RAINY-LAKE OF THE WOODS WATERSHED

14th Annual

International Rainy-Lake of the Woods Watershed Forum

March 8 - 9, 2017

Rainy River Community College

International Falls, Minnesota, USA

Table of Contents

Program At A Glance

MARCH 8 – 12:00 PM

12:00 Kick off Lunch

13:00 Session 1: Bi-National Updates – Moderator Todd Sellers

1. **Welcome & Introductions.**
2. **Binational Plan update.**
   Felicia Minotti. Global Affairs Canada
3. **International Rainy-Lake of the Woods Watershed Board update.**
   Board Co-Chairs, Col. Samuel L. Calkins / Mike Goffin. International Rainy-Lake of the Woods Watershed Board
4. **International Multi-Agency Working Agreement (IMA) update.**
   TBD-Work Group, Derrick Passee TAC. IMA Working Group / Technical Advisory Committee
5. **International Joint Commission update.**
   Commissioner Richard Moy. International Joint Commission U.S. Section

14:00 Session 2: Rainy Namakan Rule Curve Review – Moderator Kelli Saunders

6. **Making the decision about the 2000 Rule Curves.**
   Bill Werick. International Rainy Namakan Rule Curve Study Board
7. **An environmental Rule Curve for the Rainy-Namakan system.**
   Jean Morin*, Marianne Bachand, Guillaume Guénard, Sylvain Martin & Bill Werick. Hydrology and Ecohydraulic Section, National Hydrological Services, Environment and Climate Change Canada.
8. **Estimating inflows and forecasting ice-out for adaptive management of the Rainy Lake and Namakan Reservoir.**
   Jeffrey C. Kantor. Department of Chemical and Biomolecular Engineering, University of Notre Dame.
9. **Do the past Rules Curves improve the conditions for the spawning of lake whitefish in Rainy Lake and Namakan Reservoir.**
   Marianne Bachand, Sylvain Martin and Jean Morin.

15:20 Break

15:50 Session 3: Man, Nature and Voyageurs National Park – Moderator Ryan Maki

10. **Algal toxins in Lake Kabetogama, Voyageurs National Park.**
    Victoria Christensen[1], Erin Stelzer[1], and Ryan Maki[2]. [1]U.S. Geological Survey, [2]National Park Service
11. **Characterizing nineteen years of disturbances in and around Voyageurs National Park.**
    Al Kirschbaum. National Park Service, Great Lakes Inventory and Monitoring Network
12. **Comparing trace metal concentrations in water and pectoral fin rays to assess lake sturgeon populations in Voyageurs National Park, Minnesota.**
    Jeffrey R. Ziegeweid[1] and Ryan P. Maki[2]. [1]U.S. Geological Survey Minnesota Water Science Center; [2]Voyageurs National Park
13. **Wildlife aren't the only things that move — Tracking dispersal movements of floating cattail mats in Rainy Lake, Minnesota.**
    Bryce T. Olson and Steve K. Windels. Voyageurs National Park

17:10 Break (poster display set up and migration to AmericInn)

18:00 – 21:00 Foundation Reception & Poster Session (AmericInn) – See Over

MARCH 8 – EVENING

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

Guest Speakers

- Michael Goffin, Regional Director General, Environment and Climate Change Canada
- Senator Al Franken (video message – to be confirmed)

Award Presentations

- **Kallemeyn Award**
- **Wilson Award**

Posters

a. **Interaction between invasive cattails and native wild rice in Rainy Lake: How nutrient cycling and allelopathy may contribute to a competitive advantage.**
Peter Ferguson Lee[1], Kristi Dysievick*[1], and John Kabatay[2].
[1]Department of Biology, Lakehead University; [2]Seine River First Nation.

b. **Treaty #3 Watershed Management Plan**.
Lucas King and Kristie Duncan.
Grand Council Treaty #3, Territorial Planning Unit.

c. **2016 large river monitoring — Rainy River**
Karsten Klimek, Nathan Sather, Benjamin Lundeen, and Jesse Anderson.
Minnesota Pollution Control Agency

d. **Uses of temperature arrays in lakes at Voyageurs National Park**
Jaime LeDuc* and Rick Damstr.
U.S. National Park Service – Voyageurs National Park

e. **MPCA Rainy River Basin biological monitoring: Past, present, and future**
Benjamin Lundeen and David Dollinger.
Minnesota Pollution Control Agency

f. **An advance look at the IJC's Climate Change Framework**
Charlene Mason[1] and Teika Newton[2].
[1]Public Member, International Rainy-Lake of the Woods Watershed Board; [2]Public member of the Community Advisory Group to the International Rainy-Lake of the Woods Watershed Board.

g. **Lower Rainy, Rapid, and Rainy River-Rainy Lake monitoring 2017**
Nate Sather and Nate Mielke.
Minnesota Pollution Control Agency

h. **The North American Lake Management Society (NALMS)**
NALMS Members.
North American Lake Management Society

MARCH 9

08:30 Welcome & Introductions

08:40 Session 4: Lake of the Woods Past, Present & Future – Moderator Mike Kennedy

14. **Historical phosphorus dynamics in Lake of the Woods: Does legacy phosphorus still affect the southern basin?**
Edlund, M.B.[1], Schottler, S.[1], Reavie, E.D.[2], Engstrom, D.R.[1], Baratono, N.[3], Leavitt, P.[4], Heathcote, A.J.[1], Wilson, B.[5], Paterson, A.M.[6]. [1]St. Croix Watershed Research Station; [2]CWE – NRRI, University of Minnesota Duluth; [3]Watershed Ecology; [4]Department of Biology, University of Regina; [5]RESPEC, St Paul, MN; [6]Dorset Environmental Science Centre, Ontario Ministry of the Environment and Climate Change.

15. **Buoying water quality monitoring with sensors: What can we learn from two years of high-frequency data in Lake of the Woods?**
Heathcote, A.J.[1], Edlund, M.B.[1], Engstrom, D.R.[1], Hernandez, C.[2]. [1]St. Croix Watershed Research Station, Science Museum of Minnesota; [2]Minnesota Pollution Control Agency.

16. **Two-dimensional modeling of waves and wind setup on the Lake of the Woods.**
Alex Nelson, PE. US Army Corps of Engineers, St. Paul District.

17. **Whole-lake manipulations at the Experimental Lakes Area do not support the need for nitrogen reduction to reduce cultural eutrophication in lakes.**
M.J. Paterson[1], D.W. Schindler, S.N. Higgins, R.E. Hecky, D.L. Findlay. IISD-Experimental Lakes Area.

10:00 – 10:30 Break

18. **Lake of the Woods tributary monitoring and HEC-RAS modelling.**
Brooke Campbell-Paterson. Ontario Ministry of the Environment and Climate Change, Thunder Bay, ON.

19. **Lake of the Woods Total Maximum Daily Load Study: A progress report.**
Cary Hernandez[1], Mike Hirst[2], Geoff Kramer[3]. [1]Minnesota Pollution Control Agency; [2]Lake of the Woods Soil and Water Conservation District; [3]RESPEC Water & Natural Resources, Roseville, MN.

20. **Panel discussion: Binational science plan for Lake of the Woods**.
Veronique Hiriart-Baer[1], Felicia Minotti[2], Steve Cohbam[1], Janette Marsh[3] Matthew Gluckman[3].
[1]Environment and Climate Change Canada; [2]Global Affairs Canada; [3]US EPA.

21. **Address from the Honourable Robert D. Nault, P.C. M.P.**
The Honourable Robert D. Nault. Member of Parliament for Kenora, House of Commons, Ottawa.

12:10 – 13:30 Lunch (Walleye fry)

13:30 Session 5: Ecosystem Health – Moderator Brian Kotak

22. **Mitigating the contaminated source of traditional foods with an uncontaminated river system**.
Peter Ferguson Lee[1], Kristi Dysievick[1], and John Kabatay[2]. [1]Department of Biology, Lakehead University
[2]Seine River First Nation

23. **The use of sub-bottom acoustic reflection data to image glacial Lake Agassiz sediments from multiple lakes in the Rainy River watershed**.
A. Breckenridge[1], T.V. Lowell[2], N. Wattrus[3], A. Myrbo[4], T. Schilling[5], N. Langevin[1]. [1]University of Wisconsin-Superior, Department of Natural Sciences; [2]University of Cincinnati, Department of Geology; [3]Large Lakes Observatory and Department of Geological Sciences, University of Minnesota Duluth; [4]LacCore and Department of Earth Sciences, University of Minnesota, Minneapolis; [5]Midwest Archaeology Center, National Park Service, Lincoln, NE.

24. **Testing for potential impacts of *Orconectes rusticus* (rusty crayfish) on wild rice in Dumbell Lake, MN**.
Kelsey Wenner and Tyler Kaspar. 1854 Treaty Authority, Duluth MN.

14:30 – 15:00 Break

25. **MPCA Rainy River Basin biological monitoring: Past, present and future**.
Nate Sather. Minnesota Pollution Control Agency, 7678 College Road Suite 105, Baxter, MN

26. **Bass population status in Lake of the Woods, Ontario: Kenora Bass International monitoring program 1993-2015**.
Christopher Martin. Ontario Ministry of Natural Resources and Forestry, Kenora, ON

27. **Big Fork and Littlefork watershed WRAPS update**.
Michael J. Kennedy. MPCA-Duluth, MN

Closing Remarks

16:20 Forum Ends

Forum Sponsors – 2017

The organizing committee would like to thank our 2017 sponsor's for assisting with the 14th annual International Rainy-Lake of the Woods Watershed Forum. This event would not be possible without the assistance of the following groups:

- Lake of the Woods Water Sustainability Foundation
- International Joint Commission
- Consulate General of Canada – Minneapolis
- Minnesota Pollution Control Agency
- Voyageurs National Park
- Dorset Environmental Science Centre (OMOECC)
- Lake of the Woods District Property Owners Association
- Rainy River Community College
- Environment and Climate Change Canada
- North American Lake Management Society
- St. Cloud State University
- Rainy Lake Conservancy
- Rainy Lake Property Owners Association

Organizing Committee – 2017

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Presentation Abstracts

SESSION 1 – BINATIONAL UPDATES

Binational Plan Update

Felicia Minotti

[1]Global Affairs Canada

Abstract

Following a binational review of the International Joint Commission's recommendations presented in its "Water Quality Plan of Study for the Lake of the Woods Basin" to the Governments of Canada and the United States, in August 2016, the Government of Canada announced that $5.5 million would be allocated to undertake scientific studies in the Canadian portion of the Lake of the Woods Basin. This will be an update on the status and activities related to binational discussions and coordination to inform and benefit the work to be undertaken in the basin.

Brief Bio

Felicia Minotti is Senior Policy Advisor, U.S. Transboundary Affairs Division. Felicia joined Global Affairs Canada in September 1996. She has worked in a number of positions within the department, with responsibility for program delivery and policy development. Her career in Global Affairs Canada has included positions in the Asia-Pacific Branch, Regional/Multilateral Trade Policy, the office of the Minister for International Trade, and Human Resources. She played a lead role in the evacuation of Canadians from Lebanon in 2006 and was part of the G8/G20 policy team in 2009-10. She has spent most of the last 12 years in various positions with the North America Branch, and is currently responsible for all things related to the Great Lakes, ballast water and the Lake of the Woods basin.

International Joint Commission update

Richard Moy, Commissioner IJC U.S. Section

International Joint Commission

Abstract

The LOW Forum is a highly valuable meeting of the minds to collaborate on WQ issues across the basin; IJC is always privileged to participate and play an integral role in the meeting. Rainy-Lake of the Woods basin is a highly valued treasure that needs to be protected. The basin faces many water quality issues, such as, invasive species, harmful algal blooms, metal contamination; the need for better water quality assessment, monitoring and proactive response measures is a must, particularly in face of changing climate. The Bi-national Science Plan that the US and Canadian Governments are working towards will help to address WQ issues in the Basin; The LOW WQ PoS will be used as a benchmark for comparison. Rainy Rule Curve Review that IJC is completing will provide better flood prevention measures and assist in protecting the basin ecosystem. The IJC is committed to addressing and responding to water quality and flooding needs; please contact up so we can better assist.

Brief Bio

Rich Moy was appointed to the U.S. Section, International Joint Commission (IJC), by President Barack Obama, effective July 11, 2011.

Prior to joining the IJC, Mr. Moy worked as a land and water consultant where he coordinated the development of a comprehensive transboundary Crown of the Continent regional land use and environmental strategy. He was also a Senior Fellow at the Center of Natural Resources and Environmental Policy at the University of Montana.

For 27 years, Mr. Moy focused on collaborative, strategic and science-based approaches to water policy, management and planning, Native American water rights, and transboundary and regional water and land issues for the Montana Department of Natural Resources and Conservation. He worked extensively with other states and federal agencies on regional water management issues in the Missouri and Columbia River basins including water allocation, fisheries, water quality, reservoir operations and drought management. He served as chair of the 23-member Flathead Basin Commission, which has a statutory duty to protect water quality and the environment of the largest fresh water lake in the United States west of the Mississippi River. Prior to this work, he directed Montana's involvement in the High Plains Research Experiment for four years and worked as a park ranger and ecologist in Glacier National Park where he developed the park's backcountry management plan.

Mr. Moy has worked with the Canadian provinces of British Columbia, Alberta and Saskatchewan, the Canadian federal government and the IJC on water quality, fishery, wildlife, apportionment and landscape issues for over 25 years. He served as the U.S. Secretary to the IJC study that evaluated the potential impacts of a proposed coal mine in the headwaters of the Flathead River. He represented Montana in several Canada-U.S. activities including the IJC task force on the apportionment of the St. Mary and Milk rivers, the Crown Managers Partnership whose members manage the Crown of the Continent transboundary region, and the apportionment of the Poplar River. He has negotiated two transboundary environmental accords on behalf of Montana with the provincial governments of British Columbia and Alberta.

International Rainy-Lake of the Woods Watershed Board Update

Michael Goffin, Canadian Co-Chair

International Rainy-Lake of the Woods Watershed Board

Abstract

An update is presented on the background, status and activities of the International Rainy-Lake of the Woods Watershed Board during 2016 and the first part of 2017. Presented are a summary of board operations and standing committees, and activities including: water quality reporting, water levels, and public engagement. Major activities include the development of the board's second annual water quality conditions report (in progress); ongoing IWI projects, public engagement activities and work of the Water Levels Committee with engagement with H2O Power Gate Refurbishment Project and the Rainy-Namakan Rule Curve Studies.

Brief Bio

Mr. Michael Goffin is the Canadian Co-chair of the International Rainy-Lake of the Woods Watershed Board. In his day job, he is Regional Director General for Environment Canada in Ontario.

Mr. Goffin was chief negotiator of the Canada-United States Great Lakes Water Quality Agreement and the Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health and is responsible for the delivery of the Great Lakes Basin Ecosystem Initiative.

Mr. Goffin joined Environment Canada in 1981. He has worked in a number of positions at both the regional and national levels, with responsibility for program delivery, planning, and policy development. His career in Environment Canada has included positions in the Canadian Wildlife Service, Meteorological Service of Canada, Environmental Protection Service, as well as Finance and Administration.

Mr. Goffin received his undergraduate training in environmental studies from the University of Toronto, and has a Master of Science degree in Geomorphology, also from the University of Toronto.

International Multi-Agency Working Agreement (IMA) update

IMA-Workgroup Member TBD and Derrick Passe, IMA TAC AIS Subcommittee Member

IMA Working Group / Technical Advisory Committee

Abstract

An update on the activities of the IMA during the past year is presented along with future directions and role in integration and coordination of science binationally. An update on work of the Invasive Species subcommittee of the IMA Technical Advisory Committee is presented. This work is aimed at developing a risk assessment approach to AIS in the Rainy-Lake of the Woods basin.

Brief Bio

SESSION 2 – RAINY NAMAKAN RULE CURVE REVIEW

Making the decision about the 2000 Rule Curves

Bill Werick

International Rainy and Namakan Lakes Rule Curves Study Board

Abstract

By the summer of 2017, the International Rainy and Namakan Lakes Rule Curves Study Board will have sent its recommendations to the IJC for modifying or retaining the 2000 Rainy and Namakan Lakes rule curves. The Board worked closely with a Public Interest Advisory Group and Resource Agency Group, practicing that decision with them at several workshops over the last year and a half. This presentation will cover the elements that were considered, how climate change was factored in, and how we intend to keep learning about how best to regulate these lakes.

The practice decision workshops were designed to make the decision transparent and to maximize the opportunity to provide advice and opinion to the Study Board. There were three main sources of information used to make the decision: studies that had been commissioned nearly 20 years ago to monitor the impact of the change from the 1970 to the 2000 rule curves; models of how alternative rule curves would affect the region in the future under a variety of climate conditions; and operational knowledge from a variety of sources, including advice and ideas for improving the rule curves from the people who have lives have been affected by them. All these were discussed in the decision workshops. But our knowledge is still incomplete and no rule curve design can perfectly meet all objectives or eliminate all risks, so the decision workshops were also designed to foster an open dialogue about how to make tradeoffs between competing objectives and how to manage uncertainty and the irreducible risks inherent in different approaches. Finally, the Board acknowledged that while we must make decisions with imperfect knowledge, we can adaptively manage to improve our decisions through constant learning.

Brief Bio

Bill Werick is a member of the technical working group of the International Rainy Namakan Rule Curve Study Board. Bill is a water resources planner. He retired from the US Army Corps of Engineers' Institute for Water Resources in 2004 but has remained active in water resources here and around the world, and is a US member of the Great Lakes-St. Lawrence River Adaptive Management Committee.

An environmental Rule Curve for the Rainy-Namakan system

Jean Morin*, Marianne Bachand, Guillaume Guénard, Sylvain Martin & Bill Werick

Meteorological Service of Canada, Environment Canada, 1550 avenue D'Estimauville, Québec City, Québec, Canada

Abstract

The rule-curve (RC) that manages water levels in the Rainy Lake and Namakan Reservoir is presently being reviewed in an extended IJC study. The main task of the study board task is to analyse the effect of the 2000RC relative to the precedent 1970RC and possibly proposed more efficient RCs. The Study board works mainly with two tools: the SVM (Shares Vision Model) and the IERM (Integrated Ecosystem Response Model). We developed the concept of an "Environmental Rule-Curve" using the IERM and we implemented it in the SVM.

Using a combination of 1D and 2D habitat models, we developed an IERM that quantify the effect of water level fluctuations on several components of the biota. The modelling is based on a regular grid (20 m) on which several key physical variables are defined: water-levels, topography, hydroperiods (different time-scale), bottom slope and wind waves for all possible conditions at a quarter-monthly time-step. The habitat models are analysed with long term water-levels series representing historically measured levels, simulated natural levels and simulated levels based on the two rule-curves from 1950 to 2015.

In the IERM, we produced several 1D habitat models that evaluate the effect of water-level changes on wild rice, cattail, common loon nesting, walleye spawning and muskrat winter house sustainability. Based on literature, we identified the most sensitive period of their life cycle and analyzed the effects of water-level changes during these periods. We also developed spatially explicit 2D habitat models that quantify surface area of suitable habitat for wild rice, cattails, marshes, submerged and emergent plants as well as northern pike, whitefish and walleye reproduction. For these models, we used a combination of logistic regressions and several time-related processes (drowning, drying, vegetation succession, etc.).

From all habitat models, we can identify the characteristics of the water levels that would give benefits each of the considered species or groups: minimum or maximum water levels, tolerable increase and decrease during critical periods. We were able to define the fundamental properties of an annual hydrogram that would be beneficial for most groups. We also took into consideration multiyear water levels because some species, like the invasive cattail, are favored when water levels are stable from year to year. Others, like wet meadows or wild rice, are favored by variable water levels from year to year. We used basic characteristics of the "natural" fluctuation of the Rainy-Namakan system to obtain this modulation of the RC from one year to another.

The SVM (Share Vison Model) was used to build and compute the "Environmental Rule Curve" that contains most of the desired characteristics identified with the IERM. After several phases of development and several major constrains inherent to the system (flooding, navigation, ice management) that required modifications of the original "Environmental Rule Curve". We produced different version of the RC with different levels of social acceptability.

Brief Bio

Jean Morin is working for Environment Canada, since 1999. He is presently Chief of the Hydrology and Ecohydraulic section of the National Hydrological Services. He holds a Bachelor degree in Geology from the Université Laval, a Master's degree in Earth Sciences from the University of Ottawa and a PhD in Water Sciences from INRS. He has developed a large spectrum of ecohydraulic models in diverse aquatic environments for river, lake and riparian habitats. He is responsible for research projects on ecosystem modeling of the Rainy River, Rainy Lake and Namakan Reservoir. He is also active in the "International Rainy and Namakan Rule Curves Study Board", as member of the Technical Working Group.

Estimating inflows and forecasting ice-out for adaptive management of the Rainy Lake and Namakan Reservoir

Jeffrey C. Kantor

Department of Chemical and Biomolecular Engineering, University of Notre Dame
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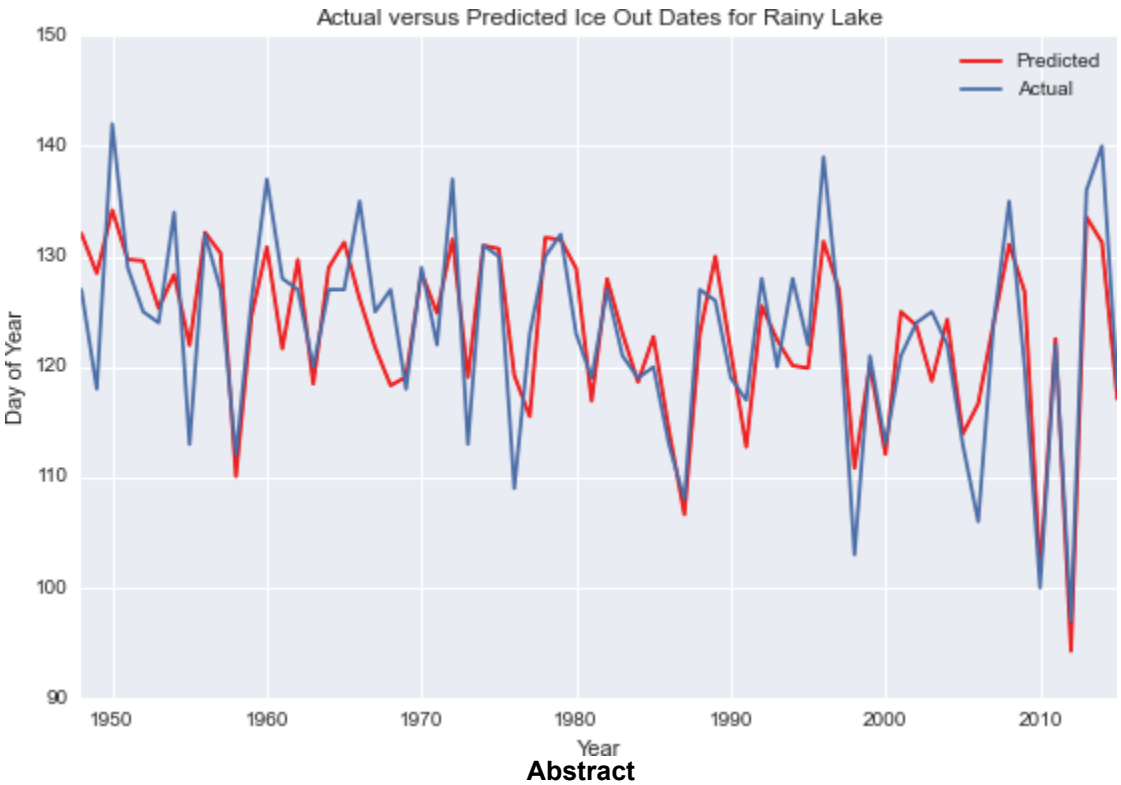

Abstract

Adaptive management of Rainy Lake and the Namakan Reservoir has been proposed in response to the recent history of high water events. The cause of the high water events has been attributed to changes in rule curve orders that were implemented in 2000, and to long-term changes in the pattern and intensity of summer rainstorms. With episodes of higher lake inflows and limited conveyance of upper Rainy River at the outflow results in higher water levels on Rainy Lake.

The goal of adaptive management is to mitigate the effects of long term changes in weather patterns on lake levels and key ecological characteristics. Implementation of effective adaptive management requires the development and validation of indicators that enable predictive control of dam operations. The indicators have to be available in time for a corresponding regulatory response to have sufficient effect.

This presentation will consider the following indicators that could potentially be incorporated into an adaptive management plan (listed in order of increasing time constant)

- Rates of change of lake levels
- Upstream flow measurements
- Precipitation forecasts
- Ice-Out forecasts
- ENSO surface sea temperature data

This presentation introduces a novel ice-out estimator developed using machine learning techniques. The ice-out predictor provides an estimate of the date of ice-out conditions on Rainy Lake using local temperature and precipitation data. The ice-out predictor can be done at a fixed date in advance of the Spring thaw, or as a rolling n-day-ahead prediction. The training and testing data sets were extracted from ice-out data reported by the International Falls Daily Journal commencing in 1948. Total degree days below freezing is the major regressor, resulting a mean error of less than 7 days.

The presentation describes a novel optimal filtering of stream flows and lake levels to create estimated inflows for Rainy Lake. The inflows estimated in this manner correlate with gaged flows in nearby streams where there has been no flow management.

Granger causality test will be applied to ENSO SST data to test for a causal relationship between sea temperature anomalies in the Pacific ocean and precipitation, flow, and level data in the Rainy River watershed.

This is ongoing work. Current status of this work is available at this site: http://jckantor.github.io/Rainy-Lake-Hydrology/

Brief Bio

Jeffrey C. Kantor is Professor of Chemical and Biomolecular Engineering at the University of Notre Dame. His research interests are in the application of control theory to a range of engineering applications including the integrated finance and control of process operations, network analysis, and model predictive feedback control. His teaching interests are in Chemical Engineering, and the ESTEEM program at Notre Dame.

Kelly McGarry is a senior undergraduate research assistant at the University of Notre Dame majoring in Chemical and Biomolecular Engineering.

Michelle Pham is a senior undergraduate research assistants assistant at the University of Notre Dame with dual majors in Biology and in Chemical and Biomolecular Engineering.

Do the past Rules Curves improve the conditions for the spawning of lake whitefish in Rainy Lake and Namakan Reservoir.

Marianne Bachand*, Sylvain Martin, Jean Morin

Hydrology and Ecohydraulic Section, Meteorological Service of Canada, Environment and Climate Change Canada Canada, 801 - 1550, avenue d'Estimauville, Québec (Québec), Canada, G1J 0C3.

Abstract

Historically, Lake Whitefish (*Coregonus clupeaformis*) has been an important element of the fisheries on Rainy Lake and Namakan Reservoir. Despite the harvest decreases since 1985 on both water bodies and the apparently healthy status of the Lake Whitefish populations, concerns still exist about the effects of the regulated water levels on their reproductive success, in particular, the large winter drawdowns allowed under past rule curves (RC) on Namakan Reservoir. Lake Whitefish usually spawn in fall at relatively shallow depths, thus winter drawdown may result in dewatering of spawning sites and desiccation of their eggs. In this study, we developed a spatially explicit model predicting the distribution of suitable spawning and egg incubation habitats for Lake Whitefish in Rainy Lake and Namakan Reservoir under different water-level management plans.

The model is based on a dense simulation grid with a node every 20 m. Each node supports local physical (ex: bottom slope and curvature, water depth, light at the bottom and wave induced velocity at the bottom (UBOT)) variables for each quarter-month (QM) of four water-level time series. The Measured water-level time series is based on historical observed water levels in both water bodies from 1973 to 2015. The three others are simulated water-level time series and represent what water levels would have been during the same period strictly under the 1970RC, the 2000RC and under Natural conditions (no RC). The habitat model was mainly built from field observations done by Allan Buschnell, Kabetogama Lake long-term resident, from 1983 to 2015. We used a binomial logistic regression with a forward stepwise procedure to identify the combination of variables that best predicted the distribution of habitat suitable for Lake Whitefish spawning according to AIC values. Then, nodes also had to be under water for all the QMs of the egg incubation period in order to be considered as suitable habitat.

The final selected model shows that Lake Whitefish spawn in sites with both conditions of shallow waters, gentle slope and high wave velocity at the bottom. Also, the mean surface areas of suitable habitat for potential spawning and egg incubation (SSSEI) of Lake Whitefish have remained relatively stable in Rainy Lake between 1973 and 2015 under the Measured water-level time series. In Namakan Reservoir, the same measure increased significantly after the implementation of the 2000RC. The mean SSSEI was similar under the simulated 1970RC and 2000RC time series in Rainy Lake. This mean was significantly lower and more variable under the simulated Natural time series. In Namakan Reservoir, the 2000RC water-level time series had significant higher mean SSSEI than the 1970RC. The 2000RC also had a higher and more stable SSSEI than the Natural time series.

Our model suggests that past RCs do not seem to reduce drastically the availability of suitable spawning sites for Lake Whitefish in both water bodies. In fact, the 2000RC is an improvement when compared to the natural conditions. Reducing the winter drawdown in Namakan Reservoir has improved availability of suitable spawning sites for Lake Whitefish and increased the probability for eggs to survive during the incubation period in winter.

Brief Bio

Marianne Bachand is currently working as a project manager in ecosystem modeling at Environment Canada. She holds a Bachelor degree in Biology from the Université de Sherbrooke (2001-2004) where she also completed a Master's degree in Environment in 2008. During her master she evaluated the impacts of tapir on vegetation dynamic in the Brazilian Atlantic forest. She later obtained a Ph.D. in plants biology at Université Laval. In her thesis she investigated the effects of white-tailed deer on the diversity of balsam fir stands. She has also contributed to research projects on ecosystem modeling of the Rainy Lake and Namakan Reservoir.

SESSION 3 – MAN, NATURE & VOYAGEURS NATIONAL PARK

Algal toxins in Lake Kabetogama, Voyageurs National Park

Victoria Christensen*[1], Erin Stelzer[1], and Ryan Maki[2]

[1]U.S. Geological Survey, [2]National Park Service

Abstract

Harmful algal blooms are a serious problem in many northern lakes. Lake Kabetogama is no exception, having recurring nuisance algal blooms that contain the toxin microcystin. Many of these algal blooms form in the same location within Kabetogama Lake every year. However, due in part to the high cost of laboratory analysis, seasonal microcystin data have not been available. Sufficient data on other toxins such as cylindrospermopsin, saxitoxin, and anatoxin-a also do not exist. Therefore, we collected water samples for laboratory analysis and measured low cost physical parameters from the blooms in Lake Kabetogama from June through September in 2016. By sampling throughout most of the open water season, not only will we be able to determine which toxins are present, but also whether toxins are present before the bloom is visible. The results of the on-going study will document how simple low cost parameters that are routinely measured may be used as a screening tool for prediction of toxin production and as an indication of the need for further testing.

Brief Bio

Victoria Christensen received her B.A. from Hamline University and B.S. and M.S. degrees from the University of Kansas. Her master's research examined the occurrence and fate of dissolved solids, nutrients, atrazine, and bacteria in an agricultural watershed. She joined the USGS Kansas Water Science Center in 1992 and the USGS Minnesota Water Science Center in 2002. Her interests and project work include real-time water-quality monitoring, effects of land use on water quality, the fate of nutrients in agricultural and reservoir systems, and reservoir sediment studies. She also has an interest in writing and communicating science topics to broad audiences and is a trainer and USGS Subject Matter Expert on Scientific Project Management.

Characterizing nineteen years of disturbances in and around Voyageurs National Park

Al Kirschbaum

National Park Service, Great Lakes Inventory and Monitoring Network, 2800 Lakeshore Drive East, Ashland, WI 54806

Abstract

Using a set of computer algorithms and Landsat satellite imagery, we have characterized disturbance regimes in nine U.S. and three Canadian watersheds in and around Voyageurs National Park from 1995 to 2013. The set of change detection computer algorithms flag potential natural and anthropogenic changes, which then go through human verification using a combination of temporally high resolution satellite imagery and high spatial resolution airphoto imagery. Not surprisingly, we have found that disturbances outside the park vary greatly from those occurring inside the park. Disturbances inside the park were the result of naturally occurring disturbances, including blowdown, fire, forest pathogens and areas flooded by beaver. Inside the park, the greatest amount of land disturbed was a result of disturbances by beaver, followed closely by forest pathogen and fire. Outside the park, disturbances were dominated by anthropogenic activities, chiefly, forest harvests. Just over 15% of the land outside the park was disturbed by forest harvest during the 19 year time span. Private industrial land had the highest percentage of land harvested within the time period at just over 25% of their land holdings being harvested. Among watersheds, the Ash River watershed in Minnesota had 23% of the land disturbed during the analysis time period, nearly all due to forest harvests. Using this data we see that naturally occurring disturbances happen nearly exclusively inside the park and that the rate of disturbance inside the park is very low compared to disturbance rates outside their border. Outside the park, natural disturbances are nearly completely absent and are instead dominated by anthropogenic disturbances. Identifying the location, size, timing, and type of disturbances can aid natural resource managers in decision-making for their respective agencies and may provide for more cooperation among land agencies.

Brief Bio

Al Kirschbaum received a BS in Forest Science at UW-Madison, then worked as a research technician validating MODIS products around the world in various ecosystems. Following that, he received a MS from Oregon State University in Forest Science where he mapped levels of pinyon-juniper mortality in the desert southwest. After completing his MS, he started working for the National Park Service Great Lakes Inventory and Monitoring Network in Ashland, WI. Here he developed a change detection monitoring program using Landsat imagery and has since implemented this technique at all nine national parks within the Network.

Comparing trace metal concentrations in water and pectoral fin rays to assess lake sturgeon populations in Voyageurs National Park, Minnesota

Jeffrey R. Ziegeweid*[1] and Ryan P. Maki[2]

[1]*U.S. Geological Survey Minnesota Water Science Center; 2280 Woodale Dr, Mounds View, MN 55112*
[2]*Voyageurs National Park; 415 S. Pokegama Ave., Grand Rapids, MN 55744*

Abstract

Namakan Reservoir is a complex, internationally-shared waterway comprised of five connected lakes that are fed by six unimpounded major rivers, and a substantial portion of Namakan Reservoir is located in Voyageurs National Park. Namakan Reservoir is one of the largest unfragmented lake sturgeon habitats in North America. Recently, proposed hydropower development in the Namakan River upstream of Namakan Reservoir prompted further investigation about potential effects of hydropower development on the sustainability of the internationally-shared sturgeon population in Namakan Reservoir. However, data about natal origins and movements of juvenile sturgeon in Namakan Reservoir were limited. Therefore, the U.S. Geological Survey and Voyageurs National Park began a study to determine whether trace metal analyses of water and nonlethally collected pectoral fin rays could be used to develop distinct chemical signatures to track movements and identify natal origins of sturgeon in Namakan Reservoir. Seasonal water samples were collected at 11 sites in Namakan Reservoir and analyzed for a suite of trace metals. In addition, cross-sections of pectoral fin rays collected during a previous study were analyzed for similar trace metals using laser ablation spectrometry. One-way analysis of variance and Tukey's Honestly Significant Differences tests of water samples indicate that Sr:Ca ratios can be used to classify the 11 sites into four distinct regions. By combining Sr:Ca and Ba:Ca ratios, each of the six rivers that historically supported sturgeon reproduction can be distinctly identified. Analyses of fin ray origins demonstrated differences in natal Sr:Ca ratios among captured sturgeons, but Sr:Ca ratios from most recent fin ray growths could not be correlated to capture locations. Therefore, Sr:Ca ratios in fin rays cannot yet be used to make inferences about migratory histories. Because sampled fish were captured shortly after ice-out, most recent fish ray growth likely represents the location of the fish during the previous autumn rather than the capture location. Additional studies using fin rays from telemetered or caged fish may help better determine relations between trace metal concentrations in fin rays and in waters of capture locations, which could then be used to further study the full migratory histories of collected sturgeon.

Brief Bio

Jeff Ziegeweid is a Hydrologist for the USGS Minnesota Water Science Center, where he has worked since 2008. His work focuses on understanding how biological communities respond to changes in hydrology. Jeff received his bachelor's degree from the University of Wisconsin-La Crosse in 2004, with majors in Biology (Aquatic Science Concentration) and Chemistry and a minor in Mathematics. Jeff received his master's degree in Forestry and Natural Resources (with a Fisheries Emphasis) from the University of Georgia in 2006.

Wildlife aren't the only things that move — Tracking dispersal movements of floating cattail mats in Rainy Lake, Minnesota

Bryce T. Olson* and Steve K. Windels

Voyageurs National Park, 360 Highway 11 E, International Falls, MN 56649

Abstract

Cattails (*Typha spp.*) can develop dense rhizomatous networks that can, over time, result in large floating mats. Mats occasionally detach from their anchor points, often due to water level changes, strong winds, and direct human intervention. Once detached, these floating mats "disperse", and in the process cause navigational hazards, damage infrastructure, or invade new areas. We have been tracking the movements of floating cattail mats in Rainy Lake near Voyageurs National Park using time series of high resolution aerial imagery. Through shape recognition, we are able to identify specific cattail mats, some of which dispersed into areas previously uninvaded by cattails. This issue appears to be increasing in occurrence and has serious implications for wildlife and fish habitat, recreation, and cultural resources such as wild rice production or archeological sites. We will discuss some of mechanisms behind this dispersal process, our techniques for monitoring, and options for management.

Brief Bio

SESSION 4 – LAKE OF THE WOODS: PAST, PRESENT & FUTURE

Historical phosphorus dynamics in Lake of the Woods: Does legacy phosphorus still affect the southern basin?

Edlund, M.B.*[1], Schottler, S.[1], Reavie, E.D.[2], Engstrom, D.R.[1], Baratono, N.[3], Leavitt, P.[4], Heathcote, A.J.[1], Wilson, B.[5], Paterson, A.M.[6]

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[2]Center for Water and the Environment, Natural Resources Research Institute, University of Minnesota Duluth, 1900 East Camp Street, Ely, MN 55731
[3]Watershed Ecology, 909 Riverside Dr, International Falls, MN 56649 USA
[4]Department of Biology, University of Regina, 3737 Wascana Parkway, Regina, SK, S4S 0A2 Canada
[5]RESPEC, 1935 County Road B2 W # 320, St Paul, MN 55113 USA
[6]Dorset Environmental Science Centre, Ontario Ministry of the Environment and Climate Change, 1026 Bellwood Acres Road, P.O. Box 39, Dorset, ON, P0A 1E0

Abstract

Using basin-wide paleolimnological analyses, a historical phosphorus (P) budget was constructed for Lake of the Woods (LoW; Minnesota-Ontario-Manitoba). Sediment cores from seven bays were radioisotopically dated (^{210}Pb, ^{137}Cs, ^{7}Be) and analyzed for geochemistry (loss-on-ignition, P, Si), diatoms, and pigments. Geochemical records for individual cores were combined using sediment focusing factors to provide whole-basin estimates of accumulation of bulk sediment, total P, and refractory and labile P fractions. Although historical monitoring shows that external P loading had been reduced since the 1950s, sediment P concentrations and accumulation rates increase monotonically upcore. A substantial proportion of sediment P is in labile P fractions and may be both mobile within the sediments and potentially available for exchange or resuspension to the lake (active layer). Two mass-balance models were used to explore historical P loading scenarios and in-lake nutrient dynamics – a static one-box model and a dynamic multi-box model, which estimates pools of P in the water column, the active sediment layer, and permanently buried P. The one-box model predicts pre-settlement loading that are slightly less than modern loads. The dynamic model showed that P in the water column was much higher in the past (1950s-1970s) than it is today and that the lake is very sensitive to external load because P losses from burial and outflow are large relative to inputs. Following nearly a decade of consistent external loads, the lake may be moving to a new steady state with respect to water column P and size of the active sediment P pool. The active sediment pool built up in the mid-20th century has been depleted through outflow and burial, and legacy P is minimal and no longer driving current lake condition. Historical nutrient dynamics are reconciled against sediment records of algal production and community change. Community changes following reduction of external P loads are in part counterintuitive, and other drivers including seasonality of P loading, shifting nutrient limitation, and climate change may be affecting modern ecosystem functioning of LoW.

Brief Bio

Mark Edlund is a senior scientist at the Science Museum of Minnesota's St. Croix Watershed Research Station. In addition to Lake of the Woods, he has worked on other Great Lakes of the world including Red Lake, the Laurentian Great Lakes, Russia's Lake Baikal, and Mongolia's Great Lakes.

Buoying water quality monitoring with sensors: What can we learn from two years of high-frequency data in Lake of the Woods?

Heathcote, A.J.*[1], Edlund, M.B.[1], Engstrom, D.R.[1], Hernandez, C.[2]

[1]*St. Croix Watershed Research Station, Science Museum of Minnesota, 16910 152nd St North, Marine on St. Croix, MN 55047*
[2]*Minnesota Pollution Control Agency, 714 Lake Avenue, Suite 220, Detroit Lakes, MN 56501*

Abstract

The persistence of algae blooms in the southern basin of Lake of the Woods (LoW), despite dramatic reductions in external phosphorus (P) inputs has been a cause for concern by agencies and stakeholders in both the USA and Canada in recent years. Previous water quality monitoring efforts, involving standard limnological techniques, have been unable to pinpoint the source or mechanism behind these blooms due to the highly dynamic nature of the shallow southern basin of LoW. High-frequency sensors offer a powerful tool for enhanced monitoring in systems such as LoW, owing to their ability to continuously record physical conditions (e.g., temperature, stratification) which are important drivers of biological and chemical processes in lakes. Here, we present a summary of two years of data from three moored instrument buoys in southern LoW that, when paired with regular monitoring data, give a comprehensive view of the physical and biogeochemical cycles of the lake on an annual scale. Together these data show both intra- and inter- annual variability in nutrient concentrations, algal abundance, and thermal stratification that would have been overlooked using traditional monitoring techniques. These results provide a high resolution, multi-year, picture of how temperature, oxygen, and sediment resuspension correlate with the timing and persistence of algal blooms in LoW.

Brief Bio

Adam Heathcote is an associate scientist at the Science Museum of Minnesota's St. Croix Watershed Research Station. Heathcote has experience using high-frequency monitoring techniques in systems ranging from the shallow prairie potholes of Iowa to deep boreal lakes on the Canadian Shield.

Two-dimensional modeling of waves and wind setup on the Lake of the Woods

Alex Nelson, PE

US Army Corps of Engineers, St. Paul District, 180 5th St E, Suite 700, St Paul, MN 55101

Abstract

Wind-driven waves and wind setup can influence many physical, chemical, and biological processes in lake ecosystems. As the sixth largest freshwater lake partially located in the United States, the Lake of the Woods in the northern most part of the U.S. state of Minnesota and a southern portion of the Canadian provinces of Ontario and Manitoba, is heavily influenced by wind and wave action due to the large size and extensive wind fetch distances. In order to quantify the magnitude of waves and wind setup for use in studies related to water quality, shoreline erosion, ecosystem habitat, and flood risk management, a two-dimensional modeling effort was undertaken for the Lake of the Woods. This model study coupled a 2D wave model capable of capturing open water wave growth and nearshore wave transformation with a 2D hydrodynamic model that captures wind setup while conserving water volume. The results from this study provide local stakeholders and future study scientists and engineers with fine-resolution spatial estimates of waves and wind setup for a wide range of wind conditions at the lake.

Brief Bio

Alex Nelson is a hydraulic engineer with the U.S. Army Corps of Engineers, St. Paul District. After graduating cum laude and receiving his B.S. degree in Civil Engineering from North Dakota State University in 2008, he began working at the Corps of Engineers in St. Paul, MN. For the past eight years, he has performed hydraulic design and analysis for a variety of complex water resource projects using 1-D and 2-D hydraulic, coastal, and sediment modeling software. These projects include hydraulic design for the Fargo-Moorhead Metro Flood Risk Management Project, wind-wave modeling for Herbert Hoover Dike at Lake Okeechobee in Florida, coastal engineering for the Hurricane & Storm Damage Risk Reduction System in New Orleans, hydraulic modeling and mapping of rivers throughout Minnesota and North Dakota, and numerous risk assessments for Texas coastal levee systems and high-hazard dams in the western United States. Alex is a Professional Engineer in the State of Minnesota and is anticipated to receive his M.S degree in Civil Engineering with an emphasis in Water Resources from the University of Minnesota in the spring of 2017.

Whole-lake manipulations at the Experimental Lakes Area do not support the need for nitrogen reduction to reduce cultural eutrophication in lakes

M.J. Paterson*[1], D.W. Schindler, S.N. Higgins, R.E. Hecky, D.L. Findlay.

IISD-Experimental Lakes Area, 111 Lombard Ave Suite 325, Winnipeg, MB, R3B 0T4 204-958-7700 ext 758

Abstract

In the 1960s and 1970s, whole-lake experiments undertaken at the Experimental Lakes Area (ELA) clearly demonstrated that phosphorus (P) was an essential nutrient to regulate to decrease cultural eutrophication. Considerable debate has persisted, however, about the need to control nitrogen (N) and several government agencies around the world are currently calling for dual control of both N and P. Over the 48-year history of ELA, there have been 10 whole-lake experiments that involved additions of N, P, or N and P combined. Taken together, the results from these experiments provide no evidence that additions of N either alone or in combination with P, resulted in greater standing crops of algae in fertilized lakes. In addition, the results of nutrient additions may not provide the best indication of the effects of nutrient input reductions. Recent data from Lake 227, which has been continuously fertilized since 1968 (with N and P until 1990 and then with P alone to present day) provide no indication that reductions of N loading will mitigate eutrophication. Despite 25 years of high P loading without concomitant N additions, concentrations of total phytoplankton biomass and chlorophyll in Lake 227 have not declined. The ELA data indicate that over-reliance on results obtained from short-term small-scale studies, such as nutrient addition bottle assays, provide a poor indication of the long-term outcome of nutrient reduction strategies in natural lakes.

Brief Bio

Lake of the Woods Tributary Monitoring and HEC-RAS Modelling

TBD-MOECC Staff

Engineering Development Program, Ontario Ministry of the Environment and Climate Change, 331 - 435 James Street South | Thunder Bay ON, P7E 6S7

Abstract

The Ontario Ministry of the Environment and Climate Change has been monitoring water quality in 10 tributaries in the Lake of the Woods watershed since 2009. In the summer of 2016, Solinst water level loggers and barologgers were installed in 4 of the 10 tributaries to provide data for flow calculations using HEC-RAS models. For each tributary, HEC-RAS models required at least 3 profile survey transects of the river bed, preferably one at the logger location, one upstream and one downstream. Water elevation was recorded at each of the transect locations and a flow measurement was taken at the logger location. Throughout the open water season in 2016, attempts were made to collect water quality samples for dissolved oxygen testing, temperature, nutrients and general chemistry during periods of high flow (i.e. storm chasing). During sampling events, data was downloaded from both the water level loggers and barologgers to develop two HEC-RAS models for each tributary. A calibration model was developed initially to ensure that the output of the model was logical. Once the calibration model was reasonable, a simulation model was developed by using hypothetical flow profiles. Several parameters were adjusted including the longitudinal slope profile to affect the output rating curve, which we matched to real world flow data. The equation from the rating curve was incorporated into the time series of the water level data and used to calculate 15-minute flow data for the tributaries from June to October 2016. The flow data and nutrient concentrations will be used to calculate the mass balance/mass loadings.

Brief Bio

Lake of the Woods Total Maximum Daily Load Study: A progress report

Cary Hernandez[1], Mike Hirst[2], Geoff Kramer[3]

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[2]Resource Technician, Lake of the Woods Soil and Water Conservation District, 119 1st Ave NW PO Box 217, Baudette, MN 56623, PH 218-634-1842 ext#3
[3]Water Resources Engineer, RESPEC Water & Natural Resources, 1935 West County Road B2, Suite 230, Roseville, MN 55113; PH 651-305-2274

Abstract

In 2008, the U.S. Environmental Protection Agency placed the Lake of the Woods on the "Impaired Waters List" for failing to comply with water quality standards conducive to aquatic recreation due to eutrophication. The U.S. Clean Water Act requires states to perform Total Maximum Daily Load (TMDL) studies on their impaired waters. TMDL studies identify water quality standards and goals/targets for U.S. waterbodies, recommend pollutant load allocations to meet the targets, and provide opportunities for stakeholders and communities to engage in the process of watershed management planning to adopt protection and restoration practices. In 2015, the Minnesota Pollution Control Agency (MPCA), in partnership with the Lake of the Woods Soil and Water Conservation District and RESPEC Water and Natural Resources, began working on the Lake of the Woods TMDL study.

The Lake of the Woods TMDL study utilizes two different models, both updated with the most recent available data. The Hydrologic Simulation Program – Fortran (HSPF) is a calibrated watershed model of the entire Lake of the Woods Watershed. The HSPF model is used to assess pollutant sources and source contributions. HSPF model results are subsequently used as inputs for the BATHTUB lake eutrophication model. The BATHTUB model is used to determine the loading capacity of the lake, including internal loading. Combined, the two models are used to develop allocations for pollutant load reductions, margins of safety, and future growth. This presentation will provide an update on the results to date. Updates will include improved estimates of internal phosphorus loading to Lake of the Woods, an updated phosphorus budget for the Lake of the Woods Watershed, and preliminary load allocations for the TMDL study.

Brief Bio

Cary Hernandez is a watershed project manager working out of the MPCA's Detroit Lakes Office. Cary works with watersheds throughout the Red River Valley and the Lake of the Woods/Rainy River Basin. Cary has been with the MPCA for the past 26 years.

Mike Hirst holds a B.S. in Geology and Technology from the University of North Dakota and has been employed with LOW SWCD for 13 years. His background in natural resources conservation includes: water quality monitoring, calculating annual loading rates on streams, local water management planning, wetland conservation, aquatic invasive species, working with private landowners on water quality projects and compliance with regulations, education and outreach and serving on local and international boards and committees for water quality in the Rainy – Lake of the Woods Watershed. As a native of northern Minnesota, Hirst is very familiar with the local, state and international resources of Lake of the Woods.

Geoff Kramer holds and M.S. in Biosystems and Agricultural Engineering from the University of Minnesota. He has extensive experience with hydrologic and water quality modeling in diverse areas such as snowmelt modeling and lake nutrient modeling. He has extensive experience with agricultural drainage design, policy, and related water quality BMPs. He also has experience with economic analysis and complex analysis related to cost effectiveness of BMPs and BMP treatment trains.

Binational science plan for Lake of the Woods: Canada-U.S. Presentation and Panel Session

Veronique Hiriart-Baer*[1], Felicia Minotti[2], Steve Cobham[1], Janette Marsh[3]; Matthew Gluckman [3].

[1]Environment and Climate Change Canada; [2]Global Affairs Canada; [3]US EPA

Abstract

In January 2015, the International Joint Commission presented its "Water Quality Plan of Study for the Lake of the Woods Basin" (POS) to the Governments of Canada and the United States. A binational Federal, provincial and state multiagency team reviewed the POS and have concluded that while all of the science recommended in the POS is of value and relevant, not all of it is critical at this time to supporting priority decision making and action by governments to protect water quality and ecosystem health in the boundary waters of the Lake of the Woods Basin.

The agencies have agreed that priority should be placed on the important issue of algae in LOW. The agencies identified science needs from the POS which relate to harmful algal blooms and additional water quality monitoring as the most critical and immediate knowledge gaps to be addressed. In an effort to address these identified gaps, a binational science plan has been developed with three objectives:

1. Enhance monitoring for the assessment of current water quality conditions to inform the setting of lake ecosystem objectives
2. Identify the causes and consequence of nutrient enrichment and algal blooms
3. Predict the lake's response to potential nutrient load reduction strategies

In partnership with the research and management community in the Lake of the Woods watershed, activities are being integrated to meet these objectives and provide support for future policy decisions.

This presentation will review the context for the binational science plan and the science approach and integration followed by an open discussion.

Brief Bio

Address from the Hon. Robert D. Nault. P.C., M.P.

The Honourable Robert D. Nault.

Member of Parliament for Kenora, House of Commons, Ottawa

Abstract

TBD

Brief Bio

Bob Nault is the Member of Parliament for the riding of Kenora, where he serves 53 communities, including 42 First Nations. As one of the largest geographical ridings in the country, Kenora encompasses one third of Ontario's land mass, and is approximately the same size as France.

Bob was first elected in 1988 and ran successfully afterwards in 1993, 1997, and 2000, furthermore serving as the Member of Parliament for Kenora-Rainy River for over sixteen years. He was the Minister of Indian Affairs and Northern Development from 1999-2003, and is a former Kenora City Councillor.

On October 19, 2015, MP Nault was elected for the fifth time with a substantial majority. In February 2016, he was elected Chairman of the Foreign Affairs and International Development Committee, as well as, Chairman of the Canadian Section of ParlAmericas.

SESSION 5 – ECOSYSTEM HEALTH

Mitigating the contaminated source of traditional foods with an uncontaminated river system

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

[1]Department of Biology, Lakehead University
[2]Seine River First Nation

Abstract

Residents of Seine River First Nation (SRFN) have traditionally been dependent on fish and gathered foods provided by the Seine River. However, studies conducted during 2012 – 2013 revealed that there are concerns associated with using food from this system. These included elevated levels of heavy metals in the sediment of Upper Steeprock Lake below the former Steeprock mine site which were above accepted provincial standards, municipal effluent from the upstream community of Atikokan, and atmospheric discharge from Ontario Power Generation's Atikokan Generating Station. A particular issue was the incidence of high mercury levels in fish regularly consumed by community residents which was reflected in high mercury concentrations in the hair of frequent fish consumers. Wild rice, another traditional stable, was found to have increased levels of lead and mercury in normally harvested areas. Ducks, inhabiting the rice areas, further bio-accumulated mercury. Other terrestrial plant species were shown to vary in mercury concentration versus concentrations in the soil. This was an added concern, since, as well as being consumed by residents, concentrations of mercury could be further elevated in deer, moose and grouse as they browsed on these plants. Controlled experiments using *Lumbriculus variegatus* showed that future elevated sulphate levels from various point sources would further increase mercury concentrations.

SRFN wishes to decrease the exposure of its residents from food produced from the Seine River. One alternative is to encourage the use of the nearby uncontaminated Turtle River system as a supplier of traditional food. This Project will collect baseline water, soil, plant, animal, fish, invertebrate and sediment samples from water bodies on the Turtle River system and compare these levels to those from the Seine river system. First Nation band members will collect the samples and Lakehead University will provide the training and analytical support for this project. Initial results suggest that both water and sediment quality varies between the two river systems. Ongoing investigations will determine if these variations will influence metal and mercury concentrations in biological tissue found on this river system.

Brief Bio

Dr. Peter Lee is a Professor of Biology at Lakehead University in Thunder Bay, Ontario. He is also he Director of the Lakehead University Environmental Laboratory and the Lakehead University Aquatic Toxicity Research Centre. His research concentrates on contaminants in aquatic systems caused by point source influences as well as aquatic plants, particularly wild rice.

The use of sub-bottom acoustic reflection data to image glacial Lake Agassiz sediments from multiple lakes in the Rainy River watershed

A. Breckenridge*[1], T.V. Lowell[2], N. Wattrus[3], A. Myrbo[4], T. Schilling[5], N. Langevin[1]

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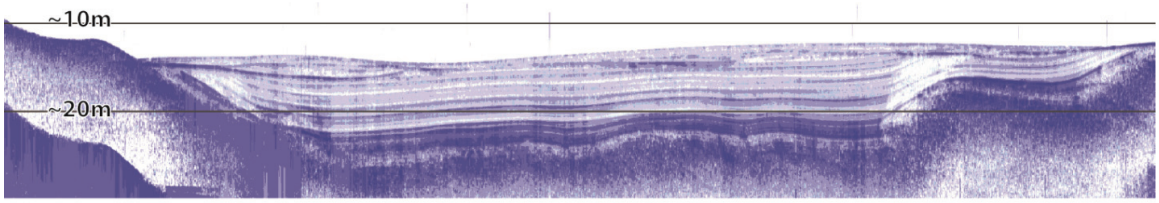
[2]University of Cincinnati, Department of Geology, Cincinnati, OH
[3]Large Lakes Observatory and Department of Geological Sciences, Duluth, MN
[4]LacCore and Department of Earth Sciences, University of Minnesota, Minneapolis, MN
[5]Midwest Archaeology Center, Lincoln, NE



Example sub-bottom profile data from Kakagi Lake (ON).

Abstract

We recently began a 4-year project to use annual laminated sediments (varves) from glacial Lake Agassiz to both evaluate the response of the Laurentide Ice Sheet to climate change, and determine the routing history of the ancient lake and the potential connections (if any) to abrupt climatic cooling events. The field work includes sub-bottom acoustic reflection surveys from many lakes in northern Minnesota and northwestern Ontario to image glaciolacustrine sediments.

Most of these lakes have thick lacustrine sediment records. For example, Lake Vermilion has 30+ meters of sediment in places. Unconformities between the post-glacial and glacial sediments are ubiquitous in nearshore areas, but these unconformities can occur in 10-m of water depth. Every lake has a thick (5+ m) thick basal unit that we interpret to be glacial Lake Agassiz varves. This unit drapes bedrock or till, and tends to have a uniform thickness. These varves are overlain by coarser-grained rhythmites, which perhaps reflect lake level lowering and eventual isolation from Lake Agassiz. The rhythmites can vary locally in thickness due to sediment focusing in the deeper basins. Post-glacial sediment patterns are complex in some of the larger lakes surveyed (Kabetogama, Pelican, Vermilion, Kakagi, and Manitou.) This must be a consequence of extreme lake level variability, during both the Lake Agassiz phase of the basin and the Holocene. Non-depositional or erosional zones that expose the glaciolacustrine sediment on the lake bottom exist in all of these lakes, and their occurrences within each basin are not predictable.

Brief Bio

Andy Breckenridge is an Associate Professor of Geology at the University of Wisconsin-Superior. His teaching and research areas cover the areas of sedimentology, stratigraphy, global climate change, glacial geology, and GIS. Wilderness canoe trips in the Canadian Shield initially steered him towards the field of limnogeology, but the promise of glacial varve studies to radically improve our understanding of ice sheets motivates his current work.

Testing for potential impacts of *Orconectes rusticus* (rusty crayfish) on wild rice in Dumbell Lake, MN

Kelsey Wenner* and Tyler Kaspar

1854 Treaty Authority, 4428 Haines Rd., Duluth MN, 55811

Abstract

Orconectes rusticus has been found to graze heavily on germinating aquatic vegetation, capable of displacing and reducing the diversity of native species. Culturally significant wild rice populations have been observed to decline in some infested areas, but the impact from rusty crayfish is unknown. This study examined 1) If *O. rusticus* negatively impacts wild rice populations and 2) Is wild rice a preferred food source. Three rectangular structures were created and placed in areas with naturally occurring wild rice with the intent to completely contain (two enclosures) or exclude (one exclosure) *O. rusticus.* Each enclosure was stocked with 50 rusty crayfish that were marked with fluorescent tags. One was paired with the exclosure and the other contained an alternative vegetative food source replenished every two weeks until mid-July, after which 50 new crayfish were stocked to test for impacts after wild rice emergence. Densities of emergent wild rice inside and outside the structures were measured with a ½ meter square plot and compared. The paired enclosure showed significantly higher density outside the enclosure (ρ-inside=0.33 ρ-outside=38.42); the exclosure showed higher density inside the structure (ρ-inside=61.67 ρ-outside= 22.92); the food plot enclosure showed higher density outside the enclosure (ρ-inside=*5 ρ-outside= 15.33) (*ρ-inside, submerged=23.67). In the enclosure with alternate food, some of the stalks appeared stunted and did not emerge throughout the duration of the study (shown in *ρ above). The density of the emergent wild rice remained unchanged. In conclusion, *O. rusticus* has the potential to negatively impact wild rice in certain conditions, and wild rice may not be a preferred food source.

Brief Bio

Kelsey has been working as an Invasive Species Technician for the 1854 Treaty Authority since January 2016. The 1854 Treaty Authority is an inter-tribal natural resource management organization that manages the off-reservation hunting, fishing and gathering rights of the Grand Portage Band of Lake Superior Chippewa and Bois Forte Band of Chippewa in the 1854 Ceded Territory (present day northeast MN). She focuses mainly on aquatic invasive species early detection, monitoring, education, and prevention. She obtained her bachelors of science in biology from the University of Minnesota Twin Cities in 2013 and is currently obtaining a professional certification in GIS. She learned about forest ecology and restoration through her position with the Conservation Corps of MN and Iowa, and has studied marine biology through her positions at the Sea Life Aquarium, James Cook University where she aided in studies about the zonation of coral reefs, and her position at the University of Minnesota where she aided in the studies about the deep-sea bacteria *Thiomargarita namibiensis.*

MPCA Rainy River Basin Biological Monitoring: Past, Present and Future

Nate Sather

Minnesota Pollution Control Agency, 7678 College Road Suite 105, Baxter, MN 56425

Abstract

The purpose of this presentation is to highlight the past, present and future monitoring work done by the MPCA in the Rainy River basin and facilitate discussion and questions at the numerous posters corresponding to the specific projects. In 2008, the Minnesota Pollution Control Agency (MPCA) began the first cycle in the Intensive Watershed Monitoring program (IWM). The purpose of the first cycle of IWM was to gather baseline information and assess the streams in all 80 watershed in the State of Minnesota over a 10-year period. In the past 9 years, the agency has done monitoring work in the Rainy Headwaters, Vermillion River, Little Fork River, Big Fork River, and Lake of the Woods watersheds. During the summer of 2017, monitoring work will begin on the Lower Rainy, Rapid River, and Rainy River-Rainy Lake watersheds. Planning for Cycle II monitoring work has begun and monitoring will begin summer of 2018 in the Little Fork watershed. New in the Cycle II process, is an application for “State and Local needs” sites for monitoring during the MPCA’s IWM efforts in each of the major watersheds in the Rainy River Basin.

Brief Bio

Bass population status in Lake of the Woods, Ontario: Kenora Bass International monitoring program 1993-2015

Christopher Martin

Ontario Ministry of Natural Resources and Forestry, 808 Robertson Street, Kenora, ON, P9N 3X9

Abstract

Biological information was collected from smallmouth (*Micropterus dolomieu*) and largemouth (*Micropterus salmoides*) bass weighed-in at the Kenora Bass International competitive fishing event between the years 1993 – 2015. Kenora District Ministry of Natural Resources and Forestry staff opportunistically sub-sample the tournament angler catch to collect information on bass species, sector of capture, total length, round weight and age. This presentation examines differences in bass samples through time, across space and between species. In 2015, the proportion of smallmouth bass captured from Sector 1 (Kenora/North Center) may have declined relative to earlier decades while the proportion of both bass species captured from Sector 6 (Big Traverse/Sabaskong) appeared to increase. Smallmouth bass total lengths increased significantly over time, and those sampled from Sector 1 were, on average, shorter than those sampled from Sectors 5 (Whitefish Bay) and 6. Generally, greater largemouth bass total lengths were observed during 2003-2013 relative to 1993-2002, and in Sector 6. Differences in mean round weight of smallmouth and largemouth bass over time and between sectors closely mirrored those of total length. Across sectors, each species appeared to grow in length and weight at similar rates, with few exceptions, and reached comparable maximum ages. Inter-species comparisons indicated that largemouth bass reach greater lengths than smallmouth bass at younger ages, grow at a rate similar to smallmouth bass after approximately age 6, and at a rate slower than smallmouth bass nearer the end of life. Also, smallmouth and largemouth bass were similar in weight at lengths under 360 mm; however, largemouth bass were expected to become progressively heavier than smallmouth bass as total length increased. Mean age of both bass species increased over the sampling periods while maximum age and number of age classes were typically greater in smallmouth than largemouth bass samples each year. The strong correlation between year class index and growing degree days suggest bass recruitment is favored by warmer growing seasons. Comparisons among Lake of the Woods, Rainy and Marmion Lake samples indicate Lake of the Woods smallmouth bass exhibit high mortality rates, shortest size distribution and greatest variability in year class strength. Increases in mean total length, round weight and age of bass from 1993 to 2015 are consistent with angling regulation changes in 1996, 1999 and 2014 expected to protect bass, particularly large individuals. KBI monitoring program data provide ample opportunity to further explore causes of the bass population trends detected. In the absence of other fish assessment methods demonstrating similar ability to detect change in bass populations, it is recommended the KBI monitoring program continue to describe status of two of the most valued sport-fish species occurring in Lake of the Woods.

Brief Bio

Christopher Martin is a District Management Biologist, Kenora District, Ontario Ministry of Natural Resources and Forestry.

Big Fork and Littlefork Watershed WRAPS Update

Michael J. Kennedy

MPCA-Duluth Office, 525 Lake Ave. S. Ste 400, Duluth, MN 55802

Abstract

This is a high level overview of the Big Fork and Littlefork Watershed Restoration and Protection Strategy (WRAPS) work done in these watersheds. Learn where the impaired waters are located, where the waters in need of protection are located, and what the various recommended strategies are for these watersheds. A glimpse of what is in store for future work in these watersheds will also be discussed.

Brief Bio

POSTER SESSION ABSTRACTS

Interaction between invasive cattails and native wild rice in Rainy Lake: How nutrient cycling and allelopathy may contribute to a competitive advantage.

Peter Ferguson Lee[1], 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 Nations

Abstract

The exotic narrowleaf cattail, *Typha angustifolia* and the hybrid *Typha glauca* (*T. latifolia x T. angustifolia*) are extremely successful invasive wetland plant species. Due to their overlap in habitat preference, the cattails have displaced large amounts of native wild rice populations in the Seine River and Rainy Lake Watersheds. We are investigating their competitive advantage over native wild rice (*Zizania palustris*) in terms of nutrient cycling and allelopathy. Our goal is to gain a better understanding of invasive-native plant interactions and how that may contribute to a successful re-establish of wild rice.

Rat River Bay a once thriving wild rice ecosystem is almost completely dominated by cattails. In the fall of 2014, SRFN conducted cutting trails of cattails in Rat River Bay using a cutting bar apparatus attached to an airboat. The cutting bar is lowered into the water and cuts cattails just above the sediment:water interface. The following spring, cattail survival in these cut areas was negligible. We hypothesized that the removal of the dead stock cut off oxygen supply to the rhizomes, killing them and preventing their vegetative reproduction. Consequently, wild rice was able to re-establish as the result of an existing seed bank. However, total, extractable and pore water results for sediment nutrients, showed that cattails were depleting many macro and micronutrients in the former wild rice areas which may have long-term implication. Of particular importance was the lower nitrogen concentrations causing chlorosis in the wild rice plants growing in the cut cattail locations.

The wild rice was able to re-establishment within our cut areas the following year without seeding. Due to this finding, the goal of our current research is to gain a better understanding of the potential impact of cattails on wild rice seed and how they may be inhibiting germination. Our hypothesis states that live cattails are releasing allelochemicals into the environment that are inhibiting the germination of wild rice. To evaluate such our experimental design involves sediment samples from cattail dominated, open water, and wild rice dominated areas as well as live and dead cattail biomass with wild rice seeds to compare germination rates between treatments. Additionally, we must consider the environmental factors that have changed due to the removal of cattails and the dense emergent overstory they create. These include their ability to buffer temperature and reduce sunlight to the understory. Therefore, we will include field measurements of both temperature and light penetration in the up coming field season.

Brief Bio

Kristi Dysievick is a Master student in the department of Biology at Lakehead University. Miss. Dysievick completed her honours bachelor's of water resource at Lakehead University in 2013. Kristi has experience working in Lakehead University Environmental Laboratory, which is an ISO 170025 accredited Laboratory. Her thesis is focusing on the re-establishment of Wild Rice and the potential influence of cattails on sediment characteristics which may be detrimental for Wild Rice development, growth and productivity.

Treaty #3 Watershed Management Plan

Lucas King and Kristie Duncan

Grand Council Treaty #3, Territorial Planning Unit

Abstract

Water is sacred to the Anishinaabe people of Treaty #3. Due to this sacred connection, the Treaty #3 border closely follows the boundary of the east portion of the Nelson River Basin. The Treaty #3 territory hosts 28 Anishinaabe communities, with a total population of 25,000 over 55,000 square miles. Traditional law dictates their sacred duty as stewards of the land to protect the environment through planning for seven generations. At the moment, there are several large-scale proposed and in-progress developments in the Treaty #3 territory. However, there is no watershed management plan that considers all secondary watersheds within the east portion of the Nelson River Basin and addresses the cumulative impacts of these projects.

Members of the Territorial Planning Unit from Grand Council Treaty #3 will present their objective to develop a Treaty #3 Watershed Management Plan founded on Anishinaabe values. They will present the results from their initial community engagement outreach sessions and proposed plan for a community-based monitoring program with Treaty #3 membership.

Brief Bio

Lucas King is the Water Resource Specialist in the Territorial Planning Unit at Grand Council Treaty #3. His work focuses on laying the foundation for a Treaty #3 Watershed Management Plan. He has a Bachelor's degree in Environmental Science from Mount Royal University and is a member of the International Multi-Agency Arrangement Technical Advisory Committee.

Kristie Duncan is the Resource Specialist at Grand Council Treaty #3 in the Territorial Planning Unit. She works on a wide range of files including the Federal Regulatory Review and is a member of the Rule Curve Public Advisory Group. Her background is in coastal geomorphology and she hold two degrees in Environmental Science.

2016 Large River Monitoring — Rainy River

Karsten Klimek, Nathan Sather, Benjamin Lundeen, and Jesse Anderson

Minnesota Pollution Control Agency, 7678 College Road Suite 105, Baxter, MN 56425

Abstract

In July and August of 2016, the Minnesota Pollution Control Agency (MPCA) conducted a survey of the Rainy River in Northern Minnesota that included an assessment of fish, macroinvertebrates, water chemistry and habitat. The effort on the Rainy River was part of a larger effort supported by the Clean Water Fund to monitor all of Minnesota's large rivers to see if they support aquatic life, aquatic recreation, and fish consumption. Thirteen 500-meter biological monitoring stations were established and sampled for fish using electrofishing gear and macroinvertebrates using Hester Dendy ™ samplers. Water chemistry data was collected multiple times at a subset of the stations and will be used along with the biological data to assess each reach on the Rainy River. Fish were collected for contaminant analysis (mercury and PCB's) at two of the stations. The data collected during this survey will be used to conduct an assessment of the Rainy River in the early part of 2018. A report of the assessment results is expected to be available in 2019.

Brief Bio

Uses of Temperature Arrays in Lakes at Voyageurs National Park

Jaime LeDuc* and Rick Damstr

U.S. National Park Service – Voyageurs National Park, 360 Hwy 11 E Int'l Falls, MN 56649

Abstract

Water temperature is an important driver of ecological processes in lakes. We deployed moored temperature arrays in the deepest areas of Little Trout and Mukooda lakes at Voyageurs National Park (VOYA) to collect continuous water temperature profiles. The arrays consist of temperature probes positioned along a vertical line from the lake surface to the bottom, spaced one meter apart. Temperatures are measured every hour, year-round. Data collection has been ongoing in Little Trout Lake since 2011 and in Mukooda Lake since 2012. Both lakes are relatively deep and contain both cold and coolwater fish species. We used the water temperature data to explore ice duration, thermal stratification, and fish habitat within these lakes. This research is ongoing and similar methods have been applied to an additional lake at VOYA as well as other national park lakes in the Great Lakes Region.

Brief Bio

Jaime LeDuc is a biological science technician employed at Voyageur's National Park. Jaime grew up on Rainy Lake.

MPCA Rainy River Basin Biological Monitoring: Past, Present, and Future

Benjamin Lundeen and David Dollinger

Minnesota Pollution Control Agency, 7678 College Road Suite 105, Baxter, MN 56425

Abstract

In 2008, the Minnesota Pollution Control Agency (MPCA) began the first cycle of Intensive Watershed Monitoring (IWM). The purpose of this first cycle is to gather baseline information from streams and lakes from all 80 major watersheds in a 10-year period, in order to inform and complete water quality assessments. As the MPCA returns to each watershed for the second cycle of IWM, some changes have taken place. This poster will identify the purpose(s) of cycle II and highlight the similarities and differences between the two cycles; using the Little Fork River watershed as an example.

Brief Bio

An Advance Look at the IJC's Climate Change Framework

Charlene Mason[1] and Teika Newton[2]

[1]Public Member, International Rainy-Lake of the Woods Watershed Board; P.O. Box 810 Ely MN 55731
[2]Public member of the Community Advisory Group to the International Rainy-Lake of the Woods Watershed Board.

Abstract

The International Joint Commission is in the process of developing a strategy to support its Boards' efforts in addressing climate change as it pertains to the mandates of the Boards. The proposed framework is intended to help the Boards consider climate change issues in their region and to encompass and connect the work of the various Boards so the contributions in each region could be used by all Boards. This is a work in progress; the poster session is intended to be time for those involved in the Climate Change Framework Working Group to interact with attendees about the framework.

Brief Bio

Ms Mason, now retired from the University of Minnesota Libraries-Twin Cities Campus, has been a member of the International Rainy-Lake of the Woods Watershed Board since its beginning. She serves as the U.S. co-chair of its Community Advisory Group as well as the U.S. co-chair of its Engagement Committee. In addition, she is a member of the International Joint Commission's Climate Change Framework Working Group.

Teika Newton is a public member of the Community Advisory Group to the International Rainy-Lake of the Woods Watershed Board and member of the International Joint Commission's Climate Change Framework Working Group.

Lower Rainy, Rapid, and Rainy River-Rainy Lake Monitoring 2017

Nate Sather and Nate Mielke

Minnesota Pollution Control Agency, 7678 College Road Suite 105, Baxter, MN 56425

Abstract

The purpose of this poster is to inform and facilitate dialogue surrounding monitoring and assessment work planned in the Rainy River Basin during the summer of 2017. Cycle I monitoring efforts by the MPCA will begin in the Lower Rainy, Rapid River, and Rainy River-Rainy Lake watersheds in the summer of 2017. These are the final three watersheds in the Rainy River Basin to be monitored by the MPCA during the first 10-year IWM cycle. Sampling of fish, macroinvertebrates, and water chemistry will take place over the next two summers. Assessments for Aquatic Life, Aquatic Recreation will take place during the winter of 2019.

Brief Bio

The North American Lake Management Society (NALMS)

NALMS – Brian Kotak

P.O. Box 5443, Madison, WI 53705

Abstract

Since 1980, NALMS has pursued its mission to forge partnerships among citizens, scientists, and professionals to foster the management and protection of lakes and reservoirs for today and tomorrow. NALMS has membership levels for individual, non-profits, affiliates and corporations. Benefits of membership include professional networking, continuing education, the NALMS Certification Program for Lake Managers and Lake Professionals, and access to NALMS publications including the Lake and Reservoir Management Journal and LakeLine Magazine.

NALMS goals are:

1. To promote the exchange of information on aspects of managing lakes and their watersheds.
2. To promote public awareness of lake ecosystems.
3. To encourage public support for promoting management of lakes and their watersheds.
4. To provide guidance to agencies involved in management activities for lakes and their watersheds.
5. To boost the professional status of those engaged in managing lakes and their watersheds.
6. To identify needs and encourage research on lake ecology and watershed management.

Brief Bio

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. All meetings are at the Rainy River Community College, except the Forum Poster Session & Reception.

	Monday March 6	Tuesday March 7	Wednesday March 8	Thursday March 9
8-9			IWCP – Civic Engagement Workshop SC-114 (8-9:30)	FORUM **Symposium Sessions** (8:30 start) **Theatre**
9-10		IJC Rule Curve Draft Decision Workshop Theatre		
10-11			IMA-WG H-118	
11-12				
12-1			**FORUM Lunch Commons**	FORUM Lunch **Commons**
1-1:30		IMA-TAC H-118	**FORUM Symposium Sessions Theatre**	FORUM **Symposium Sessions Theatre**
1:30-2:00		IJC IRLWWB-CAG S-119		
2:00-2:30				
2:30-3:30		IJC IRLWWB-IAG SC-114		
3:30-4:30	IJC IRLWWB Water Levels Committee H-118 or S-119	IJC IRLWWB/CAG/IAG S-119		
4:30-5:00		IJC IRLWWB S-119		
5:00-5:30	Project Wet Meeting H-118 or S-119		**FORUM Poster Setup AmericInn**	
5:30-6:00				
6-7			**RECEPTION – AmericInn**	
7-8		IJC Rule Curve Public Meeting Theatre		
8-9				

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