engagement

One of our objectives has always been to engage the community (both the internal Laurentian University community and the external Sudbury community) in the Vale Living with Lakes Centre and we have succeeded in spades on this front. In addition to courses delivered out of our classrooms, other groups within Laurentian University and community groups have used our multimedia rooms and our lobby almost every day. Some statistics:

- Approximately **125** groups have held events in our building representing about **2400** users
- 8 fundraising events through the Office of the President or Advancement Department
- 61 external community group users
- 39 other Laurentian University group users

Some highlights:

- Monthly **Lunch with a Lake** concerts in the lobby featuring talented musicians from Laurentian and the community.
- 2 Juried **Art Shows**: Art Impact, through which we received another coveted piece of art – Sun Worshippers by Julie Courtemanche and the Northern Artist Association juried art show.

- **Margaret Atwood's** birthday celebration reception was held after the dinner, proceeds of which went to fund students enrolled in environmental courses. Both Ms. Atwood and her partner Graeme Gibson had visited us the previous year and were most impressed by the finished product.

- The first and second Annual "**Eagle Awards" Film gala** – video and podcasts presentations jointly produced by Science Communication and Biol 5056 students.
- Monthly **Biology seminars** on a variety of topics delivered by scientists from LU and other universities and institutions.
- Countless Thesis defenses from many departments in Science and Engineering and others.
- Canada-Caribbean **Emerging Leader's Dialogue**, hosted by Vale to engage young business leaders from the cities in the Caribbean and across Canada and discuss common environmental challenges and solutions
- Many groups use our facilities to celebrate an event or showcase Sudbury to the community and to out-of-town and international visitors such as the **Northern Ontario School of Medicine** welcoming first year medical students, **School of Management** convocation and a delegation of representatives from **China,** to name a few.
- **Think tanks and conferences** including Musagetes where the Centre was filled with dioramas and play areas for children while artists, cultural mediators, public intellectuals and other partners met to develop new approaches to building community; the Greater Sudbury Watershed Alliance Green conference etc.

- Meetings of many **service clubs** including Rotary Club of Sudbury, Rotary Sunrisers, Club Richelieu and the Canadian Federation of University Women.
- **Climate Change** adaptation workshops and citizen panels hosted by OCCIAR, one of our many partners.
- Many grassroots environmental groups meet here including the Ramsey Lake Stewardship Committee,

Greater Sudbury Watershed Alliance, Junction Creek Stewardship Group, Sudbury Naturalist and many have enjoyed "private" tour as we seek to share our good fortune with those who share our goals.

- Many **donor** events including a reception to honor the **$10M donation to the Bharti School of Engineering,** and the **$250,000 TD Bank** donation to the **Science Communication program**
- Filming by TV and movies. Scenes for the Hollywood film **The Truth** were filmed here. Recently the casting call for CTV's **Dragon's Den** used our building.
- The building's beauty and design has captured the interest of the project teams for the new **School of Architecture** and the soon to be built **Northern Water Sports Centre** both wanting to pick our collective brains
- A major funder, the federal government's **Knowledge Infrastructure Program** held an **Open House** to showcase their investment in this stellar project. A concert and **Envirothon**, a competition amongst high school students sponsored by Science North to provide young people to a group of interactive field trips and workshops to help them understand forests, soils, wildlife, aquatic ecosystems and the human impact on all of the things we value in nature were two of the events to celebrate the Open House.
- Community events to stimulate interest in science: a presentation by Visiting Scientist **Dr. David Schindler**, whose presentation on the Alberta Tar Sands was live streamed throughout our building to over 100 people as well as to countless others through the internet; **Science Between the Sheets** a series of multidisciplinary presentations and discussions on current political and scientific issues covering a variety of topics such as *How the Economy can Save the Environment* and *Knowledge vs. Interests: Rational Decisions in a Chaotic System* organized by the Biology Society club and the **World Water Day** featuring a presentation by **Visiting Scientist in Residence, Dr. Bjorn Rosseland** and David Lickley's film, **Mysteries of the Great Lakes.**

- It is not just art and music that we bring into the Centre; we have also just completed our first **Living with Our Lakes Poetry Contest**. Aspiring poets submitted poems expressing the importance in our lives of the over 300 Greater Sudbury lakes: their beauty; their place in the larger ecological picture of the intertwined lives of people, animals, fish, birds and plants; and our challenge to safeguard their water quality. Dr. Roger Nash, Sudbury's Poet Laureate will select the best to be published in an anthology by Scrivener Press.
- We continue to be a partner in the annual Picture our Lakes photo contest, which provides a good database of photos of our lakes and produces an annual calendar. (Photo: Allan Oman)

Stimulating Science Collaboration

One of the important purposes for the Living with Lakes Centre is to generate new science. This continues, of course, with the core group – The Cooperative Freshwater Ecology Unit and will increase as we bring on new Principal Investigators including our new Canada Research Chair Tier II in Environmental Microbiology. But, we are also using our facilities to bring collaborators and potential collaborators together to discuss science issues, research gaps, new cooperative research projects, and new research frontiers including the Far North of Ontario

Key Science Events:

- **TALER NSERC CRD** meetings with collaborators from LU, Trent, York, Laurier, NRCAN, Xstrata and Vale
- **Innovate North** a group of researchers from Laurentian, University of Western Ontario, Waterloo, Nipissing, Lakehead led by Mirarco, has been established to discuss collaborative projects that can align with research calls such as the recent ORF Research Excellence round –Despite the fact that this funding was cancelled for the foreseeable future, this group is well-positioned to especially dealing with a strategic priority of research in Ontario's Far North.

- **OMNR Far North Branch** workshop for researchers, policy makers and First Nation community members to discuss development –related issues in the Far North of Ontario.
- Other research groups including INORD have also held collaborative workshops with researchers and stakeholders because of our excellent multimedia facilities

Fundraising

We have almost closed out our books for the capital phase of the project. We have still to raise a little over $5 M to accomplish our "research enhancement" goals. Our ambitions have expanded and we now expect to raise over $10M to fund a Canada Centre of Excellence Chair (CERC) in Northern Watershed Processes and Policies (see p. 18). If successful, this Chair will enable us to fast track our growth plan and accelerate our renovation requirements. We have collaborated on an NSERC Strategic Network grant application led by University of Toronto, an NSERC CREATE application with UQAM and will be submitting an application for a Leading Edge Fund (CFI) grant to equip our environmental microbiology lab.

Living with Lakes Centre Fundraising Revenue

Capital Project

Vale	$4,500,000
Industry Canada (Knowledge Infrastructure Program)	$5,152,676
Ministry of Training, Colleges and Universities	$5,000,000
FEDNOR	$2,475,000
NOHFC	$2,000,000
CFI OIT	$800,000
F. Jean MacLeod Trust	$150,000
City Of Sudbury	$100,000
Holcim Foundation	$25,000
Other Private Contributions	$49,824
Total Funding	**$20,252,500**

Research Enhancement – Goal $7,000,000

Ministry of the Environment	$840,000
City of Greater Sudbury	$400,000
EJLB Foundation	$30,000
Next 50 Campaign	$83,000
Total Research Funding to Date	**$1,353,000**
Research Funding Target	**$7,000,000**
Still to Raise	**$5,647,000**

NSERC CRD Program TĀLER 2010-2015

"Terrestrial Aquatic Linkages for Ecosystem Recovery"

The TĀLER project funded by NSERC, Vale Ltd. and Xstrata 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 research team for this project consisted of J. Gunn and W. Keller (Laurentian), D. Kreutzweiser (Can. For. Serv.) S. Watmough (Trent), N. Yan (York) and J. McGeer (Wilfrid Laurier) and their students and post-docs. The project was divided into 4 subprojects to address the following questions:

1) How does disturbance type (fire, logging, mining) affect benthic invertebrate recovery? (D. Kreutzweiser, J. Gunn)
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, C. Gibson and C. Chan)
4) What habitat characteristics are associated with healthy invertebrate communities? (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 OUPFB students not only participated in the TĀLER research projects under the leadership of PhD students (E. Szkokan-Emilson, E.Muto) and Drs. Beckett and Spiers, they also contributed to the research workshop and made presentations on their work. The agenda for the second TĀLER workshop follows:

Wednesday, August 31, 2011

TĀLER Projects 1 & 2 – Progress Reports - Chair: E. Muto

- E. Muto, The influence of watershed disturbances on land-water linkages affecting stream ecosystem recovery
- E. Szkokan-Emilson, Processing and fluxes of organic matter and metals from lowland wetlands: Importance to recolonizing aquatic communities in lakes
- K. Wallace, Temporal recovery in streams
- B. Kielstra, The contributing role of landscape characteristics on colonization and distribution of a freshwater amphipod (*Hyallela azteca*) in Sudbury, Ontario
- A. Langille, Extending a simple model of disturbance-driven landscape variance

TĀLER Project 3 & 4 Progress Reports - Chair: M. Celis-Salgado

- M. Celis-Salgado, Sodium chloride and sodium/calcium effects on *Daphnia pulicaria* in soft water
- C. Gibson, An inquiry on protective effects of natural organic matter to a *Daphnia* Hybrid exposed to water-borne nickel
- C. Chan, The effects of Ca^{2+} and natural organic matter on Ni toxicity to *Hyalella azteca*
- K. Livingstone, Influence of natural organic matter quantity and quality on acute Cu toxicity to the freshwater amphipod *Hyalella azteca*
- M. White, Dissolved organic matter quality, chitobiase activity, and benthic macroinvertebrate communities of small streams along a gradient of landscape disturbance
- Responses by Industry and Government Partners G. Watson, M. Butler, S. Monet, P. Welsh

Thursday, September 1, 2011

- Introduction to OUPFB contributions to TALER – E. Szkokan-Emilson
- Project 1 – Bug Tribe – Leader B. Kielstra and C. Sadlier Student presentations
- Project 2 – Wetland Tribe – Leader E. Muto Student presentations
- Project 3 – Upland Tribe – Leader P. Beckett Student presentations
- General Review and recommendations – by PIs – Yan, Keller, Kreutzweiser, McGeer, Gunn and Instructors)

Aquatic Restoration Group - Sudbury Environmental Study Lakes

In 2011 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 are sampled once annually during the period late June through early August. The data are intended to provide information on regional patterns in water quality and lake recovery in the lakes near Sudbury.

During 2011 all 44 lakes in the SES Extensive lake set were sampled once for a set of standard water chemistry parameters. 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 2011 there were 12 lakes sampled monthly (May - October) and 1 lake sampled twice-monthly (Swan lake) under the SES Intensive program.

In 2011, the SES sampling was expanded to include a lake (Whiskey Lake) in the Serpent River watershed that was acidified through the effects of acid mine drainage from Elliot Lake uranium mines and is now recovering. Zooplankton, phytoplankton and standard water chemistry data were collected for comparison to Sudbury-area recovering lakes. A *Daphnia pulicaria* bioassay was also conducted at the York University FLAMES laboratory using water from Whiskey Lake and compared to a similar bioassay using water from a Sudbury area lake (Clearwater Lake). This component of the programme is expected to provide further insight to the recovery of Sudbury lakes and will be expanded in future years.

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 2011 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 Research Program

Field Studies:

Hawley Lake Area

In August 2011, Laurentian University coordinated a sampling campaign that focused on the water chemistry and biology of a number of lakes including Hawley Lake, near the Hudson Bay Coast. This work continued studies conducted in the summers of 2009 and 2010.

This study involves scientists and technical staff from Laurentian University and the Ontario Ministries of the Environment and Natural Resources. Collaborators include University of Ottawa, Queens University, Trent University, Wilfred Laurier University, and Yale University. During 2011, scientists from the University of Toronto joined the research team. All information generated from the studies will be made available to stakeholders involved with managing and protecting water resources in Ontario's far north.

Eight lakes that were sampled last year were re-sampled in 2011, including: Aquatuk, Hawley, North Raft, Spruce, and four unnamed lakes in the tundra area between Hawley Lake and Hudson Bay.

Samples were collected in some or all of the lakes to evaluate the following components:
-Basic biology (zooplankton, phytoplankton)
-Basic water chemistry
-Water for isotope hydrology analyses
-Water for dissolved organic matter fractionation
-Lake sediment cores, to allow reconstruction of past environmental conditions
-Bulk lake sediments for laboratory studies of mercury release

In addition, peat cores and surface samples of peat were collected at three locations in the area peatlands. These samples will be used for projects assessing factors affecting peatland carbon storage and changes in peatland diatom communities.

A progress report on the science activities conducted in the Hawley Lake area during 2009-2010 has been prepared.

"Ring of Fire" Area Lake Survey

In August 2011, in collaboration with the Ontario Geological Survey, 103 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. Geochemical analyses of water and sediment samples will be conducted by OGS, additional water analyses will be conducted by MOE, and paleolimnological analyses of recent and old sediments will be conducted by Queens University. The water chemistry data will be used as part of an M. Sc. Project that has been started by Josef MacLeod, Laurentian University, to study the chemistry and zooplankton communities of northern lakes.

Northern Rivers

Fish for analyses of mercury and other contaminants were collected from two of the major rivers in the north, the Winisk and Severn. Fish sampling and field fish processing was done by members of the communities of Peawanuck (Winisk River) and Fort Severn (Severn River), the two most northerly First Nations communities in Ontario. This study targeted the three species (common whitefish, white sucker, pike) most utilized as local food fish by these communities.

In addition, chemical and biological surveys were completed on the five main rivers used by the community of Fort Severn for harvesting trout (Pipowatin, Black Currant, Niskibi, Tamuna, Mintiagan) as a collaboration between the community and researchers from Laurentian U, MOE, and MNR. Chemical sampling and benthic invertebrate sampling (following MOE, OBBN standards) were completed on all rivers and fish for contaminant analyses were collected from four of them.

Data Syntheses:

Lake data (chemistry, zooplankton, phytoplankton) from the Northern Ontario Water Resources Study conducted in the early 1970's have been entered into a computerized data base. Formerly, these data, which were never analysed or interpreted in any detail, resided only in hardcover data reports (MOE 1973, 1975). Data analyses are in progress to examine and characterize chemical and biological patterns in this dataset which includes lakes across Ontario's Arctic Watershed. While old, these data will allow us to further our understanding of northern lakes, when collection of current lake data is only beginning. Initial results were presented at Science for a Changing North II in February 2011.

Funding Research:

An effective system has been developed and implemented for funding research projects through Laurentian University, to stimulate research on the aquatic effects of climate change and multiple stressors. The availability of limited funding support for relevant projects has been announced on the website of the Cooperative Freshwater Ecology Unit at Laurentian University. Contacts at key institutions engaged in aquatic science have been made aware of the program and have been encouraged to pass on this information to colleagues. To date 10 projects have been funded at 7 universities.

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 2011 was primarily directed at two fields of research: **i) Mercury bioaccumulation and food web structure in northern fish populations.** An extensive study of temporal changes in fish mercury concentrations across the boreal shield ecozone of northern Ontario was completed in 2011 (MSc thesis project of Rex Tang, Laurentian University). Selected fish populations from this study are being examined to determine how food web structure and fish growth influence mercury bioaccumulation. A second field season was completed in the research project comparing walleye and smallmouth bass trophic ecologies across a gradient of water clarity in northern lakes (MSc thesis project of Ashley Stasko, Laurentian University). A new research project was initiated examining the influence of spiny water flea invasion on the Lake Nipissing food web. This work is funded by the OMOE Environmental Monitoring and Reporting Branch, the OMNR Far North Branch, the OMNR Aquatic Research and Development Section, the Invasive Species Partnership Fund, and NSERC. **ii) Reproductive ecology of northern fishes.**

Research on the reproductive ecology of burbot continued in 2011 with emphasis on further defining spawn timing and reproductive traits in both Northwest Territories and northeastern Ontario populations. This work, in addition to studies of burbot trophic ecology, is part of a collaborative research project with Fisheries and Oceans in Yellowknife, NT (PhD thesis project of Pete Cott, Laurentian University). This research is funded by the OMNR Aquatic Research and Development Section, Fisheries and Oceans Canada, Natural Resources Canada and NSERC.

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 the 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 410 sites have been collected from 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 2011, monitoring of long term sites continued and some new sites were sampled. These additional data were collected from a mix of impacted, reference and urban sites. Of the 85 sites visited, 57 were sites previously sampled for 2 to 9

years. 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. In an effort to fill gaps with regards to habitat type, twenty-eight new sites were sampled this past year

Communicating Graduate Student Research

Excellence in communicating science continues to be a priority for the Co-op Unit. The university home base for students in the joint LU / Science North Graduate Science Communication program (SCOM) is on the ground floor of the Lake Centre. David Pearson of the Co-op Unit is the Laurentian Co-Director of the program.

One of our experiments this year was to mix SCOM and BIOL graduate students in a 3:5 ratio and have them produce podcasts of the biologists' research projects. A Podcast Gala was held on April 4th at which Oscar style prizes were awarded for podcasts ranging from cancer genetics to lake trout dissection and Ring of Fire plankton sampling. We expect many will be posted after fine tuning and clearing copyright issues for music. Next year`s production efforts will be greatly helped by a donation of $10,000 for recording and editing equipment from Vale.

Enrolment in the 10 month Science Communication program dipped to 9 from its cap of 15 in 2010-11. Applications for 2012-13 already include a past leader of the Arctic Lake Ice and Snow Network who engaged school students across Alaska to adopt lakes, instrument them, and become young ice scientists through the winter. (She has also taken part in Antarctic survey cruises and has a healthy list of peer-reviewed publications). Her experience might well be applicable in First Nation communities in the Far North of Ontario. We are also expecting a French exchange student from Grenoble.

A recent donation of $250,000 from the TD Bank Group to the program's endowment fund for student bursaries and scholarships (already over $200,000) will help give SCOM students more support.

Fifty seven students have now graduated from the program since 2006 and have taken jobs in places such as the Council of Canadian Academies, the Perimeter Institute, Jacques Whitford Environmental Consultants, the Ministry of the Environment, the Canadian Foreign Service, Pollution Probe, World Wildlife Fund, the Toronto Regional Conservation Authority, the Royal Ontario Museum, Science North, the Sudbury Neutrino Observatory, several exhibit design companies, and as science and medical writers. Students have been interns during their program at the Natural History Museum in London, the Harvard Museum of Comparative Zoology, Let`s Talk Science, Canadian Geographic, the Canadian Polar Commission, the Great Lakes Forest Centre, CERN, the "Science Time" in Beijing, the "Discovery Channel" in Toronto, the Experimentarium`` in Copenhagen as well as in provincial government ministries, in science centres, and in exhibit design companies. It remains the only program of its kind in North America. For more information see www.sciencecommunication.ca

The program recently joined with the Science Media Centre of Canada to present a Science and the Media workshop at Laurentian. The plan is to follow this with skill development workshops for graduate students and faculty in the Fall. An undergraduate course in `Presenting and Communicating Research` is winding its way through the LU approval process.

Communities Adapting to Changing Climate in Far North, Ontario

Funding from NRCan in late 2011 has enabled vulnerability and risk assessments from changing climate in four Far North Ontario communities: Fort Severn, Fort Hope (Eabametoong FN), Webequie, and Constance Lake. Collecting community or traditional knowledge of changes in weather patterns is under way, along with workshops, community meetings, and technical work of various kinds related to severe events, drinking water, and permafrost degradation. Draft Changing Climate Adaptation Plans will be produced in collaboration with each of the four communities by September. Working through the Ontario Centre for Climate Impacts and Adaptation Resources (OCCIAR) on the campus, David Pearson is leading Laurentian in partnering on more than a dozen funding applications to Aboriginal Affairs and Northern Development Canada for changing climate adaptation planning in Far North Ontario communities from the Manitoba border to the coast of James Bay.

Citizen Panels as a way of engaging the public in adaptation planning

Two "Citizen Panels" of 12 to 15 citizens met for two weekends in Sudbury and Ottawa just before and after Christmas under the auspices of OCCIAR to discuss and agree on recommendations to the Ontario government on policies and actions to enhance climate adaptation in Ontario. These very successful panels were a small but distinctive and experimental part of Ontario's Community Adaptation Initiative operated by OCCIAR. They have rarely been used in Ontario for such science and society topics. David is the Science Advisor to OCCIAR.

TIMEX Project 2011

The year 2011 was an important year in the TIMEX (Thermocline Induced Mixing Experiment) project on Lac Croche, a 19ha lake trout lake at the University of Montreal field station in the Laurentians. The experiment is designed to experimentally manipulate the thermocline depth in this three basin lake (10-13m max depth; one basin separated with a 6m x 200m curtain), using a solar powered lake mixer (Solar Bee ®). The project is a cooperative project involving Laurentian University (J. Gunn), Univ. of Québec at Montréal (B. Beisner, Y. Prairie), Univ. of Montréal (M. Amyot) and Env. Canada (J. Chételat). The project is designed to assess the potential effects of thermocline depth change (due to warming or changing wind speed) on basin heat content, CO_2 and CH_4 flux, Hg in biota and trophic structure. The project began with a pretreatment study in 2007. However, the team realized that a 2nd reference year was needed, which occurred, this year in 2011.

Our preliminary findings after the three years of thermocline deepening (2008, 2009, 2010) are as follows: Deepening was associated with an increase in basin heat content, increase in

phytoplankton and pelagic fish biomass, increases in CO_2 and CH_4 emissions, and was associated with a decrease in Hg concentration in zooplankton and benthic fish. However, there were also strong, interannual affects related to warming during the 3 years.

In 2011 we removed the Solar Bee from the west basin but left the curtain in place to create the 2nd reference year when a full range of chemical and biological studies occur (including the Nordic fish survey). We plan now to start up the Solar Bee in 2012 for one more manipulation year. There are many exciting science findings developing from this project, as was evident when several papers from the TIMEX group were presented at the 2011 CCFFR/SCL meeting in Moncton.

Visiting Scholar in Residence Program

It was a great pleasure and honour for Dr. Bjorn Rosseland, Professor of Ecotoxicology, Norwegian University of Life Sciences, Aas, Norway to accept our invitation to be the inaugural visiting scholar in residence at VLWLC. Dr. Rosseland is one of the world research pioneers into the study of acid rain and other atmospheric contaminants on aquatic ecosystems, who participated in research programs throughout the world. In advance of his arrival at VLWLC Dr. Rosseland agreed to participate as an official thesis committee member for students at the Lake Centre. His commitment then rapidly increased ranging from giving various invited seminars and lectures, to community presentations (Rotary Club) to being the plenary speaker at Ontario Biology Day and the World Water Day event organized by the Nickel District Conservation Authority at the Lakes Centre. Dr. Rosseland has contributed daily to the science discussions at the Lake Centre and his participation will have lasting effects on our students and researchers. Dr. Rosseland and his wife Ellen were our honoured guests from Feb. 15 to May 15, 2012.

Watershed Talks

We were honoured to open the seminars program on Dec. 7, 2011 at the Living with Lakes Centre with a presentation by Dr. David Schindler, Killam Professor of Ecology at the University of Alberta entitled “Oil Sands: Economic Saviour or Environmental Disaster“.

Other seminars during the 2011/2012 season include:

- Mairi Best, University of Victoria, Victoria, BC, "How real time interactive remote sensors are changing how we do marine science"
- Peter Whittington, University of Waterloo, The hydrology of disturbed peatlands
- Gustavo Ybazeta, University of Toronto, The fish, the tree, and the clock: Applications of phylogenetics and biogeography
- Kiyoshi Sasaki, Laurentian University, Endangered traditional beliefs in Japan: Human-caused rapid evolution in snakes and influences on snake conservation
- Brendan McConkey, University of Waterloo, Evolution of protein fold and function: Analysis of functional and structural divergence in protein families
- Bjorn Rosseland, Life Science University, Oslo, Norway, Assessing food web structure using stable isotopes in African rift valley lakes
- Franco Mariotti, Science North, Sudbury, The wilds of New Zealand: Landscapes, wildlife, and conservation
- Whitfield Gibbons, Savannah River Ecology Lab, University of Georgia,
- Heidi Swanson, University of Alberta, Mercury rising? Interactions of life history, trophic ecology, and mercury bioaccumulation in coastal Arctic lakes
- Nikhil Lobo, University of Western Ontario, London,

Shared Facility Agreement with MNR and MOE

An important aspect of the move from the old Co-op Unit site on Ramsey Lake to the Living with Lakes Centre site was to sustain and strengthen the close partnership of LU with our founding provincial government agencies, OMNR and OMOE. This was accomplished through a shared facility agreement that came into effect on Sept. 1, 2011. Through this agreement the government agencies were recognized as having requirement for approximately 30% of the overall space and were encouraged to "feel at home" and make use of the facility for many of their own meetings and workshops. For example, the Far North Branch of the OMNR hosted a workshop with First Nation representatives on February 14-16, 2012. Ontario Parks and Sudbury District, OMNR have also made use of the facility within the first few months of our opening.

Canada Excellence Research Chair (CERC) in Northern Watershed Processes and Policies

The summary and rationale that we have developed for a CERC application follows:

Summary: The CERC in Watershed Processes and Policies at Laurentian University will help develop and grow a globally-recognized team of ecologists, engineers, microbiologists, hydrologists, educators, and science communicators experienced in working in northern ecosystems and with remote First Nation communities. The CERC will provide national leadership in environmental policy dialogue among scientists and governments at all levels including First Nations to aid in the protection and management of healthy watersheds in Canada's north in support of Northern people. Our focus is initially on the subarctic areas, such as the Hudson Bay Lowlands, and on the First Nations communities of this region that are

already being impacted by rapid climate change and are now preparing for large scale industrial development. These communities are also engaged in a Land Use Planning process initiated by the Ontario government within the framework of a recently approved Far North Act (Bill 191). The CERC program will have a primary focus on development of new science dealing with biogeochemical and ecological processes within northern watersheds and wetland complexes, the natural systems that deliver essential ecological services such as nutrient management, carbon sequestration, flood control and retention of deposited atmospheric contaminants (e.g. Hg and trace organics); but will then take into the policy field the implications of this cutting-edge basic science. This dual role for the CERC will require special expertise in effective communication of new science to help facilitate and directly contribute to policy development with governments, including First Nations, and industries, aimed at ensuring the sustainability of natural ecological services and their benefits for northern people. The CERC program represents a primary strategic research focus for the newly opened $21 M Vale Living with Lakes Centre at Laurentian University and of the growing Cooperative Freshwater Ecology Unit, a unique partnership of government, industry and the university.

Nature of the Science Challenge and CERC Opportunity

The Far North of Ontario (~452,000km^2) with its extensive Boreal Shield landscape, vast subarctic tundra/wetlands (3rd largest wetland on Earth), multitude of lakes and north flowing rivers (includes 5 of Canada's largest), and its 1200km marine coastline, is a globally significant ecosystem on the cusp of massive industrial, economic, cultural and environmental change. It is currently one of the largest near pristine ecosystems on Earth, is also home to 34 First Nation communities (total population ~24,000). These communities have a cultural tradition of living off the land but for much of the past century they have suffered serious social disruption, as well as economic and health deficiencies. They are in desperate need of appropriate training and educational opportunities to meet their many challenges. The changes these communities face include: unprecedented ecosystem changes due to climate warming, enormous changes associated with development of a vast new mineral discovery (i.e. Ring of Fire), changes in their exposure to contaminants (e.g. Hg), as well as changes related to the rapid opening of all weather transportation routes – all of which will occur in the context of new legislation, Bill 191. The changes occurring in the Far North require a wide range of new science, engineering, health, social and educational investments. Laurentian University and its new Vale Living with Lakes Centre (Lakes Centre) are perfectly positioned to help meet the science-based considerations in these needs and challenges.

Evidence of LU Strength

Laurentian university is a tri-lingual university with the research and education mandate to assist in meeting the challenges of effective land-use planning, First Nation education, environmental protection and the many other necessary aspects of Far North development. Our Living with Lakes Centre research group are internationally recognized experts in environment assessment and monitoring, and restoration ecology and has already begun significant new work in the Far North. Our scientists were part of the Science Panel that was consulted in the writing of Bill 191 and our President is now a member of the Ring of Fire Advisory Panel. We are one of the closest universities to the area, and all our proven strengths in environmental science, First Nations relationship building, science communication and sustainable approaches to mining can be called

on to help meet these challenges in the Far North. We also have the communication facilities within the Lakes Centre to immediately assist with First Nation education and training.

Living with Lakes Centre

The Living with Lakes Centre at Laurentian University is a multidisciplinary research institute designed to assist in the protection and management of northern aquatic ecosystems such as watersheds associated with mining development in Ontario's Far North. It is a place of experimentation and innovation where new science is generated and top young environmental scientists are trained. The Centre is well equipped with state-of-the-art laboratories and equipment, research conference and workshop facilities, as well as on-line telecommunication capabilities. However, its uniqueness lies in its strong culture of collaboration and communication, building on a 20+ year history of partnerships among scientists, universities, government agencies, and industries involved originally in the Cooperative Freshwater Ecology Unit. Here we have the makings of a true "incubator" of new ideas and approaches for the advancement of environmental science - a place for our discipline that is not unlike what the Perimeter Institute in Waterloo represents for the study of Theoretical Physics. Important too is the bold statement that the building itself makes – as a LEED Platinum level award-winning building - it demonstrates the best of energy and water saving technologies. It is a showcase for the developing "green construction" industry of Northern Ontario and will demonstrate how a new Northern Architecture School can successfully promote sustainable design in northern landscapes.

Cooperative Freshwater Ecology Unit Strategic Planning

The Cooperative Freshwater Ecology Unit, housed within the Vale Living With Lakes Centre, was established in 1989 and is a unique and successful partnership between LU, the Ontario Natural Resources (MNR), and Ontario Ministry of the Environment (MOE) with collaborators from the mining industry, Natural Resources Canada (NRCan), several other universities and the City of Greater Sudbury. Strategic planning to sustain and grow the extensive 20+ year monitoring and survey work and to expand the internationally recognized restoration ecology science at the Co-op unit began in 2003 and has lead to the addition of two CRC as well as the funding program that facilitated the construction of the VLWLC. The CERC program is designed to accelerate this grow plan which includes growth in the following areas: Aquatic Ecology (multiple stressor interactions); Wetland Ecology (restoration, biogeochemistry); Applied Microbial Ecology; Hydrology of Northern Watersheds; Environmental Engineering (solution to industrial disturbance) and Ecological Modelling of Northern Climate Impacts. In addition we plan to establish a First Nations Internship training program associated with the new research programs.

LU Drivers for the CERC Science and Policy Focus

Strong basic science research is key to our ability to attract top scholars and graduate students to the LWLC and to bring national recognition to Laurentian University. Our research findings were influential in the national and international efforts to reduce acid rain and improve industrial land use practices in North America. Maintaining our applied science focus is an essential element of our strategic planning. We will continue our tradition of being responsive to the "public good". For example, VLWLC scientists were authors of the recent expert panel reports (1.Science for a Changing Far North 2.Climate Change Impacts and Adaptations in Ontario) and we contributed to

the “gold standard” legislation for watershed planning – the 2009 Lake Simcoe Protection Act in Ontario.

Conference Organizing and Editorial Activities

Arnott, S. Associate Editor of the Journal of Applied Ecology

Arnott, S. Co-organizer of *Hemimysis* Meeting with Tim Johnson (OMNR), Queen’s University Biology Station, October, 2011.

Beckett, P. Served as Co-Chair of the Sudbury 2011 Mining and Environment International Conference (June 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

Ramcharan, C. Organized Ontario Biology Day 2012, held at Laurentian University, Sudbury.

Ramcharan, C. Served as Associate Editor of the Canadian Journal of Fisheries and Aquatic Sciences

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

Partners and Collaborators

Industry

Vale Ltd. Xstrata Nickel

Government Funding Partners

City of Greater Sudbury
NSERC
CFI/OIT
FedNor/MNDM
Environment Canada
Industry Canada
DFO
Can. Wildlife Service

Scientist Collaborators

Laurentian University
Queen's University
University of Lethbridge
Centre for Ecology and Hydrology, UK
University of New Brunswick
Université du Québec à Montréal
University of Winnipeg
Univ. of Western Ont.
Cambrian College
University of Guelph
University of Waterloo
Wilfrid Laurier University
University of Turku, FI
University of Alberta
Univ. of British Columbia
York University
University of Toronto
Indiana University
University of Ottawa
Univ. of Montreal
Trent University
Univ. of Canberra

Others

Friends of Killarney Park
Ontario Power Generation

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Strecker A.L., B. E. Beisner, S. E. Arnott, A. M. Paterson, J. G. Winter, O. E. Johannsson and N. D. Yan. 2011. Direct and indirect effects of an invasive planktonic predator on pelagic food webs. Limnol. Oceanogr. 56: 179-192. doi: 10.4319/lo.2011.56.1.0179.

Symons, C. C., S. E. Arnott and J. N. Sweetman. 2012. Nutrient limitation of phytoplankton in Subarctic lakes and ponds in Wapusk National Park, Canada. Polar Biology 35:481–489.

Szkokan-Emilson, E., B. Wesolek and J. Gunn. 2011. Terrestrial organic matter as trophic subsidies that aid in the recovery of macroinvertebrates in industrially-damaged lakes. Ecological Applications. 21(6):2082-2093

Tang, R.W.-K., T.A. Johnston and J.M. Gunn. Temporal trends in mercury concentrations of large-bodied fishes in the boreal shield ecoregion of northern Ontario. Environmental Science and Technology. In review.

Toledo, M., Y.S. Megna and Y. Alarie. 2011. Description of a new species of *Laccodytes* Régimbart, 1895 (Coleoptera, Dytiscidae, Laccophilinae) from Cuba. Zootaxa 2792: 63-67.

Tropea, A.E., A.M. Paterson, W. Keller and J.P. Smol. 2011. Diatoms as indicators of long-term nutrient enrichment in metal contaminated lakes from Sudbury, Ontario. Lake and Reserv. Mgmt. 27: 48-60.

Valois, A.E., W. Keller and C.W. Ramcharan. 2011. Recovery in a multiple stressor environment: using the reference condition approach to examine zooplankton community change along opposing gradients. J. Plank. Res. 33: 1417-1429.

Valois, A.E., C. Sarrazin-Delay, W. Keller and K. Somers. A comparison of two bioassessment protocols: can differences in sample collection and processing affect the conclusions when assessing biological impairment? Ecolog. Indicat. In prep.

Vandeligt, K., K. Nkongolo, M. Mehes and P. Beckett, 2011. Genetic analysis of *Pinus banksiana* and *P. resinosa* populations from stressed sites in Ontario. Chemistry & Ecology. 27 (4): 369-381.

Ware, L.L., S.A. Petrie, S.S. Badzinski, R.C. Bailey, Y.-W. Chen and N. Belzile. Effects of elevated selenium on body condition, oxidative stress, and organ heath in greater scaup wintering on Lake Ontario. Wildlife Society Bulletin. In press.

Webster, N.I., W. Keller and C. Ramcharan. Restoration of zooplankton communities in industrially damaged lakes: influences of residual metal contamination and the recovery of fish communities. Restoration Ecology. Under review.

White, M.S., C.L. Sarrazin-Delay and W. Keller. Natural inter-annual autumn water velocity is the dominant environmental correlate of benthic invertebrate community structure when minimum threshold is reached. Freshwat. Biol. In prep.

White, M.S., C.L. Sarrazin-Delay and B. Keller. 2011. Environmental Predictors of benthic macroinvertebrate community structure and bioassessment evaluation using the reference dataset of the Freshwater Invertebrate Research Network of Northern Ontario (FIRNNO). Cooperative Freshwater Ecology Unit Sudbury, ON. 59 p.

Weisz, E.J. and N.D. Yan. 2011. Shifting invertebrate zooplanktivores: watershed-level replacement of the native *Leptodora* by the non-indigenous *Bythotrephes* in Canadian Shield lakes. Biological Invasions 13: 115-123. DOI 10.1007/s10530-010-9794-8.

Wiegand, M.D., T.A. Johnston, L.R. Brown, S.B. Brown, J.M. Casselman and W.C. Leggett. 2011. Maternal influences on thiamine status of walleye (*Sander vitreus*) ova. Journal of Fish Biology 78: 810-824.

Wittmann, M.J., M.A Lewis, J.D. Young and N.D. Yan. 2011. Temperature-dependent Allee effects in a stage-structured model for *Bythotrephes* establishment. Biol. Invasions 13: 2477-2497. DOI: 10.1007/s10530-011-0074-z

Yao, H., C. McConnell, K. M. Somers, N. D. Yan, S. Watmough and W. Scheider. 2011. Nearshore human interventions reverse patterns of decline in lake calcium budgets in central Ontario as demonstrated by mass-balance analyses, Water Resour. Res., 47, W06521, doi:10.1029/2010WR010159.

Young, J.D., A Strecker and N.D. Yan. 2011. Vernal cladoceran density regulates the abundance of the non-indigenous zooplanktivore, *Bythotrephes longimanus*, in Canadian Shield lakes. Biol. Invasions 13: 2605-2619 DOI: 10.1077/s10530-011-0077-9

Yuille, M.J., T.B. Johnson, S.E. Arnott and L.M. Campbell. 2012. *Hemimysis anomala* in Lake Ontario food webs: stable isotopic analysis of nearshore communities. Journal of Great Lakes Research. In press.

Conference Presentations

Arnott S.E., C. Symons, J.N. Sweetman, J. Hanschell and M. Pedruski. The impact of environmental change on aquatic communities in Wapusk National Park. Science for a Changing North II – Sudbury Restoration Workshop, Sudbury, Ontario, 2011.

Arnott S.E. and J.N. Sweetman, C. Symons and M. Pedruski. Community response to environmental change in Wapusk National Park. Churchill Northern Studies Centre and Parks Canada Science Symposium, Winnipeg, Manitoba, 2011.

Beckett, P.J. G.A. Spiers, S. Monet and T. McCaffrey. New Directions in Restoring the Smelter-Impacted Landscape in Sudbury, Ontario, Canada following a Comprehensive Environmental Risk Assessment. Enviromine 2011, Santiago, Chile, November 2011

Belzile, N., Y.-W.Chen, D.-Y Yang, M.L. Schummer, S.A. Petrie and S.S Badzinsky. 2011. Interactions between selenium and mercury in aquatic animals. 10th International Conference on Mercury as a Global Pollutant, Halifax, Canada.

Belzile, N., Y.-W.Chen, D.-Y Yang, H.Y.T. Truong and M. Saleh. 2011. Aerobic and anaerobic bacteria to study interactions between selenium and mercury. 94th Canadian Conference and Exhibition, Montreal, Canada. Invited Speaker

Belzile, N., Y.-W.Chen, D.-Y Yang, H.Y.T. Truong and M. Saleh. 2011. Mitigating mercury toxicity in aquatic organisms with the help of selenium? Universidad de Santiago de Chile, Santiago, Chile. Invited Speaker

Bradley, J., C. Ramcharan and B. Keller. 2011. The effects of past industrial damage and current urbanization on phytoplankton communities in Sudbury lakes. Annual Meeting of the Society of Canadian Limnologists, Jan 2011, Toronto, ON.

Bradley, J., S.Watson and C.W. Ramcharan. 2011. The causes of bluegreen algae blooms in Ramsey Lake, Sudbury. Bluegreen Algae Workshop with David Schindler. Science North, Dec. 2011, Sudbury, ON.

Bradley, J., S. Watson, B. Keller and C. Ramcharan. 2012. Relative strengths of taxonomic versus functional groups in explaining variation in phytoplankton communities along a trophic gradient. Canadian Association of Water Quality Annual Conference. Feb 2012, Burlington, ON.

Brown, M, G. Spiers and P.J. Beckett. Lichens may monitor northeastern Ontario highways of pollution. Sudbury 2011, Mining and Environment International Conference, Sudbury, ON. 25-30, June 2011. Poster.

Cott, P.A., T.A. Johnston and J.M. Gunn. 2011. A year in the life of *Lota lota*: Seasonal variation in catch and reproductive development of burbot in a boreal lake. Oral presentation at the Canadian Conference for Fisheries Research, Toronto, ON, Canada, 6-8 January 2011.

Driscoll, K., G. Spiers, P.J. Beckett, C. Wren and J. Hargreaves. Survival of the liming effect in Sudbury area soils. Sudbury 2011, Mining and Environment International Conference, Sudbury, ON. 25-30, June 2011. Poster.

Gillespie, M. and Gunn, J. 2012. Effects of Experimental Thermocline Deepening on Fish Community Dynamics and Trophic Ecology in Lac Croche, Québec. Canadian Conference for Fisheries Research, Moncton NB. 5-7 January 2012.

Gray, D.K., R. D. Linley, N.D. Yan, W. Keller and S. E. Arnott. Using two-phased species-time relationships to separate ecological dynamics from census error in the assessment of stressed communities. 96th Annual Meeting of the Ecological Society of America. Austin, Texas, 2011.

Gray, D.K. and S.E. Arnott. The interplay between local environmental conditions and Allee effects in determining the population growth and establishment of a zooplankton species impacted by a regional stressor. Canadian Council for Fisheries Research and the Society of Canadian Limnologists meeting. Toronto, Ontario, 2011

Gunn J.M., W. Keller, N.D. Yan and P.J. Beckett. Healthy watersheds, healthy lakes,; role of land reclamation in the recovery of acid and metal damaged watersheds. Sudbury 2011, Mining and Environment International Conference, Sudbury, ON. 25-30, June 2011

Gunn, J.M. 2012. Can the environment save the economy? Oral presentation at Science and Politics Between the Sheets, Laurentian University, Sudbury, ON, Canada, 21 March 2012

Hechler, J., V. Udachin, P. Aminov, P.J. Beckett and G.S. Spiers. Characterization of dust and weathering products from the Karabash smelter area, Ural Mountains, Siberia. Sudbury 2011, Mining and Environment International Conference, Sudbury, ON. 25-30, June 2011. Poster.

Johnston, T.A., P.A. Cott, R.W.-K. Tang, A. Stasko and J.M. Gunn. 2011. Ontogenetic patterns in isotopic composition of northern fishes. Poster presentation at the Canadian Conference for Fisheries Research, Toronto, ON, Canada, 6-8 January 2011.

Johnston, T.A., R. W.-K Tang and J.M. Gunn. 2011. Interspecific variation in mercury concentrations of boreal piscivores: the relative roles of food web position and growth rate. Oral presentation at the 10th International Conference on Mercury as a Global Pollutant, Halifax, NS, Canada, 24-29 July 2011.

Johnston, T.A. 2012. Can sustainable resource management be reconciled with economic growth? Oral presentation at Science and Politics Between the Sheets, Laurentian University, Sudbury, ON, Canada, 21 March 2012.

Jokela, A., S. E. Arnott and B. Beisner. Influence of the exotic predatory cladoceran *Bythotrephes longimanus* on the vertical distribution of zooplankton prey in inland lakes of the Canadian Shield. CAISN AGM and Conference. Quebec City, QC. 2011.

Jokela, A., S. E. Arnott and B. Beisner. Influence of the exotic predatory cladoceranBythotrephes longimanus on the vertical distribution of zooplankton prey in inland lakes. ASLO Aquatic Sciences Meeting, San Juan, Puerto Rico, 2011.

Jokela, A., S. E. Arnott and B. Beisner. Influence of the exotic predatory cladoceran *Bythotrephes longimanus* on the vertical distribution of zooplankton prey in inland lakes of the Canadian Shield. Canadian Conference for Fisheries Research (CCFFR) and the Society of Canadian Limnologists (SCL). Toronto, ON, 2011.

Kreutzweiser, D.P., P. Sibley, B. Naylor, R. Mackereth and S. Holmes. Re-visiting the use of riparian buffers in forestry: Implications of natural disturbance emulation for aquatic ecosystems. Departmental Webinar, Natural Resources Canada, Canadian Forest Service, Sault Ste Marie, Ontario, 17 January 2012.

Kreutzweiser, D.P., P.K. Sibley and T.A. Scarr. Invasive forest insects may pose risks to water resources: implications for forest planning and management. Latornell Water Conservation Symposium, Alliston, Ontario, 16-18 November 2011.

Kreutzweiser, D.P. Ecological impacts of emerald ash borer in riparian and upland forest: an update. Emerald Ash Borer Science Committee Meeting, Sault Ste Marie, Ontario, 19 October 2011

Kreutzweiser, D.P., P.K. Sibley, B. Naylor and R. Mackereth. Does natural disturbance emulation in forestry protect aquatic ecosystems? Canadian Institute of Forestry Annual Meeting, Huntsville, Ontario, 18-22 September 2011 (invited)

Kreutzweiser, D.P., P.K. Sibley, B. Naylor and R. Mackereth. Re-thinking the use of riparian buffers in forestry: Implications of natural disturbance emulation as a management strategy. American Fisheries Society, Seattle, Washington, 4-8 September 2011 (invited)

Kreutzweiser, D.P. and D.G. Thompson. Non-guideline studies refine and improve the aquatic risk assessment of forest insecticides imidacloprid and neem. Society of Environmental Toxicology and Chemistry, Milan, Italy, 16-20 May 2011.

Lemmen K.D, D. Gray and S. E. Arnott. *Daphnia* species composition during recovery of acidified lakes and the contribution of the egg bank. Society of Canadian Limnologists, Toronto ON, 2011.

Luek, A., G.E. Morgan, J. Gunn and C.W. Ramcharan. 2011. Food web dynamics in lakes recovering from metal stress and acidification. Annual Meeting of the Society of Canadian Limnologists, Jan 2011, Toronto, ON.

Maltais, V., I. Horne, P.J. Beckett, A. Lock, J. Hargreaves and G.A. Spiers. The effects of treated mine effluent discharge water on a natural wetland. Sudbury 2011, Mining and Environment International Conference, Sudbury, ON. 25-30, June 2011. Poster.

Narendrula, R., K.K. Nkongolo and P. Beckett. 2011. Comparative Soil Metal Analyses in Sudbury and Lubumbashi : two contrasting mining cities with a similar legacy. Paper presented at Sudbury Restoration Workshop held in February 2011.

Narendrula, R., M. Mehes-Smith, K. K. Nkongolo, C. Roussell and P. Beckett. 2011.Genetic analysis of natural and planted populations of *Picea glauca* and *Pinus strobus*) growing from Northern Ontario. Paper presented at Sudbury Restoration Workshop held in February 2011.

Nkongolo K.K., M. Mehes-Smith, R. Narendrula, P.J. Beckett and G. Spiers .Monitoring land reclamation and conservation of plant populations from metal-contaminated and uncontaminated areas in the Greater Sudbury Region using multiple approaches. Sudbury 2011, Mining and Environment International Conference, Sudbury, ON. 25-30, June 2011

Ramcharan, C.W. 2011. Reducing incidences of bluegreen algae in Nepahwin Lake. Nepahwin Lake Stewardship Committee Annual Meeting. June 2011, Onwatin, ON.

Ramcharan, C.W. 2011. Reducing incidences of bluegreen algae in Simon Lake. Greater Sudbury Watershed Alliance Annual Meeting. May 2011, Walden, ON.

Ramcharan, C.W. 2011. An overview of Sudbury watersheds. Bluegreen Algae Workshop with David Schindler. Science North, Dec. 2011, Sudbury, ON.

Stasko, A.D., T.A. Johnston and J.M. Gunn. 2012. Quantifying niche overlap in isotopic space: the effect of water clarity on resource partitioning between native walleye and invasive smallmouth

bass. Oral presentation at the Canadian Conference for Fisheries Research, Moncton, NB, Canada, 5-7 January 2012.

Stasko, A.D., T.A. Johnston and J.M. Gunn. 2011. Variance ellipses: Using stable isotopes to measure niche overlap. Poster presentation at the Canadian Conference for Fisheries Research, Toronto, ON, Canada, 6-8 January 2011.

Sweetman, J.N., S.E., Arnott, N.M. Farquharson, R.I. Hall, L. A. MacDonald, D. McLennan, R. Sharma, C. C. Symons and B. B. Wolfe. Evaluating the impacts of recent environmental changes on freshwater ecosystems in Wapusk National Park. Canadian Society for Ecology and Evolution, Banff, Alberta, 2011.

Symons, C.C., S. E. Arnott and J. N. Sweetman. Nutrient limitation and zooplankton grazing control of phytoplankton biomass in Subarctic lakes, Wapusk National Park, Manitoba. Science for a Changing North II, Sudbury Restoration Workshop, Sudbury, Ontario, 2011.

Symons, C.C., S.E. Arnott and J.N. Sweetman. Controls on phytoplankton biomass in Subarctic lakes: Nutrient limitation and zooplankton grazing. Churchill Northern Studies Centre and Parks Canada Science Symposium, Winnipeg, Manitoba, 2011.

Symons, C.C., S.E. Arnott and J.N. Sweetman. Controls on phytoplankton biomass in Subarctic lakes: Nutrient limitation and zooplankton grazing. Society of Canadian Limnologists, Toronto, Ontario, 2011.

Szkokan-Emilson, E.,S.Watmough and J.M. Gunn. 2012. Drought-induced fluxes of metals and nutreints to lakes from peatlands in catchments vulnerable to extreme events. Society of Canadian Limnologists / Canadian Conference for Fisheries Research, Moncton, NB, Canada, 5-7 January 2012.

Tang, R. W.-K., T.A. Johnston and J.M. Gunn. 2011. Temporal trends in mercury concentrations of large-bodied fishes in northern Ontario lakes. Oral presentation at the Canadian Conference for Fisheries Research, Toronto, ON, Canada, 6-8 January 2011.

Tang, R. W.-K., T.A. Johnston and J.M. Gunn. 2011. Temporal trends in mercury concentrations of large-bodied fishes in northern Ontario Lakes. Oral presentation at the 10th International Conference on Mercury as a Global Pollutant, Halifax, NS, Canada, 24-29 July 2011.

Tang, R.W.-K., A.D. Stasko, T.A. Johnston and J.M. Gunn. 2012. The relative influence of food web position and growth rate on interspecific variation in mercury concentrations of boreal piscivores. Oral presentation at the Canadian Conference for Fisheries Research, Moncton, NB, Canada, 5-7 January 2012.

Truong, H.Y.T., Y.-W.Chen M. Saleh and N. Belzile. 2011. Effect of selenium on the methylation of mercury by the sulphur-reducing bacterium Desulfovibrio desulfuricans. 10th International Conference on Mercury as a Global Pollutant, Halifax, Canada.

Waddell, J., G. Spiers and P.J. Beckett. Understanding the fertility of agricultural soils in the Sudbury region. Sudbury 2011, Mining and Environment International Conference, Sudbury, ON. 25-30, June 2011. Poster.

Wiegand, M.D., T.A. Johnston, L.R. Porteous, D.M.-M. Wong, M.D. Moles, J.M. Casselman and W.C. Leggett. 2011. Differences in resource allocation to reproduction in two sympatric, exploited fish: walleye and lake whitefish. Oral presentation at American Society of Limnology and Oceanography, Aquatic Sciences Meeting, San Juan, Puerto Rico, 13-18 February 2011.

Yan, N. Evidence for the loss of calciphilic *Daphnia* species in Ontario shield lakes associated with Ca decline of lake waters. 2011 Canadian Conference for Fisheries Research and Society of Canadian Limnologists, 6-8 January, 2011, Toronto, ON.

Yan, N. Highlights of the Water Forum, and the state of Canada's freshwater. Invited keynote dinner speaker at the Science for a Changing North II conference, Laurentian University, Sudbury, ON, 23 February, 2011.

Yan, N. Watershed Calcium Dynamics. Invited presentation at the Muskoka River Watershed Monitoring and Management Consortium Workshop, Nipissing University, Muskoka Campus, Bracebridge, ON, 25 Feb, 2011.

Yan, N. Driving Canadian Shield Lakes to jelly: interactive effects of logging, climate change acid rain and invasive predators. Invited keynote address. McGill School of the Environment research symposium 2011 – Global environmental change. McGill University, Montreal, PQ, 13 April, 2011.

Yan, N. Bridging the gap between environmental science and policy. McGill School of the Environment, research symposium 2011 – global environmental change, 14 April 2011.

Yan, N. Regulators of the spread and establishment of the spiny water flea, *Bythotrephes*: the power of a network approach. CAISN Canadian Aquatic Invading Species Network final conference, 27-28 April, 2011. Quebec City,

Yan, N. Are catchments sentinels of global change – emerging themes from the conference. Invited review of conference highlights from "Catchment Science: interactions of hydrology, biology and geochemistry – sentinels of global change". Gordon Research Conference, 10-15 July, 2011, Bates College, Lewiston, ME.

Yan, N. Direct and indirect effects of Ca and P decline on the crustacean zooplankton populations of acid-sensitive, shield lakes. Invited plenary lecture at the Workshop on

acidification in aquatic environments: what can marine science learn from limnological studies of acid rain? 27-29 September 2011, Institute of Marine Research, Tromso, Norway.

Yan, N. Direct and indirect effects of Ca and P decline on the crustacean zooplankton populations of acid-sensitive, shield lakes. Invited plenary review in the Effects of Acidification on Organisms, Tromso Acidification Workshop, 27-29 September, 2011, Tromso, Norway

Yan, N. The rise of *Holopedium*: effects of logging, climate change, acid rain and invading Bythotrephes on composition of large Cladocera in Canadian Shield lakes. Tri-annual Conference on Cladocera, 2-8th October, 2011, Verbania, Italy.

Yan, N. The rising importance of jelly-clad taxa. Limnology lecture series, Queen's University, 15 Dec, 2011, Kingston, ON.

Yuille, M.J., T.B. Johnson and S. E. Arnott. *Hemimysis anomala* in Lake Ontario food webs: are they causing shifts in fish diets? Canadian Conference for Freshwater Fisheries Research. Toronto, Ontario, 2011.

Yuille, M.J., T.B. Johnson and S.E. Arnott. *Hemimysis anomala* in Lake Ontario food webs: stable isotopic and bioenergetic analyses of nearshore fish communities. Queen's University Biological Station, Kingston, Ontario, 2011.

Yuille, M.J., T.B. Johnson and S.E. Arnott. *Hemimysis anomala* in Lake Ontario food webs: are fish responding? St. Lawrence River Institute of Environmental Sciences, Cornwall, Ontario, 2011.

Research Grants

Arnott, S

- NSERC Discovery, The influence of dispersal on ecosystem response to environmental change
- Great Lakes Fisheries Commission, Toxicokinetic and food web models to quantify the effects of *Hemimysis anomola* on Great Lakes food webs. (with Tim Johnson, MNR and Linda Campbell)
- Friends of Killarney Park, Recovery Status of Killarney Park Lakes: a survey of water chemistry, zooplankton, and the non-indigenous macroinvertebrate, *Bythotrephes longimanus*
- Chancellor's Research Award, The interaction between dispersal and local conditions in biological recovery of zooplankton communities
- NSERC Strategic Network NSERC Network on Aquatic Invasive Species (29 PIs, Lead: Hugh MacIsaac)
- Polar Continental Shelf Project (helicopter) Assessing the role of landscape

characteristics in influencing community response to environmental change

Belzile, N

- NSERC Interaction Grant
- CORFO (Chile) Travel grant
- CEMI Effect of microwave on mine tailings

Gunn, J

- CFI/ORF Research Equipment for Industrial Watershed and Far North
- NSERC Discovery, Terrestrial/aquatic linkages in the recovery of disturbed ecosystems
- NSERC Industrial CRD with Vale Ltd. and Xstrata Ltd. Terrestrial Aquatic Linkages for Ecosystem Recovery
- OMOE, Mercury Contamination of Fish in Ontario's Boreal Shield (with T. Johnston)
- City of Greater Sudbury, Urban Lakes Restoration
- NSERC CRC, Stressed Aquatic Systems
- Vale Ltd., Junction Creek Brook Trout Restoration Research and Development
- Far North Information and Knowledge Management (FNIKM), OMNR Mercury in Far North Fish Populations (with Johnston/Keller)

Johnston, T

- MNR Operating and Capital Support
- FNIKM, OMNR Mercury in Far North Fish Populations (with Gunn/Keller)
- OMOE, Mercury Contamination of Fish in Ontario's Boreal Shield (with J. Gunn)
- NSERC Discovery, Reproductive Ecology of Boreal Fishes
- Invasive Species Partnership Fund

Keller, B

- Environment Canada, FIRNNO support (with C. Sarrazin-Delay)
- Ontario Ministry of the Environment, ARG and FIRNNO support
- Ontario Ministry of the Environment, Climate Change and Multiple Stressor Research Support
- Vale Ltd., Lake Monitoring (ARG) support
- Xstrata Nickel, Lake Monitoring (ARG) support
- FNIKM, OMNR Mercury in Far North Fish Populations (with Johnston/Gunn)

Kreutzweiser, D

- Invasive Species Centre Partnership Fund, Ecological impacts of forest invasive insect pests on Ontario's landscape
- Forest Ecosystem Science Cooperative, Bioindicators of forest stream health

Ramcharan, C

- Center for Excellence in Mining Innovation, Establishing an embedded network for weather monitoring across north Baffin Island
- Nickel District Conservation Authority, Cyanobacteria monitoring program on Ramsey Lake

Sarrazin-Delay, C

- Environment Canada, FIRNNO support (with B. Keller)
- Ontario Ministry of the Environment FIRNNO support

Yan, N

- Ontario Ministry of Natural Resources Research Contract: "Reviewing Invading Species Policy in Ontario and Canada"
- Ontario Ministry of Natural Resources Research Contract: "Recreational boats as a source of species introductions into Lake Simcoe"
- Ontario Ministry of the Environment, Environmental Monitoring and Reporting Branch Research Contract: "Zooplankton recovery in Sudbury lakes".
- Ontario Ministry of the Environment, Environmental Monitoring and Reporting Branch Research Contract: "Zooplankton in Lake Simcoe".
- Canadian Foundation for Climate and Atmospheric Sciences (CFCAS) Knowledge Synthesis: "Connecting four research solitudes: the impacts and implications of climate change for invasive species, biodiversity and society" (Yan is co-PI on the application with 5 other co-PI's)
- Laurentian University Agreement: " Correcting for the variance attributable to wind-induced water movements in long-term assessments of the effects of multiple ecological stressors on pelagic zooplankton"
- NSERC CRD: "Role of terrestrial carbon and base cations in the recovery of damaged aquatic systems" (Yan is co-PI on the application with 5 co-PIs).
- NSERC Network on Aquatic Invasive Species (Yan is one of 26 co-PI's in this network grant)
- York/MOE agreement (secures a half-time release from teaching for Yan, to enhance research on the direct and indirect effects of calcium decline on Ontario lakes)

Theses Completed

Graduate

Bradley, J. MSc. Urban and industrial drivers of phytoplankton communities in Sudbury, Ontario, urban lakes. Laurentian University, Sudbury, ON. (Ramcharan)

Gray, D.K. PhD. The role of dispersal during the recovery of acid-damaged zooplankton communities. Queen's University, Kingston, ON (Arnott)

Turko, P. W. MSc. Ecological differentiation in a hydridizing cryptic species complex. Queen's University, Kingston, ON (Arnott)

Turner, K. MSc. Influence of dispersal on community zooplankton structure and species co-occurrence patterns. Queen's University, Kingston, ON (Arnott)

Tang, R. MSc. Variation in mercury concentrations of large-bodied fishes in northern Ontario Lakes. Laurentian University, Sudbury, ON. (Gunn/Johnston)

Undergraduate

Chou, M. BSc Honours. 2011. The natural exclusion of daphnia and possible causes for the rise of *Holopedium* in Ontario lakes. York University, Toronto, ON (Yan)

Gillespie, M. BSc Honours. 2011. Impacts of changing surface winds on fish communities in Lac Croche: Results of a lake mixing experiment. Laurentian University, Sudbury, ON (Gunn)

Simpson, A. BSc Honours. 2011. To Flea or not to flea? Characterizing the distribution and effects of *Bythotrephes longimanus* invasions in Ontario's lakes. Queen's University, Kingston, ON (Arnott)

Hanschell. J. BSc Honours. 2011. Adaptive changes in salinity tolerance of *Daphnia pulicaria* in a Subarctic pond in Wapusk National Park, Manitoba. Queen's University, Kingston, ON (Arnott)

Campbell, M. BSc Honours. 2011. Dietary Preference for *Hemimysis anomala* by *Perca flavescens,* a native fish. Queen's University, Kingston, ON (Arnott)

HQP Supervised

Audet, Chantal, BSc Honours. In progress (Keller)
Béchard, Yvette, BSc Honours. In progress (Johnston)
Goto, Sara, BSc Honours. In progress (Arnott)
Hamilton, Graeme, and Nugent, Brett, BSc Honours. In progress (Johnston)
Pecorskie, Steve, BSc Honours. In progress (Arnott)
Sadlier, Caroline, BSc. Honours. In progress (Gunn)
Sauder, Janel, BSc Honours. In progress (Gunn)
Steele, Sam, BSc Honours. In progress (Arnott)

Alzharani, Ali, MSc Candidate, Chemical Sciences, Laurentian (Belzile)
Bradley, Jaimee, MSc Candidate, Laurentian University (Ramcharan)
Bresnehan, Amanda, MSc Candidate, Queen's University (Arnott)
Gibson, Christine, MSc Candidate, York University (Yan)
Gillespie, Michelle, MSc Candidate, Laurentian (Gunn)
Goral, Melanie, MSc Candidate, York University (Yan)
Kielstra, Brian, MSc Candidate, Queen's University (Arnott/Gunn)
Lemmen, Kim, MSc Candidate, Queen's University (Arnott)
MacLeod, Josef, MSc Candidate, Laurentian (Gunn/Keller)
Nisbett, David, MSc Candidate, University of Guelph (Sibley/Kreutzweiser)
Quinn, Liam, MSc Candidate, York University (Yan)
Sawdon, Lorraine, MSc Candidate, Laurentian (Gunn/Johnston)
Sharko, Tanya, MSc Candidate, Royal Roads University (Kreutzweiser)
Sinclair, James, MSc Candidate, Queen's University (Arnott)
Stasko, Ashley, MSc Candidate, Laurentian University (Gunn/Johnston)
Symons, Celia, MSc Candidate, Queen's University (Arnott)
Wallace, Kylie, MSc Candidate, Laurentian University (Gunn/Kreutzweiser)
Yuille, Michael, MSc Candidate, Queen's University (Arnott/Johnson)

Cott, Pete, PhD Candidate, Laurentian (Gunn/Johnston)
Jokela, Anneli, PhD Candidate, Queen's University (Arnott/Beisner)
Jones, Chris, PhD Candidate, Laurentin (Bailey/Gunn)
Kim, Natalie, PhD Candidate, York University (Yan)
Langille, Aaron, PhD Candidate, Laurentian (Gunn/Newman)
Muto, Elisa, PhD Candidate, Laurentian University (Gunn/Kreutzweiser)
Palmer, Michelle, PhD Candidate, York University (Yan)
Szkokan-Emilson, Erik, PhD Candidate, Laurentian (Gunn/Watmough)
Truong, Yen Thi Hoang, PhD Candidate, Boreal Ecology, Laurentian (Belzile)

Babin-Fenske, Jennifer, PDF, Laurentian (Gunn)
Celis-Salgado, Martha, PDF, York University (Yan)
Kelly, Noreen, PDF, York University (Yan)
Smith, Andrea, PDF, York University (Yan)
Tanentzap, Andrew, Banting PDF, York University (Yan)
White, Michael, PDF, Laurentian (Keller)

Linley, Dallas, Research technician, York University (Yan)
Gleason, Amber, Research technician, Can. For. Serv. (Kreutzweiser/Gunn)
Hung, Stephanie, Research technician, York University (Yan)

Staff

Laurentian University Science Building
Alarie, Yves – Biosystematics
Belzile, Nelson - Environmental Chemistry
Dirszowsky, Randy – Geomorphology/Paleolimnology
Ramcharan, Charles - Aquatic Ecologist

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

York University
Yan, Norman

Queens University
Arnott, Shelley

Living with Lakes Centre
Bailey, John – MOE Research Scientist/ LU Adjunct
Bamberger, Elizabeth – Business Manager, LU
Beckett, Peter - Education and Outreach, Faculty LU
Campbell, Daniel –Research Scientist MIRARCO/Lakes Centre
Corston, Andrew – Fisheries Technician
Ford, Andrea - Data Manager, MOE
Fram, Kim - Invertebrate Taxonomist
Gillespie, Michelle – NOHFC Intern, Living with Lakes Transition Assistant
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
Houle, Jason – Senior Fisheries Technician/ Data Manager
Johnston, Tom – MNR Senior Research Scientist/LU Adjunct
Keller, Bill – Director, Climate Change and Multiple Stressor Aquatic Research, LU
MacPhee, Shannon – Research Associate, LU
McCourt, Jason – Environmental Officer, MOE
Oman, Karen – Research and Administration, LU
Pearson, David - Urban Lakes Coordinator/Science Communication, Faculty LU
Sarrazin-Delay, Chantal - Biomonitoring Biologist
White, Mike – Postdoctoral Fellow
Witty, Lynne – Invertebrate Taxonomist

Field Technicians and Research Assistants

Antoniolli, Nathan, LU
Elsasser, McKenna, LU
Kielstra, Brian, LU
Legault, Josée, OMNR
Lahnalampi, Tamsen, LU
Poulin, Samuel, LU
Sadlier, Caroline, LU
Watkins, Karrah, LU