8th Annual - International Water Quality Forum

March 9 - 10, 2011

Rainy River Community College

International Falls, Minnesota, USA

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Program At A Glance

MARCH 9

08:00 – 14:00 Registration open

12:00 – 13:00 Lunch

13:00 – 14:00 Meetings of individual collaborative groups

This hour is reserved for individual meetings of groups collaborating in the basin, rather than general sessions.
Groups meeting: -- Historical nutrient loading re-construction paleo working group (A. Paterson, lead)

14:00 Break

14:30 – 17:00 IJC International Lake of the Woods & Rainy River Watershed Task Force: Shared Waters, Shared Management – What is the Best Approach?

This session is an important opportunity to participate with the Task Force to develop recommendations for bi-national management of our watershed – please plan to attend and participate!

17:00 Break

18:00 – 21:00 FOUNDATION RECEPTION & POSTER SESSION (AMERICINN)

Guest Speaker – Robert Sandford, Chair, Canadian Partnership Initiative United Nations' "Water for Life" Decade

Kallemeyn Award Presentation

Student Poster Award Presentation

The AmericInn is the former Holiday Inn across the street from the Rainy River Community College

POSTER SESSIONS – MARCH 9 (AMERICINN) & MARCH 10 (RAINY R. COLLEGE)

The Foundation Reception on March 9 includes a new poster session (at the AmericInn). Posters will also be set up at the College on the 10th as we've done in the past.

1. Dispersal of a Post-Spawn Walleye Run: Initial Results of a Walleye Tagging Project on Rat Root River (Rainy Lake). Nicholas Schlesser, Kevin Peterson, and Thomas Burri, Minnesota Department of Natural Resources
2. A midge-based paleolimnological assessment of historical water quality changes in Poplar Bay, Lake of the Woods, Ontario. Jamie .C.Summers[1], K.M. Rühland[1], J. Kurek[1], A.M. Paterson[2], and J.P.Smol[1]
   [1]Queen's University (PEARL); [2]Ontario Ministry of the Environment, Dorset Environmental Science Centre
3. Water quality on Lake of the Woods, Northwest Angle. Kayla J. Bowe, Shane E. Bowe.
   Red Lake Department of Natural Resources, Red Lake Band of Chippewa Indians
4. The Use of Remote Sensing In Determining the Source of Septic System Pollution Entering Bass Lake. Alan W. Cibuzar, A.W. Research Laboratories, Inc., Brainerd, MN.
5. International Lake of the Woods and Rainy River Watershed Task Force - Mandate and Progress to Date.
   Task Force members: Melanie Neilson, Jim Chandler, Gail Faveri. Lee Grim, Lisa Bourget, Kelli Saunders
6. Assessing total phosphorus concentrations in the Lake of the Woods and it's sheltered embayments using empirical and paleolimnological approaches. Hargan, K.E.[1], C.V. Hyatt[2], A.M. Paterson[3], K.M. Rühland[2], P.J. Dillon[4], and J.P. Smol[2]
   [1]Trent University, Peterborough, ON'; [2]Queen's University (PEARL); [3]Ontario Ministry of the Environment, Dorset Environmental Research Centre; [4]Trent University, Peterborough, ON
7. Distribution, movements, and population characteristics of juvenile lake sturgeon in the Namakan System – Preliminary Results. C. Trembath[1,2], B. McLaren[2], R. Mackereth[2,3], S. Chipps[4]
   [1]Voyageurs National Park, International Falls, MN; [2]Lakehead University, Thunder Bay, ON;
   [3]Ontario Ministry of Natural Resources, Thunder Bay, ON;[4]South Dakota Cooperative Fish and Wildlife Research Unit, South Dakota State University, Brookings, SD
8. Movement and Seasonal Distribution of Lake Sturgeon in the Namakan River, Ontario (2010 Progress Report).
   Darryl McLeod and David Denyes, Ontario Ministry of Natural Resources, Fort Frances, ON
9. The Influence of Lake Characteristics on Invertebrate Community Structure in the Littoral Zone: The Importance to Lake Sturgeon (*Acipenser fulvescens*). Matt Lebron, Lakehead University, Thunder Bay, Ontario
10. What's Happening in Minnesota on the AIS Front? Darrin Hoverson, Minnesota Department of Natural Resources, Park Rapids, MN
11. Lake of the Woods Control Board in the Basin. Rick Cousins, Matt DeWolfe, Lake of the Woods Control Board.

MARCH 10

08:15 Welcome and Introductions

08:25 SESSION 1 – UPDATES

1. International Multi-Agency Arrangement (IMA) Report.
2. International Lake of the Woods and Rainy River Watershed Task Force Presentation. Gail Faveri
   Canadian Member, International Lake of the Woods and Rainy River Watershed Taskforce
3. The Steep Rock Iron Mine site: past, present, and future. Amy L Godwin[1], Peter F Lee[1], Andrew G Conly[2]
   Lakehead University – [1]Department of Biology and [2]Department of Geology

9:20 SESSION 2 – STATE OF THE FISHERIES

1. Keynote 1 – Management Challenges with Lake Trout: A Species From a Different Time and Place. John M. Gunn, Canada Research chair in Stressed Aquatic Systems, Laurentian University, Sudbury, Ontario

10:00 Break

2. Keynote 2 – State of the Fisheries – Don Pereira
   Fisheries Research and Policy Manager, Minnesota Department of Natural Resources
3. State of the fishery: Border Water monitoring efforts of the MN DNR: Nicholas Schlesser
   Minnesota Department of Natural Resources, International Falls, MN
4. The Decline and Recovery of Lake Sturgeon in the Rainy River – Lake of the Woods System. Tom Heinrich, Minnesota Department of Natural Resources, Baudette MN
5. Management of lake trout in Lake of the Woods, ON. Tom Mosindy
   Ontario Ministry of Natural Resources – Lake of the Woods Fisheries Assessment Unit

12:10 Lunch and Poster Session

13:30 SESSION 3 – NUTRIENTS AND WATER QUALITY

1. A high altitude plunge into the mud: multiple focal lengths for Lake of the Woods monitoring. Timothy Pascoe, Tana McDaniel, Caren Binding, Ram Yerubandi, and Sue Watson
   Environment Canada, Science and Technology Branch, Burlington ON
2. Modelling of hydrodynamics and water quality in Lake of the Woods. Susan B. Watson Weitao Zhang and Ram Yerubandi
   Environment Canada – National Water Research Institute
3. Hydrologic conditions in Lake of the Woods and selected tributaries, April–October 2010. Jenifer A. Bode and James D. Fallon
   U.S. Geological Survey, Mounds View, MN
4. Water quality in the southern basin of Lake of the Woods: 2010. Sarah Elliot and Richard L. Kiesling
   U.S. Geological Survey, Mounds View, MN

14:50 Break

15:20 SESSION 4 – ALGAE AND REMOTE SENSING

1. Algal biomass response to recent warming in the Lake of the Woods, Ontario. Andrew Paterson[1], Kathleen Rühland[2], Crystal Hyatt[1,2], Neal Michelutti[2], and John Smol[2]
   [1]Ontario Ministry of the Environment - Dorset Environmental Science Centre
   [2] Queen's University – Paleoecological Environmental Assessment and Research Laboratory
2. Assessment of human exposure risks to the algal toxin, microcystin, in Lake of the Woods and Winnipeg River, Ontario. Brian G. Kotak[1] and Hedy Kling[2]
   [1]AlgalTox International, Pine Falls MB, [2]Algal Taxonomy and Ecology Inc., Winnipeg MB
3. Satellite remote sensing of potentially harmful algal blooms in Lake of the Woods. C. Binding[1], T. Greenberg[1], R. Bukata[1], G. Letourneau[2] & Susan B. Watson
   Environment Canada – Canada Centre for Inland Waters, Burlington ON
   Environment Canada – Water Quality Monitoring and Surveillance - Montréal, QC
4. Using remote sensing to monitor and assess the geospatial and temporal trends of water quality and land use in the Lake of the Woods watershed. Leif Olmanson and Marvin Bauer
   University of Minnesota – Departments of Forest Resources & Remote Sensing & Geospatial Analysis Laboratory.

16:40 – 17:00 CLOSING REMARKS – Robert Sandford, United Nations' Water for Life Decade

Organizing Committee – 2011

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Forum Sponsors – 2011

The organizing committee would like to thank our 2011 sponsor's for assisting with the 8th Annual International Lake of the Woods Water Quality Forum. This event would not be possible without the assistance of the following groups:

- Lake of the Woods Water Sustainability Foundation
- International Joint Commission
- Ontario Ministry of Environment
- Minnesota Pollution Control Agency
- Manitoba Water Stewardship
- North American Lake Management Society
- Lake of the Woods District Property Owners Association
- Rainy River Community College
- St. Cloud State University
- Dorset Environmental Science Centre (OMOE)
- Environment Canada

Presentation Abstracts

International Multi-Agency Arrangement – 2010-2011 Update

Michael Carroll, IMA Workgroup Chair, Minnesota Department of Natural Resources

Abstract

The Intenational Multi-Agency Working Arrangement (IMA) is a framework within which partners and stakeholders can actively engage in coordinated activities to help protect and restore water quality in LOW. The purpose of the IMA is to foster trans-jurisdictional coordination and collaboration on science and / or management activities to enhance / restore water quality in the Lake of the Woods Water Watershed (Lake of the Woods and Rainy River Basins). In May 2009, nine organizations signed on as members of the IMA, including: Environment Canada, Lake of the Woods Water Sustainability Foundation, Minnesota Department of Natural Resources. Minnesota Pollution Control Agency, Ontario Ministry of the Environment, Ontario Ministry of Natural Resources, Manitoba Water Stewardship, Red Lake Band of Chippewa Indians, and the United States Environmental Protection Agency. An update on collaborative activities during 2010 and plans for 2011 will be presented.

International Lake of the Woods and Rainy River Watershed Task Force Presentation

Gail Faveri

Canadian Member, International Lake of the Woods and Rainy River Watershed Taskforce
c/o, Boundary Water Issuesm MSC, Operations Ontario, Environment Canada, 867 Lakeshore Road, Burlington (Ontario) L7R 4A6 gail.faveri@ec.gc.ca

Abstract

The International Lake of the Woods and Rainy River Watershed Task Force was established in July, 2010 by the International Joint Commission (IJC) to help it respond to a reference from the Governments of Canada and the United States for advice on how to address management of water quality, water quantity and related issues in the Lake of the Woods and Rainy River Watershed both now and in the future. This presentation will describe the efforts of the Task Force to review the ways that the two governments work together to manage water quality, water quantity and related issues in the watershed, to identify gaps in the current approach, to identify key existing or emerging issues that require attention, and to recommend any new or adjusted governance mechanisms that would help address the identified future needs. We will show the issues that have been raised so far and present the highlights of our interim report due in March. Further details of our mandate, directive and workplan are available on our website: http://www.ijc.org/conseil_board/rainy_river_watershed/

The Steep Rock Iron Mine Site: Past, Present, and Future

Amy L Godwin[1], Peter F Lee[1], Andrew G Conly[2]

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Abstract

In 1938 the richest hematite deposit in North America to date was discovered below Steep Rock Lake near Atikokan, Ontario, Canada. During the Second World War an enormous water diversion project was undertaken to access the ore. The Seine River, which once flowed through Steep Rock Lake, was diverted from Marmion Lake through Raft and Finlayson Lakes into the West Arm of Steep Rock Lake. The Middle and East arms of Steep Rock Lake were drained, and 210 Mm^3 of very soft lake bottom sediment was dredged in order to mine the ore bodies (Sowa et al., 2001).

Pit mining of the ore continued until 1979 by which time 78 million tonnes of iron ore had been extracted (Sowa, 2003). The pumps that had been keeping the pits dewatered were shut down, which allowed the pits to begin filling with groundwater, surface runoff, and precipitation. Following closure of the mines in 1979, the site was returned to the Ministry of Natural Resources in 1985 (Regional Engineering Services, 1986).

The closure of the Steep Rock Iron Mine left behind an area of severe environmental concern. Lakehead University undergraduate and graduate students have been studying the two pit lakes in cooperation with the Ministry of Natural Resources since 1999. Seasonal sampling of the water columns in both lakes shows that the Hogarth and Caland pit lakes differ in the concentration and distribution of various organic and chemical parameters. The geochemical influence of the pit wall rocks has contributed to the distinct differences in the water quality between the two pits. Hogarth has elevated levels of dissolved sulphate (1200—2000 mg/L) throughout the water column and shows little chemical stratification. Caland shows moderate levels of sulfate (200—500 mg/L) and is chemically stratified with an oxygenated fresh water mixolimnion, a distinct chemocline, and a sulfate-saline anoxic monimolimnion. pH remains circum-neutral (Caland = 7.85; Hogarth = 7.50) due to carbonate buffering.

Initial investigations in 1999 suggested that Hogarth contained little aquatic life and standard LC_{50} toxicity tests showed that Hogarth was acutely toxic to *Daphnia magna*. By 2004, Hogarth no longer exhibited acute toxicity, but using *Ceriodaphnia dubia* as an indicator species was shown to have chronic toxicity during winter months. Toxicity indicator evaluations (TIE) revealed that the most likely cause was elevated SO_4^{2-}, Ca^{2+}, and Mg^{2+}. Geochemical weathering continues to alter the water quality of this dynamic system. With continued filling, the two pits will merge and discharge into the adjacent seine river system sometime between 2030 and 2070 (Jackson, pers comm., 2007). This would likely impact downstream areas including Rainy Lake and Lake of the Woods.

Keynote 1 – Management Challenges with Lake Trout: A Species From a Different Time and Place

John M. Gunn

Canada Research chair in Stressed Aquatic Systems, Laurentian University, Sudbury, Ontario

Abstract

In our multicultural societies we are slowly, and sometimes painfully, coming to the realization that we all don't see everything "the same way". However, in fisheries science, we still often think that the species that we are trying to "manage" are, or at least were, before industrial society arrived on the edge of the lake, finely and perfectly adapted to their local environment. In our traditional approach we rarely if ever consider that our "native species" are also just another recent immigrant (in terms of evolutionary time) and that they too may be quite out of place in the ecosystems them find themselves in. So – let's do this kind of thinking with one of our classic native species, the lake trout (*Salvelinus namaycush)* and see if it helps explain why they are so difficult to manage.

Keynote 2 – State of the Fisheries

Don Pereira

Fisheries Research and Policy Manager, Minnesota Department of Natural Resources

Abstract

State of the Fishery: Border Water Monitoring Efforts of the MN DNR

Nicholas Schlesser

Minnesota Department of Natural Resources, 392 Hwy 11 East, International Falls, MN 56649 218-286-5220 cell 712-541-9634 Nicholas.Schlesser@state.mn.us

Abstract

The Minnesota Department of Natural Resources (MN DNR) has carried out annual sampling on Rainy Lake, Lake Kabetogama, and Lake of the Woods since 1983 as part of its Large Lake Program leading to a long term dataset of fisheries information available for research and monitoring projects. The current state of the fishery and methods used to monitor it will be discussed for Rainy Lake and Lake Kabetogama. Unique features of the fisheries monitoring efforts on Lake of the Woods and the remainder of the Namakan reservoir will also be discussed.

The Decline and Recovery of Lake Sturgeon in the Rainy River – Lake of the Woods System

Tom Heinrich

Minnesota Department of Natural Resources - Baudette Area Fisheries

Abstract

Lake sturgeon were among the first fish species commercially exploited after European settlement in the Lake of the Woods – Rainy River area. Commercial harvest began in 1888, and by 1894 harvest peaked at almost 1.8 million pounds. After 1898 harvest declined rapidly; commercial harvest did not exceed 10,000 pounds per year after 1918. Despite low levels of commercial harvest and closure of the commercial lake sturgeon fishery in Minnesota in 1940, the lake sturgeon population did not recover. Degraded water-quality in the Rainy River, which had been noted as early as 1914, likely prevented recovery. The water pollution was largely due to industrial and municipal point sources, located at the head of the Rainy River in International Falls, Minnesota, and Fort Frances, Ontario. With the passage of environmental legislation in the United States and Canada, water-quality in the Rainy River improved, and the lake sturgeon population began to recover.

Management of lake trout in Lake of the Woods, ON

Tom Mosindy

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Abstract

Lake trout are currently restricted to Clearwater-Echo-Cul de Sac and Whitefish Bays on Lake of the Woods. Populations are especially vulnerable to exploitation and habitat loss, resulting from eutrophication and shoreline development. Management actions by MNR over the last two decades have attempted to address these stresses. Measures have included more restrictive angling regulations, development guidelines, and increased public education. Lake trout populations have been sustained although their future in light of ongoing development pressures, aquatic species invasions and global warming remains uncertain.

A High Altitude Plunge into the Mud: Multiple Focal Lengths for Lake of the Woods Monitoring

Timothy Pascoe, Tana McDaniel, Caren Binding, Ram Yerubandi, and Sue Watson

Environment Canada, Science and Technology Branch, PO Box 5050, 867 Lakeshore Rd E, Burlington, ON L7R 4A6

Abstract

Concerns regarding excess nutrient loading and cyanobacteria blooms in Lake of the Woods (LoW) prompted the formation of Environment Canada's Lake of the Woods Science Initiative in 2008. As part of a larger program to assess and remediate deteriorating water quality in Lake Winnipeg, this initiative sought to identify and fill knowledge and data gaps in nutrient transport and cycling in LoW, and the subsequent impacts on the aquatic environment. In partnership with stakeholders at all levels, Environment Canada has worked over the last three years to engage scientific expertise working at multiple scales in a coordinated effort. Large scale efforts have included remote sensing of algal production using satellite-based platforms, and whole-lake hydrodynamic models of nutrients and water transport. At a more local scale, water quality samples have been collected at discrete locations throughout all major basins within the lake. Finally, macro-benthos and phytoplankton populations have been examined to help provide a backdrop to the physical and chemical characteristics of their environment. The talk will provide an overview of each of these efforts, outline the state of research at this time, and identify future goals for Environment Canada. Subsequent talks in this session will outline two of these initiatives in detail.

Modelling of hydrodynamics and water quality in Lake of the Woods

Susan B. Watson[1] Weitao Zhang[1] and Ram Yerubandi[1]

[1]NWRI, Water Science and Technology Directorate, Environment Canada, 867 Lakeshore Road, Burlington, ON, L7R 4A6, Canada.

Abstract

Lake of the Woods (LOW) is characterized with highly complex morphometric features and large spatial variations in water quality parameters. A hydrodynamic model in conjunction with a mass-balance model for total phosphorous (TP) have been applied to the lake during the period from 2000 to 2009 to assess the interactions among physical, chemical and biological properties of LOW. The hydrodynamic model with high spatial resolution was calibrated by using water level data and flow measurements in 2009. The lake was divided into six segments to represent the lake's spatial environment for the water balance and eutrophication model. The exchange flows across each segment determined from circulation patterns were incorporated into multiple-segments mass-balance model. The eutrophication model framework includes the simulations of phytoplankton dynamics using a semi-empirical model. The model results of water quality variables are in reasonable agreement with the observed data of total phosphorus and chlorophyll-a. The model reproduced spatial and temporal distribution features of water quality parameters, such as total phosphorus gradient decreased from the south segment to the north segment. Because of the differences in hydrodynamic and topographic characteristics, the central and south segments resembled shallow lakes with strong variability of TP concentrations and phytoplankton biomass, whereas two relatively isolated segments in the north are characterized with lower phytoplankton biomass and less variability of TP concentrations

Hydrologic conditions in Lake of the Woods and Selected Tributaries, April–October 2010

Bode, Jenifer A and Fallon, James D.

U.S. Geological Survey, 2280 Woodale Dr., Mounds View, MN 55112 763-783-3100 jabode@usgs.gov

Abstract

The Minnesota Pollution Control Agency (MPCA) included Lake of the Woods on its 2010 draft list of impaired waters because of nutrient, eutrophication, and biological indicator impairments. Hydroacoustic instrumentation was used to monitor streamflow and hydrologic conditions in Lake of the Woods and the Rainy and Warroad Rivers during the open-water season of 2010, as part of a cooperative study between the U.S. Geological Survey and MPCA. These data will be used to construct a BATHTUB hydrodynamic water-quality model of Lake of the Woods to address total maximum daily load (TMDL) issues. Hydroacoustic instrumentation was used to measure streamflow at the two major tributaries to the U.S. side of the lake, and to obtain bi-weekly cross-sectional and velocity information from the five outflow channels of the lake. In addition, lake surface elevation was monitored in the five outflow channels to document elevation differences indicative of lake seiche. Data indicate that spring-flush streamflow rates into the lake were much lower than normal. At the Rainy River at Manitou Rapids, with a streamflow record of 80 years, streamflow rates in 2010 were 39 percent of the long-term median for April–June. The low inflow rates likely increased lake residence time and affected water quality. In lake outflow channels, channel cross sections indicate that water velocities are highly variable. For example, at Northwest Angle Flowage, average channel velocities (ranging from 0.46 to 0.24 ft/s) dropped by one-half in just 15 minutes. This variability could be attributed to a number of factors including wind speed or direction and lake seiche. Data collected to date indicates a complex limnological system with many factors possibly affecting the flow of water through the lake.

Water Quality in the Southern Basin of Lake of the Woods: 2010

Sarah Elliot and Richard L. Kiesling

US Geological Survey, 2280 Woodale Drive, Mounds View, MN 55112 763-783-3100 selliott@usgs.gov

Abstract

During 2010, an intensive, 27-week water quality study was conducted in the southern basin of Lake of the Woods (LOW) by the US Geological Survey in partnership with the MN Pollution Control Agency (MPCA). Water quality data were collected from 12 lake sites: five open water sites, 2 inflow sites, and 5 lake channel sites connecting the southern and northern ends of the lake. Sites were sampled every two to three weeks during the ice-free season. Physical and chemical field parameters were collected at each site. Water quality samples were analyzed for nutrients, major ions, and chlorophyll-a.

Temperature, dissolved oxygen and nutrient concentrations provide evidence that the lake is well mixed; however, water quality differences among lake sites highlight the hydrologic complexity of the lake. Significant differences among open water sites existed for silica, orthophosphate, and chloride. Algal biomass remained fairly constant at all sites until early June but increased through September, reaching peaks ranging from 18.8 – 45.5 micrograms per liter chlorophyll-a. Silica decreased early in the season at some sites but concentrations increased from June through September. Within the lake, phosphorus and silica concentrations decreased along a south to north gradient, however nitrate and ammonia concentrations often appeared to be higher in the northernmost bay and the outflows. The results of this study indicate that, despite the lake being well mixed, the nutrient dynamics of the southern basin of LOW are highly complex.

Algal Biomass Response To Recent Warming in the Lake of the Woods, Ontario

Andrew Paterson[1], Kathleen Rühland[2], Crystal Hyatt[1,2], Neal Michelutti[2], and John Smol[2]

[1] Dorset Environmental Science Centre, Ontario Ministry of the Environment, andrew.paterson@ontario.ca;
[2] Paleoecological Environmental Assessment and Research Laboratory, Department of Biology, Queen's University

Abstract

A warmer climate will affect important lake-water properties and biota in numerous and often surprising ways. Recent data from high-resolution ^{210}Pb-dated sediment cores from several locations in the Lake of the Woods revealed strong, coherent shifts in diatom assemblage relative abundances since the early 1900s. Compositional changes were significantly correlated with air temperature records over the past century that show a warming trend, and to changes in lake ice phenology. Building on previous findings, we examine spectrally-inferred determinations of chlorophyll *a* (Chl *a*) in lake sediment cores as a measure of past changes in aquatic primary production across this large, complex lake. Visible reflectance spectroscopy is a rapid, non-destructive technique that has been recently validated against known histories of lake production in Arctic, boreal and prairie lakes. At multiple sites in the Lake of the Woods, we report rises in lake sediment Chl *a* concentrations since the mid-1900s, with more marked increases since the early 1980s. When compared to long-term trends in measured and diatom-inferred water quality (e.g., total phosphorus concentrations), and to air temperature records, regression analyses reveal that climate measures are much stronger predictors of Chl *a* concentrations over time. These data suggest that a warming climate, directly through changes to the physical structure of lakes, and indirectly through its impact of chemical cycles, may exacerbate algal blooms in moderately-enriched lakes. This has direct implications in the Lake of the Woods, where there is a perception among the general public that algal blooms have increased in severity in recent years.

Assessment of human exposure risks to the algal toxin, microcystin, in Lake of the Woods and Winnipeg River, Ontario

Brian G. Kotak[1] and Hedy Kling[2]

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[2]Algal Taxonomy and Ecology Inc., 31 Laval Drive, Winnipeg, MB R3T 2X8. (204) 261-1471 hkling@mts.net

Abstract

Water samples were collected by cottagers as part of a study in 2009 funded by the Lake of the Woods District Property Owners Association. The study assessed the potential human exposure risk to microcystin through recreation (e.g., swimming) and use of water for drinking and other cottage uses. Eighteen cottagers, from widespread locations across Lake of the Woods and the Winnipeg River system in Ontario, collected samples. In addition, participants filled out a short survey to document their use of water at their cottage/camp and their perceptions of how (or if) water quality has changed over time.

From the survey, it was evident that few (less than 1/3) cottagers involved in the study used lake or river water for drinking purposes. However, most used lake or river water for showering or washing dishes. Of those surveyed, two-thirds indicated that they treat their water prior to use. Treatment ranged from simply adding bleach, to single or multiple filter systems (basic coarse filters carbon filters, ceramic filters). One cottage/camp used ultraviolet disinfection.

Cottagers collected a total of 155 water samples. These represented lake water samples collected from the shoreline in front of their cottage/camp property during algal blooms, water from water lines prior to treatment and water from kitchen taps (after treatment). For consistency, all three types of samples were collected within minutes of each other on each sampling date. As algal blooms were virtually absent in June and July of 2009, most samples were collected in August and September. Highest microcystin concentrations measured in LOW were from lakeshore samples collected in the Morson (up to 45 ug/L), Nestor Falls (up to 145 ug/L), Bigstone Bay (up to 545 ug/L), Pine Portage Bay (up to 59 ug/L) and Rat Portage Bay areas (up to 105 ug/L). In addition, high microcystin concentrations were also found at Gun Lake (Minaki area – up to 238 ug/L). According to World Health Organization criteria, microcystin concentrations in excess of 20 ug/L would represent a **high** health risk to humans for recreational contact with water. Therefore, high microcystin concentrations along shorelines can, on occasion, represent a human health risk for recreational activities, or for pets drinking lakeshore water in LOW. Other areas of LOW, such as Clearwater Bay, Lobstick Bay and Shoal Lake, contained low (<1.5 ug/L) or undetectable (<0.1 ug/L) concentrations of microcystin in shoreline samples. Microcystin concentrations in samples from water lines (prior to treatment) or from kitchen taps (with or without water treatment systems) were generally below detection limits (i.e., <0.1 ug/) or were very low (<0.2 ug/L). For comparison, the Health Canada drinking water guideline for microcystin is 1.5 ug/L. This indicates that even when shoreline concentrations of microcystin may be very high, concentrations in water lines and kitchen taps will typically be very low, likely due to the depth of the water line intake.

Analysis is currently underway to identify the algal (cyanobacterial) species potentially producing microcystin in LOW. This will be discussed during our presentation.

From the above study, the most significant risk for human exposure to microcystin in LOW is from recreational contact during algal blooms. Recreational activities and allowing pets to drink lake water from shorelines at times when significant algal blooms are occurring in an area should be avoided.

Satellite Remote Sensing of Potentially Harmful Algal Blooms in Lake of the Woods.

C. Binding[1*], T. Greenberg[1], R. Bukata[1], G. Letourneau[2] & S. Watson.

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Abstract

With its remote location and its hydrologically complex waters, Lake of the Woods is a difficult waterbody to adequately monitor using in situ sampling alone. Results presented here will demonstrate the potential of satellite remote sensing for monitoring algal blooms on the lake. Optical properties of Lake of the Woods waters were measured and a full assessment of chlorophyll products from the MERIS sensor was carried out during an intense surface algal bloom in September 2009. Images are shown to adequately identify the bloom and are used to track the evolution of the bloom across the lake. Evidence is presented of the effects of variable depth distributions of cyanobacteria on the surface signal seen by the sensor; imagery suggests that day to day variations in wind-induced mixing have a profound impact on surface algal biomass as detected by remote sensing.

Using remote sensing to monitor and assess the geospatial and temporal trends of water quality and land use in the Lake of the Woods watershed

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Abstract

The size, hydrologic complexity and dynamic nature of algal blooms on Lake of the Woods necessitates intensive long-term water quality monitoring on a broad regional and spatial scale for effective lake management. Unfortunately this complexity while giving the lake its unique characteristics also make it difficult and economically challenging to monitor using in situ methods alone. The use of remote sensing is a cost-effective way to gather information on water and land resources needed for effective water planning and management. Although it is not possible to go backwards in time and collect historical water quality information using conventional field methods, Landsat images have been collected and archived regularly since the early 1970s, enabling extraction of some historical land use/cover and water quality information on lakes. The University of Minnesota Remote Sensing Laboratory has developed methods that have been used to create state-wide water and land assessments. We recently completed a 33-year (1975 – 2008) comprehensive water clarity database for all Minnesota lakes and state-wide land cover and impervious maps for 1990 and 2000. These assessments have been made available at water.umn.edu and land.umn.edu . While the Minnesota portions of the Lake of the Woods and its watershed are included in these assessments the lakes complexity necessitates more intensive monitoring. Fortunately there are many opportunities to use remote sensing for a comprehensive assessment of Lake of the Woods. Landsat could be used for historical and current assessments of water clarity and land use/cover to determine any spatial or temporal trends. The higher temporal resolution of MODIS and MERIS imagery could allow for real time monitoring of algal blooms. While the higher spectral resolution of MERIS could be used for assessment of more variables such as chlorophyll, colored dissolved organic matter (CDOM) and cyanobacteria to help detect and characterize potential algal blooms. Development of the Minnesota water clarity and land use/cover assessments, some temporal and geospatial trends will be discussed along with examples of using the different imagery for water quality assessment of Lake of the Woods.

Poster Abstracts

Dispersal of Post-Spawn Walleye Run: Initial Results of a Walleye Tagging Project on Rat Root River (Rainy Lake)

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Abstract:

Historically, there was an important spawning run of walleye up the Rat Root River which empties into Black Bay on Rainy Lake. Records from a walleye egg take site (1933-1943 and 1971-1978) as well as periodic DNR monitoring of the spawning run from 1991 to 2010, using daytime electrofishing, indicate that the number of walleye in the Rat Root River spawning run has substantially decreased. Recent surveys of the spawning run have documented a steady increase in the mean length of both male and female walleye, a potential indicator of recruitment problems. In 2010, a tagging study was initiated to monitor dispersal of the Rat Root River walleye in Rainy Lake and determine spawning site fidelity. After one year of tagging, a previously unknown dispersal of walleye into the Ontario managed North Arm of Rainy Lake, up to ~100 km from the tagging site, has been documented. The dispersal and potential recruitment concerns raise questions about management of shared stocks with Ontario as well as questions about factors driving dispersal, genetics of the stock, Rat Root spawning success, and the opportunities to spark a recovery in the population through habitat improvement projects.

A Midge-Based Paleolimnological Assessment of Historical Water Quality Changes in Poplar Bay, Lake of the Woods, Ontario

Jamie C. Summers[1], Rühland, K.M.[1], Kurek J.1, Paterson, A.M.[2], and Smol, J.P.[1]

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Abstract

Poplar Bay (49.69°N, 94.56°W), a moderately deep bay (~29 m) within Lake of the Woods, Ontario, has undergone a rapid increase in cottage development since the mid-1990s with the construction of over 150 seasonal cottages. Consequently, there is concern that shoreline development may be having a negative impact on water quality, including nutrient increases and deep-water oxygen depletion. Additionally, Lake of the Woods is a region within Ontario that has experienced substantial increases in air temperature (mean annual and mean winter) that is particularly notable after ca. 1980. This recent increase in temperature has the potential to exacerbate the effects of other environmental stressors on Poplar Bay, adding to the challenge of developing appropriate lake management strategies. In this paleolimnological study, changes in sedimentary chironomids and *Chaoborus* assemblages (larvae of non-biting midges) over the past ca. 150 years are used to determine whether deep-water oxygen levels have recently declined during this period of warming and greater shoreline development. These results will be compared to a diatom-based paleolimnological study using this same sediment core that found no directional change in total phosphorus (TP) concentration in the last ca. 150 years. In a multiple stressor system like Poplar Bay, [TP] may not be the ideal metric for fully assessing aquatic ecosystem health. To further explore whether shoreline development and/or recent warming exerted a notable impact on other aspects of aquatic ecosystem health, midge assemblages are used to track changes in deep-water oxygen. Gaining an improved understanding of historical changes in deep-water oxygen levels and how they compare to [TP] trends will help determine base-line conditions for Poplar Bay and assess long-term patterns in water quality.

Water Quality on Lake of the Woods, Northwest Angle

Kayla J. Bowe, Shane E. Bowe

Red Lake Department of Natural Resources, Red Lake Band of Chippewa Indians

Abstract:

The Red Lake Department of Natural Resources of the Red Lake Band of Chippewa Indians, a signatory to the International Multi-Agency Working Arrangement for Lake of the Woods, increased water quality monitoring efforts during the 2010 sampling season on Lake of the Woods, Northwest Angle streams. Seven streams and two open water lake sites at the Northwest Angle were sampled. Three sampling events took place beginning in August 2010. Typical physical and chemical water quality parameters were collected and analyzed. Data show overall good water quality of Lake of the Woods at Northwest Angle sites indicating low nutrient input from these stream sites. Sampling efforts for the 2011 season include increased sampling events and the inclusion of flow monitoring on stream sites.

The Use of Remote Sensing In Determining the Source of Septic System Pollution Entering Bass Lake

Alan W. Cibuzar

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Abstract

The Thirty Lakes Watershed District through their annual lake monitoring program observed the quality of Bass Lake (MN Lake ID #18-402) deteriorating. They retained A.W. Research Laboratories (AWRL) to conduct an investigation using remote sensing. The use of remote sensing is invaluable for lake management because it summarizes environmental conditions in a format that is easily understood. A large area can be investigated quickly, often revealing evidence not visible at ground level. Remediation can then be prioritized based on the findings to minimize the adverse impacts of the located problems.

Aerial TSI monitoring of Bass Lake revealed that TSI values in certain areas of the lake were far greater than those observed at the center where the TSI samples were taken. A “Groundwater Intrusion Overflight” was done to determine where nutrient loads were entering the lake through groundwater sources. Once these areas were located, winter sampling was done to collect groundwater samples beneath the lake ice and identify the exact points of intrusion. As a result, specific septic issues were identified and prioritized for remediation.

International Lake of the Woods and Rainy River Watershed Task Force - Mandate and Progress to Date.

Task Force members: Melanie Neilson, Jim Chandler, Gail Faveri. Lee Grim, Lisa Bourget, Kelli Saunders

Abstract

The International Lake of the Woods and Rainy River Watershed Task Force was established in July, 2010 by the International Joint Commission (IJC) to help it respond to a reference from the Governments of Canada and the United States for advice on how to address management of water quality, water quantity and related issues in the Lake of the Woods and Rainy River Watershed both now and in the future. This poster display describes the efforts of the Task Force to review the ways that the two governments work together to manage water quality, water quantity and related issues in the watershed, to identify gaps in the current approach, to identify key existing or emerging issues that require attention, and to recommend any new or adjusted governance mechanisms that would help address the identified future needs.

Assessing total phosphorus concentrations in the Lake of the Woods and it's sheltered embayments using empirical and paleolimnological approaches

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Abstract

Lake eutrophication results from excess fertilization with nitrogen and phosphorus. Symptoms include algal blooms and hypolimnetic oxygen depletion resulting in the loss of coldwater fish habitat. In the last few decades, reductions in length of ice-cover on temperate lakes by almost a month has resulted in increases in the length of the growing season for algal communities and changes in the strength and duration of thermal stratification. In already nutrient-rich systems, the added effects of warming can potentially trigger an increase in the frequency and/or intensity of algal blooms.

The combined use of paleoecological and empirical modelling approaches may allow lake managers to examine changes in lake water quality in response to a single "targeted" stressor (e.g., nutrient loading from residential shoreline development) and to multiple environmental stressors (e.g., climate change, hydrological management), that are captured in the paleoecological data. Empirical and paleoecological modelling both have value and limitations, but the combined used of these methods will greatly strengthen lake management capabilities.

Lake of the Woods (LOW) is the second largest inland lake in Ontario. It provides drinking water, supports important recreational and commercial fisheries, and is a focus of tourism for thousands of people in northwestern Ontario, Manitoba, and northern Minnesota. Here, we compare empirical modelling and paleoecological reconstructions of total phosphorus (TP) in the LOW and it's sheltered embayments. There is a need to thoroughly examine current and historical water quality in certain bays to determine whether TP concentrations have recently increased as a result of shoreline development, and whether this has led to the exacerbation of nuisance blooms and degradation of lake trout populations in these bays.

Results from empirical modelling using the Lakeshore Capacity Model (LCM) suggest that anthropogenic TP loading from shoreline development has increased in several bays, with Clearwater Bay being one of the most heavily developed and populated cottage areas of LOW. Unlike the empirical trends, paleolimnological diatom data do not show a strong directional trend in modern DI-TP at many sites in LOW. Results from the DI-TP model suggest that diatoms are not solely tracking changes in TP through time. Rather, other factors (e.g., length of growing season and possible changes in the natural background export of TP from the catchment) are likely playing an important role in diatom assemblage structure, particularly over the last few decades.

Distribution, movements, and population characteristics of juvenile lake sturgeon in the Namakan System – Preliminary Results

C. Trembath[1,2], B. McLaren[2], R. Mackereth[2,3], S. Chipps[4]

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Abstract

Lake sturgeon (*Acipenser fulvescens*) in the Namakan System are of management concern for stakeholders on both sides of the international border. Information on the ecology of juvenile sturgeon (i.e., those <60cm in length) is lacking in this system, and across the species' range in general. We initiated a study of juvenile sturgeon in the summer of 2010 to address the following objectives: 1) to determine juvenile sturgeons habitat use in both riverine and lacustrine environments, 2) identify their basic population parameters (length, weight, and age), 3) use acoustic telemetry to determine fine scale movements and habitat use.

Gillnets (mesh sizes 38-76 mm) were used to sample the Namakan River and Reservoir from 1 June to 15 July 2010. A total of 132 juvenile sturgeon were captured with the majority of these (106) being captured in deep (> 10 m) flowing portions of the Namakan River. No juvenile sturgeon were captured within the Reservoir except near the mouth of the Namakan River where deep water and sufficient current occur. A total of 18 of the sturgeon were implanted with acoustic transmitters and released: 10 in Bill Lake, 4 in Little Eva Lake, and 4 in Namakan Lake. The movements of telemetered fish in Bill Lake are being recorded on a fine scale through signal triangulation by an array of acoustic receivers. Movements between river and lake habitats are also recorded with an existing array of submersible receivers.

Movement and Seasonal Distribution of Lake Sturgeon in the Namakan River, Ontario (2010 Progress Report)

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Abstract

Acoustic telemetry continues to be used to assess movement and seasonal distribution of adult lake sturgeon in the Namakan River between Namakan Lake and Lac La Croix, Ontario from May 2007 to October 2010. Three hydroelectric generating facilities have been proposed for development at Hay Rapids, High Falls, and Myrtle Falls by Ojibway Power and Energy Group (OPEG). Thirty-four sturgeon were sampled, surgically implanted with coded transmitters, and released. An array of 15 submersible, hydrophone receivers were deployed near constrictions and points of rapid elevation change along the river extending from below Lady Rapids to above Snake Falls. Preliminary findings confirmed both upstream and downstream movement of sturgeon at most locations including Lady Rapids, Hay Rapids, Back Channel around Eva Island, Quetico Rapids, Twisted Rapids and Myrtle/Ivy Falls. Only downstream migration at High Falls was confirmed, along with movement into Quetico Provincial Park at two locations, including Quetico River and Bearpelt Creek.

A total of 397 sturgeon (605 to 1,746 mm in length) were also externally tagged with 18 reported recaptures. Both tagged (n = 4) and telemetered (n = 22 of 34) lake sturgeon moved to and from the Namakan Reservoir (a shared international water with Minnesota). Additional telemetered fish (n = 18 of 26) from the Reservoir also moved into the Namakan River above Lady Rapids during the 3 year study period. Potential spawning habitats exist at most natural rapids based on the presence or staging of fish during critical periods. Selection of preferred habitats was confirmed in the three lake environments and below major rapids or falls. Sturgeon avoided shallow rapids in winter with no detected movement between receivers from November through April, and over-winter habitats selected by individual fish were also documented. Mean speed of travel for movements exceeding 10 km was 3.4 km/day with a maximum of 9.9 km/day. Fish moved through shallow rapids and falls at water flows ranging from 33 to 464 m^3/sec and temperatures ranging from 6.8 to 24.9°C. Movements of lake sturgeon were evaluated in relation to genetics, season, water flow and temperature, for consideration in environmental assessments and water management planning. Preliminary results of this study provide insight into the importance of the entire river to the continued sustainability of the population.

The Influence of Lake Characteristics on Invertebrate Community Structure in the Littoral Zone: The Importance to Lake Sturgeon (*Acipenser fulvescens*)

Matt M. Lebron

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Abstract

Most research on Lake Sturgeon has been focused on habitat within flowing, riverine environments where hydroelectric dams and other human influences pose problems for spawning, migration and feeding. Other research topics in these lotic systems pertain to populations and development of habitat suitability models (HSMs) for feeding and spawning. Whereas HSM for feeding in rivers uses depth, flow rates and lake bottom substrate to predict habitat suitability, the HSM developed in this study will use different variables. The aim of this study is to investigate how different lake characteristics influence production and community structure of aquatic invertebrates, an important factor in Lake Sturgeon feeding habitat. Development of a HSM based on lake characteristics will require data showing changes in the invertebrate community when exposed to different extremes of littoral slope, fetch (the distance across the water that wind and waves travel without disruption) and angle of exposure (to wind and wave action). Combinations of these variables will make a total of eight different site types for sampling during the field season. Because Lake Sturgeon are bottom feeders that prefer specific prey items such as insect larvae, leeches, crayfish and mollusks, it will be possible to use invertebrate biomass and community structure as a predictor of how valuable a shoreline is for feeding.

During the 2010 summer field season, Swell bay, a portion of Rainy Lake's south arm was sampled over a period of three months. During this time a total of forty eight sites were sampled for invertebrate community structure and biomass. This level of sampling resulted in a total of six replicates for each of the different site types. Because invertebrate communities are not stable and can change from month to month, one set of site types were monitored throughout all months. Without this component of the sampling design it would be difficult to relate one month of sampling to the next.

What's Happening in Minnesota on the AIS Front?

Darrin Hoverson

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Abstract

The Minnesota Department of Natural Resources has been addressing aquatic invasive species (AIS) issues in Minnesota since 1991. Program efforts include prevention of new introductions, early detection and rapid response, containment of established AIS populations, and reducing the harm caused by established AIS populations. In recent years AIS has continued to spread across the state with numerous bodies of water newly identified with zebra mussels, eurasian watermilfoil, spiny water fleas, faucet snails, Asian carp, VHS, and others in 2010 alone. Property owners, local governments, fishing clubs, lake associations, and many other stakeholders interesting in stopping aquatic invasive species from hitching a ride to their favorite lake, river, or wetland are calling for additional resources and changes to existing rules and policies to better combat AIS. The MN DNR with its many partners is focused on stopping AIS and has implemented new and additional measures in recent years and continues to come up with new ideas and tactics to better prevent new introductions and alleviate problems with existing populations.

Lake of the Woods Control Board in the Basin

Rick Cousins and Matt DeWolfe

Lake of the Woods Control Board,

Abstract

Informational display: The Lake of the Woods Control Board (LWCB) is a Canadian board consisting of four members, each with an alternate, who represent Canada (one member), Ontario (two members) and Manitoba (one member). The Board, established in 1919, is responsible for the regulation of levels in Lake of the Woods and Lac Seul and flows in the Winnipeg and English Rivers downstream of these lakes to their junction. In addition, when the level of Lac Seul exceeds certain specified levels, the Board controls the diversion of water from Lake St. Joseph (Albany system) into Lac Seul. The Board"s authority is defined by concurrent Canada/Ontario/Manitoba legislation (The Lake of the Woods Control Board Act; 1921, 1922, 1958) and is further mandated by a Canada-United States of America Treaty (Convention and Protocol for Regulating the Level of the Lake of the Woods, 1925), necessary since Lake of the Woods is an international boundary water. This treaty also created a second board, the International Lake of the Woods Control Board (ILWCB). While Lake of the Woods is normally regulated solely by the LWCB, the outflow from the lake is subject to the approval of the ILWCB whenever the level of the lake rises above or falls below certain elevations specified in the treaty. The responsibilities of the LWCB are fulfilled by directing what the outflows of Lake of the Woods and Lac Seul (and at times the Lake St. Joseph diversion) shall be. To assist it in determining these flows, the Board maintains a full-time Secretariat that monitors conditions in the basin, provides information and analysis, and recommends regulating strategy and/or specific outflows. It also implements strategy when so directed, conducts studies and maintains communications with basin users.