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RAINY-LAKE OF THE WOODS WATERSHED

16th Annual

International Rainy-Lake of the Woods Watershed Forum

March 13 - 14, 2019

Rainy River Community College

International Falls, Minnesota, USA

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(See over)

EVENING DAY 1 – MARCH 13

18:00 Foundation Reception & Poster Session (AmericInn)

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Award Presentations

- Kallemeyn Award
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    [1]Lakehead University; [2]IISD ELA; [3]Trent University; [4]Institut National de Recherche Scientifique, Québec

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11:10 Session 5

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    [1]St. Croix Watershed Research Station, Science Museum of Minnesota; [2]Water Resources Science, University of Minnesota; [3]Red Lake Department of Natural Resources; [4]Natural Resources Research Institute, University of Minnesota Duluth; [5,6]Minnesota Pollution Control Agency-Detroit Lakes

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DAY 2 – MARCH 14 (Cont'd)

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16:10 Closing Remarks

Forum Partners – Sponsors

The organizing committee would like to thank our 2019 sponsor's for assisting with the 16th annual International Rainy-Lake of the Woods Watershed Forum. This event would not be possible without the assistance of the following groups:

- International Joint Commission
- Voyageurs National Park – National Parks Service
- Consulate General of Canada - Minneapolis, Global Affairs Canada
- Minnesota Pollution Control Agency
- Rainy River Community College
- Lake of the Woods District Stewardship Association
- St. Cloud State University
- Dorset Environmental Sciences Centre (Ontario Ministry of the Environment, Conservation and Parks)
- Rainy Lake Conservancy
- Rainy Lake Property Owners Association
- Voyageurs National Park Association
- Environment and Climate Change Canada / Environnement et Changement climatique Canada
- Lake of the Woods Water Sustainability Foundation

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Oral Presentation Abstracts

Session 1 – Binational Updates

International Rainy-Lake of the Woods Watershed Board Update

Board Chair/Member TBD

International Rainy-Lake of the Woods Watershed Board

Abstract

This update includes the activities of the Rainy-Lake of the Woods Watershed Board during 2018 to date, highlighting those related to aquatic ecosystem health, water levels and public engagement as well as updates on International Watershed Initiative projects and proposals and the work of the International Watershed Coordination Program. The Board began a project to review and make recommendations on water quality and aquatic ecosystem health Objectives and Alert Levels, as well as finalization of a transboundary emergency response/coordination document. The presentation also highlights the role of the Water Levels Committee, the communication efforts of the Engagement Committee and the ongoing support provided by the International Watershed Coordinator in linking international, regional and local efforts in the basin.

Brief Bio

Location of Study

The Board's geographic mandate includes the entire Rainy-Lake of the Woods Watershed.

International Multi-Agency Work Group Update

IMA Work Group Member TBD

International Multi-Agency Arrangement

Abstract

The International Multi-Agency Arrangement (IMA) has been working as a collective of cross border agencies focused on water quality in the watershed since 2009. This past year, in response to suggestions of the potential role the IMA could play in a binational approach for the basin, the group has developing revised terms of reference and work plans for both the managerial Working Group and the Technical Advisory Committee. The focuses of the IMA has been organized four subcommittees of the TAC, specifically: i) Core monitoring / collaborative needs); ii) Water quality (current focus on nutrients and algae); iii) Aquatic Invasive Species; iv) Contaminants. The IMA is recognized as an important binational, local science and resource management entity.

Brief Bio

Location of Study

Global Affairs Canada Binational Update

Felicia Minotti

Address

Abstract

An update will be presented on development of a binational approach to research and management in the Rainy-Lake of the Woods Basin.

Brief Bio

Felicia Minotti is Senior Policy Analyst, U.S. Transboundary Affairs, Global Affairs Canada. For several years, Felicia has been working to develop a binational approach for Lake of the Woods.

Location of Study

Binational Rainy-Lake of the Woods Basin

Building the foundation for monitoring aquatic ecosystem health in the Rainy-Lake of the Woods Watershed

Bev Clark and Nolan Baratono

RLWWB Objectives & Alerts Study Team

Abstract

The ability to monitor the health of the aquatic ecosystem binationally in the Rainy-Lake of the Woods Watershed has been constrained over the years by i) outdated and limited water quality objectives and ii) the lack of an agreed-upon, useful definition of aquatic ecosystem health (AEH). In order to overcome this, the International Joint Commission's Rainy-Lake of the Woods Watershed Board has recently launched phase 1 of a project to develop recommendations for establishing Objectives (Os) and Alert Levels (ALs) relevant to priority issues in the basin, such as water quality, aquatic invasive species, climate change indicators and adaptation, and ground and surface water contamination. The focus will be on established priorities that include both water quality and aquatic ecosystem health (AEH). The project will run from November 2018 to November 2019.

This presentation will review progress to date on this project, which includes:

- a review of primary documents with respect to water quality and AEH criteria;
- the identification of priority issues;
- the identification of appropriate watershed segments (hydrogeographies) for each priority;
- recommendation of objectives, alert levels or narrative guidelines for each priority;
- assessing AEH indicators and metrics appropriate to report on efficacy of Os & ALs;
- a gap analysis with respect to monitoring and reporting on priority Os & ALs; and the status of and lessons learned from other basins / boards.

Brief Bio

Location of Study

Entire Rainy-Lake of the Woods Basin, with particular focus on boundary waters.

Session 2 – ECCC / Trent U. Science

Loading of nutrients from nearshore developments to Lake of the Woods

Dale R. Van Stempvoort*[1], Will D. Robertson[2], D. Ross MacKay[1], Pamela Collins[1], and Susan J. Brown[1]

[1]Environment and Climate Change Canada, Watershed Hydrology and Ecology Research Division, 867 Lakeshore Road, PO Box 5050, Burlington, Ontario, Canada L7S 1A1
[2]University of Waterloo

Abstract

The focus of this study is on loading of nutrients from septic systems to the nearshore waters of Lake of the Woods. The septic systems investigated include cottages at Poplar Bay and other developments in the Sioux Narrows area. Over the period 2016 to 2018 samples were collected from nearshore surface waters and from shallow groundwater. The majority of the groundwater samples were collected beneath septic system drainfields and in their immediate vicinity. In addition to nutrients and major ions, artificial sweeteners have been analyzed as tracers of wastewater. It is anticipated that the field component of this study will be completed in 2019.

Brief Bio

Dale has been a Research Scientist with Environment and Climate Change Canada since 1999. His research is primarily on assessment of the occurrence and fate of contaminants in groundwater. His recent publications have focused on the analyses of chemical tracers, and of emerging contaminants in groundwater. Recently his research has also included the investigation of nutrients in groundwater and surface water. Dale is the Government of Canada lead with respect to the Groundwater Annex under the Great Lakes Water Quality Agreement.

Location of Study

Northern portion of Lake of the Woods, with focus on Poplar Bay near Kenora and on two sites at Sioux Narrows

Cyanobacterial and harmful algal blooms in Lake of the Woods

Arthur Zastepa

Environment and Climate Change Canada, Canada Centre for Inland Waters, Burlington, Ontario

Abstract

Lake of the Woods is a complex system, with limited exchange between its multiple basins and strong spatiotemporal variance in physicochemical conditions and susceptibility to cyanobacterial and harmful algal blooms. Nutrient input from tributaries has contributed to a highly productive southern basin with widespread cyanobacterial and harmful algal blooms, which are also present in some northern sub-basins. A recent binational, multi-agency review of the International Joint Commission's 2015 report, "A Water Quality Plan of Study for the Lake of the Woods Basin" has identified key science needs critical to supporting action by governments to protect the Lake of the Woods Basin. Environment and Climate Change Canada's progress and future direction is presented on the recently developed binational science plan as it relates to nutrient enrichment and cyanobacterial and harmful algal blooms. Specifically, nutrient dynamics, internal loads and hypoxia, and the characterization of phytoplankton community structure and associated toxins are discussed.

Brief Bio

Arthur Zastepa is a research scientist at the Canada Centre for Inland Waters at Environment and Climate Change Canada. He is actively involved in collaborative work with toxigenic and harmful algal blooms and source-water impairment in systems across Canada including in the Lake of the Woods, Lake Winnipeg, Lake Erie, and Lake Ontario. His research examines the factors regulating the abundance and diversity of microbes, their chemical ecology, and the fate and consequences of toxins produced in these systems. He has developed expertise in the application of bioanalytical technologies and paleolimnological tools to aquatic ecosystem research and has led the design and execution of large-scale field studies and surveys.

Location of Study

Algal bloom remote sensing on Lake of the Woods; update on 2018 conditions and in situ validation efforts

Caren E. Binding*[1], Zeng, C.[1], and Pizzolato, L.[1]

Environment and Climate Change Canada, Water Science and Technology Directorate, 867 Lakeshore Rd, Burlington, Ontario, Canada, L7S 1A1

Abstract

Comprehensive lake-wide observations of algal blooms on Lake of the Woods (LoW) are critical to assessing the lake's health status, developing ecosystem objectives, measuring lake responses to nutrient management practices, and providing an improved understanding of the processes driving blooms. Earth observation satellites offer frequent, synoptic views of LoW that enable quantitative assessments of algal biomass and can provide both near-real-time and historical information on algal bloom conditions. Results will be presented documenting progress made on ECCC's satellite remote sensing activities for monitoring and further understanding LoW algal blooms. Quantitative indices for algal bloom intensity, spatial extent, and duration, derived from the European Space Agency's (ESA) Sentinel-3 sensor, will be presented for the 2018 season and compared with historical conditions. Preliminary results will be shown from satellite validation experiments conducted in 2018 using flow-through fluorescence transects and buoy observations. Fixed station time-series observations capturing the diurnal changes in the optical properties and vertical distribution of the bloom in Miles Bay will also be presented and the impact on satellite retrievals discussed. Historical imagery from ESA's MERIS (Medium Resolution Imaging Spectrometer) previously analysed in relation to bloom drivers will be presented in the context of other similarly turbid eutrophic lakes.

Brief Bio

Location of Study

Trent University Watershed Loading Study Part One: Characterizing the hydrology of the Lake of the Woods watershed

Wes Greenwood* and Catherine Eimers

Trent School of the Environment, Trent University, Peterborough ON K9L 0G2 wesleygreenwo@trentu.ca

Abstract

Nutrient budget estimates for the Lake of the Woods (LOW) require reliable hydrologic and meteorological data; however, the sheer size and complexity of the watershed present practical challenges for monitoring. In order to address these challenges, the Canadian portion of the watershed was divided into contributing areas that represent the major surficial geology types (Canadian Shield vs. Agassiz clay plain), and the major forms of land cover/land use disturbance within each zone (i.e., forested -> harvested, shrubland -> agricultural). A total of 12 tributary and 3 deposition monitoring stations were established in 2018, and new and historical climate and streamflow records were used to evaluate spatial patterns and temporal (inter-annual and seasonal) variability in both meteorology and hydrology. Relationships between hydro-meteorological variables and basin geology and geomorphic characteristics (e.g., contributing area, elevation, gradient) were also assessed. These spatial relationships, as well as temporal patterns of runoff in different seasons (e.g., spring freshet, summer storm events) will be used to extrapolate deposition and tributary export measurements across the basin and evaluate sensitivity to future changes in climate.

Brief Bio

Wes Greenwood (MSc.) is a hydrologist based in Thunder Bay. He is currently leading the field monitoring campaign for the Trent U. watershed loading project (2018-2020).

Location of Study

Trent University Watershed Loading Study Part Two: Updated estimates of tributary loading: importance of storm events and year-round measurements

Catherine Eimers* and Wes Greenwood

Trent School of the Environment, Trent University, Peterborough ON K9L 0G2 ceimers@trentu.ca

Abstract

Early analysis of tributary monitoring data collected in 2018 indicate that stream chemistry varies consistently within geologic zones in the LOW watershed, with northern, Canadian Shield watersheds consistently having lower total P (TP) concentrations, and southern sedimentary watersheds having much higher TP levels, which greatly exceed water quality guidelines. Early measurements suggest that nutrient export is similar within disturbed subwatersheds (i.e. agricultural; harvested) compared with more natural subwatersheds, although there is substantial spatial variability. Nevertheless, storm-targeted TP concentrations measured in 2018 are consistently higher than concentrations measured during baseflow at the same tributaries in previous years. These early observations suggest that past estimates of TP loading may have been too low, as much of the annual export occurs in the non-growing season, and specifically in the spring melt period, which is often missed during routine sampling. Underestimates of nutrient export have likely been greater in the southern sedimentary part of the basin compared with the northern Shield zone due to the strong contribution of spring melt to annual hydrologic budgets in the south. Consistent correlations between TP and geogenic metals (e.g. iron, aluminum) suggest much of the P transport in the southern basin is particulate, arising from sedimentary sources.

Brief Bio

Catherine Eimers (PhD) is a professor at Trent University. She is currently leading a 2-year (2018-2020) research program in the LOW watershed to improve estimates of nutrient loading to LOW via tributaries and atmospheric deposition, with funding from Environment and Climate Change Canada.

Location of Study

ECCC's Lake of the Woods integrated modelling – lake and watershed

Reza Valipour, Craig McCrimmon, Ram Yerubandi*, Jun Zhao, Phil Fong

Environment and Climate Change Canada, Canada Centre for Inland Waters, Burlington, Ontario, L7S 4A1

Abstract

An integrated modelling framework was developed for the US and Canadian watersheds to simulate seasonal hydrodynamics, nutrients transport and algal blooms in Lake of the Woods. To date, the watershed model has completed preliminary calibration and beneficial management practices (BMP) scenarios are being tested. The integrated modelling approach aims to assess the lake's seasonal algal bloom responses to potential nutrient loading strategies as a combination of BMP and climate change adaptation scenarios. The CanSWAT watershed model is used to (i) provide lake input loading estimates for modelling lake responses, (ii) assess a combination of BMPs with particular focus on forests and agriculture impact on nutrient loadings, (iii) examine climate change adaption scenarios (iv) compare results with previous models, and (v) determine if the suggested BMPs can be used to meet targets such as total maximum daily load (TMDL) to the lake. Two hydrodynamic-water quality models 1) AEM3D (also known as ELCOM-CAEDYM), which simulates seasonal hydrodynamics and water quality in the lake, and 2) Delft 3D, which simulates surface waves and sediment transport, are used to assess algal blooms and sediment erosion characteristics in the lake. These models use spatially variable observed winds from bi-national stations, Rainy river inflows and Kenora and Norman dams' outflows, and are initialized using observed hydrodynamic and water quality profiles across the lake. The integrated modelling framework can also be used to support bi-national nutrient management objectives as required. In addition, a local integrated model has been created to study the impact of cottages on the Poplar Bay sub-watershed. The accuracies of model results are examined using extensive field observations collected during two different years (2016-2018).

Brief Bio

Location of Study

Session 3

The sturgeon recovery program on the Winnipeg River

Al Anderson

The Dalles First Nation

Abstract

DRAFT – UPDATE ON the Sturgeon Recovery Program on the Winnipeg River. We've been working on this project for four years and this is our second release. Last year we released 12 adults, this year we released 15. This is an important fish to our community as we have sturgeon clan members here. We almost lost our sturgeon here on the Winnipeg River because of the mills, the pollution, and dams. By cultivating our partnerships with Rainy River First Nation, Ontario Power Generation, and Kenora MNR we are focusing on the fact that when we take out our differences a lot of our beliefs and things that we are struggling for are very similar. Through this we are celebrating what we have in common.

Brief Bio

Location of Study

Leveling up: Adding a macroscale gamescape to SimRiver a widely adopted environmental education software tool

Matthew L. Julius*, William Gorcica, Mark Gill

St. Cloud State University, St. Cloud, MN, USA

Abstract

The diatom project is an international collaboration with 25+ contributors. The projects goal is to enhance the scientific understanding and personal appreciation of fluvial ecosystems globally. The team hopes this understanding and awareness will promote stewardship of aquatic resources and reduce personal water use footprints. The educational multilingual materials produced by the DiatomProject team are freely available web based resources, most notable is the SimRiver Interactive Game. To date the DiatomProject website supports 21 different languages and SimRiver is available in 19 different languges. Students and Educators from 30+ different countries have provided feedback concerning their experience with the educational modules. SimRiver is an educational tool for upper level science classrooms. The program is freely available and works on either Mac or PC systems. Acceptance in the international community has been widespread, with the SimRiver's incorporation into the curriculum of secondary science education and collegiate classrooms globally. The simulator allows students to manipulate various parameters in a river basin; including landuse, population, and season. Primary production species communities, specifically diatoms, are produced by the program based upon the environmental parameters selected by the students in developing the river basin. Students can quantitatively and qualitatively evaluate these species communities to measure water quality. Environmental variables can then be adjusted producing a new simulated species community, allowing students to discover the resulting change in water quality. SimRiver allows students the opportunity to participate in a hands on experimental environment change activity that allows a complex understanding of the relationship between organisms and environmental disturbance. Activities such as this are often unavailable to educators because the complexity and time required to observe actual changes in species communities. While SimRiver has been a success and has been adopted in schools around the world, a common theme in feedback from users is the desire for an interactive environment simulating the ecology created by students during the SimRiver exercise. An interdisciplinary team is working to address these concerns and a new modules are being developed to allow students to explore the macroscale river environment created during the "original" SimRiver gaming experience. The first of these modules is presented and participants are welcome to test this "Beta" version and provide feedback to the authors. Additionally, participants will be introduced to the "original" version with focus on classroom utilization and connection to specific learning outcomes.

Brief Bio

Location of Study

Session 4 – IISD Experimental Lakes Area Science

IISD Experimental Lakes Area at 50 – where we have come from and what we see for the next 50 years

Pauline Gerrard

IISD Experimental Lakes Area Inc. (IISD-ELA), 111 Lombard Ave. Suite 325. Winnipeg, MB. R3B 0T4

Abstract

The IISD Experimental Lakes Area (IISD-ELA) is an exceptional natural laboratory comprised of 58 small lakes and their watersheds in Northwestern Ontario that have been set aside for scientific research. Through whole ecosystem research on these small systems, scientists are able to examine how all aspects of the ecosystem respond. This unique research approach has influenced billion-dollar decisions of governments and industries and has generated more cost-effective environmental policies, regulations and management of freshwater systems around the world.

Established in 1968, IISD-ELA has fifty years of experience on whole ecosystem research and long-term monitoring of freshwater lakes. This presentation will provide an overview of key projects and outcomes over the fifty years. It will examine the advantage of this unique whole ecosystem approach and will discuss connections between public engagement, science education and policy impact moving forward for the next 50 years.

Brief Bio

Pauline Gerrard is the Deputy Director of IISD Experimental Lakes Area (IISD-ELA). She works with the Executive Director, IISD-ELA, on overall strategic, financial and operational management of IISD-ELA. She is also responsible for board relations and liaison, theory of change progress tracking and monitoring, continued leadership of IISD-ELA's outreach and education programming.

Ms. Gerrard's educational background is in Environmental Science and Ecology, and she has extensive experience in program management and training program delivery, having worked from 2001-2010 for WWF in Laos as a program manager for both the Greater Mekong Program and WATER (Wastewater Treatment through Effective Wetland Restoration of That Luang Marsh).

Pauline has also worked as a consultant, research associate and field technician in forestry, fisheries management, wetlands restoration, natural resources management, biodiversity conservation and climate adaptation.

Location of Study

IISD Experimental Lakes Area, northwestern Ontario

Bioenergetic and Biomarker Results of a Whole-Lake Nanosilver Addition on Fish

Lauren D. Hayhurst[1,2], Jonathan D. Martin[3], Valerie S. Langlois[4], Chris D. Metcalfe[3], Michael D. Rennie[1,2]

[1]Department of Biology, Lakehead University, Thunder Bay, ON, Canada
[2]IISD Experimental Lakes Area Inc., Winnipeg, MB.
[3]The School of the Environment, Trent University, Peterborough, ON, Canada
[4]Institut National de Recherche Scientifique, Québec, QC, Canada

Abstract

Nanosilver (nAg) is a successful antibacterial and antimicrobial, currently unregulated in Canada. Its wide use in hundreds of commercial products and industrial applications suggests a high potential for release into freshwater environments. As part of a collaborative nAg addition study (environmental concentrations = 1-15µg/L), conducted at the International Institute for Sustainable Development – Experimental Lakes Area Inc. (IISD-ELA), we evaluated changes in yellow perch (*Perca flavescens*) biomarkers at the cellular-level, as well as changes in individual-level bioenergetics, and extrapolated modelled consumption rates to the population-level for comparison before, during, and after whole-lake nAg addition. Results were compared to nearby unmanipulated reference lakes monitored over the same period. Biomarker analysis revealed down-regulation of catalase (*cat*) and glutathione peroxidase (*gpx*) in perch collected the first year of nAg exposure. The mean ratios of reduced to oxidized glutathione (GSH:GSSG) were significantly elevated in the liver tissues of perch collected in the second year of nAg addition. These biomarkers indicate oxidative stress in fish. Further, bioenergetics analysis revealed perch consumption and total metabolism rates were significantly different during and after nAg addition, compared to baseline data, and gross consumption of prey declined after nAg was added to the lake. This study evaluated fish effects in relation to the rest of the ecosystem – achievable only through whole-lake experimentation. Based on these results, nAg appeared to have had significant direct impacts on perch from the cellular- to population-levels during the two years of exposure.

Brief Bio

Lauren Hayhurst is currently working as a Fisheries Research Biologist with IISD-ELA, after completing her M.Sc (Biology) degree with Lakehead University in Thunder Bay, and B.Env. St. (Co-operative Education) with the University of Manitoba in Winnipeg. She has a background in water quality sampling, bioenergetics modelling, and population estimation, with experience working on a whole-lake nanosilver addition, and compiling the database of historical Eastern Newt (*Notophthalmus viridescens*) sightings at IISD-ELA. She attributes her early interest in freshwater and fish research to her experiences and time spent at her family's island on Lake of the Woods.

Location of Study

Changes in the aquatic community of a freshwater lake following a whole-lake drawdown experiment

Michael J. Paterson, R.A. Bodaly, I. Davies, A. Salki, D. Rosenberg

IISD Experimental Lakes Area Inc. (IISD-ELA), 111 Lombard Ave. Suite 325. Winnipeg, MB. R3B 0T4

Abstract

Many reservoirs experience winter drawdowns when power demands are greatest. To better understand the effects of these drawdowns on reservoir biogeochemistry and food webs, we undertook a whole-lake experiment where we lowered water levels by 2-3 m for 3 consecutive winters in a 13m deep boreal lake at the Experimental Lakes Area in northwestern Ontario. Exposure of whitefish eggs in the drawdown zone resulted in large declines in their recruitment and abundance. In the drawdown zone, benthic invertebrates and macrophytes were also greatly reduced in abundance. Although emerging chironomid abundance decreased in the drawdown zone, overall whole-lake emergence did not change substantially. This was because chironomids adjusted to changes in water level by moving to deeper waters. In the pelagic zone, zooplankton abundance and species composition was not substantially affected by drawdown. Similarly, epilimnetic nutrient concentrations and phytoplankton communities did not change dramatically in years following winter drawdown. Overall results indicate that nearshore communities were strongly influenced by winter drawdown, but pelagic communities were comparatively unaffected.

Brief Bio

Michael Paterson is the Senior Research Scientist at the IISD-Experimental Lakes Area (ELA), where he has worked since 1992. His research focuses on the ecosystem effects of human activities on freshwater lakes and his areas of expertise include aquatic food webs, plankton ecology, nutrients, and contaminants.

Location of Study

Lake 226 at the IISD-ELA in northwestern ON

Examining the Potential Effects of Controlled Spills of Diluted Bitumen and Conventional Heavy Crude Oil at the IISD-Experimental Lakes Area: The FOReSt Project

Vince Palace

IISD Experimental Lakes Area Inc. (IISD-ELA), 111 Lombard Ave. Suite 325. Winnipeg, MB. R3B 0T4

Abstract

Potential environmental impacts of oil spills are a concern for the Canadian public and the oil industry. There is also uncertainty on the part of regulators and the scientific community on which methods are best to employ when cleaning up oil spills in different environments. Improving the effectiveness of cleanup procedures, and demonstrating this under realistic field situations is required to address these significant knowledge gaps. The International Institute for Sustainable Development-Experimental Lakes Area (IISD-ELA) is leading a collaborative program to examine the fate and behaviour of diluted bitumen and conventional heavy crude oil in the freshwater shoreline environment. The program will also compare clean-up methods for oil spilled in that environment. Baseline chemical and biological information was collected in 2017 for a natural lake study site. In 2018, model oil spills in contained shoreline environments will be used to quantify the efficiency of immediate product recovery and then to compare degradation via natural attenuation of residual oil constituents. Basal degradation rates of residual (i.e after initial cleanup) weathered conventional crude or diluted bitumen in shoreline environments will be determined either with moderate or low energy inputs (i.e. waves). Detailed analysis of residual oil constituents, microbial community responses and potential impacts at multiple trophic levels will be evaluated in the enclosed aquatic system for 16 weeks. The information from this portion of the project will be used to determine if degradation trajectories are significantly different for diluted bitumen and conventional heavy crude oil and if wave energy has a significant effect on oil degradation rates in the freshwater shoreline environment. Results form this portion of the project will be used to design a larger project, to be performed in 2019, comparing the efficacy of different shoreline clean-up techniques relative to natural attenuation.

Brief Bio

Vince Palace, Ph.D. is an aquatic toxicologist with more than 20 years experience. He is currently the Head Research Scientist for the International Institute for Sustainable Resource Development – Experimental Lakes Area (IISD-ELA). During his time with government, industry and now with an NGO he has studied many different contaminants including arsenic, selenium, heavy metals, brominated and organophosphorous flame retardants, endocrine disruptors, pesticides, PCBs and PAHs in many sectors including mining, municipal and industrial wastewater, and agricultural runoff. His most recent work is examining the potential effects of oil spills and how best to remediate affected systems.

Location of Study

The effect of changes in atmospheric deposition on mercury accumulation by zooplankton and fish: the METAALICUS project

Michael J. Paterson, P.J. Blanchfield, L.E. Hrenchuk, H.H. Hintelmann

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Abstract

Fish from many lakes in North America and Europe have concentrations of mercury (Hg) that exceed consumption guidelines, which has led to proposals in Canada and the United States to restrict Hg emissions from coal-fired power plants at a potential cost of billions of dollars. Because of the complexity of the Hg cycle, it has proven difficult to demonstrate the efficacy of proposed emission reductions and there are many questions about how quickly ecosystems will respond. To answer these questions, Hg deposition to a lake and its watershed at the IISD-Experimental Lakes Area (ELA) was experimentally increased for 7 years (2001-2007) using enriched Hg stable isotopes. Different stable isotopes were added to the lake and the surrounding catchment using a boat and an airplane, respectively. During the addition phase, Hg isotopes added directly to the lake rapidly increased in fish and zooplankton, but only small changes were observed for isotopes added to the terrestrial system. After the cessation of experimental Hg additions in 2007, concentrations in zooplankton of isotopic methyl Hg declined steadily for 3 years and then leveled off. Concentrations in fish also declined, but more slowly. Eight years after isotopic Hg additions were ended, detectable isotopes were observed in all biota, indicating that some deposited Hg remains biologically available for many years.

Brief Bio

Michael Paterson is the Senior Research Scientist at the IISD-Experimental Lakes Area (ELA), where he has worked since 1992. His research focuses on the ecosystem effects of human activities on freshwater lakes and his areas of expertise include aquatic food webs, plankton ecology, nutrients, and contaminants.

Location of Study

Lake 658 at the IISD-ELA in northwestern ON

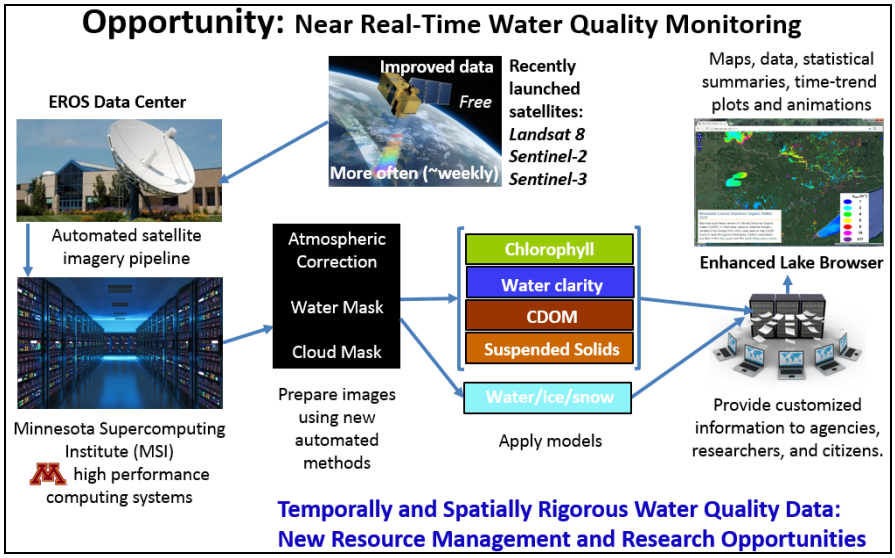
Session 5

Advanced Remote Sensing Methods for Automated Lake Water Quality and Ice Phenology Mapping

Leif G. Olmanson[1] and Benjamin P. Page[2]

[1]University of Minnesota, Department of Forest Resources, St. Paul, MN;
[2]University of Minnesota, Water Resources Center, St. Paul, MN

Abstract



Brief Bio

Recent advances in satellite technology along with cloud and supercomputing capabilities have enabled the use of satellite data for automated regional scale measurements of water resource characteristics. The launch of NASA/USGS's Landsat-8 and the European Space Agency's Sentinel-2 & 3 have improved the capability of satellite optical data to measure chlorophyll, colored dissolved organic matter (CDOM) and suspended sediment (SS), the main determinants of water clarity. Further, coupling optical imagery with Sentinel-1 synthetic aperture radar (SAR) data opens up new opportunities to measure lake-ice phenology in the winter months without the constraints of cloud contaminated scenes.

To explore and develop the capabilities of these systems we have conducted a number of field campaigns to measure snow depth and ice thickness in the winter and to measure optical water quality characteristics and *in situ* reflectance spectra nearly contemporaneously with satellite imagery in the summer at sites with wide ranges of optical complexity. We are using these measurements along with publically available data to validate our processing steps to develop field-validated methods that will be implemented in an automated water quality and ice phenology monitoring system. Water quality models developed for Landsat-8, Sentinel-2 and Sentinel-3 data are used to map chlorophyll, CDOM, SS and water clarity. The combination of optical and SAR data will be used to identify the onset of lake ice, snow and ice thickness to map ice phenology in all Minnesota lakes. This approach will enable near real-time monitoring of water quality variables and ice phenology at regional scales, which will enhance our understanding of spatial and temporal variability and responses of surface waters to environmental change. Examples from the Rainy -Lake of the Woods Watershed will be presented.

Location of Study

Linking science to management solutions: How sediment records and paleolimnology are informing lake management in the basin

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Abstract

Understanding, protecting, and restoring our northern lakes are goals that lakeshore owners, anglers, scientists, and agencies agree upon. Unfortunately, these groups often remain challenged in communicating with one another. Scientists have long struggled to communicate their work to the public and decision makers. Agency personnel must work within regulatory pathways when developing management strategies, and boots-on-the-ground stakeholders, who are most likely to see and be affected by the condition of their lakes, may not be adequately included. It does not have to be this way! We present examples of how scientists, resource management agencies, and stakeholder groups are working in concert to successfully and effectively translate the science into lake management solutions. On Lake of the Woods, studies in the southern basin provided critical information on pre-degradation lake condition, the fate and cycling of legacy nutrients, and current trajectory of algae problems. These data were key components used to develop the first US nutrient management plan for the lake directed at continued reduction of nutrients and blue-green algae blooms. South of Lake of the Woods lies its cousin Upper and Lower Red Lakes, which also struggle with periodic harmful algal blooms and elevated nutrients. Similar studies on the Red Lakes show that these higher-than-normal nutrients may be natural for this lake and that there has been little historical change in this largely unimpacted waterbody. Management plans now include a modified monitoring strategy and a possible site-specific nutrient standard just for the Red Lakes. Small lakes in the basin also benefit from science-inspired management. Small and shallow, Bartlett Lake (Northome, MN), received direct nutrient inputs from industry and sanitary sewers that were curtailed in the 1970s. The lake still has elevated nutrient levels and algal blooms over 40 years later. Sediment studies show that lake recovery from nutrient pollution is a slow process, and that over those four decades the lake has incrementally improved. Management plans can leverage the continued improvement and tweak the fisheries structure to accelerate lake recovery. These three case studies provide examples where lake management was informed by sound science to produce realistic and fact-based restoration goals with special attention paid to communicating both the scientific results and the management options to local stakeholders. We champion this approach as a way to simultaneously engage all parties that have an interest in protecting and restoring our most precious natural resources.

Brief Bio

Mark Edlund is a Senior Scientist at the Science Museum of Minnesota's St. Croix Watershed Research Station. He's been bringing up mud from the bottom of lakes since the 1990s to understand how lakes change over time and especially how the diatom algae reveal that history.

Location of Study

Lake of the Woods, Upper and Lower Red Lakes, Bartlett Lake

Identifying targets for restoration and protection in the Ash and Black Duck River watersheds

Amy Mustonen and Jenny Jasperson

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Abstract

The Rainy River – Headwaters watershed is currently undergoing Watershed Restoration and Protection Strategy (WRAPS) development. Intensive watershed monitoring and assessment, a precursor to WRAPS development, has indicated the lower Ash River and Black Duck River are not currently meeting the Total Suspended Solids (TSS) aquatic life water quality standard. This information guided the decision to place these two stream segments on Minnesota's 2018 proposed impaired waters list. Subsequent biologic stressor identification is providing supporting data for upcoming Total Maximum Daily Load (TMDL) and restoration and protection strategy development for these rivers. Through an improved understanding of the sediment dynamics and variability throughout these river systems and identification of banks displaying proportionately high sediment contributions, we can identify locations for potential restoration and protection efforts to help manage the contribution of sediment to these two rivers.

Stressor identification fieldwork has included collection of flow data, longitudinal TSS and Total Suspended Volatile Solids (TSVS) sampling, continuous turbidity monitoring, and collection of Bank Erosion Hazard Index (BEHI) and Near Bank Stress (NBS) field observations for incorporation into a Bank Assessment for Non-point source Consequences of Sediment (BANCS) model. In addition, a desktop review of existing forest change data has provided an indication of activities that are driving change on the landscape that could be contributing to TSS through changing the preexisting hydrologic system in the watershed for these rivers. The results of this work will inform the development of protection and restoration strategies.

Brief Bio

Amy Mustonen is a project manager for the Minnesota Pollution Control Agency's (MPCA) watershed program. The MPCA employs a watershed approach to restoring and protecting Minnesota's rivers, lakes, and wetlands. Money to accelerate efforts to monitor, assess, and restore impaired waters, and to protect unimpaired waters was funded by the Minnesota's Clean Water Legacy Act.

Location of Study

Ash River and Black Duck River watersheds; lat 48.34, lon -92.91

The Minnesota Pollution Control Agency's water quality and fisheries assessment of the Rainy River, 2016-2017

Jesse Anderson and Karsten Klimek

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Abstract

The Minnesota Pollution Control Agency monitored water quality and fish communities in the Rainy River from 2016-2017 as part of routine surveys of the State's largest rivers. The Rainy River's fish community was sampled at thirteen 500 meter long stations to assess aquatic life conditions in four segments from International Falls & Fort Frances to Lake of the Woods. The fish community characteristics were used to calculate Fish Index of Biological Integrity (IBI) scores. Overall, fish communities identified during the survey indicated very good to exceptional conditions in the River. Fish IBI scores were highest downstream of the Little Fork and Big Fork Rivers, and lowest near the dam in International Falls. Water quality was sampled by MPCA and Koochiching County SWCD staff biweekly from May – September at nine fixed stations within the same River segments. Sampling focused on conventional parameters (such as dissolved oxygen, nutrients, and suspended sediment), and E. Coli bacteria to assess if the River was meeting State water quality standards to support aquatic life and aquatic recreation (i.e. swimming). All four segments of the River had consistently low concentrations of E. Coli bacteria, and were meeting Minnesota's regional river eutrophication standards. Sediment levels in the Rainy River were periodically high in the segment below the confluence with the Little Fork and Big Fork Rivers, particularly during periods of high river flow. Over the past decade, this reach has been intensely monitored at the Manitou Rapids location, as part of the MPCA's Load monitoring program. Using a weight of evidence approach, the MPCA and local resource managers agreed that the Rainy River segment below the Little Fork and Big Fork Rivers will not be assessed as impaired due to periodic exceedances of Minnesota's regional TSS standard. MPCA monitoring has documented that the Little Fork River is a significant source of sediment and nutrients to the Rainy River and Lake of the Woods, and watershed protection and restoration strategies are on-going. Overall, results confirm that the Rainy River is a high quality water that has recovered from historical point-source pollution. This assessment will augment past IJC studies in the River, Minnesota's Lake of the Woods Impaired Waters Study, and future cooperative studies in this historic boundary water.

Brief Bio

Location of Study

What makes beaver populations fluctuate?

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[2]Voyageurs National Park, National Park Service, Natural Resources Research Institute, University of Minnesota Duluth, 5013 Miller Trunk Hwy., Duluth, MN 55812 USA.
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[4]Forest Wildlife Populations and Research Group, Minnesota Department of Natural Resources, 1201 E. Hwy. 2, Grand Rapids, MN 55744 USA.

Abstract

Understanding, quantifying, and predicting how beaver populations respond to density-dependent and environmental factors is important for understanding and managing the impacts beavers have on boreal ecosystems. Using a long-term dataset collected from 1975 to 2002, we evaluated the relative influence density dependence and a suite of extrinsic covariates (weather, harvest, habitat quality, predation) had on annual growth rates across 15 separate beaver (*Castor canadensis*) populations in northern Minnesota. Results indicated density dependence was most responsible for changes in annual population growth rates, but a lack of accompanying demographic data restricted us from determining the mechanisms driving these fluctuations. Three weather variables also significantly influenced growth rates, however the results were opposite from what we expected. Cold winters (lag-0), spring drought (lag-0), and fall drought (lag-2) were correlated with greater population growth rates, results that appear contrary to what is known about beaver biology. Harvest, predation, and habitat quality did not influence beaver population growth rates, though we suspect the latter was due to the coarse metric we used for our analysis. We suggest more research is needed to understand how density dependent mechanisms, and weather variables in particular, influence beaver population fluctuations.

Brief Bio

Location of Study

A comparison of the Turtle River Watershed to the Seine River Watershed as a source of traditional foods

Peter Ferguson[1] Lee and Kristi Dysievick[1] and John Kabatay[2]

[1]Lakehead University, Department of Biology, 955 Oliver Road, Thunder Bay, ON P7B 5E1;
[2]Seine River First Nation

Abstract

Residents of the Seine River First Nation (SRFN) utilize the Seine River Watershed (SRW) for hunting and gathering of native foods. This watershed has considerable anthropogenic development. Major point sources of contaminants on the Seine River include the abandoned Steeprock mine site, municipal effluent from the Town of Atikokan, the Ontario Power Generation's Station on Marmion Lake, and a series of dams controlling the water levels on the river. Earlier studies revealed that some contamination was present in the Seine River that could affect the quality of the collected food. Results from these investigations showed elevated mercury in fish and corresponding elevated mercury levels in the hair of residents. Other results included elevated contaminants in wild rice, waterfowl and some terrestrial plants. The SRFN wished to investigate whether the relatively pristine Turtle River Watershed (TRW), just north of the Seine River Watershed, could be used as an alternative source of traditional foods.

Sample sites were established within the TRW stretching from the northwestern section of the watershed to its southern junction with the Seine River near Mine Centre, Ontario. The same procedures used for sampling and analyzing contaminants in the SRW were used for the TRW. Seven waterbodies were sampled for water, sediment, fish and invertebrates. Samples were also collected for berries, seed, and game. Additionally, a food consumption survey was conducted for community residents with corresponding testing of mercury levels in their hair.

The water quality in the TRW was similar throughout the watershed for all parameters measured with the exception of Robinson and Eltrut Lakes. These two lakes had higher levels of phosphorus, nitrogen and total mercury. Compared to the SRW, the TRW had softer water with lower conductivity, alkalinity, calcium, magnesium and pH than the SRW. The TRW had higher phosphorus but lower nitrogen and mercury values. Precipitation measurements revealed that the SRW received higher pH, zinc and mercury concentrations in rain and snow. The sediment was similar within the two systems with the TRW having somewhat higher bulk densities. There was considerable within watershed variation for the sediment parameters making general comparisons difficult. Total mercury in fish varied among species and within species for lakes. Of the commonly consumed fish, Northern Pike and Walleye had the highest concentrations of mercury with the lowest for Whitefish followed by Sturgeon. Highest fish tissue concentrations for mercury occurred in the lower regions of the TRW with concentrations in Walleye above the accepted consumption levels. Comparing the two watersheds, Northern Pike, Walleye and Bass had similar mercury concentrations while Sturgeon and Whitefish were significantly lower in the TRW. The SRW had consistently higher concentrations of zinc and aluminum in fish tissue. In terms of invertebrates, similar mercury concentrations were found in most classes with the exception of the Gastropoda and Isopoda which were significantly higher in the TRS. In terms of berries, seeds and game, the only concern was the consumption of waterfowl more than eight times per week. Concentrations of mercury in blueberries were higher in the TRS. Concentrations of mercury in human hair were all found to be below the acceptable level of 1.0 ppm and were shown to increase with age as well as number of meals of fish per week.

The SRFN is assessing the results of the study in terms of recommendations and advisements to its residents. There are advantages to the consumption of different species of fish from some lakes in the TRW versus the SRW but social issues such as access to these lakes and acceptance of a change in diet must be considered.

Brief Bio

Dr. Peter Lee is Professor Emeritus of Biology at Lakehead University in Thunder Bay, Ontario. His research concentrates on contaminants in aquatic systems caused by point source influences as well as studies on aquatic plants, particularly wild rice.

Location of Study

Seine River, Turtle River - Rainy Lake Watershed

Treaty #3 Community Based Monitoring

Chris Herc

Grand Council Treaty #3, 237 Airport Rd, Kenora, ON P9N 0A1 environment.monitor@treaty3.ca

Abstract

The Anishnaabe world view of water states "We have the right and responsibility to protect the water". Based on this view, Grand Council Treaty #3 has created and implemented a Community Based Monitoring (CBM) program. The overall objective of the CBM program is to protect the traditional waters of the Anishinaabe people through the goals of protecting, conserving and restoring traditional community waters; building environmental knowledge and capacity of community members; and prioritizing youth engagement in the program.

2018 was the pilot year for the CBM program with two Treaty #3 communities participating in it. With community members guidance it was decided that basic water quality parameters would be monitored using YSI Pro Plus meters throughout the Summer and Fall. Data collected during the program was considered bassline data and with it a water quality database was created for each community. This data will be used in future water conservation and protection efforts and be used to hold industries accountable for the results of their actions on the environment. Overall the 2018 year for the CBM program has been considered a success with a large step forward being made with the project objective of protecting the traditional waters of the Anishinaabe people.

Brief Bio

Chris Herc has B.Sc. in Environment and Natural Resources from the University of New Brunswick. He has lived and worked across Canada gaining over six years environmental/biological experience and over three years teaching environmental education. Currently he is working for Grand Council Treaty #3 as their environmental monitoring coordinator and implementing a community based monitoring program across Treaty #3 Territory.

Location of Study

Dalles First Nation, Winnipeg River, ON and Whitefish Bay First Nation, Lake of the Woods, ON

Water, wild rice, power. Unpacking the complex of water level management, power, and self-determination the Rainy Lake watershed

Johann Strube

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Abstract

Water management in the Rainy-Lake of the Woods Watershed is contested and political. This emerging sociological study will investigate how the management of water levels on Rainy Lake affects livelihood opportunities, how hydrological interventions are determined and implemented, and, finally, how water management relates to political power in the watershed. In particular, the research will examine the impact of water level management on wild rice/manoomin (*Zizania palustris*) and the lacustrine Saultaux Ojibwe communities for which the plant has traditionally been of utmost cultural, spiritual, and economic importance. This presentation will outline the goals, theoretical framework, and methods of this research, and aims to begin a conversation about the role that natural resource managers can play in addressing long-standing concerns about environmental management and treaty obligations and responsibilities.

Brief Bio

Johann Strube is a rural sociologist with a focus on the sociology of food and agriculture. Previous research projects were centered on peasant economies in Upstate New York, Italy and Austria. He holds a master's level diploma in landscape planning and landscape architecture from the University of Natural Resources and Life Sciences, Vienna (Austria).

Location of Study

Testing the Effectiveness of Muskrats as a Native Biocontrol of Invasive Hybrid Cattails

Steve K. Windels[1], Matykiewicz, Benjamin R.[2], Olson, Bryce T.[1], Wolf, Tiffany M.[3], Ahlers, Adam A.[2]

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Abstract

Invasive hybrid cattails (*T x. glauca*) are expanding in the United States and out-competing native wetland vegetation. *T x. glauca* can grow in deeper water and much denser stands than native cattail species thereby reducing open water habitat to native wetland species. Current management techniques of *T x. glauca* are costly and can be destructive to pristine wetland ecosystems. Muskrats (*Ondatra zibethicus*) are native aquatic herbivores that feed on aquatic vegetation and have demonstrated an ability to control aquatic vegetation through herbivory. During the Summer of 2018 we established 10 wetland sites affected by *T x. glauca*, 5 to be stocked with muskrats and 5 as controls, in Voyageurs National Park, MN, USA. Through the Summer we trapped and translocated 125 muskrats to the treatment wetlands, 23 of these were implanted with internal VHF transmitters to assess post-translocation survival and movements. Eight of the radiomarked muskrats (35%) remained in the treatment wetlands, dispersal distances ranged from 244 to 5,066m. Daily survival was best predicted through our body condition index (tail index) and sex model. Future work will focus more heavily on telemetry immediately after translocation to account for dispersal from wetlands and estimating survival of non-radiomarked muskrats within treatment wetlands.

Brief Bio

Location of Study

Voyageurs National Park, MN, USA

Poster Session Abstracts

The contribution of particulate export to phosphorus delivery to the Lake of the Woods, Ontario

Kelly Macgillivray and Catherine Eimers

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Abstract

Phosphorus delivery to the Lake of the Woods (LOW) is expected to be associated with particulate matter in the southern Rainy River Watershed. Vast differences in surficial geology and disturbance regime (agriculture) across the LOW watershed are predicted to play a role in the level of particulate export and associated phosphorus levels. This study will contrast suspended sediment and phosphorus transport between the northern region, which is dominated by bedrock with lower particulate transport, and the southern Rainy River region, where glacial lacustrine deposit are associated with higher particulate transport. Relationships between sediment transport and phosphorus across the two regions will help quantify the importance of phosphorus arising from sedimentary sources. This study will ultimately inform best management practices that limit sediment and associated phosphorus transport.

Brief Bio

Kelly Macgillivray is an M.Sc Candidate in the Environmental and Life Sciences Program at Trent University. She is part of Trent University's Lake of the Woods Watershed Loading Project.

Location of Study

Biological monitoring In the Rainy River Basin – Past, present, and future

Nathan Mielke

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Abstract

In 2007, the Minnesota Pollution Control Agency initiated the Intensive Watershed Monitoring (IWM) approach to monitor and assess waters of the state. The IWM method utilizes an unbiased, nested watershed design to sample streams throughout each major watershed from a coarse (HUC 8) to fine (HUC 14) scale. This process not only identifies impaired waters but also those in need of additional protection. Information gathered during the IWM process supports the development of an effective strategy to restore impaired waters. After ten years of monitoring, every major watershed within the State of Minnesota has been assessed. With these findings, we discuss past monitoring, current conditions, and the future of biological monitoring in the Rainy River Basin.

Brief Bio

Location of Study

Impact of sampling methodology on the comparability of water quality parameters in Lake of the Woods

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[2]Ontario Ministry of the Environment, Conservation and Parks, Dorset Environmental Science Centre, 1026 Bellwood Acres, Dorset, ON PO Box 39, P0A 1E0

Abstract

Multiple agencies on both sides of the international border monitor and report on water quality in the Lake of the Woods watershed. While field sampling and laboratory methods differ, data from many of these monitoring programs have been used to inform basin-wide nutrient modeling efforts and to track changes in water quality over time. One of the recommendations of the International Joint Commissions' Plan of Study for the Lake of the Woods watershed is to develop an international monitoring program for Lake of the Woods. Attaining this goal could involve standardizing field sampling methods amongst agencies that, in turn, could affect individual long-term data sets. The Ontario Ministry of the Environment, Conservation and Parks (MOECP) and Environment and Climate Change Canada (ECCC) monitor water quality on Lake of the Woods (LOW), often at co-located sampling stations.

We initiated an investigation to explore how differences in sampling methods and pre-analytical processing between MOECP and ECCC may affect water chemistry data. Currently ECCC collects a grab sample at 1 m below the surface; pre-analytical processing involves filtering water for some parameters through a 0.45 um filter. MOECP collects an integrated sample from the surface to the Secchi depth and coarse filters most parameters through an 80 um mesh. We designed three treatments to investigate the impacts of these differences to water chemistry data: 1. ECCC sampling method and processing, 2. MOECP sampling method and processing, 3. MOECP sampling method and ECCC processing. Cations, anions, dissolved phosphorus, total and dissolved nitrogen and ammonia concentrations were similar amongst all three treatments. Dissolved organic carbon was 5% lower using ECCC processing methods while dissolved inorganic carbon was 2% higher. Concentrations of nitrate-nitrite were 5% lower using MOECC sampling methods. Concentrations of some parameters were more impacted by differences in methodology, especially during the early fall when algal blooms may be occurring. In the fall, total phosphorus was, on average, 20% higher using ECCC methodology compared to MOECC. We attributed this to the impact of pre-filtering samples through a mesh filter to remove zooplankton and clumps of algae. This highlights the importance of being cognisant of exactly what components each agency is measuring when combining data.

Brief Bio

I have worked for Water Quality Monitoring and Surveillance at ECCC for 9 years, previous to this I worked for the Canadian Wildlife Service (ECCC) on wildlife ecotoxicology. In past years, I was the secretary to the former International Rainy River Water Pollution Board and the International Rainy Lake Board of Control where I was fortunate to work and interact with many colleagues and friends in the Lake of the Woods basin. My work on Lake of the Woods focuses on environmental monitoring of water and sediments, for nutrients, contaminants and biological impacts to the benthic community. I also liaise with local lay collectors to coordinate sampling on the Rainy and Pinewood Rivers.

Location of Study

Status of zebra mussel spread in the Big Fork River, Minnesota, USA

Michael Duval and Rich Rezanka

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Abstract

Since an initial infestation of zebra mussels was detected in 2013 at Sand Lake in the headwaters of the Big Fork River, Minnesota DNR and local government partners have conducted ongoing assessments of population expansion and downstream movement in the river system. This poster presents the current status of downstream movement of this invasive species toward the confluence with the Rainy River in the LOW watershed and provides communication and coordination contacts to ensure that interested stakeholders remain informed.

Brief Bio

Michael Duval is a District Manager for the MnDNR Division of Ecological and Water Resources, supervising implementation of the state's Invasive Species Program in northeastern Minnesota.

Location of Study

How long has it been in the lake? Sediment reveals invasion history of Spiny Water Flea

Nichole DeWeese, Donn Branstrator, Euan D. Reavie*

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Abstract

The spiny water flea (*Bythotrephes longimanus*) is an invasive predacious zooplankton species that has spread to lakes throughout the upper Midwest, Northeast, and Canada. Once introduced to a lake, the spiny water flea devastates native phytoplanktivorous zooplankton populations, especially *Daphnia* and *Bosmina* species. The impacts of reductions of native zooplankton cascade across lower food webs and can lead to increased algal blooms and reduction of prey for young fish. However, these impacts take time to appear and require knowledge of when spiny water flea first invaded an ecosystem, which is difficult to estimate from water column samples because of the species' small size. To explore this problem, we examined lake sediments for subfossils of spiny water flea to estimate first invasion of the species and changes in its population over time. We reconstructed populations in Mille Lacs Lake and Kabetogama Lake in northern Minnesota from present until 1970 and found spiny water flea subfossils in all sediment samples. These results suggest that spiny water flea has been present in both lakes at least 30 years before they were detected in the water column.

Brief Bio

Location of Study

Hands-on Demo – Leveling up: Adding a macroscale gamescape to SimRiver a widely adopted environmental education software tool

Matthew L. Julius, William Gorcica, Mark Gill

St. Cloud State University, St. Cloud, MN, USA

Abstract

The diatom project is an international collaboration with 25+ contributors. The projects goal is to enhance the scientific understanding and personal appreciation of fluvial ecosystems globally. The team hopes this understanding and awareness will promote stewardship of aquatic resources and reduce personal water use footprints. The educational multilingual materials produced by the DiatomProject team are freely available web based resources, most notable is the SimRiver Interactive Game. To date the DiatomProject website supports 21 different languages and SimRiver is available in 19 different languges. Students and Educators from 30+ different countries have provided feedback concerning their experience with the educational modules. SimRiver is an educational tool for upper level science classrooms. The program is freely available and works on either Mac or PC systems. Acceptance in the international community has been widespread, with the SimRiver's incorporation into the curriculum of secondary science education and collegiate classrooms globally. The simulator allows students to manipulate various parameters in a river basin; including landuse, population, and season. Primary production species communities, specifically diatoms, are produced by the program based upon the environmental parameters selected by the students in developing the river basin. Students can quantitatively and qualitatively evaluate these species communities to measure water quality. Environmental variables can then be adjusted producing a new simulated species community, allowing students to discover the resulting change in water quality. SimRiver allows students the opportunity to participate in a hands on experimental environment change activity that allows a complex understanding of the relationship between organisms and environmental disturbance. Activities such as this are often unavailable to educators because the complexity and time required to observe actual changes in species communities. While SimRiver has been a success and has been adopted in schools around the world, a common theme in feedback from users is the desire for an interactive environment simulating the ecology created by students during the SimRiver exercise. An interdisciplinary team is working to address these concerns and a new modules are being developed to allow students to explore the macroscale river environment created during the "original" SimRiver gaming experience. The first of these modules is presented and participants are welcome to test this "Beta" version and provide feedback to the authors. Additionally, participants will be introduced to the "original" version with focus on classroom utilization and connection to specific learning outcomes.

Brief Bio

Location of Study

Meetings of Other Research / Working Groups Co-Located Around The Forum Program

The following invitational meetings of collaborative groups are co-scheduled around the Forum program.

	Tues. Mar 12	Wed. Mar 13	Thurs Mar 14
8:00		CAG/IAG/IRLWWB (8 – 9 am) RRCC – H-118	
8:30			
9:00	IMA WG / TAC Joint meeting (9 – 11 am) RRCC – H-118	IRLWWB (9 – 10:30) RRCC – H-118	FORUM Oral Przs (9 am – 4:30 pm) (RRCC – Theatre)
9:30			
10:00			
10:30			
11:00		FORUM Oral Przs (11 am – 5 pm) (RRCC – Theatre)	
11:30			
12:00	Objectives/Alerts Experts Workshop (12 – 4 pm) RRCC – S-119		
12:30			
1:00			
1:30			Civic Engagement Workshop (1:30 – 4 pm) RRCC – H-118
2:00	CAG / IAG (2 – 4 pm) RRCC: CAG H-118; IAG – SC-114		
2:30			
3:00			
3:30			
4:00			
4:30	Objectives/Alerts Stakeholder Workshop (4:30 pm – 6:30 pm) RRCC – S-119		FORUM ENDS (4:30 pm)
5:00		Poster Setup (5 – 6 pm) (AmericInn)	
5:30			
6:00		Poster Session Foundation Reception (6 – 9 pm) Cascades Ballroom AmericInn	
6:30			
7:00	IJC WLC Public meeting RRCC – Theatre		

Border Waters Atlas WG (8 - 12) RRCC H-119

Acronyms

IJC	International Joint Commission
IRLWWB	IJC International Rainy-Lake of the Woods Watershed Board
CAG	Community Advisory Group to the RLWWB
IAG	Industrial Advisory Group to the RLWWB
IMA WG	International Multi-Agency Arrangement Working Group (managers)
IMA TAC	International Multi-Agency Arrangement Technical Advisory Committee
RRCC	Rainy River Community College