

# Cooperative Freshwater Ecology Unit Annual Report 2004





## **Cooperative Freshwater Ecology Unit Annual Report 2004**

### **New Members and Achievements**

- Dr. Norman Yan received the York University Faculty Association Merit Award for 2004. Dr. Yan was also invited to serve as associate editor at Limnology and Oceanography.
- Dr. Tom Johnston became the new Managing Research Scientist (MNR) at the Co-op Unit in the Fall of 2004.
- George Morgan was awarded the Mike Fruetel Memorial Award for his work in fisheries assessment and development of standard of methods.
- Dr. Charles Ramcharan was awarded his tenure by Laurentian University.
- Two of our long-term contract staff moved to full-time positions in 2004 but have remained in the Sudbury area: Ed Snucins, as a permanent Environmental Officer with the MOE and Christine Brereton as an Environmental Coordinator with Inco Ltd..

### **Conferences, Workshops, and Invited Presentations**

- The 2004 Sudbury Restoration Workshop had the largest turnout ever with more than 200 participants. Theme sessions included: Urban and Industrial Watersheds of the Boreal Shield Workshop- Feb. 18, 2004, Biomonitoring and State of Resource Assessment Workshop- Feb. 19, 2004, and Sudbury Ecological and Human Health Risk Assessment Workshop- Feb. 19, 2004.
- The Co-op Unit hosted a Symposium on Selenium in the Environment on Oct. 19, 2004 as a part of the Co-op's involvement in the NSERC mercury network. This one day meeting was held October 19, 2004 and was well attended by researchers from across the country.
- The Co-op Unit organized an Aquatic Biodiversity Workshop on Dec. 7, 2004 at Laurentian University with 60 participants. Presentations included an invited lecture by Dr. Donald Baird, Research Professor Aquatic Biodiversity, University of New Brunswick, and a number of presentations by researchers at the Co-op Unit and the Laurentian University Biology Dept.
- Arnott, S. Session organizer and chair. Jan. 2004. Multiple stressors in aquatic ecosystems. Annual joint meeting of Society of Canadian

- Limnologists/Canadian Conference for Fisheries Research. St.John's, Newfoundland.
- Arnott, S. October 2004. Biological recovery of lakes from acidification. University de Quebec a Montreal (UQAM). INVITED SEMINAR
  - Arnott, S. April 2004. Biological recovery of lakes from acidification. Great Lakes Research Consortium seminar, SUNY Brockport. INVITED SEMINAR
  - Arnott, S. March 2004. Biological recovery of lakes from acidification. Biology Department, University of Waterloo. INVITED SEMINAR
  - Belzile, N. and J.M. Gunn. 2004. Effect of contamination in a recovering environment. National Research Council of Italy, Institute of Chemical and Physical Processes, Pisa, Italy. INVITED LECTURE.
  - Belzile, N., Y.-W Chen, and C. Lang. 2004. Comportement géochimique du mercure dans les sédiments lacustres. University of Geneva, Institut F.A. Forel, Geneva, Switzerland. INVITED LECTURE.
  - Belzile, N. and Y.-W. Chen. 2004. Effet antagonistique du sélénium sur l'assimilation du mercure par les organismes vivants. University of Geneva, CABE, Geneva, Switzerland. INVITED LECTURE.
  - Belzile, N., Y.-W. Chen, J. Tong, and C. Lang. 2004. Biogeochemistry of selenium, mercury and antimony in aquatic systems: Analytical challenges. 87<sup>th</sup> Canadian Society of Chemistry Conference, London, Canada. INVITED LECTURE.
  - Gunn, J. Presented the opening keynote lecture for Research Week at Laurentian University entitled 'Laurentian University: On the Water's Edge'. Nov. 15, 2004.
  - Ramcharan, C. Session co-organizer. June 2004. Do invertebrate predators have bit parts or leading roles in lake food webs?.American Society of Limnology and Oceanography, Savannah GA.
  - Yan, N. Planning for biodiversity management in an increasingly complex Ontario". Ontario Ministry of Natural Resources Senior Manager's conference, Geneva Park, Orillia, Sept. 30, 2004. INVITED PLENARY LECTURE

## **Living with Lakes Centre**

Plans for the Living with Lake Centre took a major step forward when Castellan James and Partners Architects Inc were retained in March 2004 to prepare a conceptual design. They were charged with designing facilities that would achieve 2 important goals:

- The building must be operationally sustainable – i.e. cost no more than the current facilities (<\$42,000 per year) in order to sustain the long-term monitoring, research and education programmes.

- The building and site should demonstrate the best of environmentally sound shoreline development and stormwater management and be ecologically sustainable.

The resulting Conceptual Design report, completed at the end of June, expanded the scope of the project beyond the initial sustainability goals. The new goal is to achieve Platinum certification from the prestigious LEED (Leadership in Energy and Environmental Design) accreditation system and become the first building in Canada to accomplish this.

The following table compares a conventional building of the same size (about 16,000 sq. ft. in the main building, plus 11,000 sq. ft. basement for future expansion, plus 4,000 sq. ft. field compound) to this high performance, energy efficient design:

	<u>Living With Lakes Centre</u>	<u>Conventional</u>
• Total Annual Operating Cost	\$5,000	\$120,000
• Lifecycle Cost -		
Roof	0 (no roof replacement < 25 yrs)	\$400,00 (20yrs)
HVAC	\$40,000 (15 yrs)	\$100,000 (15yrs)
Windows	\$100,000 (20 yrs)	\$190,000 (20yrs)
• Payback Period	< 6 yrs	n/a
• Savings over 25 yr	> \$1 million	n/a

The building design is as beautiful as it is functional, blending into the site on which it will be located. Some of the sustainable design features include:

- Green roof to store and filter rain water, water leaving roof will be conveyed to an underground cistern for non potable use and to improve winter and summer thermal performance
- Ground source heat pump
- Net Metering
- Breathing Wall
- Renewable energy: Geothermal energy, wind turbine, photovoltaics for remaining electrical needs.
- Management of stormwater: permeable paving for driveways and parking lots, bioswale/rain garden adjacent to parking lots, vegetative buffers on water's edge and through green roof etc.
- High performance thermal envelope: minimum insulation levels of R34 for walls, R45 for roof and R8 for high performance glazing - solar heat gain of less than .3
- passive solar heat gain/loss management

- High performance HVAC systems including radiant floor hydronic, solar water heating, displacement ventilation, ventilation preheat (heat recovery and earth tube)
- High performance electrical systems and controls (smart building systems), energy efficient appliances, computers etc.)
- Potable water demand reduction: through ultra low flow fixtures, composting toilets and waterless urinals, greywater treatment
- Use of salvage materials and non toxic materials

Since completion of the conceptual design there have been over 30 presentations to numerous groups within the community from the Greater Sudbury Development Board to members of the Northern Ontario Heritage Fund Corporation Board to gain support for the project. Laurentian University's President has been working hard to shore up political and financial support. Enthusiasm for the project is widespread and many letters of support have been received. Upcoming meetings and presentations to potential funders are scheduled. The team continues to be very optimistic that the project will move ahead soon and the dream to have a new building to meet the emerging and future needs of the partnership will be a reality.

### **Adopt a Lake - The "Million Lakes" Campaign**

The "Adopt-a-Lake" Fund was established to help support the Co-op Unit's science communication and public outreach work (e.g. restoration workshops, reports, books, newsletters, websites). By adopting one of the million lakes of the Boreal Shield ecozone, individuals or groups can make sure that important environmental information gets widespread attention.

To date, 47 lakes have been adopted and nearly \$4000 has been raised.

### **Field Courses**

Aquatic Restoration Ecology

- Dr. Norman Yan and Dr. John Gunn, Instructors. August 23-29, 2004.

This course was held at the Co-op Unit site as part of the Ontario Field Camp Course Program. Students are introduced to the theory of field methods in aquatic restoration ecology and participated in research studies on Clearwater and Junction Creek. They also toured the region including the Falconbridge Wetland Rehabilitation Site and saw first hand the recovery in the Sudbury region. This course provided the opportunity for the Co-op Unit to showcase itself to students from eight universities.

## International Outreach

Sustainable Cities Initiative (SCI):

- Dr. John Gunn participated as an invited keynote speaker to present the Sudbury story as part of a community planning meeting in Matamoros and Reynosa in Mexico, Jan. 23-27, 2005. The success of this meeting has led to a follow-up request for Co-op Unit and Laurentian University staff and faculty to participate in the broader SCI program. Cristina Greco is participating in the March 6-11, 2005 Mexican workshops as a science communication specialist.

## Publications

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

Arnott, S. E., A. Jackson, and Y. Alarie. Water Beetle Assemblages in Lakes Recovering from Acidification. Submitted to Freshwater Biology, Conditional Acceptance received.

Belzile, N., Y.-W. Chen, J.M. Gunn, J. Tong, Y. Alarie, T. Delonchamp, and C.Y. Lang. 2004. The effect of selenium on mercury bioaccumulation by freshwater organisms. Canadian Journal of Fisheries and Aquatic Sciences, (submitted).

Belzile, N., Y.-W. Chen, J. Tong, J.M. Gunn, Y. Alarie, G.J. Wu, and V. Appanna. 2004. The antagonistic role of selenium in mercury bioassimilation by aquatic organisms. Materials and Geoenvironment (7<sup>th</sup> International Conference on Mercury as a Global Pollutant), 51, 803-806.

Belzile, N., Y.-W. Chen, J.M. Gunn, and S. Dixit. 2004. Sediment trace metal profiles in lakes of Killarney Park, Canada: from regional to continental influence. Environmental Pollution 130: 239-248.

Binks, J., S. E. Arnott, and W.G. Sprules. Local factors and colonist dispersal influence biotic recovery from cultural acidification. Submitted to Ecological Applications. Conditional acceptance received.

Binks, J.A., G.E. Morgan, M.D. Malette, and J.M. Gunn. 2004. Northern Pike (*Esox lucius*) life history variation in Boreal Shield lakes; a large scale study of patterns and processes. Can. J. Fish. Aquat. Sci. Submitted.

Binks, J.A., G.E. Morgan, M.D. Malette, and J.M. Gunn. 2004. Sexual differences in life history traits of northern pike (*Esox lucius*) in Boreal Shield lakes. J. Fish. Biol. Submitted.

- Binks, J.A., G.E. Morgan, and M.D. Malette. 2004. Analysis of proposed fishing divisions. Report.
- Binks, J.A., G.E. Morgan, and M.D. Malette. 2004. Power analysis: Developing a Walleye monitoring program for the North East region of the Ontario Ministry of Natural Resources. Report.
- Boeing W.J., B. Wissel, and C.W. Ramcharan. 2004. Costs and benefits of *Daphnia* defense against fish in nature. Can. J. Fish. Aquat. Sci. Accepted.
- Boudreau, S.A. and N.D. Yan. 2004. Auditing the accuracy of a volunteer-based surveillance program for the aquatic invader, *Bythotrephes*. Env. Monitor. Assess. 91: 17-26.
- Cena, C. J., G. E. Morgan, M. D. Malette, and D.D. Heath. 2004. Inbreeding, outbreeding and environmental effects on genetic diversity in 46 walleye (*Sander vitreus*) populations. Molecular Ecology. Accepted with revisions.
- Girard, R., N.D. Yan, J. Heneberry, and W. Keller. 2004. Physical and chemical data series from Clearwater, Lohi, Middle and Hannah lakes near Sudbury Ontario: long term responses to liming and natural recovery from historical acidification and metal contamination. Ontario Ministry of the Environment Data Report. Dorset, Ontario.
- Gunn, J.M., C. Greco, L. Vasseur, C. Salazar, and B. Lautenbach. 2004. Sudbury: From pollution record holder to a model system for Canada's Sustainable Cities Initiative. Submitted to International Conference on Acid Deposition, Prague 2005 for publication in Water, Air and Soil Pollution.
- Gunn, J.M., W. Selinger, E. Snucins, and G. Morgan. 2004. Use of the Nordic standard method to assess recovery of Lake trout (*Salvelinus namaycush*) populations in NE Ontario after decades of acidification. Submitted to International Conference on Acid Deposition, Prague 2005 for publication in Water, Air and Soil Pollution.
- Henderson, B.A., G.E. Morgan, and A. Vaillancourt. 2004. Growth, injection rates and metabolic activity of walleye in lakes with and without lake herring. Journal of Fish Biology. 65: 1270-1282.
- Heneberry, J., W. Keller, D. McNicol, and R. Weeber. 2004. Preliminary characterization of crustacean zooplankton communities in 22 small lakes near Sudbury, Ontario. Unpublished report, Cooperative Freshwater Ecology Unit.

- Hyatt K.D., C.W. Ramcharan, D.J. McQueen, and K.L. Cooper. 2004. Competition for food between juvenile sockeye salmon and the macroinvertebrate predator, *Neomysis mercedis*, in Muriel Lake, British Columbia, Canada. *Ecoscience* (accepted).
- Jeffries, D.S., D.M. Antoniadou, A Bourne, R. Carignan, L. Cheng, T.A. Clair, S. Couture, P.J. Dillon, C. Gagnon, M. Gilliss, M. Hilderman, B. Keatly, W. Keller, M.L. Mallory, P.M. McEachern, D.K. McNicol, N. Michelutti, K.A. Moser, R. Pienitz, B. Raymond, K.M. Ruhland, A.M. Scheuhammer, M.A. Turner, R.C. Weeber, and A.P. Wolfe. (in press). Aquatic Chemistry, Lake Status, Data Description. P. 3-4, In D. Jeffries, D. McNicol, and R. Weeber (in press). Chapter 6: Effects on Aquatic Chemistry and Biology. In *2004 Canadian Acid Deposition Science Assessment*, [CD-ROM]. (2005). Environment Canada.
- Jeffries, D.S., T.A. Clair, S. Couture, J. Franklyn, C. Gagnon, W. Keller, D.K. McNicol, F. Norouzian and R.C. Weeber. (in press). Aquatic Chemistry, Lake Status, Current Chemical Status. P. 5-13, In D. Jeffries, D. McNicol, and R. Weeber (in press). Chapter 6: Effects on Aquatic Chemistry and Biology. In *2004 Canadian Acid Deposition Science Assessment*, [CD-ROM]. (2005). Environment Canada.
- Jeffries, D.S., T.A. Clair, S. Couture, P.J. Dillon, J. Franklyn, W. Keller, D.K. McNicol, F. Norouzian, A.M. Paterson, M.A. Turner, and R.C. Weeber. (in press). Aquatic Chemistry, Changes in Lake Chemistry, Trend Analyses. P. 13-25, In D. Jeffries, D. McNicol, and R. Weeber (in press). Chapter 6: Effects on Aquatic Chemistry and Biology. In *2004 Canadian Acid Deposition Science Assessment*, [CD-ROM]. (2005). Environment Canada.
- Jeffries, D.S., T.A. Clair, S. Couture, P.J. Dillon, J. Dupont, W. Keller, D.K. McNicol, and M.A. Turner. (in press). Aquatic Chemistry, Changes in Lake Chemistry, Factors Other than Deposition that Influence Trends. P. 25-29, In D. Jeffries, D. McNicol, and R. Weeber (in press). Chapter 6: Effects on Aquatic Chemistry and Biology. In *2004 Canadian Acid Deposition Science Assessment*, [CD-ROM]. (2005). Environment Canada.
- Jeffries, D.S., T.A. Clair, S. Couture, P.J. Dillon, W. Keller, D.K. McNicol, and R.C. Weeber. (in press). Lakes from Regional Monitoring Programs, Chemical Recovery. P. 5-8, In R.C. Weeber, D.S. Jeffries and D.K. McNicol (in press). Chapter 7: Recovery of Aquatic Ecosystems. In *2004 Canadian Acid Deposition Science Assessment*, [CD-ROM]. (2005). Environment Canada.



- Johnston, T.A., L.M. Miller, D.M. Whittle, S.B. Brown, M.D. Wiegand, A.R. Kapuscinski, and W.C. Leggett. Effects of maternally-transferred organochlorine contaminants on early life survival in a freshwater fish. Submitted to Environmental Toxicology and Chemistry. Conditional Acceptance received.
- Keller, W., J. Heneberry, J.M. Gunn, E. Snucins, G. Morgan, and J. Leduc. 2004. Recovery of acid and metal – damaged lakes near Sudbury, Ontario: trends and status. Cooperative Freshwater Ecology Unit Report. Sudbury, Ontario.
- Keller, W., J. Heneberry, and J. Leduc. 2005. Linkages between weather, dissolved organic carbon, and coldwater habitat in a Boreal Shield lake recovering from acidification. Can. J. Fish. Aquat. Sci. In press.
- Keller, W., J. Heneberry, J. Leduc, J. Gunn, and N. Yan. 2005. Variations in epilimnion thickness in small Boreal Shield lakes: relationships with weather, transparency, and acidification. Env. Mon. Asses. Under review.
- Malette, M., and G.E. Morgan. 2004. Provincial summary of Northern Pike history characteristics based on Ontario's Fall Walleye Index Netting (FWIN) Program 1993-2002.
- Malette, M., E. Snucins, J. Gunn, and W. Keller. 2004. Restoration of the aurora trout to its native habitat. Annual Report for the Endangered Species Recovery Fund. Cooperative Freshwater Ecology Unit.
- Molot, L.A., W. Keller, P.R. Leavitt, R.D. Robarts, M.J. Waiser, M.T. Arts, T.A. Clair, R. Pienitz, N.D. Yan, D.K. McNicol, Y. Prairie, P.J. Dillon, M. Macrae, R. Bello, R. Nordin, P.J. Curtis, J.P. Smol, and M. Douglas. 2004. Risk analysis of dissolved organic matter-mediated ultraviolet B exposure in Canadian inland waters. Can. J. Fish. Aquat. Sci. 61:2511-2521.
- Patrick, K.L., J.M. Gunn and M. Futter. 2004. A model to predict the timing and duration of ice cover in small shield lakes. Can. J. Fish. Aquat. Sci. Conditional acceptance received.
- Purchase, C.F., N.C. Collins, G.E. Morgan, and B.J. Shuter. 2004. Sex-specific co-variation among life history traits of yellow perch (*Perca flavescens*). Evolutionary Ecology. Accepted.
- Reynoldson, T.B., C.I. Brereton, W. Keller, and C. Sarrazin-Delay. (under review). Development of a northern Ontario benthic invertebrate reference condition approach (RCA) biomonitoring network to meet metal mining environmental effects monitoring requirements. Technical Report, Cooperative Freshwater Ecology Unit, Sudbury.

- Snucins, E. 2004. Sport Fish in Acidified Ontario Lakes. P. 22, In R.C. Weeber, D.K. McNicol and D.S. Jeffries. (in press). Chapter 7: Recovery of Aquatic Ecosystems. In *2004 Canadian Acid Deposition Science Assessment*, [CD-ROM]. (2005). Environment Canada.
- Snucins, E., T. Tunney, T. Kleinboeck and J. Gunn. 2004. Establishing a standard sampling season for fish assemblages in Ontario lakes using the international Nordic method. *North American Journal of Fisheries Management*. Submitted
- Strecker, A. and S. E. Arnott. Interaction of multiple stress agents in boreal lakes: invasion of *Bythotrephes* and acidification. *Canadian Journal of Fisheries and Aquatic Sciences*. Conditional acceptance received.
- Winter, J.G., W. Keller, A.M. Paterson, K.M. Somers, and N.D. Yan. 2004. Monitoring biological recovery of Clearwater Lake from acid and metal contamination using phytoplankton community composition (Brief submitted as a contribution to the 2004 National Acid Rain Assessment Report).
- Weeber, R.C., M.F. Bowman, R.W. Brook, L. Champoux, W. Keller, D.A. Kirk, S. Legare, S. MacPhee, D.K. McNicol, R.A. Reid, E. Snucins and K.M. Somers. (in press). Invertebrates. P, 29-38, In D. Jeffries, D. McNicol, and R. Weeber (in press). Chapter 6: Effects on Aquatic Chemistry and Biology. In *2004 Canadian Acid Deposition Science Assessment*, [CD-ROM]. (2005). Environment Canada.
- Weeber, R.C., R.W. Brook, D.S. Jeffries, W. Keller, D.K. McNicol, A.M. Paterson, E. Snucins, K.M. Somers, R.D., Vinebrooke, J.G. Winter, and N.D. Yan. (in press). Lakes from Regional Monitoring Programs, Lakes Near Large Point Sources. P. 8-21, In R.C. Weeber, D.S. Jeffries and D.K. McNicol (in press). Chapter 7: Recovery of Aquatic Ecosystems. In *2004 Canadian Acid Deposition Science Assessment*, [CD-ROM]. (2005). Environment Canada.
- Weeber, R.C., D.S. Jeffries, W. Keller, D.K. McNicol, and M.A. Turner. (in press). Summary. P. 51-55, In R.C. Weeber, D.S. Jeffries, and D.K. McNicol (in press). Chapter 7: Recovery of Aquatic Ecosystems. In *2004 Canadian Acid Deposition Science Assessment*, [CD-ROM]. (2005). Environment Canada.
- Yan, N.D., R. Girard, J.H. Heneberry, W. (B.) Keller, J.M. Gunn and P.J. Dillon. 2004. Recovery of Copepod, but not Cladoceran, zooplankton from severe and chronic effects of multiple stressors. *Ecol. Letters*. 7: 452-460.

Yan, N.D. and W. Keller. 2004a. Promising progress in recovery of the zooplankton in Clearwater Lake (Brief submitted as a contribution to the 2004 National Acid Rain Assessment Report).

### **Conference and Workshop Presentations**

Alarie, Y. Recognizing discontinuity in an ecological continuum: the role of water beetles. Symposium "Aquatic Biodiversity Assessment and Research" Freshwater Cooperative Unit, Laurentian University, December 7th 2004

Belzile, N., Y.-W. Chen, J. Tong, J.M. Gunn, Y. Alarie, G.J. Wu, and V. Appanna, V. 2004. Selenium-mercury interactions in aquatic organisms. 5<sup>th</sup> Annual Congress of the Collaborative Mercury Research Network. Gimli, Canada.

Belzile, N., Y.-W. Chen, J.M. Gunn, and Y. Alarie. 2004. Evidence of selenium antagonism on mercury assimilation in biological species. Workshop on Se-Hg Interactions, Laurentian University, Sudbury, Canada.

Belzile, N., Y.-W. Chen, J.M. Gunn, and Y. Alarie. 2004. Evidence of selenium antagonism on mercury assimilation in biological species. Canadian Conference for Fisheries Research (CCFFR). University of Windsor, Ontario, Canada.

Belzile, N. and Y.-W. Chen. 2004. Biogeochemical cycling of selenium in the aquatic environment. Workshop on Se-Hg Interactions, Laurentian University, Sudbury, Canada.

Bowman, M.F., C. Brereton, W. Keller, and K. Somers. 2004. The Greater Northern Ontario Mining Effects Study – reference site analysis. P. 117-121, in Proc. 2004 Aquatic Toxicity Workshop, Charlottetown, PEI

Chen, Y.-W. and N. Belzile. 2004. Selenium speciation in natural water and sediment samples. Workshop on Se-Hg Interactions, Laurentian University, Sudbury, Canada.

Chen, Y.-W., N. Belzile, X.L. Zhou, and T.H.Y. Truong. 2004. Selenium and its organic compounds – the photochemical reactions. 5<sup>th</sup> Annual Congress of the Collaborative Mercury Research Network. Gimli, Canada.

Gunn, J.M. 2005. Habitat vs. exploitation experiment revisited. Canadian Conference for Fisheries Research (CCFFR). University of Windsor, Ontario, Canada.

- Kaufman, S.D., J.M. Gunn, and G.E. Morgan. 2005. Community based differences in fish activity using muscle enzymes. Canadian Conference for Fisheries Research (CCFFR. University of Windsor, Ontario, Canada.
- Kaufman, S.D., J.M. Gunn, and G.E. Morgan. 2004. A test of optimal foraging by Walleye (*Sander vitreus*) in lakes with different prey communities. Canadian Conference for Fisheries Research, St.John's Newfoundland.
- Kaufman, S.D., J.M.Gunn, and G.E. Morgan. 2004. A novel approach to measure fish activity using muscle enzymes. American Fisheries Society Walleye Technical Committee Meeting, Winnipeg, Manitoba.
- Keller, W. 2004. Sudbury Environmental Study (SES) an overview. Chapter 7 in OPG/NSERC Research Chair Watershed Biogeochemistry 2002-2003 Workshop Report, November 17<sup>th</sup> – 18<sup>th</sup>, 2003.
- Lang, C., Y.-W. Chen, M. Wang, and N. Belzile. 2004. Methodology for the determination of mercury in sediment porewaters. 5<sup>th</sup> Annual Congress of the Collaborative Mercury Research Network. Gimli, Canada.
- Lippert, F., J. Gunn. And G. Morgan. 2005. Use of Nordic method assessment techniques to evaluate the effects of invasive species on fish communities recovering from acidification. Canadian Conference for Fisheries Research (CCFFR. University of Windsor, Ontario, Canada.
- Morgan, G.E., E. Snucins, and J. Gunn. 2005. Nordic biodiversity assessment method: Applications for climate change and invasive species research. Canadian Conference for Fisheries Research (CCFFR. University of Windsor, Ontario, Canada.
- Ramcharan C.W. Zooplanktivory in lakes: Have we nabbed the wrong suspect? American Society of Limnology and Oceanography, Savannah GA, June 2004.
- Webster, N. , J. Gunn, B. Keller, and C. Ramcharan. 2005. Experimental lake mixing: simulating global climate change effects on shield lakes. Canadian Conference for Fisheries Research (CCFFR. University of Windsor, Ontario, Canada.
- Woods, S., L. Haslam, and J. Gunn. 2005. Bio-logging of core body temperature of lake trout to assess thermal habitat use and climate change effects. Canadian Conference for Fisheries Research (CCFFR. University of Windsor, Ontario, Canada.
- Yan, N. "Recovery of Ontario lakes from acid rain: a work in progress",

- presented at Glendon College, York University 3<sup>rd</sup> year Natural Science Class, 1 December, 2004.
- Yan, N. "Recovery of Ontario lakes from acid rain: a work in progress", presented at University of Waterloo ecology seminar series, 18 November, 2004, University of Waterloo, Waterloo, ON.
- Yan, N. "Limits to the roles of science in the management of non-indigenous invasive species: the example of the spiny water flea in Canadian Shield lakes", presented at the York University conference entitled Interdisciplinary approaches to the problems caused by invasive species, 7-8 November, 2004, York University, Toronto, ON.
- Yan, N. "Assessing the risk of invasive non-indigenous species: the example of the spiny water flea in Canadian Shield Lakes", presented at University of Toronto Ecology lunch seminar, 25 October, 2004, Ramsay Wright Zoological Laboratories, University of Toronto, Toronto, ON.
- Yan, N. "Successful water partnerships", presented at the symposium "Working Horizontally to Support Clean Water in Ontario", hosted by MOE, MNR, MAF and MNDM, Toronto, Ontario, 10-11 June, 2004.
- Yan, N. "Impacts on zooplankton of fish compared to invertebrate planktivores" presented at 2004 summer meeting of the American Society of Limnology and Oceanography, 13-18 June, 2004, Savannah, GA (co-authored presentation by C. Ramcharan).
- Yan, N. "Review of the impacts of the non-indigenous invertebrate zooplanktivore, *Bythotrephes*, on Canadian Shield lakes" presented at 2004 summer meeting of the American Society of Limnology and Oceanography, 13-18 June, 2004, Savannah, GA (co-authored presentation by C. Ramcharan)
- Yan, N. "Summer death rates and a predator refuge for *Bythotrephes longimanus* in Harp Lake, Ontario, Canada." presented at 2004 summer meeting of the American Society of Limnology and Oceanography, 13-18 June, 2004, Savannah, GA (co-authored poster of my student, J. Young)
- Yan, N. "Covariates of calcium concentrations of zooplankton of Canadian Shield lakes". presented at 2004 summer meeting of the American Society of Limnology and Oceanography, 13-18 June, 2004, Savannah, GA (co-authored presentation by my student Adam Jeziorski).
- Yan, N. "The need to regenerate the Dorset Environmental Research Centre's Spatial reference datasets" presented at an ad hoc, 4-university and two

agency workshop on environmental change in the southern boreal shield, Dorset Environmental Science Centre, Dorset, Ontario.

Yan, N. "The emerging issue of invasive non-indigenous species" presented in York U course FES 2400. March 9, 2004.

Yan, N. "Recovery of Ontario's acidified lakes from historical acidification: a work in progress", presented at University of Toronto Mississauga, Department of Zoology seminar series, Feb 6, 2004.

Yan, N. "Can zooplankton communities recover from severe and chronic effects of physical, chemical and ecological stress?", presented at the Society of Canadian Limnologists 2004 annual meeting, Jan 8-10, 2004, St. John's Newfoundland

#### **Sudbury Restoration Workshop, Feb. 18-19, 2004**

Arnott, S. E. Conceptual overview of biological recovery. Sudbury Restoration Workshop, Sudbury, ON, February 2004.

Alarie, Y. Water Beetle Communities in lakes recovering from acidification . Sudbury Restoration Workshop. Sudbury, On. February 19th-20th 2004

Brereton, C. and W. Keller. 2004. The development of an invertebrate RCA Biomonitoring network for northern Ontario to meet metal-mining EEM requirements. p.25, in Proc. Sudbury Restoration Wkshp., 2004, Laurentian Univ., Sudbury.

Davidson, J. and W. Keller. 2004. Are invertebrates in Sudbury streams responding to urban stresses? p.64, in Proc. Sudbury Restoration Wkshp., 2004, Laurentian Univ., Sudbury.

Delonchamp, T., J.M. Gunn, N. Belzile, Y.-W. Chen, Y. Alarie, and J. Tong. 2004. Antagonistic effects of selenium on mercury accumulation by invertebrates and fish in Sudbury area lakes. Sudbury Restoration Workshop 2004, Sudbury, Canada.

Derry, A., S.E. Arnott, and P. Boag. Rapid evolution of zooplankton following environmental change. Sudbury Restoration Workshop, Sudbury, ON, February 2004.

Greco, C.G., S. Watson, J.M. Gunn, and B. Keller. 2004. From air base to "Living with Lakes Centre": evolution of the Cooperative Freshwater Ecology Unit

- site on Ramsey Lake. p.69, in Proc. Sudbury Restoration Wkshp., 2004, Laurentian Univ., Sudbury.
- Gunn, J.M., C.W. Ramcharan, and B. Keller. 2004. Lake mixing experiment to test potential effects of climate change: loss of coldwater habitat. p.70, in Proc. Sudbury Restoration Wkshp., 2004, Laurentian Univ., Sudbury.
- Jackson, A. and S. E. Arnott. Phenotypic responses of zooplankton to water beetles. Sudbury Restoration Workshop, Sudbury, ON, February 2004.
- Keller, W., J. Heneberry, and J.M. Gunn. 2004. Recovery of acid and metal-damaged lakes near Sudbury Ontario. p.33, in Proc. Sudbury Restoration Wkshp., 2004, Laurentian Univ., Sudbury.
- Keller, W., J. Heneberry, and J. Leduc. 2004. Explaining long-term variations in cold water habitat in small Boreal Shield lakes recovering from acidification. p.43, in Proc. Sudbury Restoration Wkshp., 2004, Laurentian Univ., Sudbury.
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Ferguson, L. June, 2004. Potential effects of climate change on Walleye (*Sander vitreus*) life history characteristics. MSc.Thesis. Department of Biology, Laurentian University.

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Parrott, E. 2004. Variability in abundance and development of the non-indigenous spiny water flea, *Bythotrephes*, among Canadian Shield lakes. Honours B.Sc. thesis, York University

## **Research Grants**

### **J. Gunn**

- Canada Research Chair, Tier 1
- NSERC Collaborative Research and Development Grant (CRD) – (conditional)
- CFI "Aquatic Restoration Ecology Lab" (AREL)
- Inco Ltd., Junction Creek Restoration
- HRDC, Youth Canada Internships
- Ontario Ministry of Natural Resources, Endangered Species Recovery (Aurora Trout)
- Environment Canada, Youth Internship

### **B. Keller**

- Inco Limited, Aquatic Restoration Group support
- Falconbridge Limited, Aquatic Restoration Group support
- Ministry of the Environment, Aquatic Restoration Group support
- Environment Canada, Canadian Wildlife Service, Aquatic Restoration Group support
- Environment Canada, Ontario Region, EEM studies
- Inco Limited, EEM studies
- Newmont Canada Ltd., EEM studies
- Williams Operating Corp., EEM studies



- Goldcorp Inc., EEM studies
- Placer Dome Limited, EEM studies
- SARA Group, Sudbury Area Risk Assessment

**N. Yan:**

- FedNor Youth Internship to train Allegra Cairns in ecotoxicology
- Metis Nation Ontario Training Initiative to train Alison Croft in operation of FLAMES lab.

**C. Ramcharan**

- NSERC Discovery, “Novel directions in lake food webs”, five year grant.
- Laurentian University Research Fellowship, “Surveying the benthos of Sudbury’s lakes”
- CFI equipment grant “Foodwebs study of Boreal Lakes”

**Co-op Unit Staff 2004**

*Ramsey House:*

John Gunn – <i>Canada Research Chair</i>	Bill Keller - <i>Limnologist</i>
Ed Snucins - <i>Rehabilitation Biologist</i>	Cristina Greco – <i>Science Communication</i>
Tom Johnston - <i>Fisheries Scientist</i>	Karen Oman - <i>Data Manager</i>
Elizabeth Bamberger - <i>Business Manager</i>	Jake Irwin - <i>Fundraising Assistant</i>

*Laurentian University Science Building:*

Charles Ramcharan - <i>Aquatic Ecologist</i>	Dave Pearson - <i>Urban Lakes Coordinator</i>
Lynne Witty - <i>Zooplankton Taxonomist</i>	Nelson Belzile - <i>Environmental Chemistry</i>
Yves Alarie - <i>Biosystematics</i>	

*Water House:*

Jocelyne Heneberry - <i>Monitoring Coord.</i>	Julie Selway - <i>Data Manager</i>
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*Fish House:*

George Morgan - <i>Extension Biologist</i>	Mike Malette - <i>Data Manager</i>
Julie Leduc - <i>Data Manager</i>	Jessie Binks - <i>Fisheries Technician</i>
Jason Houle - <i>Fisheries Technician</i>	

*Bug House:*

Chantal Sarrazin-Delay - <i>Biomonitoring Biol.</i>	Lee Haslam - <i>Fisheries Technician</i>
Christine Brereton - <i>Biomonitoring Biol.</i>	Jennifer Davidson - <i>Invertebrate Biol.</i>
Kim Fram - <i>Biomonitoring Tech.</i>	

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

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Jessica Forrest  
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Matas Remeikis  
Melissa Cuke  
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Lindsay Watson  
Lee Stach  
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Matt Moles  
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*Field Technicians and Research Assistants:*

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Rob Snider  
Emily Lemieux  
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Nicole Breau  
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Jessica Amos  
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