



Cooperative Freshwater Ecology Unit Annual Report 2007





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New Members

Peter Beckett joined the Co-op Unit in 2007 as a wetland ecologist and the coordinator for community outreach work. Peter is the long serving Co-Chair of VETAC (Vegetation Enhancement Technical Advisory Committee) and contributes to many other community initiatives. In 2007 he also took on the huge task of preparing the program for the Sudbury 2007 Mining and the Environment Conference.

Randy Dirszowsky joined the Co-op Unit in 2007 as a paleo limnologist who specializes in geomorphology and other watershed processes that affect aquatic systems. Randy was a successful NSERC applicant in 2007.

Awards and Recognition

Bill Keller is the 2008 recipient of the Frank H. Rigler Award, the highest honour given by the Society of Canadian Limnologists.

Norman Yan held a Gledden Visiting Senior Fellowship at the University of Western Australia, March to May 2007.

Shelly Arnott was an organizing committee member for the American Society of Limnology and Oceanography meeting, Santa Fe, NM, Feb. 2007

John Gunn was a Co-Chair of the Mining and the Environment International Conference held in Sudbury Oct. 19-26, 2007. He was also appointed to the Lake Simcoe Science Advisory Committee with the term beginning in 2008.

George Morgan was appointed as the Academic Advisor to the Fisheries Management Zone 10 Council for the Ontario Ministry of Natural Resources beginning in 2008.

David Pearson was appointed as the Co-Chair for the Ontario expert panel on climate change and as director of OCAIRN. In addition (amazingly), Dave has resumed his role of Science Director of Science North in 2007.

Ed Piché Director of the Environmental Monitoring and Reporting Branch in the Environmental Sciences and Standards Division of the Ministry of the Environment and

long time supporter of the Cooperative Freshwater Ecology Unit officially retired in 2007. We recognize the importance Ed has had in our history and wish him the best in his retirement. In turn, we welcome and look forward to working with the new Director John Mayes.

Cheryl Lewis, former Manager of the Aquatic Research and Development Section received a promotion in 2007 and is now the Director of the Applied Research and Development Branch of the Science and Information Resources Division of the Ministry of Natural Resources. We wish to congratulate Cheryl on her accomplishments and welcome the new Manager Sandra Orsatti to our team.

Living with Lakes Centre Project Update

2007 was an exciting year for the Living with Lakes project. Not only did the design development advance to create the exciting image illustrated on the cover of this report, but significant funding success was achieved. On March 26, 2007 FedNor confirmed the increase of their support for the detailed design to \$475K and are continuing to work to provide major additional support for research equipment for the new facility. On August 8, 2007 the Honourable Rick Bartolucci, then Minister of Northern Development and Mines, announced \$2M from the Northern Ontario Heritage Fund Corporation. On Feb. 28, 2008 Vale Inco made a contribution of \$4.5 M and Vice President Scott McDonald agreed to lead the Laurentian Capital campaign that will help see the project completed. In recognition of their support, Laurentian agreed that the new centre will be called the Vale Inco Living with Lakes Centre. On Feb. 28, 2008 we were delighted further by an announcement of an additional \$5M of support for the centre by the Honourable John Milloy, Minister of Training Colleges and Universities.

This brings the total funding commitments to \$12.75 M – more than half way to our total goal of \$23 M and within \$3 M of the estimated funds required for the capital construction. We are now confident that the project will go to tender in late summer for a fall 2008 start to construction.

Community Outreach

Once again, the Co-op Unit has been active in many community-based initiatives.

- **Greater Sudbury Lake Improvement Advisory Panel:** John Gunn, Bill Keller and David Pearson provide technical advice for this program. We also assisted in the development of a “lake quality report card” and reviewed the lake stewardship grant proposal.
- **Junction Creek Stewardship Committee:** John Gunn and Peter Beckett, among others, provide considerable technical advice and other resources. Jason Houle, Karen Oman and John Gunn authored a synthesis report on the water quality monitoring program.
- **Sudbury Water Forum:** For the first time, the Nickel District Conservation Authority and its Source Water Protection Program, Junction Creek Stewardship

Committee, City of Greater Sudbury's Lake Water Quality Program, and the Sudbury District Health Unit collaborated on this event to inform the community about the state of its water resources. Bill Keller, Peter Beckett and John Gunn participated as panel members and fielded questions from the audience. The event was an outstanding success with over 150 people attending. We expect this partnership to continue and share resources for future events to inform and engage the community.

- **Picture our Lakes Photography Contest:** The Co-op Unit was asked to take a lead role with Artists on Elgin, in a contest to celebrate the more than 330 lakes in the city's boundaries. Other community partners included: Downtown Sudbury, the Chamber of Commerce, and the City of Greater Sudbury. We received media sponsorship from Northern Life and CTV. Vale Inco provided a major sponsorship for the contest. Over 535 photos were submitted, from which citizens voted on their 40 favourite shots. A blue ribbon panel of judges selected the best from these to be featured in a 2008 calendar. The contest and calendar were very successful and a contest has been launched for 2008. The ultimate goal for the Co-op Unit is to generate a database of pictures of all 330 lakes as well as promote lake stewardship within the public through contest related education.
- **VETAC:** Peter Beckett chairs this committee and participates in various subcommittees. (Note: VETAC was the winner of the 2008 Community Builders Award).
- **Rainbow Routes:** Peter Beckett is an Environmental Advisor for Rainbow Routes and has led field trips and contributed to the development of curriculum for schools called "Learning with Trails". The Living with Lakes project has helped leverage support for ongoing trail development along the south shore of Ramsey Lake. .
- **EarthDay:** We once again participated in EarthDay with a booth featuring both our research program and the Living with Lake Centre which generated considerable interest among the thousands of people who attended this event.
- **Greenspace Advisory Panel:** Peter Beckett is a technical resource person to assist in defining what areas should be conserved in Sudbury.

Science Communication Graduate Program

David Pearson, Laurentian Co-Director

Interest in the program remains strong with enrollment for 2007-8 at 9 full time students and 1 part time student. This year the students are largely recent graduates from Ontario with the exception of two students, one who brought ten years of experience in the field of environmental consulting to the program, and the other with years of experience in the health field. Whereas previous years have seen a varied interest amongst the students in a wide range of science communication disciplines, this year's group shows a keen interest in the work done in science centres and other public institutions.

Last year, internships included the Experimentarium in Denmark, Pollution Probe, exhibit production companies in Montreal and Toronto, and the IMAX Production Unit at Science North. This year, students will take advantage of learning opportunities with exhibit and multi media production firms, Science North's Northern Ecosystem Project, the Sudbury and District Health Unit, and Laurentian's Northern Ontario School of Medicine, to name a few.

The Ministry of the Environment's Environmental Monitoring and Reporting Branch played host to our program in February 2008, and led the 3rd Science Communication in Government Workshop. Students participated in discussions about the role of science and public understanding in policy development. Special guests included Ken Ogilvie, Executive Director of Pollution Probe and the Honourable David Anderson, former federal minister for Environment Canada.

Applications have already been received for 2008-9. Students with science or technology degrees or equivalent experience in the field of science communication are invited to apply. Enrolment is limited to 15. For more information see www.sciencecommunication.ca

Climate Change

David Pearson's other hats include Co-Chair of the Ontario Government's recently appointed Expert Panel on Climate Change Adaptation. The mandate of the Expert Panel on Climate Change Adaptation is:

- To provide advice to government concerning issues related to climate change impacts and adaptation such as
 - actions, plans and best practices
 - adaptation policies
 - research needs
- To respond to requests for advice on impact and adaptation topics or issues as requested -utilizing external expertise when required

David also secured funding for and leads the Ontario Centre for Climate Impacts and Adaptation Resources (at Laurentian University). With a similar mandate to the former C-CIARN, O-CIAR will:

- Promote and deliver resources and outreach activities related to climate change impacts and adaptation in Ontario through:
 - stakeholder workshops
 - an adaptation "toolkit" for municipalities to introduce climate change adaptation into everyday decision making processes
 - communicating the science of climate change, and potential impacts and adaptation issues
 - developing adaptation resource materials related to impacts on communities and stakeholders
 - maintaining a climate change "knowledge" and stakeholder network
 - maintaining a bibliographic database
 - maintaining a website of impacts and adaptation information, links etc

- promoting regional climate modeling

Aquatic Restoration Group

Sudbury Environmental Study Lakes

In 2007 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 is 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 2007 all 44 lakes in the SES Extensive lake set were sampled once for a set of standard water quality parameters.

The SES Intensive program is a set of lakes sampled monthly or bimonthly through the ice-free season for a wide range of physical, biological and chemical parameters (water quality, 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 2007 there were 12 lakes sampled monthly (May – October) and 1 lake sampled bimonthly (Swan lake) under the SES Intensive program.

These Sudbury area monitoring programs are 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 programs have also become very important in the study of the interactive effects of acidification and other large-scale stressors like climate change, base cation depletion, and UV radiation on aquatic systems.

Northern Ontario Benthic Invertebrate Reference Condition Approach (RCA)

Biomonitoring Network

The Northern Ontario Benthic Invertebrate Reference Condition Approach Biomonitoring Network (Northern Ontario RCA Network) is 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 objective of this study is to develop a large network of reference and test sites to assess and monitor mining effects on surface waters by detecting any impairment in benthic invertebrate community structure. The Northern Ontario RCA network began in 2003, with a large field effort generating data for over 200 reference and test sites from 4 mining centers including Red Lake, Hemlo, Sudbury and Timmins. Additional sites were sampled in 2004 with these data also added to our database housed on Environment Canada's Canadian Aquatic Biomonitoring Network (CABIN). Preliminary and refined models were created using these data as well as a preliminary assessment of temporal, spatial, replication and methodological variability in the database (Vascotto et al., 2007). In 2005 and 2006, the RCA project focused on increasing sample size for evaluating database variability including temporal, spatial, replication and methodological factors. The reference database was also expanded to include more urban and historically impacted reference sites. Understanding of these confounding factors may

prove to be important to enable better interpretation of EC benthic monitoring results as some mine receiving environments are in urban areas or in locations that are impacted by historical mining activity

The sampling of sites previously sampled in order to document temporal variation continued again in 2007. Sampling was undertaken from September 19th to November 8th 2007. Well over 10% of the sites in the database were resampled, some for their fifth year. Some sites that were visited were impossible to sample due to extreme water levels. Three sites were too dry to sample when visited in October. Late fall rains filled these creeks with enough water to allow sampling in November. These sites may provide some insight into “recovery” following drought. It was also noted that many of the streams that we were able to sample had visibly lower water levels than in past years. As in previous years, ten percent of the sites were randomly selected to serve as quality control, quality assurance program (QA/QC) sites. Seven sites were sampled in triplicate to track replication variability.

The Northern Ontario RCA Network now includes data for over 300 sites. Models will continue to be refined as more data are collected including examination of the confounding factors of urbanization and historically impacts as well as the exploration of new modeling techniques. Due to the versatility of this network and the potential application to other industrial sectors and government agencies, there is considerable potential for the Northern Ontario RCA Network to continue to grow and to serve as a reference database for many stakeholders.

N SERC CRD Program- Barriers to Biological Recovery

2007 marked the completion of year 3 of this 4 year partnership program between the Co-op Unit (J.Gunn, W. Keller, C. Ramcharan, G. Morgan), York University (N. Yan), and our industrial partners Vale Inco. (G. Watson, L. Lanteigne, C. Brereton) and Xstrata (M. Butler) designed to determine the factors that affect recovery of urban industrial lakes. Much of the field work in 2007 focused on completion of the extensive survey work: benthic invertebrates, fish, zooplankton and water. There were primarily 3 sampling projects: 1) the 38 lakes and industrial ponds within the high metal deposition zone (< 20 km from the smelters) 2) the regular 44 SES MOE lakes and 3) the 8 Dorset A lakes used for contaminant analysis (sediments, water, zooplankton). In addition, in 2006 we added an experimental component with the initiation of the biomanipulation project led by G. Morgan to test the effects of altered predator/prey communities on recovery dynamics. In 2006 we also added a new project by M.Sc. Ashley Tremblay assessing the genetic factors related to yellow perch recovery and interaction with introduced smallmouth bass. In 2007 we added two new M.Sc. students (Erik Szkokan-Emilson and Brian Wesolek) to address watershed and lake habitat factors that affect benthic invertebrate recovery. In 2007, PIs and students presented CRD findings at both the CCFR/SCL and the Sudbury 2007 Mining and the Environment Conference.

Northern Fisheries Research Program

This program is supported by base research funding from the OMNR Aquatic Research and Development Section. The work of this research program improves our understanding and aids the management of the fish populations that support the recreational, commercial and

subsistence fisheries of northeastern Ontario. The program currently includes a variety of research projects that examine: i) reproductive ecology of northern fish populations, ii) effects of cage aquaculture on the northern Lake Huron ecosystem, and iii) food web structure and mercury bioaccumulation in northern fish communities. In 2007, the emphasis of the research effort was directed at reproductive ecology. A broad-scale analysis of variation in lake trout egg quality across Ontario populations, both wild and hatchery broodstocks, continued this year. Results to date have shown that egg quality is consistently related to maternal size and age across diverse wild populations, and that hatchery-maintained broodstocks exhibit shifts in egg quality following several generations in captivity. Another reproductive ecology project is examining divergence in life history strategies of naturalized steelhead populations across the Great Lakes (B.Sc. thesis project of Micalé Prévost). A study of several northern fish species is examining how variability in fish mercury bioaccumulation is related to the combined effects of gender and growth rate (B.Sc. thesis project of Kyla Standeven). Finally, a new research project initiated in 2007 will focus on the ecology of a northern fish, the burbot. The research will address various aspects of the burbot's reproductive ecology and position in northern food webs, and will form part of a collaborative research project with Fisheries and Oceans in Yellowknife, NT (Ph.D. thesis project of Pete Cott).

Monitoring and State of the Resource Reporting

During the summer of 2007, the Cooperative Freshwater Ecology Unit (George Morgan, P.I.) collaborated with the Ontario Ministry of Natural Resources (Dr. Nigel Lester, Fisheries Research and Steve Sandstrom, Muskoka Lakes Fisheries Assessment Unit) in the testing and development of the proposed index netting method for Ontario's monitoring and state of resource reporting for lake trout and walleye (i.e., Ontario Lacustrine Index Netting or OLIN). The Cooperative Freshwater Ecology Unit conducted intensive mark-recapture experiments on 9 lakes to calibrate fish density to relative abundance (from paired Nordic and OLIN nets in all lakes). In addition, 2 lake trout lakes and 2 walleye lakes were netted in the northeast region using the proposed OLIN method.

Field Courses

Ontario Universities Field Courses in Biology (OUPFB)

In 2007 Laurentian joined OUPFB to provide our students with access to 41 new field courses offered by 16 universities. The field course program covers a broad range of topics, from behavioural energetics, to methods in ecotoxicology, to arctic, marine, desert, alpine and tropical reef biology.

The Co-op Unit offered the Methods in Aquatic Biodiversity Assessment Course on Aug.26-Sept. 8, 2007. Students were introduced to a wide variety of field methods for use in assessing the effects of multiple stressors (e.g. climate change, excessive exploitation, acidification, shoreline development) on the biodiversity of Boreal Shield lakes. The course focused on sampling fish, benthic invertebrates and zooplankton using standard methods currently employed by many government agencies in Canada and Scandinavia. All participants were trained in boat safety and obtained an official pleasure boat operators card. They received extensive class, lab and field training in proper sampling design, sampling equipment and procedures, species identification, sample processing, and data management.

After a one week training period in Sudbury the students went to Killarney Park and completed a full biodiversity assessment of 3 long term study lakes: George, Johnnie, and Bell.

Shelley Arnott also offered an OUPFB field course on August 26-Sept. 8, 2007 through Queen's University entitled 'Limnology of Stressed and Recovering Ecosystems' This course was held in Killarney Park and was very successful.

In 2008 the Cooperative Freshwater Ecology Unit will again be participating in the OUPFB program providing the course 'Restoration Ecology of Damaged Watersheds', led by Peter Beckett, John Gunn and Graeme Spiers.

OBBN field course

Chris Jones and Chantal Sarrazin-Delay instructed a 2 day Ontario Benthic Biomonitoring Network Participant Certification Course at the Mining and Environment Conference on October 20-21, 2007 in Sudbury, Ontario. This short course was available to delegates of the conference as well as members of the general public and feedback from the course has been positive. Chris and Chantal also conducted an OBBN course as part of the OUPFB field course at the Co-op Unit in August 2007.

Mining and the Environment Conference IV

The Co-op Unit co-hosted the Mining and the Environment Conference with the Centre for Environmental Monitoring which was held at Laurentian University, Sudbury from Oct 19 – 26, 2007. The 'Sudbury Restoration Workshop' was integrated into the conference as the Mining Waters Symposium.

The theme for the conference was sustainability and it welcomed over 500 delegates from 16 countries, with over 75% of these delegates traveling to the city. The Co-op Unit lead the Mining Waters Symposium which encompassed variety of topics related to the sustainability of mining-affected aquatic ecosystems. During the Conference, the Co-op Unit also offered the Ontario Benthos Biomonitoring Network Certification Course (2 days) lead by Chris Jones and Chantal Sarrazin-Delay in addition to actively participating in the Sudbury Watershed Tours.

Dr. David Schindler from the University of Alberta presented the Keynote plenary address, opening both the conference and our Mining Waters Symposium. Jeffrey Simpson of the Globe and Mail was the banquet speaker, discussing climate change politics in Canada.

The conference was a resounding success. Industry stepped up to provide considerable support with lead contributions from Vale Inco (\$25,000) and Xstrata (\$15,000). 50 other sponsors added \$120,000 making this the most financially successful conference to date. In addition to the financial success, many contacts were established for future collaboration which may generate new research projects.

Partners and Collaborators

Industry

Vale Inco Ltd.	Xstrata Nickel
Placer Dome (CLA) Ltd.	Goldcorp Inc.
Williams Operating Corp.	Ontario Hydro
Newmont Canada Inc.	

Government Funding Partners

NSERC	CFI/OIT	Environment Canada
Industry Canada	Norway	HRDC/FedNor/MNDM
DFO	City of Greater Sudbury	Can. Wildlife Service
Nat. Water Res. Inst.		

Scientist Collaborators

Laurentian	Cambrian College	York	Queen's
Guelph	Toronto	McGill	Regina
Alberta	Acadia	Indiana	Dartmouth College
Wisconsin	California	Bergen, Norway	

Others

Living Legacy Trust
Friends of Killarney
Anglers Associations
First Nations
Cottagers Associations

Reports and Publications

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

- Alarie, Y., and Michat, M. 2007. Phylogenetic analysis of Hydroporinae (Coleoptera:Dytiscidae) based on larval morphology, with description of first-instar *Laccornellus lugubris*. *Annals of the Entomological Society of America* 100: 655-665.
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- Derry, A. M., and Arnott, S. E. 2007. Adaptive reversals in acid tolerance in copepods from lakes recovering from historical stress. *Ecological Applications* 17:1116-1126.
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- Ramcharan, C.W., Keller, B., and Yan, N.D. A review of allometric models used for estimating zooplankton weight and clearance rate. To be submitted to *J. Plank. Res.* (in prep.)
- Ramcharan, C.W., McQueen, D.J., and Yan, N.D. Planktivory by fish and macro-invertebrates: intra-guild predation in lake food webs. To be submitted to *Ecology.* (in prep.)
- Rasmussen, J.B., Gunn, J.M., Sherwood, G., Iles, A., Gagnon, A., Lacroix, A., Campbell, P.G.C., and Hontela, A. 2007. Direct and Indirect effects of metal exposure on the growth of yellow perch (*Perca flavescens*); Implications for Ecological Risk Assessment. *Journal of Human and Ecological Risk Assessment.* (In press).
- Rusak, J.A., Yan, N. D. and Somers, K.M. 2008. Regional climatic drivers of synchronous zooplankton dynamics in Dorset lakes. *Can. J. Fish. Aquat. Sci.* (in press).
- Sarrazin-Delay, C.L., Bowman, M.F., Keller, W., and Somers, K.M. 2007. Using Benthic Invertebrates as Biomonitors in Northern Ontario: Progression of the RCA Network. *Proceedings of the Mining and the Environment IV International Conference, October 19-26. Sudbury, Ontario.* 8 pp.
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- Vascotto, S., Sarrazin-Delay, C.L., and Keller, W. 2007. Variability in Benthic Invertebrate Community Data and Methodological Implications on Test Site Assessments. Cooperative Freshwater Ecology Unit Report, Sudbury, Ontario. 51 pp.
- Venturelli, P.A., Murphy, C.A., Johnston, T.A., van Coeverden de Groot, P.J., Boag, P.T., Casselman, J.M., Leggett, W.C., Montgomerie, R., Wiegand, M.D., and Shuter, B.J. 200x. Female spawner quality affects the dynamics of collapsing and recovering fish stocks. Submitted to Proceedings of the National Academy of Sciences, November 2007. (under review)
- Walseng, B., Yan, N.D., Pawson, T.W., and Skarpaas, O. 2007. Acidity versus habitat structure as regulators of littoral microcrustacean assemblages. *Freshwater Biol.* (in press)
- Wiegand, M.D., Johnston, T.A., Leggett, W.C., Watchorn, K.E., Ballevena, A.J., Porteous, L.R., and Casselman, J.M. 2007. Contrasting strategies of ova lipid provisioning in relation to maternal characteristics in three walleye populations. *Canadian Journal of Fisheries and Aquatic Sciences* 64: 700-712.
- Winter, J.G., Keller, W., Paterson, A.M., and Yan, N.D. 2007. Phytoplankton recovery from acid and metal contamination: a comparison of limed and un-manipulated lakes. Sudbury 2007 Mining and Environment Conference.
- Winter, J.G., Keller, W., Paterson, A.M., and Yan, N.D. 2007. Three decades of recovery of the phytoplankton community in Clearwater Lake (Sudbury, Canada) from acid and metal contamination. *Verh. Internat. Verein. Limnology*, in press.
- Yan, N.D., Somers, K.M., Girard, R.E., Paterson, A., Keller, B., Ramcharan, C., Rusak, J., Ingram, R., Morgan, G., and Gunn, J. M. 2008. Long-term changes in crustacean

zooplankton communities of Dorset, Ontario lakes: the probable interactive effects of changes in pH, TP, Dissolved Organic Carbon, and predators. *Can. J. Fish. Aquat. Sci.* (in press).

Young, J. D. and Yan, N.D. 2008. Modification of the diel vertical migration of *Bythotrephes longimanus* by their cold-water planktivore, *Coregonus ardtedi*. *Freshwater Biol.* (in press).

Invited Presentations

Arnott, S. Stony Brook University, Department of Ecology and Evolution, Stony Brook, NY, 2007.

Belzile, N., Chen, Y.-W., Polack, R., Truong, Y.T.H., and Yang, D.-Y. 2007. Reduction of hydride forming elements under controlled conditions and mechanisms of mercury – selenium interactions. Institute of Geochemistry, Chinese Academy of Sciences, Guiyang, China.

Belzile, N., Chen, Y.-W., Truong, Y.T.H., Polack, R., and Yang, D.-Y. 2007. Speciation and redox studies of hydride and vapour forming elements using atomic fluorescence spectrometry (AFS). Chengdu University of Technology, Department of Applied Chemistry and Bioengineering, Chengdu, China.

Belzile, N., Chen, Y.-W., Yang, D.-Y., Truong, Y.T.H., and Polack, R. 2007. Applications de la spectrométrie de fluorescence atomique dans les études environnementales. Spectr'Atom 2007, Pau, France.

Gunn, J.M. and Keller, W. 2007. 30 Years of Restoration and Natural Recovery of Ecosystems in Sudbury, Canada. Norwegian University of Life Sciences. Aslo, Norway. May 30, 2007.

Conference and Workshop Presentations

Arnott, S. E., Derry, A., Duke, L., Forrest, J., Pokorny, J., and Strecker, A. The influence of dispersal on community composition depends on local factors. *Advancing the Science of Limnology and Oceanography (ASLO)*. Santa Fe, New Mexico.

Derry, A.M., Arnott, S.E., Hebert, P.D.N., and Boag, P.T. Maintenance of adaptive diversity along landscape gradients. *Society of Canadian Limnologists*. Montreal, Quebec.

Derry, A.M., Arnott, S.E., and Boag, P.T. Contemporary evolution of zooplankton following lake acidification and recovery. *Advancing the Science of Limnology and Oceanography (ASLO)*. Santa Fe, New Mexico. (NOTE: Alison was the session organizer)

Genrich, E., and Gunn, J.M. 2007. Using littoral zone fish and benthic invertebrate communities to assess recovery of acid damaged lakes in Sudbury, Ontario. *SCL CCFER* Montreal, Quebec January 4-6, 2007.

- Hatton, L., Campbell, L., and Arnott, S. E. 2007. Temporal changes in mercury bioaccumulation in south-central Ontario lakes. Gananoque Metals in the Environment. Gananoque, Ontario. poster
- Hatton, L., Campbell, L., and Arnott, S. E. 2007. Temporal changes in mercury bioaccumulation in south-central Ontario lakes. Society of Canadian Limnologists. Montreal, Quebec. Poster
- Kaufman, S., Selinger, W., Snucins, E., and Gunn, J.M. 2007. Road access as the vector for two invasives in lake trout lakes of northeastern Ontario: Anglers and Bass. SCL CCFFR Montreal, Quebec January 4-6, 2007.
- Linley, R.D., Ramcharan, C.W., and Wissel, B. 2007. Diet and trophic position of zooplankton, *Chaoborus*, and Yellow Perch as determined by stable isotopes. International Association of Theoretical and Applied Limnology (SIL), Montreal, Quebec.
- Lippert, K.A., Gunn, J.M., and Morgan, G.E. 2007. Effects of colonizing predators on yellow perch (*Perca Flavescens*) populations in lakes recovering from acidification and metal stress. SCL CCFFR Montreal, Quebec January 4-6, 2007.
- Morgan, G.E., and Gunn, J.M. 2007. The role of colonists and invaders in the recovery of Sudbury's acidified lake fish communities. SCL CCFFR Montreal, Quebec January 4-6, 2007.
- Petrie, S., Badzinski, S., Belzile, N., and Chen, Y.-W. 2007. Food-chain transfer and effects of selenium in waterfowl. Metals in the Human Environment Research Network 2007 Annual Symposium, Gatineau, Canada.
- Shead, J.A., and Arnott, S.E. Limited biological recovery of Killarney Park Lakes (Ontario) from historical acid deposition despite chemical recovery: 1971-2005. Society of Canadian Limnologists. Montreal, Quebec.
- Somers, K.M., and Keller, W. 2007. Northern Ontario Benthic Invertebrate Reference Condition Approach (RCA) Biomonitoring Network. Environmental Effects Monitoring Meeting, March 20. Toronto, Ontario.
- Somers, K.M. 2007. Experimental Designs and Assessment Methods for Evaluating the Environmental Effects of Effluents. Aquatic Toxicity Workshop. October 1, Halifax, Nova Scotia.
- Strecker, A. L., and Arnott, S. E. Dispersal mediates the effects of an invasive predator, *Bythotrephes*, on a zooplankton community. Advancing the Science of Limnology and Oceanography (ASLO). Santa Fe, New Mexico.

- Strecker, A. L., and Arnott, S. E. Regional dispersal of zooplankton may dampen the effects of an invasive predator, *Bythotrephes*, on local communities. Society of Canadian Limnologists. Montreal, Quebec.
- Venturelli, P.A., Shuter, B.J., Murphy, C.A., Johnston, T.A., de Groot, P. J.v-C., Montgomerie, R.D., Casselman, J.M., Boag, P.T., and Leggett, W.C. 2007. Ricker revisited: Effects of fishing and females on recruitment dynamics of walleye (*Sander vitreus*). Oral presentation at Canadian Conference for Fisheries Research, Montréal, QC, Canada, 4-6 January 2007.
- Wiegand M.D., Johnston, T.A., Kollar, S., Leggett, W.C., Casselman, J.M., and Pyle, G.G. 2007. Maternal influences on metal composition of walleye (*Sander vitreus*) and whitefish (*Coregonus clupeaformis*) eggs. Poster presentation at American Society of Limnology and Oceanography Aquatic Sciences Meeting, Santa Fe, NM, USA, 4-9 Feb 2007.
- Wilson, C.C., Johnston, T.A., Haslam, L.C., Addison, P.A., Gillett, D., and Geiling, W.D. 2007. Prevalence and reproductive status of escapee domestic rainbow trout in spawning tributaries of northern Lake Huron. Oral presentation at Canadian Conference for Fisheries Research, Montréal, QC, Canada, 4-6 January 2007.
- Yan, N. The need for enhanced international collaboration, and the challenge for a Transboundary Research University Network (TRUN): an applied ecologist's perspective. Invited presentation at the TRUN workshop, Niagara Falls, 28 Sept, 2007.
- Yan, N. Phytoplankton community composition in Clearwater Lake (Sudbury, Canada), from 1973 to 2005 indicates biological recovery from acid and metal contamination. Presented at 30th annual Congress of the International Association of theoretical and Applied Limnology, 12-18 August, 2007, Montreal (co-authored presentation of J. Winter).
- Yan, N. New soft-water medium (FLAMES medium) for Cladocera (Crustacea) culturing and testing. Presented at 30th annual Congress of the International Association of theoretical and Applied Limnology, 12-18 August, 2007, Montreal (co-authored presentation of my student M.P. Celis-Salgado).
- Yan, N. Extirpation of molluscs: a case study linked to the decline of aqueous calcium in boreal ecosystems. Presented at 30th annual Congress of the International Association of Theoretical and Applied Limnology, 12-18 August, 2007, Montreal (co-authored presentation of M. Turner).
- Yan, N. Conducting Environmental Science in an increasingly complex world: a Canadian example. Ecohydrology seminar series, School of Environmental and Systems Engineering, University of Western Australia, Perth, Australia, 16 May, 2007

- Yan, N. Recovery of Canada's acidified lakes – a complex and developing story. Invited lecture, School of Environmental and Systems Engineering, University of Western Australia, Perth, Australia, 15 March, 2007.
- Yan, N. Recovery of Ontario's acidified lakes: progress but no cigars. Inaugural term seminar, Department of Biology, University of Waikato, Hamilton, NZ, 7 Feb, 2007.
- Yan, N. Recovery of Ontario's acidified lakes: progress but no cigars. Lecture, Department of Biology, University of Otago, Dunedin, NZ, 15 Feb, 2007.
- Yan, N. Geographic predictors of invasion success in a non-indigenous zooplanktivore, *Bythotrephes longimanus*. Presentation at the 2007 ASLO conference, Sante Fe, New Mexico, USA (co-authored the poster presentation by my MSc student, Erika Weisz)
NB: This presentation received an award of excellence for student posters.
- Yan, N. A 300 lake *Bythotrephes* survey: objectives, methodologies and invaded lakes. Presentation at the 2007 annual meeting of the Society of Canadian Limnologists, Jan 5-7, Montreal (co-authored presentation by my research technician, A. Cairns)
- Yan, N. Using GIS to optimize the design of a regional *Bythotrephes* survey in Ontario. Presentation at the 2007 annual meeting of the Society of Canadian Limnologists, Jan 5-7, Montreal (co-authored presentation by my research technicians, A. Cairns and M. Elliot).

Mining Water Symposium

Mining and the Environment Conference Sudbury 2007 Oct. 19-26, 2007

- Arnott, S. E., and Shead, J. Chemical and biological recovery of Killarney Park, Ontario lakes following sulphur emission reductions.
- Celis-Salgado, M. and Yan, N. Assessing the potential for recovery of zooplankton from mining impacts.
- Gunn, J. and Yan, N. Healthy watershed, healthy lakes: role of land reclamation in the recovery of Sudbury lakes.
- Gunn, J.M., Keller, W., Yan, N.D., Beckett, P.J., and Dirszowsky, R. 2007. Healthy watershed, healthy lakes: role of land reclamation in the recovery of Sudbury lakes. p. 88
- Keller, W. and Heneberry, J. 2007. Environmental monitoring: nice or necessary?
- Luek, A., Ramcharan, C.W., Keller, B., and Morgan, G. 2007. Relative importance of benthic and pelagic energy sources in food webs of recovering lakes. Poster.
- Morgan, G.E. and Gunn, J.M. 2007. Quantifying the impact of colonists and invaders in the recovery of Sudbury's acidified lake fish communities.

Sarrazin-Delay, C.L. 2007. Using Benthic Invertebrates as Biomonitors in Northern Ontario: Progression of the RCA Network.

Somers, K.M. 2007. Experimental Designs and Assessment Methods for Evaluating the Environmental Effects of Effluents.

Tremblay, A., Lesbarreres, D., Merritt, T., and Gunn, J.M. 2007. Genetic structure of yellow perch (*Perca falvenscens*) populations across habitat and contamination gradients in Sudbury, ON.

Truong, H.Y.T., Chen, Y.-W., and Belzile, N. 2007. Reduction of selenite under controlled conditions.

Valois, A.E., Ramcharan, C.W., Keller, B., and Heneberry, J. 2007. Spatial patterns of zooplankton in recovering Sudbury Lakes.

Yan, N. The Mining and Water symposium – a synthesis of the conference. Invited plenary lecture to synthesize the highlights of the Sudbury Mining and the Environment Symposium, October 2007.

Yang, D.-Y., Chen, Y.-W., Belzile, N., Gunn, J.M., and Maretinez-Garcia, M.L. Methylmercury in aquatic systems: antagonistic effect of selenium on its accumulation in fish.

Webster, N.I., Ramcharan, C.W., and Keller, W. 2007. Effects of metal contamination and fish predation on the recovery of zooplankton in Sudbury lakes. Poster.

Winter, J., and Yan, N. Phytoplankton recovery from acid and metal contamination: a comparison of limed and un-manipulated lakes.

Theses Completed

Graduate

Martha Celis-Salgado and Michelle Palmer passed their Ph.D. qualifying exams at York U. Both are doing research relevant to recovery of Sudbury lakes.

Lang, C.-Y. 2007. Ph.D. Thesis. Geochemistry of mercury in lake sediments. Department of Applied Chemistry and Bioengineering. Chengdu University of Technology, Chengdu.

Alison Derry, PhD. Thesis. Adaptive diversity across population genetic and community scales in zooplankton from boreal shield lakes. Department of Biology, Queen's University.

Angela Strecker, PhD. Thesis. Responses of zooplankton community structure and ecosystem function to the invasion of an invertebrate predator, *Bythotrephes longimanus*. Department of Biology, Queen's University.

Polack, R. 2007. M.Sc. Thesis. Behaviour of antimony (III) in presence of dissolved ferrous and sulfide ions. Department of Chemistry and Biochemistry, Laurentian University, Sudbury.

Justin Shead, MSc. Thesis. Chemical and biological recovery of Killarney Park, Ontario lakes (1972-2005) from historical acidification. Department of Biology, Queen's University.

Elizabeth Hatton, MSc. Thesis. The Role of Invasive *Bythotrephes longimanus* in Lake Food Webs. Department of Biology, Queen's University.

Undergraduate:

Kristin Mulligan. 2007. Effects of predators on yellow perch (*Perca flavescens*) feeding apparatus from littoral and pelagic habitat zones. Laurentian University.

Lisa Porter. 2007. Morphological adaptations in the gill structures of yellow perch (*Perca flavescens*) in response to the presence of piscivores. Laurentian University.

Kristy Wilson. 2007. Clove oil as an anesthetic for Sea Lamprey (*Petromyzon marinus*). Laurentian University.

Esther Chan. 2007. Variation in calanoid copepod resting egg abundance among lakes with different acidification histories. Department of Biology, Queen's University.

Lisa Duke. 2007. Does dispersal modify the local community response to environmental disturbance? Department of Biology, Queen's University.

Megan MacLennan. 2007. Changes in thermal structure and zooplankton assemblages in response to elevated summer temperatures in clear and coloured lakes of Killarney Park, Ontario. Queen's Univ.

Research Grants

Y. Alarie

- NSERC Operating Grant

S. Arnott

- Ontario Ministry of the Environment, Best-in-Science, Climate effects on vertical structure in lakes and implications for food web interactions. 2007-2009
- NSERC Discovery Grant, The importance of regional and local factors in recovery from environmental stressors, 2004-2009
- NSERC Network Grant, Canadian Aquatic Invasive Species Network. 500 lake synoptic survey to identify regional spread, colonization success and *Bythotrephes longimanus* impacts on food webs of Shield lakes. 2005-2010.

N. Belzile

- NSERC Discovery Grant, Biogeochemistry of toxic trace elements in lake sediments
- NSERC MITHE-SN Network (with Petrie, Chen) Effect of selenium in waterfowl.

J. Gunn

- NSERC/Canada Research Chair, Tier 1
- NSERC Collaborative Research and Development Grant (with York University, Vale Inco Ltd., Xstrata Ltd.) Barriers to Biological Recovery.
- NSERC Discovery Grant, Effects of warmwater invasive species on lakes recovering from acidification.
- OMOE, Best in Science (Benthic Invertebrate Methods)
- CFI “Aquatic Restoration Ecology Lab” (AREL)
- Vale Inco Ltd., Junction Creek Restoration
- HRDC, Youth Canada Internships
- HRSDC, Job Creation Partnership Program Interns
- NOHFC, GIS Intern
- OMNDM, Summer Student Subsidies

T. Johnston

- Northern fisheries research (Johnston, Ontario Ministry of Natural Resources, Aquatic Research and Development, Base Operating Funds, 2004 – ongoing)

B. Keller

- Vale Inco Limited, Aquatic Restoration Group (ARG) support
- Xstrata Limited, ARG support
- Ontario Ministry of the Environment, ARG support
- Environment Canada, Northern Ontario Benthic Invertebrate Biomonitoring Network (NOBIBN) support
- Vale Inco Limited, NOBIBN support
- Ontario Ministry of the Environment, NOBIBN support
- Ontario Parks, Evaluating Habitat Suitability for Wild Aurora Populations in their Native Lakes
- FedNor, Environmental Technologist for Mining-Impacted Waters

C. Ramcharan

- NSERC Discovery Grant, New directions in lake foodwebs

N. Yan

- MOE Best in Science -Ca decline (in conjunction with Queen’s Univ.)
- Canadian Wildlife Service – Ca decline threshold determination
- NSERC – Partnership development with Univ. of Western Australia studying the dispersal of invading plankton
- MOE Best in Science – Lake Simcoe

Co-op Unit Staff 2007

Ramsey House:

Elizabeth Bamberger - Business Manager
Chad Bouchard- Communications Intern - FedNor
John Gunn – Canada Research Chair, LU
Tom Johnston - Fisheries Scientist, MNR
Bill Keller – Limnologist, MOE
George Morgan – Aquatic Systems Analyst
Karen Oman – Research and Administration

Laurentian University Science Building:

Yves Alarie – Biosystematics
Peter Beckett- Education and Outreach
Nelson Belzile - Environmental Chemistry
Dave Pearson - Urban Lakes Coordinator/Science Communication
Micale Prévost- Research Technician
Charles Ramcharan - Aquatic Ecologist

Water House:

Andrea Ford - Data Manager
Jocelyne Heneberry - Monitoring Coordinator, MOE
Jason McCourt – Environmental Officer, MOE

Fish House:

Jason Houle – Senior Fisheries Technician/ Data Manager
Lee Haslam – Senior Fisheries Technician, MNR

Bug House:

Kim Fram – Invertebrate Taxonomy
Chantal Sarrazin-Delay - Biomonitoring Biologist
Lynne Witty - Invertebrate Taxonomist
Nikki Boucher – FedNor intern
Dan Dechaine – NOHFC intern

Ph.D., M.Sc. and B.Sc. (Honours) Students Supervised:

Dallas Linley	Shannon MacPhee	Amanda Valois
Kristin Mulligan	Natalie Webster	Andreas Luek
Erika Genrich	Brian Wesolek	Erik Szkokan-Emilson
Natalie Webster	Dan Yang	Yen Thi Hoang Truong
Dave Hasek	Lisa Porter	Russell Polack
Chun-Yan Lang	Qiu-Xiang Zhao	Evan Fairn
Anneli Jokela	Alison Derry	Angela Strecker
Derek Grey	Liz Hatton	Justin Shead
Michael Pedruski	Leah James	Colleen Inglis
Ashley Tremblay	Corinne Daly	Johanna Pokorny

Thea Whitman
Pete Cott

Micale Prévost
Kristy Wilson

Kyla Standeven

Aquatic Technologists, HRSDC:

Danielle Belisle
Donna Strang
Natalie Boulrice

Dan Dechaine
Ross MacLeod
Kyla Standeven

Konstantin Tolkach
Erik Szkokan-Emilson
Shannon Ross

Field Technicians and Research Assistants:

Megan Chute
Paule Cholette

Matthew Little
Alison Colotello

