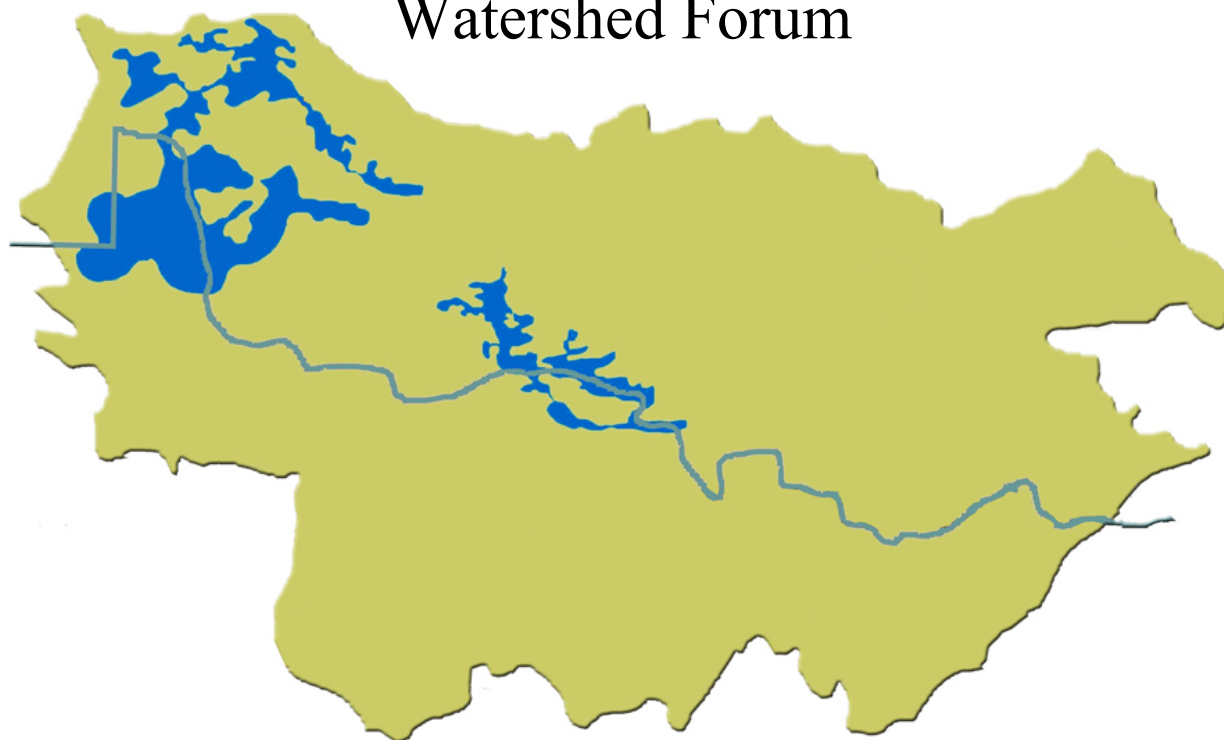


RAINY-LAKE OF THE WOODS WATERSHED 2020 FORUM

Proceedings of the 17th Annual International Rainy-Lake of the Woods Watershed Forum



March 11 - 12, 2020
Rainy River Community College
International Falls, Minnesota, USA

Forum Partners – Sponsors

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- St. Cloud State University
- Rainy Lake Conservancy
- Rainy Lake Property Owners Association
- Environment and Climate Change Canada / Environnement et Changement climatique Canada
- Voyageurs National Park Association

The information contained in this Proceedings report was compiled by the Lake of the Woods Water Sustainability Foundation, on behalf of the Organizing Committee of the 16th International Rainy-Lake of the Woods Watershed Forum, from summaries of presentations and from the March 13 & 14 symposium poster and presentation abstracts as supplied by the presenting authors.

We are grateful to the International Joint Commission for financial support to prepare this report.

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Todd Sellers
Executive Director
Lake of the Woods Water Sustainability Foundation

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Executive Summary



Crowd at Forum attend presentations by Lucas King, Grand Council Treaty 3 on the Treaty 3 Nibi (water) Declaration and by Caren Binding, Environment and Climate Change Canada on the use of satellite remote sensing to develop indices of algae extent, duration and severity on Lake of the Woods.

Lake of the Woods and its watershed went under the microscope again at the 2020 International Rainy-Lake of the Woods Watershed Forum, March 11-12 at the Rainy River Community College in International Falls, Minnesota. The auditorium was packed with 135 researchers, resource managers, policy makers and members of the public attending the two days of oral and poster presentations.

Elder Priscilla Simard of the Coochiching First Nation and Women's Council of Grand Council Treaty #3 (GCT3) helped open the Forum with a prayer and ceremony honouring water and the work to be done together to respect and protect it.

Chief Lorraine Cobiness of Niisaachewan Anishinaabe Nation presented the Foundation with the Nibi (Water) Declaration of GCT3 and a ceremonial gift of a blanket and spoke to how the Nibi Declaration provides teachings and principles to fulfill our responsibilities for honouring and respecting Nibi that unites us all.

As the Forum attendees focused their eyes on the results of research in our watershed, little did we realize that the world was changing rapidly around us with the first declaration of COVID-19 as a pandemic reaching us on the last day of the Forum and restrictions on travel and gatherings soon to come.

Participants reflected a broad range of interests and involvement in the watershed, representing 55 organizations, including local governments, soil and water conservation districts, provincial and state governments, federal governments, U.S. Tribes, Canadian First Nations, the International Joint Commission, industry, non-governmental organizations, universities, undergraduate and graduate



Chief Lorraine Cobiness presents the Nibi Declaration and a gift of a blanket to the Foundation; from left: Kelli Saunders, LOWWSF; Lucas King, GCT#3; Todd Sellers, LOWWSF; Chief Lorraine Cobiness, Niisaachewan Anishinaabe Nation. Photo: Wayne Jenkinson, IJC.

students, and citizens interested in the future health of our watershed. A list of organizations attending the Forum is included as Appendix A.

The Forum is the only professional symposium for scientists and resource managers working on research and management activities related to the binational Rainy-Lake of the Woods watershed. The Forum's ecosystem focus is a venue for presentations from all disciplines relevant to water quality and aquatic ecology in the watershed.

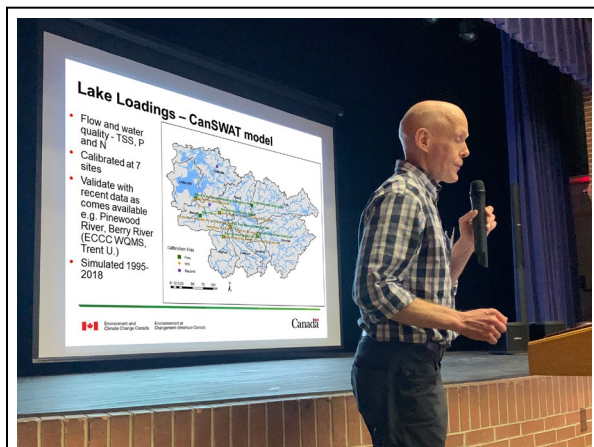
This year's Forum featured a two-day symposium and an evening poster session, together totalling 38 presentations. The schedule was full, with research presentations covering a wide range of disciplines including sessions on: watershed governance, an update on the Minnesota TMDL plan to cut phosphorus, a focus session on toxins produced by algae, a session on nutrient research in Canadian tributaries, a full day dedicated to outcomes of Environment and Climate Change Canada's (ECCC) Lake of the Woods science program and an international panel discussion session on next steps – with science as the foundation, what opportunities and approaches are needed to address nutrients and ecosystem health.

ECCC Science Session / Trent University Tributary Research

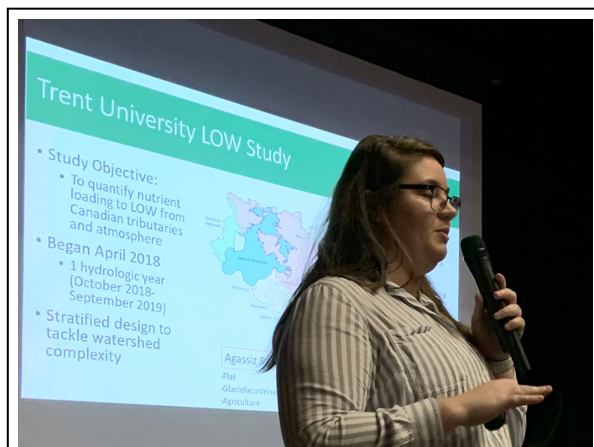
The full day devoted to outcomes of the Canadian federal science program on Lake of the Woods included reports on seven ECCC studies and three studies by Trent University researchers. Of note were reports on:

- Nearshore nutrient loading studies, indicating that modern septic drain fields function effectively in preventing phosphorus from entering the lake.
- Advances in satellite remote sensing technology and the development of quantitative indices for algal blooms that may provide useful tools to track and assess indices of algae bloom severity. Bloom severity indices have decreased since 2002, suggesting that the lake may be responding to historical decreases in phosphorus loads.
- Integrated watershed-lake-ecological outcome modeling, showing how they can be used to identify hotspots for nutrient loads and applicability of best management practices; the models indicate that lake phosphorus concentrations and algae can respond to reductions in watershed phosphorus sources and that cyanobacteria (blue green algae) reductions are more pronounced than other algae.
- Research on nutrient exports in Canadian tributaries by Trent University researchers, working with ECCC. These studies point to the importance of ongoing monitoring and that there are potentially important hotspots of phosphorus loading in small Ontario streams flowing into the Rainy River and Lake of the Woods that are candidates for best management practices.

ECCC also provided an update on the next steps that will be taken to determine what phosphorus reductions are necessary to achieve desired water



Craig McCrimmon, ECCC, presents results of CanSWAT modeling for Lake of the Wood watershed.



Kelly McGillivray, Trent University, presents her studies of phosphorus export in Canadian tributaries.

quality and ecosystem outcomes, and the actions that can help to achieve those reductions for the Canadian portion of the Rainy-Lake of the Woods Basin. Presented was its next step to engage Indigenous Peoples, stakeholders, and the public on appropriate ecosystem outcomes and the potential establishment of phosphorus targets based on ECCC and partners' science.

Cyanotoxin Session

The focus theme on cyanotoxin research featured six presentations from national to local levels of concern. Of note were:

- An overview of toxic harmful algal bloom occurrence and impacts on US Federal lands and Trust Species (protected species).
- An update on EPA research and recent national guidance / health advisories for microcystin and cylindrospermopsin exposures for both drinking water and recreational contact; and an overview of using EPA's mobile phone app from the Cyanobacteria Assessment Network (CyAN).
- A review of algal neurotoxin studies (anatoxin and saxitoxin) which are two of the most potent of the known cyanobacteria produced neurotoxins that are present in our basin waters but understudied.
- A study examining how algae toxins can accumulate in water and transfer up the food chain, including into fish tissues – information that will contribute to ecological risk assessments and importantly help inform human health risk in lakes plagued by blue-green algal blooms.

Other Research & Management Sessions

There were numerous other research presentations during the two-day symposium sessions. Many of the presentations this year focused on ecosystem monitoring, research and management implications or aspects informed by the research completed in the past few years.

Examples of this management focus included a progress update on the MPCA's WRAPS (Watershed Restoration and Protection Strategy) approach to restoring and protecting water quality in the Rainy Basin, and two presentations on experimental management of invasive hybrid cattail in Voyageurs National Park. There were also presentations detailing community based monitoring efforts focused on mercury contamination by Wabaseemoong Independent Nations on the Winnipeg and English rivers and the Community Based Monitoring (CBM) programs regionally by Grand Council Treaty #3 in Treaty #3 territories and specific presentation of the CBM program of Anishinaabeg of Naongashiing (Big Island) on Lake of the Woods.

Binational Updates Session

Michael Goffin, Canadian Co-Chair of the IJC International Rainy-Lake of the Woods Watershed Board provided an update on contributions to binational water management being made by the watershed board and its committees. Of note was the Board's in-progress development of a new committee for adaptive management and the project to review and develop revised recommendations for international Objectives and Board Alert Levels for water quality and aquatic ecosystem health. Updates were provided on the work of the Board's Engagement Committee, Water Levels Committee and Aquatic Ecosystem Health Committee.

A more detailed overview and progress report of the Board's "Objectives & Alert Levels" project was provided in a later presentation by Board Aquatic Ecosystem Health Committee Co-Chair Todd Sellers. He reported that Phase 1 was completed including a public comment period in this past December. Recommendations include developing a suite of international water quality objectives for phosphorus for

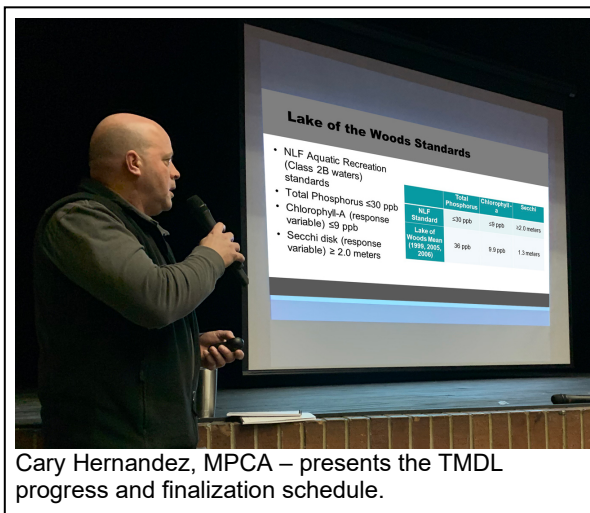


Reid Plumb, Voyageurs National Park biologist, explains details of the VNP restoration project to remove invasive hybrid cattails.

various segments of Lake of the Woods and the Rainy River and Alert Levels for other priority issues of potential concern.

Lucas King, on behalf of the GCT3 Women's Council and the GCT3 Territorial Planning Unit made a detailed presentation about the Nibi (water) Declaration, its principles and meanings for Anishinaabe water governance in the Treaty #3 Territory of Northwestern Ontario. Details of the resource management activities and next steps underway were provided and the Treaty #3 Watershed Model explained, based on four elements: Community based monitoring; Governance; Ceremony; and Community Outreach and Education. In response to questioning, Lucas explained that the IJC was an important element of working in the basin and that efforts were in progress to develop respect and working relationships with the IJC on a nation to nation basis.

An update on the activities of the International Multi-Agency Arrangement (IMA) during 2019-2020 (to date), was presented by Shane Bowe of Red Lake DNR. Much progress has been made since approval at the Forum last year of IMA restructuring and project approval by the IMA Workgroup (managerial committee). Details were provided on deliverables completed or in progress by the Technical Advisory Committee subcommittees for priority issues: Core Monitoring; Aquatic Invasive Species; Water Quality; and Contaminants. A basin-wide inventory of monitoring programs has been completed; an AIS Risk assessment should soon be underway; a draft outline for a white paper on challenges and approaches to water quality objectives is complete. Although the Contaminants subcommittee has yet to be formed, contaminants were included in the core monitoring inventory.

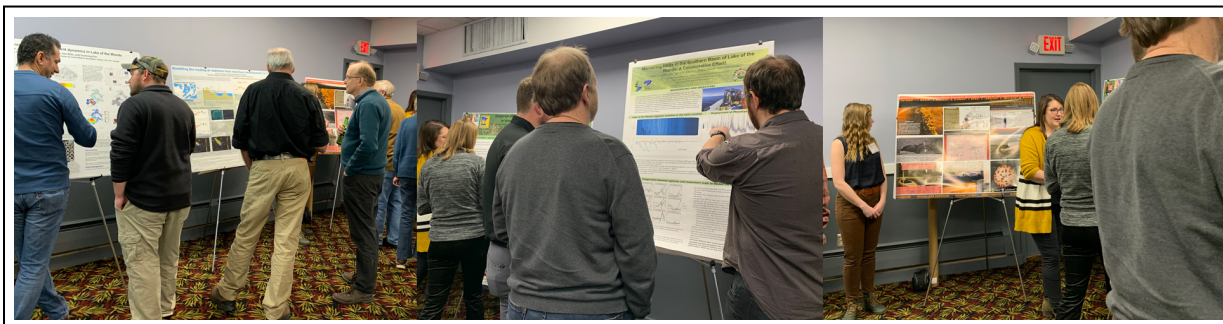


Cary Hernandez, MPCA – presents the TMDL progress and finalization schedule.

An update on the MPCA TMDL was presented by the tag-team of Cary Hernandez, MPCA and Geoff Kramer from RESPEC, the consulting engineering firm doing the TMDL modeling. The history and basis for the TMDL was reviewed and the HSPF watershed loading model and the BATHTUB lake model outputs presented. Model apportionment of loads by source and country were detailed and recent iterative refinements of the model discussed. An overall reduction in phosphorus load of 162.6 t/yr is recommended along with specific sector and source apportionment of reductions. The TMDL work is complete and is in final review with the US EPA. A summer rollout of public meetings on the TMDL is expected.

Foundation Reception and Poster Session

The Foundation reception and poster session on the evening of March 11th provided a collegial atmosphere to review the day's work, discuss the research poster presentations and develop professional networks. Posters presented covered a wide range of topics including details of Minnesota's comprehensive watershed plan (One Watershed One Plan) and studies of mercury, nanosilver, harmful algal bloom monitoring, cattails and sediment and nutrient dynamics and loading in Lake of the Woods.

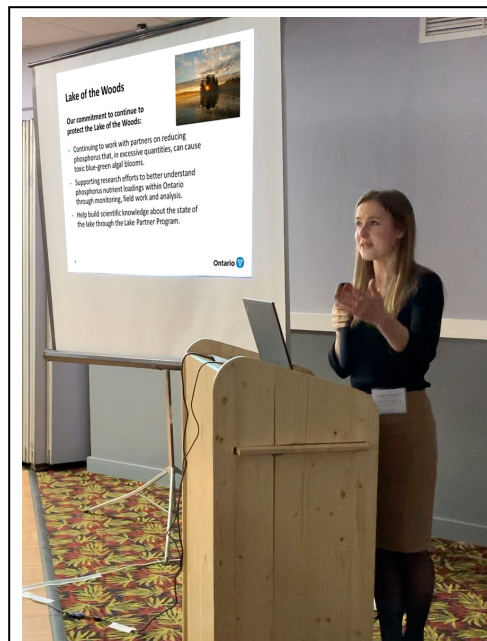


In addition to the Poster Session, the Foundation reception featured two guest presentations.

Andrea Khanjin, Parliamentary Assistant (PA) to the Ontario Minister of Environment, Conservation & Parks, Jeff Yurek, and MPP for Barrie – Innisfil attended the Forum and addressed the attendees at the reception. On behalf of Minister Yurek, PA Khanjin delivered an address highlighting progress under Ontario's Environment Plan which identified Lake of the Woods as a priority for actions. PA Khanjin noted with appreciation the effective collaborations between agencies, First Nations, US Tribes, NGOs and the public in the Rainy-Lake of the Woods Watershed – as evidenced by the Forum. She also asserted the commitments of the Government of Ontario to Lake of the Woods, including:

- Continuing to work with partners on reducing phosphorus that, in excessive quantities, can cause toxic blue-green algal blooms.
- Supporting research efforts to better understand phosphorus nutrient loadings within Ontario through monitoring, field work and analysis.
- Helping to build scientific knowledge about the state of the lake through the Lake Partner Program.

The efforts of PA Khanjin to attend the Forum and present these messages on behalf of Minister Yurek were greatly appreciated.



Andrea Khanjin, Parliamentary Assistant to the Ontario Minister of Environment, Conservation and Parks, Jeff Yurek, speaks to Ontario's commitments to Lake of the Woods.

Pauline Gerrard, Deputy Director of the International Institute for Sustainable Development – Experimental Lakes Area (IISD-ELA) provided a thought-provoking address on the experiences and lessons learned at the IISD-ELA in building relationships with First Nation communities.

After a brief review of the history of the IISD-ELA in applying whole-ecosystem research to solve environmental problems, Pauline spoke of the activities underway at the IISD-ELA to work more closely with Indigenous communities to look at how the two ways of knowing can work together and benefit each other.

Pauline highlighted a few key achievements including collaboration with the GCT3 to support community based monitoring and Ojibwe language translation of some key education materials. Pauline concluded with a discussion of what she and the IISD-ELA have learned along the way, including the importance of individual connection with respect and honesty; understanding communities' needs; and incorporating the preservation and revitalization of Indigenous culture and language into collaboration efforts.



Pauline Gerrard, IISD-ELA delivers address at reception on "Relationships: Lessons from a Western science facility located in First Nations territory"

The Kallemeyn Award

Tim Pascoe, Environmental Scientist with ECCC is the 2020 recipient of the Kallemeyn Award, recognizing his outstanding professional achievements and contributions to collaborative research and resource management in the Rainy-Lake of the Woods Basin.

The Lake of the Woods Water Sustainability Foundation presented the award on behalf of the community of scientists and resource managers from the United States and Canada working in our watershed.

Tim is described by his international colleagues as their first contact – the “go to guy” – who other agencies and scientists turn to when they need data from ECCC, advice or assistance with collecting water or sediment samples and who is always helpful in connecting partners with ECCC scientists.

Tim has led the Lake of the Woods and Rainy River monitoring program for ECCC for more than a decade. This has included the collection of water quality and biomonitoring data that have formed the basis of technical reports, scientific studies, and national and international collaborations. The Kallemeyn Award selection committee noted that Tim works tirelessly behind the scenes to ensure that ECCC collects high quality data, and that these data are made available to answer important research and management questions in the basin. These data have been used in nearly every major initiative, including published papers, the 2014 Rainy-Lake of the Woods State of the Basin Report, International Joint Commission reports, and Minnesota's Lake of the Woods Total Maximum Daily Load study.

A heartfelt thanks and congratulations to Tim from the Foundation and the researchers gathered at the Forum for a well-deserved accolade!

Wilson Stewardship Award

Pauline Gerrard, Deputy Director of IISD Experimental Lakes Area (IISD-ELA) is the 2020 recipient of the Wilson Stewardship Award. She was honoured with this international award for her leadership in developing environmental education programs at IISD-ELA; for building knowledge sharing between scientists, First Nations community members and the general public; and for helping to educate the scientists of tomorrow.

The Lake of the Woods Water Sustainability Foundation presented the award to Pauline on behalf of the community of scientists, resource managers and water stewards from the United States and Canada. As Deputy Director of IISD-ELA, Pauline Gerrard is building high impact education and outreach programs through the IISD-ELA that reach the broadest audience and those who can make a difference.

Congratulations to Pauline and her team at the IISD-ELA!



Tim Pascoe of ECCC (3rd from left) received the Kallemeyn Award accompanied by former award recipients (at left) Ryan Maki, Voyageurs National Park and Mark Edlund, Science Museum of Minnesota and (from right) Kevin Peterson, Minnesota DNR and Jesse Anderson, Minnesota Pollution Control Agency. Todd Sellers (3rd from right) presented the award on behalf of the



Pauline Gerrard of the IISD-ELA was honoured with the Wilson Stewardship Award at the 2020 Rainy Lake of the Woods Watershed Forum. From left: Todd Sellers, LOWWSF, Pauline Gerrard, IISD-ELA, Kelli Saunders, LOWWSF, and Jeff Pike, White Iron Chain of Lakes Association.

Meetings of Other Groups Co-located at the Forum

The 17th Annual International Rainy-Lake of the Woods Watershed Forum was not only host to a jam-packed, two-day science symposium, but once again served as the hub for a series of additional meetings and workshops that take advantage of having scientists, resource agencies, IJC staff and others all together in one place. Here are highlights from the ancillary meetings that took place:

International Multi Agency Arrangement (IMA) – Joint Technical Advisory Committee and Working Group (Attendance: 29)

Once again this year, the IMA's Technical Advisory Committee (TAC) and the Working Group (WG) met jointly during the day before the Forum. Following on the past year's successful launch of priority projects by the TAC, the U.S. co-chair, Shane Bowe of Red Lake Band, facilitated discussions on progress that has been made and funding opportunities that may be available to support the TAC projects, including the IJC's IWI fund. The need for a core monitoring framework was highlighted as a project that would service both the IMA and the Board and is one of the priorities of the TAC's Core Monitoring Subcommittee. Of particular note was the headway made by the TAC's Aquatic Invasive Species (AIS) Subcommittee to develop a communication strategy across the border, to develop a real time mapping of invasive aquatic species in the basin and to gear up to support the future Objectives and Alerts project team and the team who will be working on a basin-wide coarse scale risk assessment for AIS.

Water Levels Committee Public Meeting

Approximately 30 people attended the Water Levels Committee public meeting on Tuesday, March 10th. The Committee presented a summary of basin conditions and long-term forecast information and announced its decision to use the high flood risk rule curve on Rainy Lake this spring. Members of the IRLWWB Adaptive Management Task Team also provided an overview of the board's progress on the implementation of an adaptive management strategy.

International Rainy-Lake of the Woods Watershed Board – Community Advisory Group Meeting (Attendance: 9)

Members of the CAG received updates from the Aquatic Ecosystem Health Committee on the Objectives and Alerts Project and other upcoming possible IWI project funding requests. The Water Levels Committee provided information on the implementation of the brand new 2018 rule curves for Rainy and Namakan Lakes. In roundtable discussions, members discussed cumulative effects of mining, shoreline development pressures and twinning of the TransCanada Highway between Kenora and Winnipeg.

International Rainy-Lake of the Woods Watershed Board – Industry Advisory Group Meeting (Attendance: 15)

Members of the IAG met on the afternoon of March 10 for their annual face to face session. The group heard updates from IJC advisors and the International Watershed Coordinator. Members also received updates on each of the Board's committees and enjoyed a presentation on the 2019 detection of zebra mussels in Lake of the Woods from the Minnesota Department of Natural Resources Aquatic Invasive Species Specialist, Nicole Kovar. IAG members also discussed round table issues, most of which revolved around industry impacts of the extreme 2019 fall rains and water levels going into freeze up.

CAG/IAG and Board Meeting

The Board met with members of both the CAG and IAG on the afternoon of March 10th. This was an opportunity for advisory group members to receive updates on board activities, including water levels, aquatic ecosystem health and public engagement activities and to voice any issues, concerns or topics of interest to the Board.

IRLWW Board Meeting

The board met in the afternoon of March 10 to discuss board business, including filling vacant seats on advisory groups, status of the annual board report and initial preparations for the board meetings in August, which are to be held in Kenora, ON this year. Updates on board projects were then provided, including current status of the new Adaptive Management Committee, plans to launch Phase II of the Objectives and Alerts project, updates on IWI projects and then updates from the board's AEHC, WLC

and Engagement Committee. The meeting closed off with updates from the CAG, IAG, IJC and International Watershed Coordinator.

International Watershed Coordination Program: Fourth Binational Civic Engagement Workshop (Attendance: 27)

The fourth Binational Civic Engagement Workshop ran on the day before the Watershed Forum, hosted by the Lake of the Woods Water Sustainability Foundation and Minnesota Pollution Control Agency. It drew a crowd from Soil and Water Conservation Districts, lake associations, resource agency staff, NGOs, the International Joint Commission and others who came together to hear from each other on civic engagement programs, successes and approaches.

Presentations were made on topics ranging from how to bring science to citizens, finding common ground to protect water quality and prevent AIS with partners and promoting stewardship through a diverse toolkit. Diane Schwartz-Williams was one of the presenters, highlighting the success of the Area News magazine, the LakeSmart Program and on-the-ground projects like the purple loosestrife/beetle project and Metal Waste Collection Day.

Some key messages that came from the workshop were: continuously get the word out on your stewardship successes; utilize social media wherever possible; and, don't be afraid to include a bit of "wow" factor in outreach materials to attract attention. With 27 people in attendance, the session was well attended and there was great conversation



Civic engagement programs of LOWDSA were highlighted at the workshop including LakeSmart, Invasive species prevention and youth engagement programs.

Program At A Glance

DAY 1 – MARCH 11

8:30	0:30	Coffee available in Rainy River Community College Cafeteria
9:00	0:40	Welcome & Traditional Protocols
Session 1 - Governance Updates		
9:40	0:15	International Rainy-Lake of the Woods Watershed Board update Board Co-Chair (M. Goffin or Col K. Jansen TBD)
9:55	0:10	Global Affairs Canada binational update Felicia Minotti, GAC
10:05	0:20	Nibi (water) Declaration: Anishinaabe water governance in the Treaty 3 area in Northwestern Ontario Lucas King, Grand Council Treaty 3
10:25	0:15	International Multi-Agency Arrangement update Shane Bowe, IMA WG US Co-Chair
10:40	0:30	Break - Coffee
11:10	0:20	Lake of The Woods Total Maximum Daily Load Study: A progress report Cary Hernandez, MPCA ; G. Kramer, J. Blackburn, RESPEC
11:30	0:20	IJC Objectives and Alert Levels Project IJC Objective and Alerts Study Team
Session 2 - Cyanotoxins		
11:50	0:20	Algal toxin exposures on Reserved Federal Lands and Trust Species Z. Laughrey et al. (Victoria Christensen), USGS
12:10	0:20	EPA Region 5 Harmful Algal Blooms Update Janette Marsh and Wendy Drake, US EPA Region 5
12:30	1:30	Lunch
14:00	0:20	Freshwater neurotoxins and concerns for human, animal, and ecosystem health with a focus on Kabetogama Lake, Voyageurs National Park Victoria Christensen et al., USGS
14:20	0:20	Investigating presence of cyanotoxins in fish of Voyageurs National Park Seth McWhorter, U. Georgia
14:40	0:20	Rapid-assessment test strips: Effectiveness for cyanotoxin monitoring in a north temperate lake Jaime Leduc et al., Voyageurs National Park
15:00	0:20	Distribution and flux of microcystin congeners in lake sediments Arthur Zastepa, ECCC
15:20	0:30	Break - Coffee
Session 3: Ecosystem Monitoring, Research & Management		
15:50	0:20	Update on the MPCA's watershed approach to restoring and protecting water quality in the Rainy Basin Mike Kennedy, Lindsey Krumie and Amy Mustonen, MPCA
16:10	0:20	Do muskrats eat hybrid cattail? An experimental approach using feeding trials with wild-caught muskrats Steve K. Windels et al., Voyageurs National Park
16:30	0:20	WIN English-Wabigoon Rivers Remediation Project Marvin McDonald, Wabaseemong Independent Nations
16:50	0:20	Hybrid cattail removal and wetland restoration in Voyageurs National Park: A project update Reid Plumb, VNP
17:10	0:20	Grand Council Treaty #3: Community based monitoring Chris Herc and Len Gibbons, Grand Council Treaty 3
17:30	0:30	Free Time & Poster Setup
18:00	3:00	Poster Session & Foundation Reception / Buffet Dinner (AmericInn) (See next page)

EVENING DAY 1 – MARCH 11

6:00 Foundation Reception & Poster Session (AmericInn, buffet dinner)

Guest Speakers

Andrea Khanjin

Parliamentary Assistant to the Ontario Minister of Environment, Conservation and Parks, and Member of the Ontario Provincial Legislature for Barrie – Innisfil

Pauline Gerrard, Deputy Director, International Institute for Sustainable Development – Experimental Lakes Area (IISD-ELA)

"Building relationships: Lessons from a western science facility located in First Nations territory"

Award Presentations

- Kallemeyn Award
- Wilson Stewardship Award

Posters

1. Trends in regional wet mercury deposition and lacustrine mercury concentrations in four lakes in Voyageurs National Park—an update
[Mark E. Brigham](#)¹, [David VanderMeulen](#)², and [Ryan Maki](#)²
¹U.S. Geological Survey; ²Voyageurs National Park
2. Summary of Fish Responses to a Whole-Ecosystem Nanosilver Addition at IISD-Experimental Lakes Area
[Lauren Hayhurst](#)^{1,2}, [Jonathan Martin](#)³, [Valerie Langlois](#)⁴, [Sarah Wallace](#)^{4,5}, [Brenden Slongo](#)², [Tyler Ripku](#)², [Chris Metcalfe](#)³, and [Michael D. Rennie](#)^{1,2}
¹IISD Experimental Lakes Area; ²Lakehead University; ³Trent University; ⁴Institut National de Recherche Scientifique; ⁵Queen's University
3. Monitoring HABs in the Southern Basin of Lake of the Woods: A Collaborative Effort!
[Adam J. Heathcote](#)¹, [Mark B. Edlund](#)¹, [Shane Bowe](#)²; [Cary Hernandez](#)³
¹St. Croix Watershed Research Station, Science Museum of Minnesota; ²Red Lake Department of Natural Resources; ³Minnesota Pollution Control Agency
4. Lake of the Woods Watershed Comprehensive Watershed Plan: Putting Science into Action
[Jeremiah Jazdzewski](#)¹ and [Mike Hirst](#)²
¹Houston Engineering, Inc.; ²Lake of the Woods Soil and Water Conservation District
5. Dispersal of Floating Cattail Mats in Rainy Lake, Minnesota
[Chandra L. Wiley](#)¹, [Reid T. Plumb](#)¹, [Bryce T. Olson](#)², [Steve K. Windels](#)¹
¹Voyageurs National Park; ²Ressurs Consulting LLC
6. Potential role of sediment resuspension on nutrient dynamics in Lake of the Woods
[Reza Valipour](#), [Ian Droppo](#), [Johann Biberhofer](#), [Jun Zhao](#), and [Yuanrong Pan](#)
Environment and Climate Change Canada
7. Modelling the loading of nutrients from nearshore developments to Poplar Bay
[Dale R. Van Stempvoort](#), [Craig McCrimmon](#), [Reza Valipour](#) and [Serban Danielescu](#)
Environment and Climate Change Canada

DAY 2 – MARCH 12

7:45	0:40	Coffee available in Rainy River Community College Cafeteria
8:25	0:05	Day 2 Welcome and Introductions
Session 4 - Canadian Tributary Hydrology		
8:30	0:20	Longitudinal patterns in nutrient export in the lower Rainy River watershed Kelly Macgillivray, Trent U.
8:50	0:20	Characterizing the hydrology of the Lake of the Woods watershed: the potential influence of basin storage on flow regime and streamflow response to extreme weather Wes Greenwood, Trent U.
Session 5 - Environment & Climate Change Canada's Lake of the Woods Science Program		
9:10	0:10	Introduction and overview of the ECCC science session Mohamed Mohamed, ECCC
9:20	0:20	An integrated modelling and monitoring framework for assessing nutrient dynamics and algal blooms in Lake of the Woods. Ram Yerubandi, ECCC
9:40	0:20	10 Years On: A Summary of ECCC Monitoring in Lake of the Woods Tim Pascoe, ECCC
10:00	0:30	Break
10:30	0:20	Phosphorus loading in the LOW watershed: tributaries and atmospheric deposition Catherine Eimers, Trent U.
10:50	0:20	Loading of nutrients from nearshore developments to Lake of the Woods Dale Van Stempvoort, ECCC
11:10	0:20	Spatiotemporal diversity of phytoplankton structure and function in Lake of the Woods: Insights into bloom formation and toxin production A. Zastepa, ECCC
11:30	0:20	An overview of ECCC's progress in satellite remote sensing of algal blooms on Lake of the Woods Caren Binding, ECCC
11:50	0:20	Application of CanSWAT watershed modelling for Lake of the Woods Craig McCrimmon, ECCC
12:10	0:05	<i>Slack - Overrun</i>
12:15	1:30	Lunch - Walleye Fry
13:45	0:20	Phosphorus loads and algal response scenarios: outcomes from the application of a coupled watershed-lake model of Lake of the Woods Reza Valipour, ECCC
14:05	0:10	Summary and synthesis of ECCC science presentations Mohamed Mohamed, ECCC
14:15	0:20	ECCC Policy: Path forward Michael Goffin, ECCC
14:35	0:15	Break -- 7th inning stretch
14:50	1:10	Session 6 Moderated Panel Discussion
		"Opportunities moving forward: Building from the science to date to address ecosystem health" Michael Goffin/Tricia Mitchell, ECCC ; Janette Marsh, USEPA ; Nicole Blasing, MPCA ; Jeff Hrubes, BWSR
16:00	0:10	Closing Remarks - Forum Ends 4:10 pm

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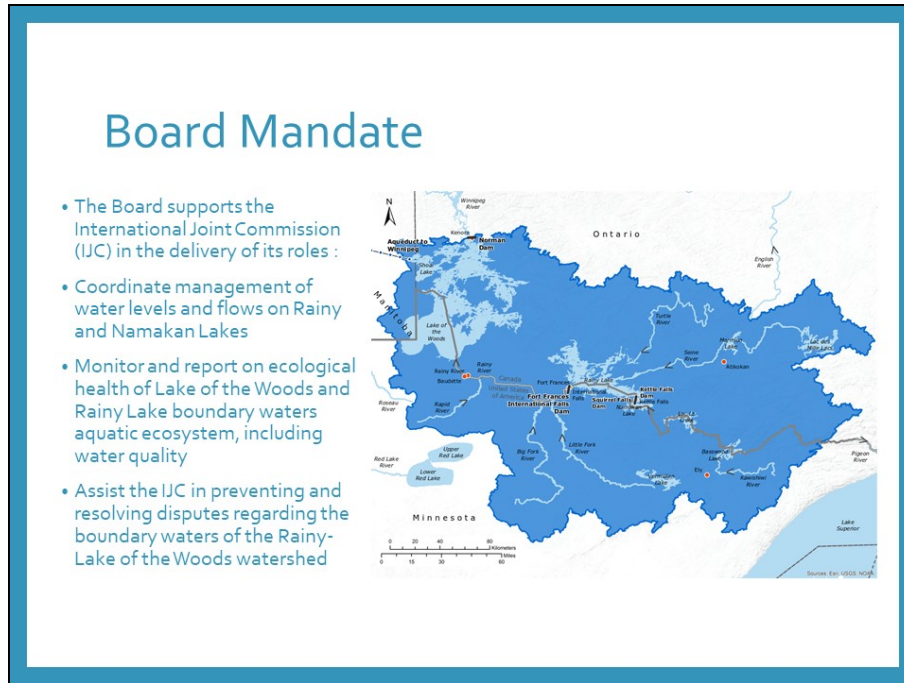
Oral Presentation Abstracts

Session 1 – Watershed Governance

International Rainy-Lake of the Woods Watershed Board update

Board Canadian Co-Chair: Michael Goffin

International Rainy-Lake of the Woods Watershed Board



Abstract

This update includes the activities of the Rainy-Lake of the Woods Watershed Board during 2019 – 2020 to date, highlighting those related to aquatic ecosystem health, water levels and public engagement as well as updates on International Watershed Initiative projects and proposals and the work of the International Watershed Coordination Program. The Board completed Phase 1 of a project to review and make recommendations on water quality and aquatic ecosystem health Objectives and Alert Levels as well as finalization of a transboundary emergency response / coordination document. The presentation highlights the role of the Water Levels Committee, the communication efforts of the Engagement Committee and the ongoing support provided by the International Watershed Coordinator in linking international, regional and local efforts in the basin.

Brief Bio

Michael Goffin is the Canadian Co-chair of the International Rainy Lake of the Woods Watershed Board and a member of the Aquatic Ecosystem Health Committee. Mike is Regional Director General (Ontario) for Environment and Climate Change Canada. Over the course of his more than thirty-year career in the Public Service of Canada, he has been engaged in policy development and program delivery for environmental protection, wildlife management, meteorology, water and ecosystem management, intergovernmental affairs and community outreach and engagement. For more than a decade, he has been responsible for leading Canada's efforts to restore and protect the water quality and ecosystem health of the Great Lakes. Mr. Goffin received his undergraduate training in environmental studies from the University of Toronto, and a Master of Science degree in Geomorphology, also from the University of Toronto.

Location of Study

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

Global Affairs Canada binational update

[Felicia Minotti](#)

Global Affairs Canada, 125 Sussex Drive, Ottawa, Ontario K1A 0G2



Abstract

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

Brief Bio

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

Location of Study

Binational Rainy-Lake of the Woods Basin

Nibi (water) Declaration: Anishinaabe water governance in the Treaty 3 area in Northwestern Ontario

Lucas King

Grand Council Treaty #3



Abstract

Based on the responsibility and sacred connection that Anishinaabe women have to water, the Women's Council of GCT3 have lead a nation-based development of a Nibi (water) Declaration. Grounded in Indigenous values, the Declaration provides water policy to guide watershed management planning in Treaty 3 Territory.

Beginning from the premise that water has a spirit, this project, the development of the Nibi Declaration probes Indigenous knowledge of sacred, cultural and spiritual relationships with water. The Declaration builds on land-based contextual knowledge of the Anishinaabe people of Treaty 3, an area which houses a significant amount of freshwater in Northwestern Ontario.

This presentation focuses on the development of the Declaration and how as an indigenous values policy, the declaration, can influence and guide watershed management planning. Extending from the understanding of the obligations and responsibilities that flow from the sacred relationship with water will impact individuals, families and communities in their actions. This will assist with principled nation-based, external policy and decision-making relating to the watershed and territories that continue to face growing pressure from forestry and mining, sport and commercial fishing and water extraction for commercial use.

Grand Council Treaty 3 (GCT3) and Decolonizing Water Governance have jointly supported the Women's Council in community-led and community-engaged research and collaborative governance for the development of a nation-based Nibi (Water) Declaration. Prioritizing the need to strengthen Treaty 3's Indigenous water governance, the purpose of this project is to support the development and ratification of a Nibi Declaration based on Indigenous normative values, principles and protocols. This will assist in clarifying roles and responsibilities that Anishinaabe, Anishinaabe Government, allies and external entities and decision-makers have in support of the exercise of those responsibilities.

The Nibi Declaration was initiated by the Women's Council of the Grand Council Treaty 3 (GCT3) the traditional government of 28 First Nations communities. The women who represent the

various regions with the GCT3, along with other Anishinaabe have asserted their inherent stewardship for water and developed a statement of the nation's relationship with water, which will serve to provide policy and project guidance the creation of an indigenous values foundation for watershed management planning.

Through the series of regional and national engagement sessions, guidance and teachings were shared to develop the Nibi (water) Declaration. Elders and knowledge keepers talked about the veins of the Territory and the water that flows through them connecting the Nation. The toolkit will not only support the Declaration but also enhance the process of Treaty 3 watershed management planning. Planning will be guided using interactive Treaty 3 maps online, developing the understanding of past impacts, current state of the Territory and future implications. This coincides with the GCT3 community based monitoring program as data can be stored and viewed to inform decision making, water policy and management planning on a community, regional and national level.

Treaty 3 is marked by rapid expansion in resource development such as mining, forestry and nuclear waste management. Indigenous knowledge speaks to water being alive and having a spirit, therefore the activities to protect it must respect this spirit and personhood. The Declaration will influence watershed management planning from a foundation of Indigenous values, bringing together the two paths of ceremony and management practices to protect Treaty 3 water for future generations. This creates a holistic approach, respecting all beings in creation, in water management unseen in current western practices.

Brief Bio

Lucas King is Director (Acting) of the Territorial Planning Unit.

Location of Study

Treaty #3 Territory.

International Multi-Agency Arrangement update

Shane Bowe, IMA Work Group US Co-Chair

International Multi-Agency Arrangement



Abstract

The International Multi-Agency Arrangement (IMA) has been working as a collective of cross border agencies focused on water quality in the watershed since 2009. This past year, progress of the IMA Technical Advisory Committee (TAC) subcommittees for Aquatic Invasive Species and Water quality (current focus on nutrients and algae) are highlighted including the development of a project for AIS risk assessment, in support of the IJC Rainy-Lake of the Woods Watershed Board and a white paper on development of nutrient objectives.

Brief Bio

Shane Bowe is the US Co-chair of the IMA Working Group and the water resources director of the Red Lake Department of Natural Resources.

Location of Study

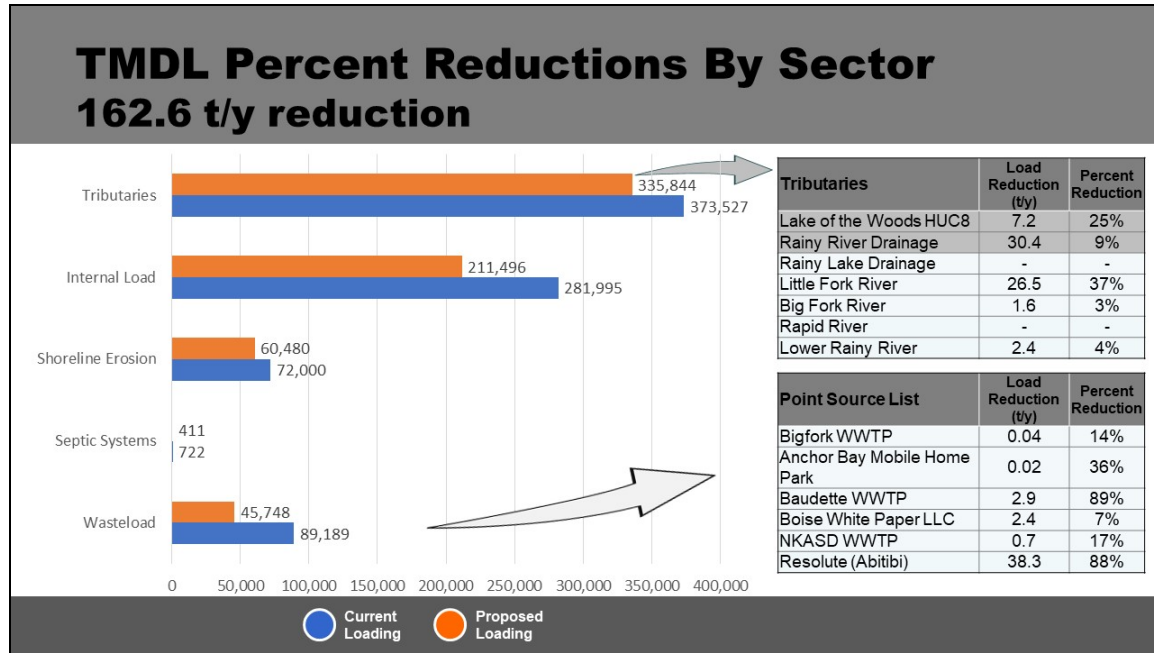
Rainy-Lake of the Woods watershed.

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

Cary Hernandez¹; Geoff Kramer², Julie Blackburn²

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²RESPEC Water & Natural Resources, 1935 West County Road B2, Suite 230, Roseville, MN 55113; PH 651-305-2274, geoff.kramer@respec.com; 651-305-2272, julie.blackburn@respec.com



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.

To prepare the TMDL, discharge and nutrient loading from Lake of the Woods' tributaries were characterized using the Hydrologic Simulation Program-FORTRAN (HSPF) model, which was run for the period 1996-2014 and calibrated to available tributary monitoring data. The HSPF output for the TMDL study period (2005-2014) was used to develop a BATHTUB model for the lake, which was used to determine the in-lake response to nutrient loading. A mass balance analysis of internal phosphorus loading was conducted to quantify internal loading for use in BATHTUB. The BATHTUB model was then used to determine the annual loading the lake can support while achieving its water quality standards.

While declines in phosphorus loading have occurred as wastewater treatments have improved, further reductions are needed. Internal loading remains a major phosphorus source. A review of US and Canadian point source discharges was conducted to finalize present and future conditions including growth expectations. The TMDL allocations are being finalized as part of the TMDL report.

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 29 years.

Geoff Kramer holds an M.S. in Biosystems & Agricultural Engineering from the University of Minnesota. He has extensive experience with hydrologic, hydraulic, and water quality modeling in urban, rural, and forested watersheds. He has experience with lake TMDLs and the BATHTUB eutrophication model. He also has experience with water quality BMPs, economic analysis, and analysis related to cost effectiveness of BMPs and BMP treatment trains.

Julie Blackburn is the Minnesota Area Manager for RESPEC. She has worked extensively with SWCDs, watershed districts, state and federal conservation agencies in the fields of watershed management, drainage management, TMDL implementation, and resource conservation planning. She has also provided leadership to watershed districts, overseeing all facets of comprehensive watershed management.

Location of Study

Entire Rainy-Lake of the Woods Watershed

IJC Objectives and Alert Levels Project

Todd Sellers

Co-Chair, Aquatic Ecosystem Health Committee, Rainy-Lake of the Woods Watershed Board



Phase 1 Recommendations

1. Remove outdated Objectives for Rainy River
2. Develop set of TP Objectives for sub-segments Lake of the Woods and Rainy R.
3. Establish Alert Levels for short list of priority substances
4. AIS – Alert Levels based on demonstrated risk – risk assessments needed
5. More work required to pin down approach to AEH in consultation with Board and others
6. Incorporate indigenous considerations in development of Objectives and Alerts

Abstract

In November 2018, the Rainy-Lake of the Woods Watershed Board began a two-phase project to review existing Objectives and Board Alert Levels for the Rainy River and recommend new or revised one, not just for the Rainy River but for the boundary waters under the Board's mandate. This is part of a broader review process by the IJC and its four boards with water quality mandates. Objectives refer to international objectives agreed to by Canada and the USA. Alert Levels are Board-adopted trigger levels for advising the IJC of issues of potential concern where there are no international Objectives. This presentation provides an update on Phase 1 and a preview of activities for Phase 2. Phase 1 was completed in December 2019 with a report to the IJC and 30 day public comment period. Phase 1 identified priority issues and related needs for Objectives or Alert Levels and where they were needed. Development of specific metrics or indicators will be the focus of Phase 2. Phase 1 recommendations include: 1) the development of international Objectives is phosphorus, for Lake of the Woods and the Rainy River, with set of Objectives for subsegments of these waters; 2) Alert Levels for a short list of priority substances of potential concern; 3) Alert Levels based on demonstrated risk (and risk assessments) for aquatic invasive species; 4) Incorporation of indigenous considerations in the development of these Objectives and Alert levels is recommended.

Brief Bios

Todd Sellers is a Canadian public member of the Rainy-Lake of the Woods Watershed Board and Co-chair of its Aquatic Ecosystem Health Committee. Todd is Executive Director of the Lake of the Woods Water Sustainability Foundation. He holds a Master of Science degree in aquatic biology from the University of Alberta, with his thesis work on impacts of climate change on lake trout habitat conducted at the IISD-Experimental Lakes Area, east Kenora.

Location of Study

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

Session 2 – Cyanotoxins

Algal toxin exposures on Reserved Federal Lands and Trust Species

Zachary R. Laughrey¹, Robert J. Dusek², Victoria G. Christensen^{*3}, Sarena Senegal¹, Lee Jones⁴, Tracy Ziegler⁵, Daniel K. Jones⁶, Brianna M. Williams⁶, Stephanie E. Gordon⁶, Julia S. Lankton², and Keith A. Loftin¹

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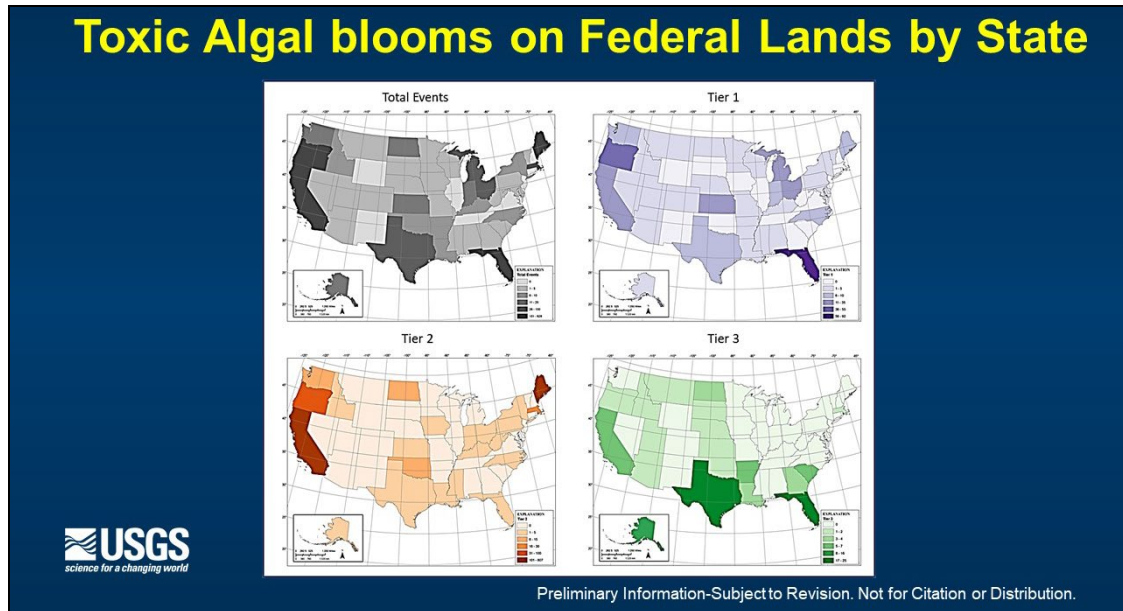
²United States Geological Survey, National Wildlife Health Center, Madison, WI 53711

³United States Geological Survey, Upper Midwest Water Science Center, Mounds View, MN 55112

⁴US Fish and Wildlife Service, Wildlife Health Office, Bozeman, MT 59715

⁵National Park Service, National Parks of Eastern North Carolina, Manteo, NC 27954

⁶United States Geological Survey, Utah Water Science Center, West Valley City, UT 84119



Abstract

Toxic harmful algal blooms (HABs) are perceived to be increasing in frequency and duration in US surface waters. The US Federal government holds approximately 640 million acres of land, many of which contain surface water, in trust (Federal lands). These lands are managed by federal agencies for flood control, habitat preservation, and recreation. Waterbodies within these holdings are comprised of fresh, marine, and estuary waters and each contains different species of algae and cyanobacteria, which may produce toxins that could affect ecosystem, animal, and human health. For this study, peer reviewed literature, government reports, and government issued warnings/closures were divided into four tiers of increasing likelihood of health impacts: occurrence; occurrence that exceeded a state or local threshold; suspicions of animal deaths or illness; or animal illness or death confirmed to have been caused by HAB toxins. From this review, it was determined that approximately 12% of Federal lands (parks, reserves, reservoirs, etc.) met at least one of the four criteria used for inclusion. Additionally, the US Federal government protects certain species of animals (Trust Species) due to laws and treaties (endangered species, migratory birds, and marine mammals). To date, over 60 trust species have been exposed to toxins produced by algae and cyanobacteria leading to illness and death. The history of HABs on US Federal lands and trust species, data gaps, and possible future studies will be discussed.

Brief Bio

Victoria Christensen is a Research Scientist at U.S. Geological Survey. She is a member of the USGS Integrated Ecosystems & Toxins Science Teams, and serves as Associate Editor of the USGS GeoHEALTH news. Her research focuses on nutrient enrichment & algal bloom formation in lake and river systems, with a focus on toxins.

Location of Study

US Federal lands.

EPA Region 5 Harmful Algal Blooms Update

Janette Marsh and Wendy Drake

US EPA Region 5, 77 W. Jackson Blvd., Chicago, IL 60604 312-886-4856 marsh.janette@epa.gov

- CyAN Mobile App provides water quality managers with a user-friendly tool that reduces the complexities associated with accessing satellite data to allow fast, efficient, initial assessments across lakes and drinking water reservoirs.
- Data from the Ocean and Land Colour Instruments (OLCI) sensor onboard the European Space Agency Copernicus Sentinel-3 satellite are used in *near real-time* to make initial water quality assessments and quickly alert managers to potential problems and emerging threats related to cyanobacteria.



A partnership

CyAN is a multi-agency (NASA, NOAA, USGS and EPA) effort that supports environmental management and public use of US lakes and reservoirs by providing a capability of *detecting and quantifying algal blooms* using satellite data records and disseminating this information through a mobile application developed and hosted by EPA.

10

Abstract

EPA Region 5 staff will present information about what EPA is doing in the region, as well as nationally, related to harmful algal blooms (HABs). For example, Region 5 has been convening regular (e.g., triannual) calls with the six states in the region (Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin) to discuss related EPA research and share information about state initiatives. EPA HAB-related guidance and projects will be briefly summarized during this presentation, including the EPA/NASA/NOAA/USGS Cyanobacteria Assessment Network mobile application (CyAN app), Regional Applied Research Effort (RARE) projects, and other EPA-funded initiatives. Additional EPA HAB-related resources are available online: <https://www.epa.gov/cyanohabs>.

Brief Bio

Janette Marsh is the International Watersheds lead with US EPA Region 5. Wendy Drake is the Harmful Algal Blooms (HABs) lead with US EPA Region 5.

Location of Study

Six states of the EPA Region 5.

Freshwater neurotoxins and concerns for human, animal, and ecosystem health with a focus on Kabetogama Lake, Voyageurs National Park

Victoria G. Christensen*, Ryan P. Maki, Erin A. Stelzer, Jaime F. LeDuc, Jack Norland, and Eakalak Khan

*North Dakota State University, Environmental and Conservation Sciences Program, Fargo, ND, and U.S. Geological Survey, Upper Midwest Water Science Center, Mounds View, MN, USA, 2280 Woodale Drive, Mounds View, MN 55112, 612-759-3187, vglenn@usgs.gov



Cyanobacterial bloom on Kabetogama Lake, photo taken September 25, 2018 by Jaime LeDuc, NPS.

Abstract

Toxic cyanobacteria are a growing concern worldwide because they can negatively affect humans, animals, and ecosystems. We reviewed studies of anatoxin-a and saxitoxin, two of the most potent of the known classes of cyanobacteria-produced neurotoxins, which are understudied in freshwater environments. Examples of human and animal health concerns can range from acute to chronic. However, few studies have focused on chronic or sub-lethal effects of the neurotoxins, even though these neurotoxins have been detected regionally, including Voyageurs National Park. In Kabetogama Lake, we documented the presence of neurotoxin-forming cyanobacteria, as well as anatoxin-a and saxitoxin, indicating that additional sampling for neurotoxins may be necessary to fully assess human health risk. Ecosystem health also is a concern, as the effects of toxicity may be far reaching and include consequences throughout the food web. The growing concern over cyanotoxins will require further study of: 1) neurotoxins such as anatoxin-a and saxitoxin, 2) their occurrence and biogeography, 3) triggers of production and release, 4) environmental fate and degradation, 5) primary and secondary exposure routes, diurnal variation, food web effects, 6) the effects of cyanotoxins mixtures, and 7) sublethal health effects on individual organisms and populations.

Brief Bio

Victoria Christensen is a Research Scientist at U.S. Geological Survey. She is a member of the USGS Integrated Ecosystems and Toxins Science Teams, and serves as Associate Editor of the USGS GeoHEALTH news. Her research focuses on nutrient enrichment and algal bloom formation in lake and river systems, with a focus on toxins.

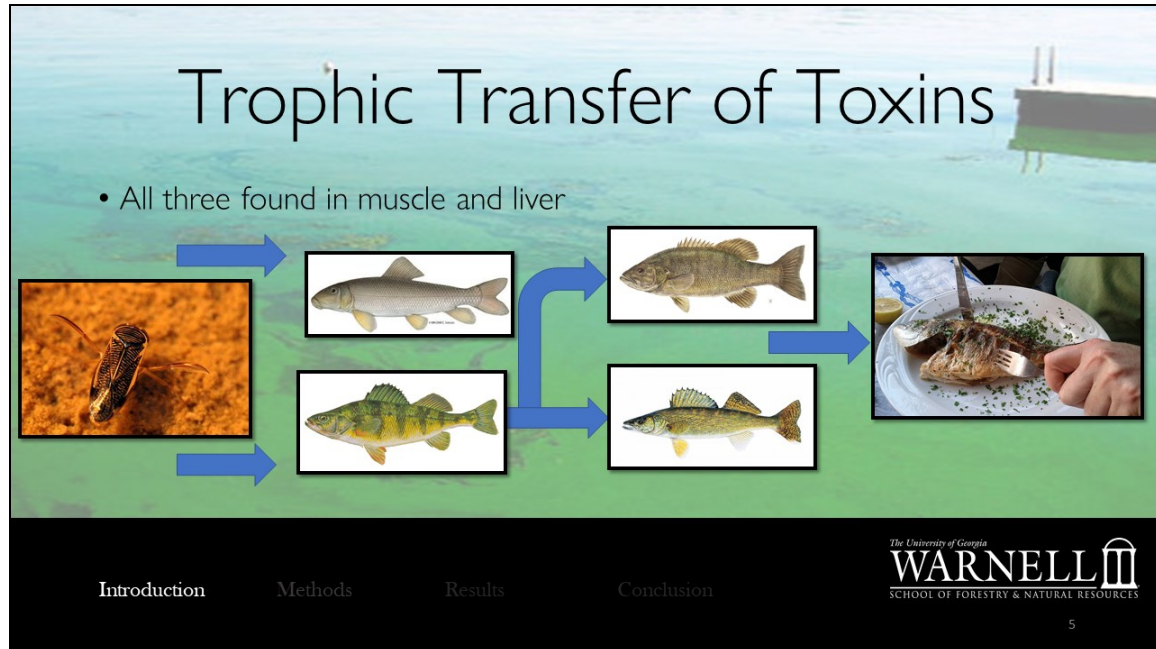
Location of Study

Kabetogama Lake, Voyageurs National Park.

Investigating presence of cyanotoxins in fish of Voyageurs National Park

Seth McWhorter, Victoria Christensen, Ryan Maki, Jaime LeDuc, Susan Wilde

University of Georgia- Warnell School of Forestry and Natural Resources
180 E Green St, Athens, GA 30602 (678)895-2661 Seth.mcwhorter@uga.edu



Abstract

Harmful cyanobacterial algal blooms (cyanoHABs) are an increasing concern at Lake Kabetogama in Voyageurs National Park (VOYA). Toxin producing genes from cyanobacteria responsible for hepatotoxins (microcystin) and neurotoxins (saxitoxin and anatoxin-a) were found in water samples from bloom sites. Our study investigated whether these toxins were present in walleye, yellow perch, smallmouth bass, and white suckers from Lake Kabetogama and Rainy Lake at VOYA. Measuring cyanotoxin concentrations in fish fillets allows us to help inform human health risk. Adult fish were sampled by gillnetting, and young of year (YOY) fish were sampled by seining from July to September in 2017 and 2018. We extracted toxins from whole YOY fish and the liver and muscle from adult fish using established extraction methods. Toxin concentrations of fish were measured using ELISA. For anatoxin-a and microcystin, toxins were >5parts per billion (ppb), which is outside the detection range for ELISA testing (0.15 to 5.0 ppb). Further analysis with LC/MS/MS will confirm toxic samples and reveal false positives, a common issue with ELISA tests.

Brief Bio

Seth McWhorter is studying ecotoxicology at Warnell School of Natural Resources (University of Georgia) in Athens, GA. Specifically, Seth is interested in studying harmful cyanobacterial algal blooms that release hepatotoxins, neurotoxins, and dermatotoxins into water systems. Working with Voyageurs National Park, USGS, and University of Georgia, Seth aims to further research the ecological fate of microcystin, anatoxin-a, and saxitoxin in water bodies as well as in animal tissues. At the University of Georgia, Seth works with Susan Wilde's lab to examine characteristics of the novel cyanotoxin aetokthonos in the southeastern United States. In studying cyanobacteria and cyanotoxins, Seth hopes to contribute to ecological risk assessments in areas impacted by cyanobacterial harmful algal blooms.

Location of Study

Rainy Lake and Lake Kabetogama in Voyageurs National Park.

Rapid-assessment test strips: Effectiveness for cyanotoxin monitoring in a north temperate lake

Jaime F. LeDuc*, Victoria G. Christensen, Ryan P. Maki

*Voyageurs National Park, 360 Highway 11 East, International Falls, MN 56649, 218-283-6686, jaime_leduc@nps.gov



October Blooms

Abstract

Precise and rapid methods of determining toxin levels are needed in lakes used for recreation and drinking water to facilitate a quick risk assessment during cyanobacteria blooms. Therefore, we tested rapid-assessment test strips, a newer technology for estimating the toxicity of algal blooms, in Kabetogama Lake, a popular recreational area of Voyageurs National Park in northern Minnesota (USA). Sixty-seven percent of the test strip results matched results of enzyme-linked immunosorbent assays, with individual toxin results matching in 75% (anatoxin-a), 80% (cylindrospermopsin), and 64% (microcystin) of tests. These results provide some evidence that the test strips may be effective for rapid detection of toxins in north temperate lakes, although some improvements to the test strips may be beneficial. Despite the intensive processing required and uncertainty of some results, the availability of a rapid and inexpensive field method allowed us to sample opportunistically in the fall, when we documented dangerously high toxin concentrations at places where waterfowl retrieving dogs may be at particular risk of exposure.

Brief Bio

Jaime LeDuc is a shared employee between the Great Lakes Network and Voyageurs National Park where she is stationed. She received her B.S. degree from Bemidji State University, where she majored in Aquatic Biology (Fisheries Management and Aquatic Systems) and minored in Environmental Science. She received her M.S. degree in Biological Sciences from Michigan Technological University studying spiny water flea and fish interactions.

Location of Study

Kabetogama Lake, Voyageurs National Park in northern Minnesota.

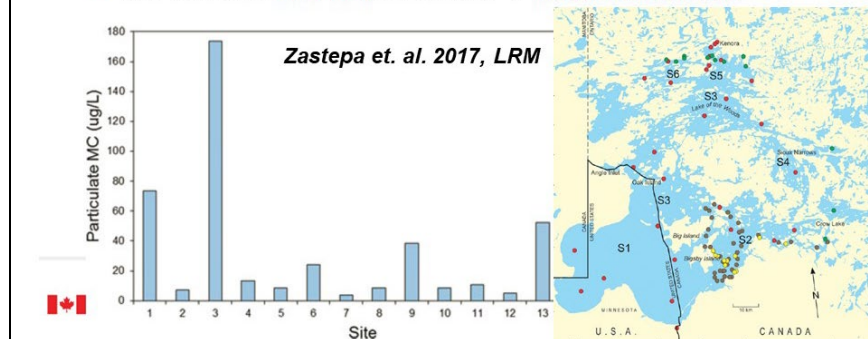
Spatiotemporal distribution of cyanotoxins in Lakes of the Woods

Zastepa, A. *, Pick, F.R., Blais, J.M.

*Environment and Climate Change Canada, Burlington, Ontario, Canada, arthur.zastepa@canada.ca

Spatial distribution of microcystins → 2006 to 2015

- Low offshore despite high chlorophyll
- Lower toxicity (microcystins) with P-deficiency
- High along shorelines, high variability
- MC-LR and MC-LA dominant → bioaccumulation



Abstract

Sediment concentrations of microcystin congeners and exchange across the sediment–water interface were determined in Lake of the Woods, a large water body between Canada and the United States experiencing cyanobacterial blooms. Dated sediment cores were used to examine historical occurrence of microcystins and showed that microcystins were below detection prior to the 2000s. In more recent sediments the most abundant congeners were MC-LA and -LR with -RR, -YR, -7dmLR, -WR, -LF, -LY, and -LW also present. MC-LA and -LR were also distributed in the pore waters whereas MC-RR and -YR were more strongly adsorbed to sediment particles. Sediment burial rates for MC-LA and -LR were determined from the product of the microcystin concentration on sediment particles (ng/g dw) and the burial rate (based on ^{210}Pb radiochronology [g/m²/d]). Diffusion from sediments was estimated from the concentration gradient between pore water of surficial sediments and overlying water using Fick's first law. Overall, burial rates were low across sites (2.6 to 298.1 ng/m²/d) when compared to diffusion of microcystins from sediments to overlying water (303.1 to 1078.0 ng/m²/d) suggesting that sediments can be a source of microcystins to the water column. However, the relatively high diffusive flux may be short term and the result of a temporal disconnect between water column productivity and sediment processes. The higher diffusion fluxes and lower burial rates of MC-LA compared to MC-LR point to differences in environmental fate. Given that microcystin congeners vary in their toxicity, these results highlight the need for congener-specific measurements of environmental fate and persistence.

Brief Bio

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

Location of Study

Lake of the Woods.

Session 3 – Ecosystem Monitoring, Research and Management

Update on the MPCA's watershed approach to restoring and protecting water quality in the Rainy Basin

Mike Kennedy, Lindsey Krumrie, and Amy Mustonen

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Abstract

The Minnesota Pollution Control Agency employs a watershed approach to restoring and protecting Minnesota's surface waters. Through this approach, the MPCA and its local partners undertake intensive water quality monitoring and assessments every ten years. These assessments provide the foundation for the development of Watershed Restoration and Protection Strategy (WRAPS) reports in each major watershed. These WRAPS documents become the foundation of the local water planning process.

The first ten-year cycle of this approach focused on characterizing water quality throughout each major watershed in Minnesota. This comprehensive process provides a statewide baseline of water quality we can measure future change against. All of Minnesota's major watersheds, including those in the Rainy Basin, have now been monitored and assessed. In addition, many of the major watersheds have undergone stressor identification and watershed restoration and protection strategy development. The associated reports provide a resource for local water quality managers to begin to implement restoration and protection strategies throughout the Rainy Basin.

The second round of the watershed approach focuses on supporting our local partners in developing a firm understanding of the watershed science needed to implement restoration and protection projects. This approach will be customized to the biophysical and social properties of each individual watershed. Investigating water quality protection opportunities and restoration projects on a field scale is imperative to the success of initiating change on the landscape. The outputs of the second round will vary tremendously throughout the Rainy Basin depending on

needs, local conditions, and priorities developed by local partners with local watershed community members. The resulting updated WRAPS reports will be designed to include customized products useful to local governments and other watershed stakeholders to accelerate the progress toward water quality restoration and protection.

Come learn about the current work being conducted and the resources available to protect Minnesota watersheds of the Rainy River Basin!

Brief Bio

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

Location of Study

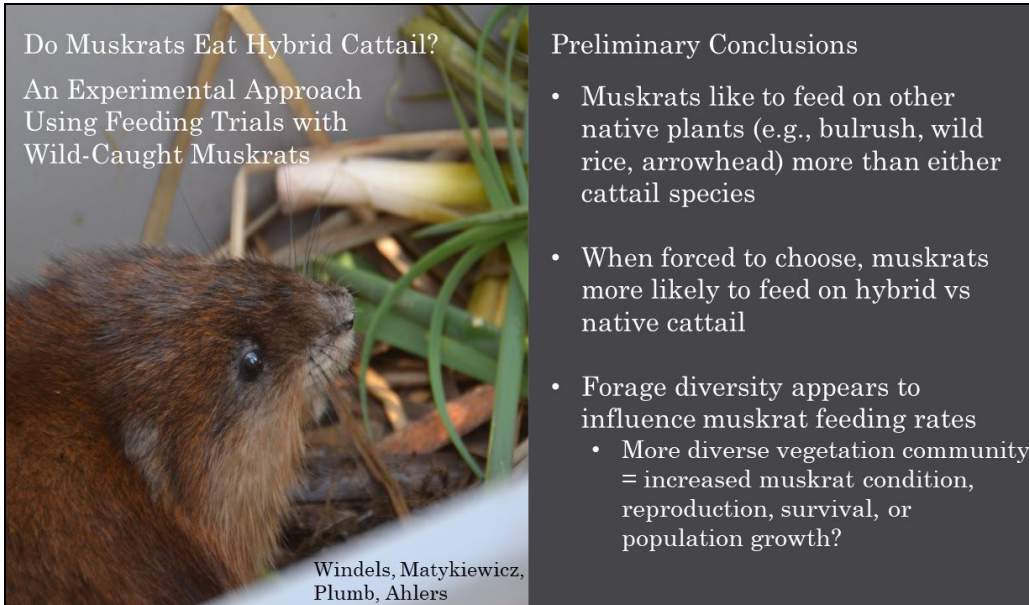
Rainy Basin, northeastern Minnesota.

Do muskrats eat hybrid cattail? An experimental approach using feeding trials with wild-caught muskrats

Steve K. Windels^{*1}, Benjamin R. Matykiewicz², Chandra L. Wiley¹, Reid T. Plumb¹, Adam A. Ahlers²

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Abstract

Invasive hybrid cattails (*T x. glauca*) are expanding in the United States and out-competing native wetland vegetation. Current management techniques of *T x. glauca* are costly and can be destructive to pristine wetland ecosystems. Muskrats (*Ondatra zibethicus*) are native semiaquatic herbivores that are thought to be highly selective for *Typha* spp., and muskrat herbivory could be used as a natural biocontrol agent for invasive *Typha*. However, the level of selection of muskrats for hybrid vs. native cattail has never been tested. Likewise, limited evidence also exists for how muskrats feed on *Typha* spp. vs. other native plants such as bulrush (*Scirpus* spp.), arrowhead (*Sagittaria* spp.), or wild rice (*Zizania palustris*). During summer 2019, we placed wild-caught muskrats from Voyageurs National Park into ~2.25m² wooden enclosures (aka Ratagons!) to examine muskrat feeding rates and selectivity for different food types. Enclosures were equipped with Go-Pro cameras to record all muskrat activity during the 2-hour trials. We completed 33 separate trials: 12 trials testing preferences of hybrid vs. native cattail only, and 21 trials testing both cattail species plus a choice of bulrush, arrowhead, wild rice, and sweet flag (*Acorus calamus*). We will present preliminary results of this novel approach to understanding interactions of native muskrats with a non-native species.

Brief Bio

Steve Windels is a wildlife biologist at Voyageurs National Park, MN. He conducts research and monitoring on a variety of wildlife species including American beaver, muskrat, gray wolf, moose, white-tailed deer, American marten, Canada lynx, bald eagle, common loon, and double-crested cormorant. He holds adjunct faculty positions at University of Minnesota Fisheries, Wildlife and Conservation Biology Graduate Program and University of Minnesota-Duluth in the IBS program. He holds degrees from Michigan Technological University (PhD-Forest Wildlife Ecology), Texas A&M Univ.-Kingsville (MS-Wildlife Ecology), and Univ. of Minnesota (BS-Wildlife Management).

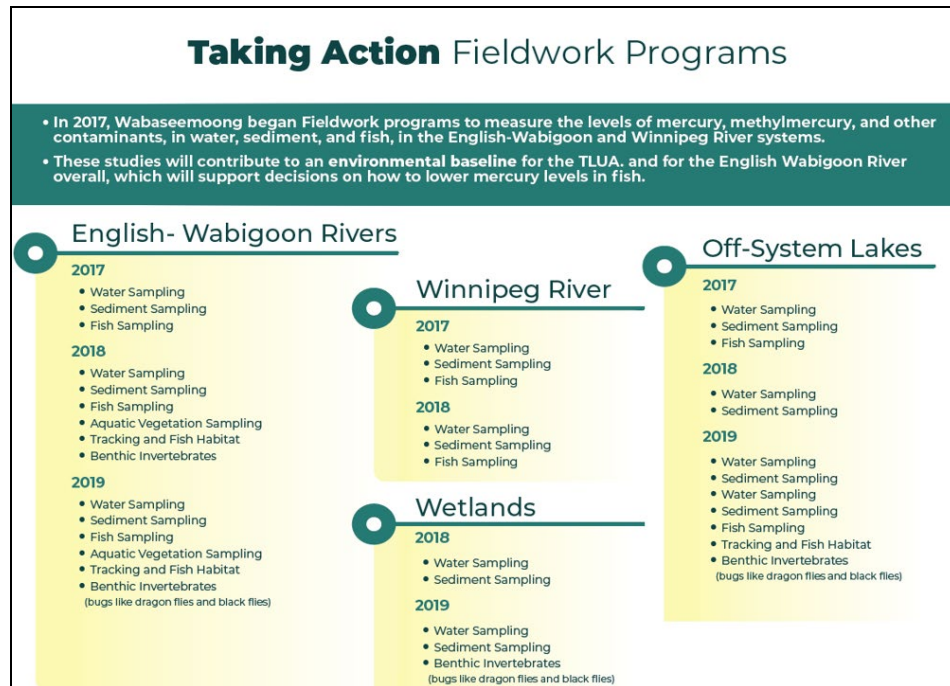
Location of Study

Voyageurs National Park.

WIN-English and Wabigoon Rivers Remediation Project

Marvin Lee McDonald

Wabaseemoong Independent Nations, General Delivery, White Dog, ON, P0X 1P0, (807) 927-2000 ext. 251



Abstract

The Membership of Wabaseemoong independent Nations, are River People they have a long tradition of living off the land and waters, since before recorded time, fish, wild game and plant foods, have served as a dietary staple, however in the 1950's it was disrupted, due to the development of two hydro-electric dams on the Winnipeg and English /Rivers, and in the 1960's mercury poisoning of the English River both of which led to the environmental, social and economic degradation. In 2017 the English and Wabigoon Rivers Remediation Project, started.

Brief Bio

Location of Study

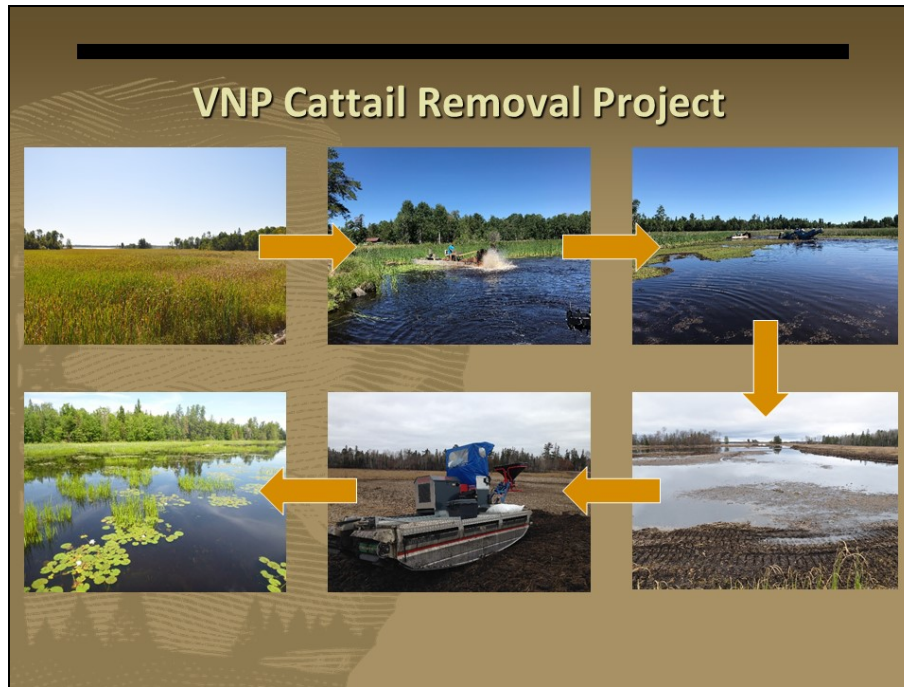
English and Wabigoon Rivers, Northwestern Ontario.

Hybrid cattail removal and wetland restoration in Voyageurs National Park: A project update

Reid T. Plumb¹, Steve K. Windels¹, Chandra L. Wiley¹, Bryce T. Olson²

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²Ressurs Consulting LLC, Fertile, MN 56540, olson1bry@gmail.com



Abstract

Non-native cattails are known to disrupt ecosystem balance by creating dense monotypic stands which displace native species and reduce biological diversity. Hybrid cattail (*Typha x. glauca*) is the dominant plant species in most wetlands in Voyageurs National Park, MN. We started a project in 2016 to reduce cattail abundance and restore wetlands to more diverse natural states. Lakes in Voyageurs National Park are designated as “Outstanding Resource Value Waters” where the use of herbicide is prohibited. We treated ~17 acres of invasive cattails in 3 test wetlands using 6 different mechanical methods on Rainy Lake. We conducted pre- ($n = 125$) and post-treatment ($n = 201$) vegetation surveys of treatment wetlands and compared percent vegetative composition for each treatment type. Total removal of cattail using heavy equipment was the most effective removal treatment method with the presence of cattail being reduced from 98% composition to 0%. We also used mechanical harvesters in Kabetogama Lake to remove a 4.5 acre floating cattail mat which traveled nearly 10 miles from its natal location. This case study, plus an overall project update, will be presented including preliminary findings and the direction of future work

Brief Bio

Reid Plumb is a Wildlife Biologist at Voyageurs National Park. He holds a Master of Science degree in Biology from Kansas State University. At Voyageurs, he is the project manager of the wetland restoration project that aims to reduce hybrid cattail abundance, restore wetlands, and investigate the effects of restoration efforts on wetland wildlife and plant communities.

Location of Study

Rainy Lake and Kabetogama Lake, Voyageurs National Park.

Grand Council Treaty #3: Community based monitoring

Chris Herc and Len Gibbons

Grand Council Treaty #3, 2650 Hwy 17E, Kenora, ON, P9N 3W8, (807) 548-4214
environment.monitor@treaty3.ca



Abstract

Abstract: Grand Council Treaty #3's community based monitoring (CBM) program works with Treaty #3 communities to protect and preserve their traditional waters, collect baseline data & develop monitoring across Treaty #3 territory, and prioritize youth engagement. The CBM program has been in operation since 2018 and currently has three Treaty #3 communities participating in it. Participating communities collect basic water quality data over the field monitoring season, and as of 2019 collect fish tissue samples to be sent away for mercury analysis. This presentation will cover the creation and implementation process of the CBM program, data insights and highlights, and have CBM participants from Treaty #3 discuss how the CBM program has been/will be a benefit to their community.

Brief Bio

Chris Herc has B.Sc. in Environment and Natural Resources from the University of New Brunswick. He has lived and worked across Canada doing natural resource management work & teaching environmental education. Currently he is working for Grand Council Treaty #3 as their environmental monitoring coordinator and implementing/coordinating a community based monitoring program across Treaty #3 Territory. Len Gibbons is a community member of Anishinaabeg of Naongashiing (Big Island) on Lake of the Woods, who is leading community based monitoring programs in parts of Lake of the Woods.

Location of Study

Lake of the Woods & Winnipeg River.

Building relationships: Lessons from a western science facility located in First Nations territory

Pauline Gerrard and Dilber Yunus

IISD Experimental Lakes Area, 111 Lombard Ave, Suite 325, Winnipeg MB, R3B 0T4, 204-807-3903
pgerrard@iisd-ela.org



Abstract

How do we begin to build meaningful relationships in a time when bridging Western and Indigenous Science can help in addressing some of the most pressing environmental crises facing our world?

The story of Canada's most unique scientific research facility has plenty to teach us.

IISD Experimental Lakes Area (IISD-ELA) is a freshwater research facility located in the traditional Anishinaabe territory of Treaty #3 in northwestern Ontario. For years, it has been working to expand its portfolio in public communication and prioritizing Indigenous engagement.

Located in Treaty #3 traditional land, IISD-ELA has seized upon a unique opportunity to work more closely with Indigenous communities to look at how the two ways of knowing can work together and benefit each other.

This presentation will explain how IISD-ELA has partnered with Indigenous groups through various projects in areas of mercury contamination, community-based monitoring, and Ojibwe interpretation of scientific research to promote knowledge sharing, highlighting a few key achievements including collaboration on community based monitoring support with the Grand Council of Treaty#3 and Ojibwe Language translation of some key education materials. It will also explore what IISD-ELA has learned along the way, including the importance of individual connection with respect and honesty; understanding communities' needs; and incorporating the preservation and revitalization of Indigenous culture and language into collaboration efforts.

Brief Bio

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

Location of Study

Experimental Lake Area, Northwestern Ontario, Canada

Session 4 – Canadian Tributary Hydrology

Longitudinal patterns in nutrient export in the lower Rainy River watershed

Kelly Macgillivray* and Catherine Eimers

Trent University, School of the Environment, 1600 West Bank Dr., Peterborough, ON K9L 0G2

kellymacgillivray@trentu.ca

Objectives

Quantify the contribution of particulate transport to phosphorus delivery in the Rainy River Watershed

- How does this vary spatially (natural vs. agricultural)?
- What are the sources?



Trout River, August 2019



Everett Creek, May 2019



Sturgeon River, August 2019

Abstract

Oftentimes in watershed monitoring programs, water quality is sampled at a single location along a river course, which is assumed to represent the entire upstream area. However, sampling at a single site and scale makes it difficult to evaluate relationships between water quality and landuse/landcover (LULC). To address this, we sampled water quality both above and below existing long-term monitoring stations on four rivers in the lower Rainy River watershed, that either drain into the Rainy River (Sturgeon, Everett) or the Lake of the Woods directly (Little Grassy and McGinnis). A number of different water quality parameters were analysed at each station during both high flow (spring melt) and low flow periods in 2019, including total phosphorus, total dissolved phosphorus, nitrogen species, metals and total suspended sediments (TSS). Preliminary longitudinal and inter-season differences in water quality and associations between sediment transport and phosphorus export will be evaluated to assess relationships between LULC and nutrient losses. This will ultimately lead to a better understanding of sources of nutrients and best management practices to limit phosphorus loading.

Brief Bio

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

Location of Study

Lower Rainy River watershed.

Characterizing the hydrology of the Lake of the Woods watershed: the potential influence of basin storage on flow regime and streamflow response to extreme weather

Wes Greenwood, Catherine Eimers, and Andrew Williams

Trent University - School of the Environment, Peterborough, ON K9L 0G2 (705) 768-4261

wesleygreenwo@trentu.ca

Conclusions

- Flow data for Canadian tributaries is very limited both spatially and temporally
- Rivers on the shield tend to be much more stable and resilient to changes in weather (i.e., water balance)
- Rivers on the Agassiz clay plain are very flashy and relatively sensitive to changes in weather (i.e., water balance) - require more widespread and frequent monitoring
- This difference is likely due to greater dynamic storage on the shield in the form of lakes.
- More sensitive Agassiz basins may also be experiencing more recent land use change:
 - Mining
 - Pasture → row crops (comes with tilling and tiling)
 - Pasture → shrublands

Abstract

Nutrient export from rivers and streams can vary greatly depending on flows; therefore, nutrient budget estimates for the Lake of the Woods (LOW) require reliable flow data and a strong understanding of the local basin hydrology. The sheer size and complex nature of the LOW basin, which spans two major surficial geology types (Canadian Shield and Agassiz clay plain) and is subject to several forms of landscape disturbance (e.g., forestry, mining, farming), makes monitoring costly and exemplifies the importance of efficient monitoring program design. Recent work has shown that rivers and streams draining the Agassiz clay-dominated portion of the LOW basin are very flashy and exhibit much more flow variability relative to those on the Canadian Shield, likely due to the abundance of lakes and dynamic storage in the latter. This, coupled with higher nutrient concentrations and fluxes seen in Agassiz clay plain streams, suggests that high-frequency monitoring is important in this area. Furthermore, previous work has suggested that basins with greater dynamic storage and relatively stable hydrographs (like those on the shield) may be more resilient to both climate change and future land-use disturbance. However, the intermittent nature of flow records in the Canadian portion of the LOW basin have not allowed this spatial pattern to be evaluated over a range of hydro-climatic conditions. Here we compare the flow regimes of rivers on the Agassiz clay plain to those on the Canadian shield during two back-to-back years with very different hydroclimatic conditions (2018 and 2019) in order to assess a) whether or not the pattern of flashy, more variable flow on the Agassiz clay-plain vs. relatively subdued, stable flow on the Canadian Shield persists and b) how these rivers may or may not respond differently to weather extremes (e.g., different snowpack and snowmelt dynamics and extreme summer rainfall events). This information may be used to inform future monitoring design and evaluate potential sensitivity to climate change.

Brief Bio

Wes Greenwood is a surface water specialist based out of Edmonton, AB. He led the field monitoring campaign for the Trent U. watershed loading project in 2018-19, and he is currently assisting with the program's data analysis and reporting.

Location of Study

Tributaries of the Rainy River and Lake of the Woods in the Canadian portion of the Rainy-Lake of the Woods basin.

Session 5 – Environment and Climate Change Canada's Lake of the Woods Science Program (2016-2020)

Introduction and overview of the ECCC science session

Mohamed Mohamed

Environment and Climate Change Canada, Watershed Hydrology and Research Division, 867 Lakeshore Rd, Burlington, Ontario L7S 1A1

Monitoring & Research Plan	Components of Plan Watershed Monitoring / Research
<ul style="list-style-type: none">Started 2016, concludes 2020Goals of plan:<ul style="list-style-type: none">Conduct experimental and field studies to improve understanding of lake response to nutrient loadingDevelop coupled watershed-lake, process-based hydrodynamic model to<ul style="list-style-type: none">Better understand potential lake response under various scenariosInform on the potential of nutrient reductions to achieve ecosystem objectives	<ol style="list-style-type: none">Lake and river monitoring – Timothy PascoeSmaller streams & atmosphere – Catherine EimersGroundwater – Dale VanStempvoortCyanobacteria/harmful algal blooms – Arthur ZastepaRemote sensing – Caren BindingWatershed model – Craig McCrimmonCoupled watershed-lake model – Reza ValipourSummary and load-response scenarios – Mo MohamedPath forward – Michael GoffinPanel discussion – Opportunities moving forward: Building from the science to address ecosystem health moderator: Mike Kennedy

Abstract

Environment and Climate Change Canada (ECCC) has an extensive history of conducting research and monitoring at the Lake of the Woods. The most recent plan of study, which began in 2016, concludes this year. Here, we present an overview of the various components that were included in the plan, providing insight into their motivation, integration, and goals in informing management of the Lake of the Woods and its watershed.

Brief Bio

Mohamed is the Research Program Manager in the Watershed Hydrology and Ecology Research Division of Environment and Climate Change Canada.

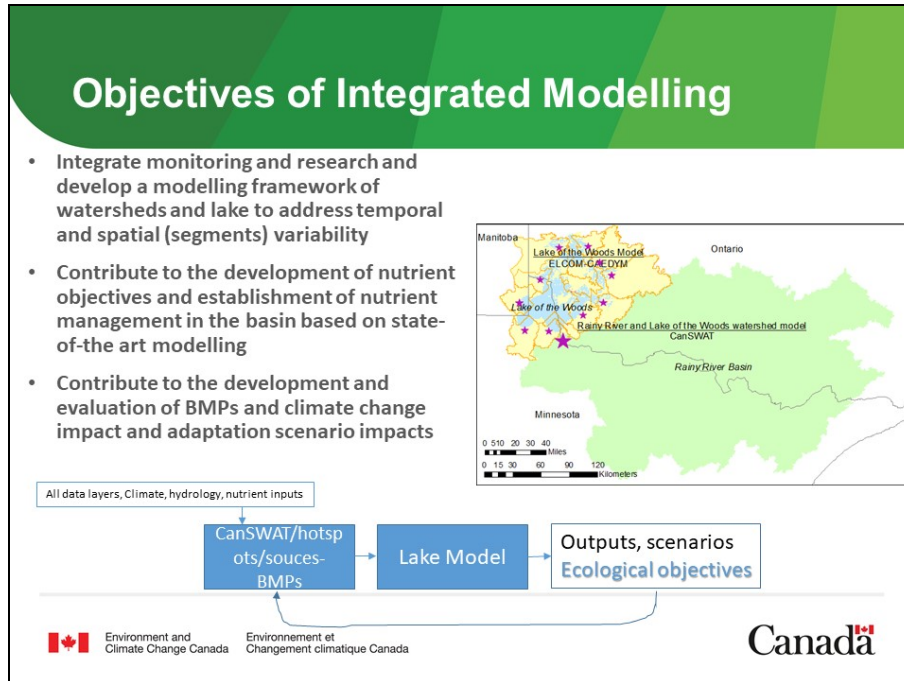
Location of Study

Lake of the Woods and Rainy River.

An integrated modelling and monitoring framework for assessing nutrient dynamics and algal blooms in Lake of the Woods

Ram Yerubandi on behalf of ECCC/WSTD team

Environment and Climate Change Canada, Water Science and Technology, CCIW, 867 Lakeshore Road
Burlington, ON, Canada, L7S 4A1 Ram.Yerubandi@Canada.ca 905-3364785



Abstract

Lake of Woods (LOW) is being impacted by enrichment of nutrients as well as extensive algal blooms, which are at times toxic. This impairs water quality and the lake's value for recreation, drinking water, and fish habitat. Since 2016 ECCC has been conducting integrated research, modelling and monitoring program designed to provide the necessary science to support the assessment of nutrient loads to the LOW and understand the factors responsible for algal blooms and develop predictive models for the potential ecological response to nutrient management decisions and actions. In this talk, I will provide an overview of monitoring, process-based research and state-of-the art modeling (linked watershed and lake model covering the entire LOW. The watershed (CanSWAT) and in-lake models (3D hydrodynamic-ecological coupled model) examined the cycling of nutrients (i.e., phosphorus, nitrogen) within the lake. We examined the lake response (eg: in-lake nutrient concentrations, algal blooms) for different P-loading scenarios. The next steps will be optimization of Beneficial/Best Management Practice (BMP) scenarios using the watershed model for achieving the necessary load reductions to the lake.

Brief Bio

Ram Yerubandi is a research manager in the Watershed Hydrology and Ecology Research Division of Environment and Climate Change Canada. Ram previously led ECCC's initial lake efforts on Lake of the Woods in the late 2000s and has led ECCC's current modeling program. He was presenting on behalf of the ECCC/WSTD modeling team.

Location of Study

Lake of the Woods

10 Years On: A Summary of ECCC Monitoring in Lake of the Woods

Timothy Pascoe

Environment and Climate Change Canada, Water Quality Monitoring and Surveillance, Science and Technology Branch, PO Box 5050, 867 Lakeshore Rd E, Burlington, ON, Can L7R 4A6 905-336-6239

Tim.Pascoe@ec.gc.ca

SUMMARY

- 10 years of bi-annual monitoring data for Lake of the Woods (~25 stations)
- Bi-weekly or Monthly Rainy River
- Relationships between in-situ measurements, remotely sensed data, and modeling results positive
- Relationship between Total P and in-situ Chl-a stronger in the southern, well mixed basins, than in the deeper northern basins
- Amplitude and Variability of TP in Rainy River significantly lower when compared to historical monitoring data
- 3 years of automated data assisting the understanding of Canadian tributary contributions to the lake
- Issues such as declining water clarity observed in some locations; providing evidence of broader impacts



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Abstract

In 2008, Environment and Climate Change Canada (ECCC) initiated a monitoring program in the Lake of the Woods basin as part of its broader efforts to investigate algal blooms in the lake. Developed by the Water Quality Monitoring and Surveillance (WQM&S) division, the goal of the program was to generate foundational data to support ECCC science initiatives, and establish a baseline data set to aid in the assessment of environmental change over the longer term. The presentation will look at three key aspects of the monitoring program: a summary of the data collected to date, an exploration of some parameters of interest across the lake over the ten-year period, and how these data are being used to support both ECCC efforts, as well as partner agencies throughout the basin.

Brief Bio

Tim Pascoe is an Environmental Monitoring Scientist with Environment and Climate Change Canada's Water Quality Monitoring and Surveillance division. Tim has led ECCC's monitoring work on Lake of the Woods since 2008 and continues to coordinate these efforts to this day. Tim has a Masters degree in Environment Planning from the University of Waterloo and has worked for ECCC since 1998. He is ECCC regional lead for the Canadian Aquatic Biomonitoring Network (CABIN). TIM has also been involved in the development of web-enabled tools and distributed data systems for benthic data management and sediment assessment and in applying new technologies to monitoring to expand the role genomic barcoding through the use of eDNA for bioassessment.

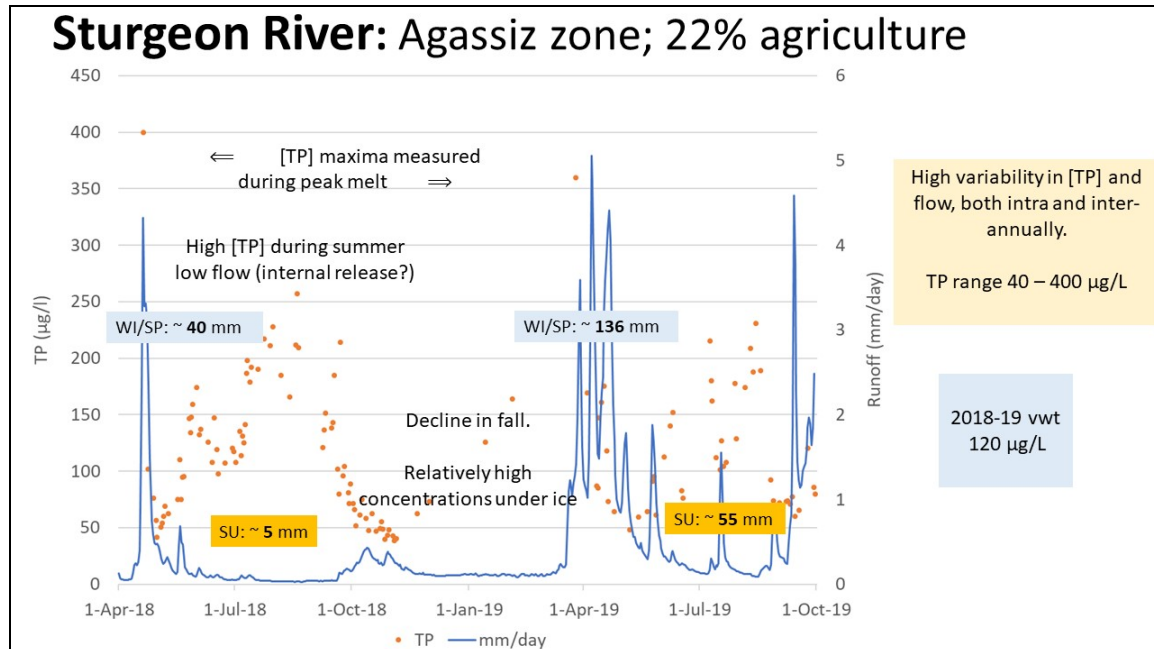
Location of Study

Lake of the Woods and Rainy River.

Phosphorus loading in the LOW watershed: tributaries and atmospheric deposition

*Catherine Eimers, Wes Greenwood, Andrew Williams, Kelly MacGillivray

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



Abstract

Intensive monitoring within the Canadian portion of the Lake of the Woods (LOW) basin between April 2018 and September 2019 indicate that phosphorus concentrations and export vary greatly across the watershed, and are highly sensitive to geology, extreme weather and seasonal differences from year to year. Atmospheric deposition estimates over this short period of study are higher than previous estimates and suggest that direct atmospheric input to the Lake of the Woods may be an important source of phosphorus nutrition. Phosphorus concentrations in tributaries were particularly high during spring melt, but were also high during summer low flow conditions, perhaps due to redox related release from streambed sediments. Climate conditions in 2018 were in stark contrast to 2019, with vastly different winter precipitation, spring melt magnitudes, summer low flows and fall high flows. Data from these contrasting years suggest that phosphorus export is highly sensitive to hydrologic conditions and provide strong justification for longer-term monitoring.

Brief Bio

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

Location of Study

Canadian portion of the Lake of the Woods Basin.

Update: Loading of nutrients from nearshore developments to Lake of the Woods

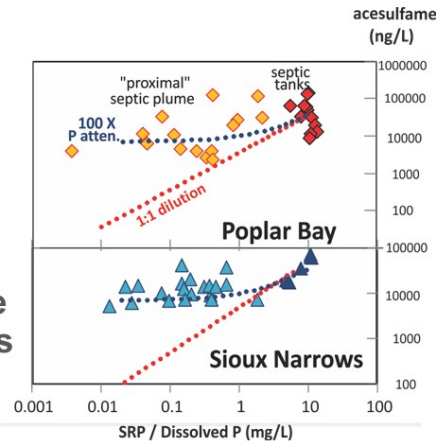
Dale R. Van Stempvoort¹, Will D. Robertson², D. Ross MacKay¹, Pamela Collins¹, Susan J. Brown¹ and Serban Danielescu¹

¹Watershed Hydrology and Ecology Research Division, Environment and Climate Change Canada

²University of Waterloo

Summary of key results

- High dissolved P in septic wastewater
- Attenuation of septic-derived P in the subsurface / close to septic beds
- This prevents seepage of P-rich septic plumes to nearshore areas



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Abstract

The focus of this study is loading of nutrients from septic systems to the nearshore waters of Lake of the Woods, with a focus on dissolved phosphorus. Septic wastewater has been suggested as a potential nutrient source that drives localized algal blooms in isolated bays. Septic systems investigated include cottages (Poplar Bay) and other developments in the Sioux Narrows area. Samples were collected periodically (11 visits in 2016-2019) from nearshore surface waters and from shallow groundwater and analyzed for nutrients and major ions. Most of the groundwater samples were collected beneath septic system drainfields and in the immediate vicinity of these drainfields. Analyses of wastewater tracers (artificial sweeteners) in the groundwater, together with analyses of samples of sand collected from the drainage tile fields, provided key evidence that much of the phosphorus load from septic systems is attenuated in the subsurface, mostly within the drainfields, thus preventing seepage of P-rich plumes to nearshore areas of the lake. Modeling and further interpretation of the results are in progress, as described in a separate poster presentation.

Brief Bio

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

Location of Study

Poplar Bay, Sioux Narrows, Keewatin bay areas of Lake of the Woods.

Spatiotemporal diversity of phytoplankton structure and function in Lake of the Woods: Insights into bloom formation and toxin production

Arthur Zastepa

Environment and Climate Change Canada, Canada Centre for Inland Waters, Burlington, Ontario, Canada, arthur.zastepa@canada.ca

Conclusions

- Spatiotemporal diversity in phytoplankton community structure and function, bloom formation mechanisms, and local modulating factors/drivers emphasizes the need to consider local management solutions and expect heterogeneity in response/outcome (magnitude, timeline)
- Bloom severity and duration could be enhanced/extended and management efforts could be limited/delayed due to the complexity of the system
 - Presence of metalimnetic/hypolimnetic sources of biomass
 - Presence of sediment sources of biomass
 - Internal nutrient loading (P/trace metals) by diffusive flux both transient (polymictic) and established (stratified)



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DRAFT – Page 17 – April 6, 2020

Canada

Abstract

Lake of the Woods is a complex system, with limited exchange between its multiple basins and strong spatiotemporal variance in physicochemical conditions and susceptibility to cyanobacterial and harmful algal blooms. Lake-wide, multi-year, and seasonal measurements support the association of phosphorus concentration with chlorophyll-*a* as well as phytoplankton biomass; however, our investigations also reveal an unexplained diversity in phytoplankton structure, function, and potential for cyanotoxin production throughout the basin. Focused studies in impacted embayments identified new (internal) sources of nutrients and biomass and suggest proximate drivers of bloom formation. Notably, deep-living phytoplankton/microbial communities and reservoirs of biomass in sediments were identified as potential sources in localized bloom formation. While reducing tributary nutrient loadings are expected to reduce phytoplankton biomass over the long-term, the spatiotemporal heterogeneity in conditions throughout the basin and diversity in bloom formation mechanisms/proximate drivers may result in a heterogeneous response in cyanobacterial bloom formation.

Brief Bio

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

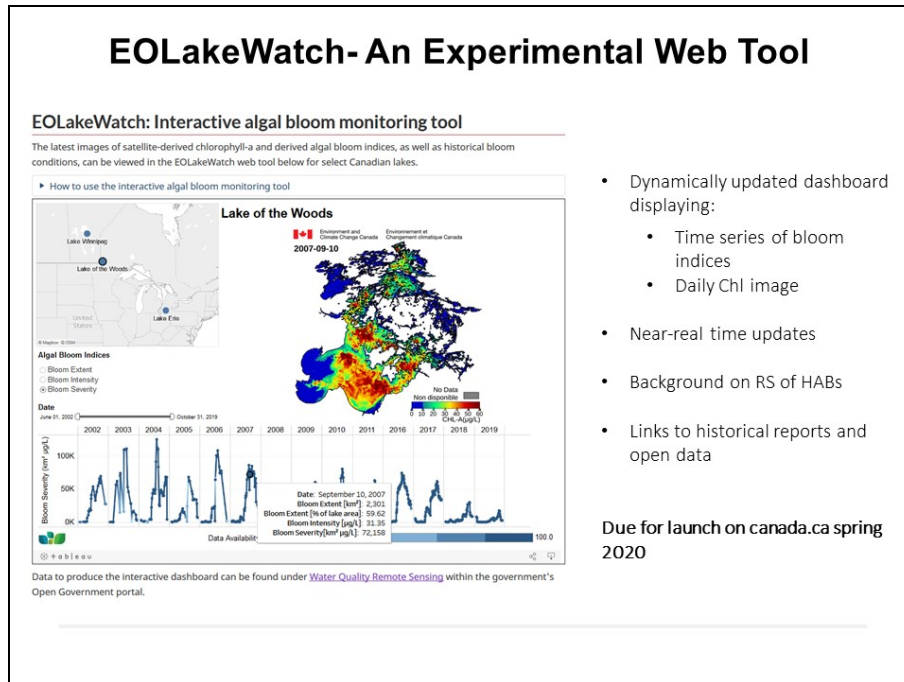
Location of Study

Lake of the Woods.

An overview of ECCC's progress in satellite remote sensing of algal blooms on Lake of the Woods

Caren Binding*, Larissa Pizzolato, and Chui Zeng

Environment and Climate Change Canada, Canada Centre for Inland Waters, 876 Lakeshore Road, Burlington, ON Caren.Binding@canada.ca



Abstract

Comprehensive lake-wide observations of algal blooms on Lake of the Woods (LoW) are critical to assessing the lake's health status, developing ecosystem objectives, measuring lake responses to nutrient management practices, and providing an improved understanding of the processes driving blooms. The highly dynamic nature of algal blooms means that adequately capturing bloom timing and spatial extent is challenging with limited in situ observations. Earth Observation (EO) satellites offer frequent, synoptic views of LoW, which enable quantitative assessments of algal biomass and can provide both near-real-time and historical information on algal bloom conditions. ECCC's capacity for operational near-real-time satellite image acquisition and processing, and development of quantitative indices for algal bloom spatial extent, intensity, duration and severity, have dramatically improved bloom monitoring capabilities on LoW. Annual algal bloom reports, and the EOLakeWatch portal, will be presented as key stakeholder deliverables from the project. Quantitative analysis of bloom conditions will also be shown, from 2002 to present, which document significant decreases in all bloom indices, suggesting the lake is responding to historical reductions in loadings. Satellite observations provide benchmark chlorophyll conditions for model validation in determining future LoW response to nutrient reduction scenarios. Further insight on the complexity of bloom drivers will be presented, which suggest that climate variables and related lake processes (water column stability, hypoxia, internal nutrient loading) may be confounding factors in further anticipated lake recovery.

Brief Bio

Caren Binding is a Research Scientist specializing in Aquatic Optics and Remote Sensing with Watershed Hydrology and Ecology Research Division of Environment and Climate Change Canada.

Location of Study

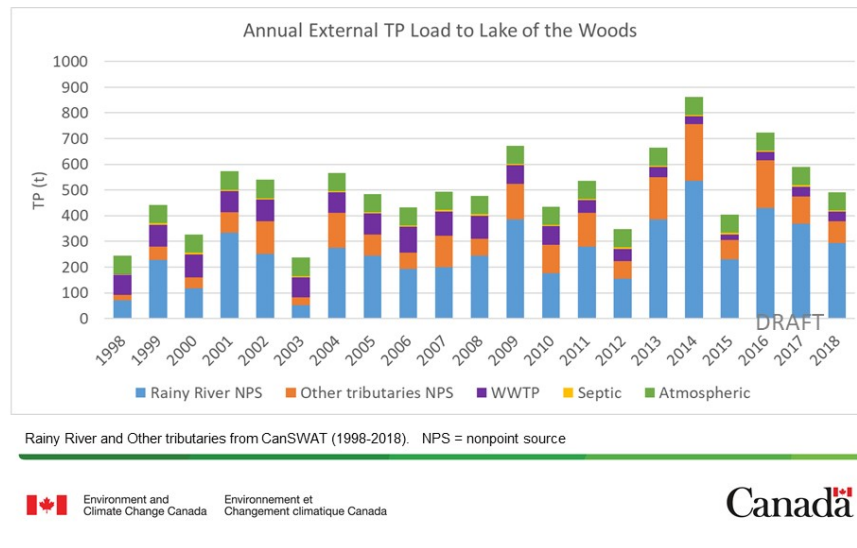
Lake of the Woods.

Application of CanSWAT watershed modelling for Lake of the Woods

Craig McCrimmon, Phil Fong, Luis Leon, Reza Valipour, Ram Yerubandi.

Water Science and Technology, Environment and Climate Change Canada, 867 Lakeshore Rd, 2nd Floor,
Office R250 Burlington, Ontario L7S 1A1 905-336-4885 craig.mccrimmon@canada.ca

Lake Loadings



Abstract

An integrated modelling framework was developed for the US and Canadian watersheds to simulate seasonal hydrodynamics, nutrients transport and algal blooms in Lake of the Woods. The integrated modelling approach aims to assess the lake's seasonal algal bloom responses to potential nutrient loading strategies as a combination of BMP and climate change adaptation scenarios. A CanSWAT watershed model of the Lake of the Woods entire watershed was built to simulate watershed runoff flow and water quality from 1995-2018 and was used to (i) provide lake input loading estimates for modelling lake responses, (ii) assess a combination of BMPs with particular focus on forests and agriculture impact on nutrient loadings, (iii) examine climate change adaption scenarios (iv) compare results with previous models and observations, and (v) determine if the suggested BMPs can be used to meet targets to the lake.

Brief Bio

Craig is a watershed, river and lake modeller with Environment Climate Change Canada (ECCC) since 1999. Recent work has been on watershed modelling to provide information on nutrients for lake modelling including developing land management options and climate change adaptation scenarios.

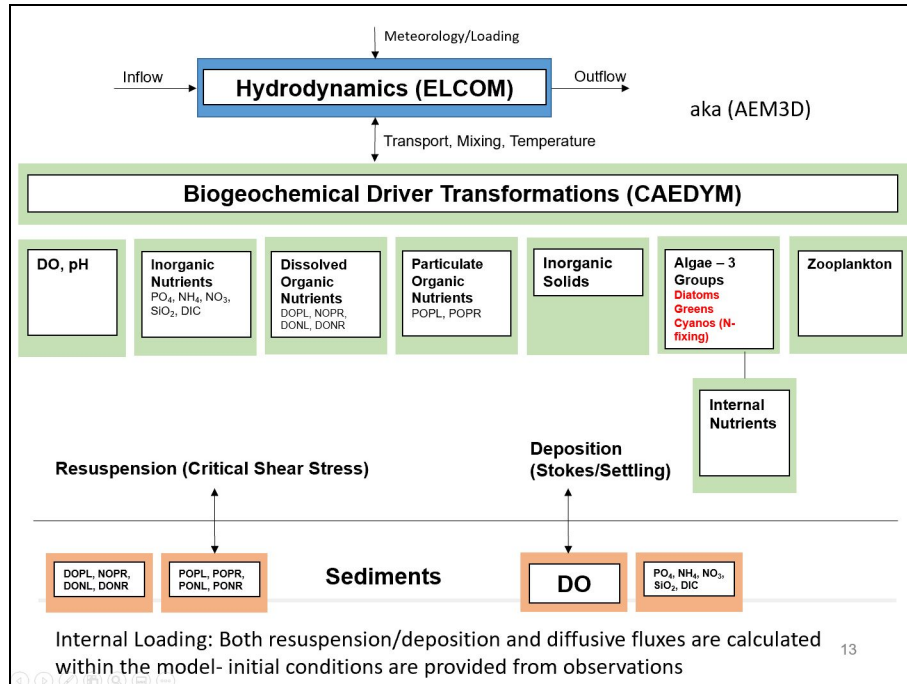
Location of Study

Lake of the Woods watershed.

Phosphorus loads and algal response scenarios: outcomes from the application of a coupled watershed-lake model of Lake of the Woods

Reza Valipour, Craig McCrimmon, Phil Fong, Luis Leon, and Ram Yerubandi

Water Science and Technology, Environment and Climate Change Canada, 867 Lakeshore Rd, 2nd Floor, Office R250 Burlington, Ontario L7S 1A1 905-319-7204 reza.valipour@canada.ca



Abstract

The Lake of the Woods lake modelling is a part of an integrated modelling framework and aims to replicate and predict water movements and water quality patterns in the lake from the US and Canadian watersheds discharges. Here, we present the lake model results on water circulations, nutrient dynamics (e.g., Total Phosphorus) and algal blooms using ELCOM-CAEDYM. This model is a three-dimensional hydrodynamic-ecosystem process-based model, and was setup at 250m resolution and forced with lake-wide meteorological data, CanSWAT model riverine outputs, and outflows at Kenora and Norman dams. The model was initialized, calibrated and validated using the collected field observations from two year-round mooring deployments, lake-wide water quality measurements, Satellite Images, and different functional groups of total chlorophyll-a. We used the lake model results to develop load-response curves to express the relationships between different Total Phosphorus load reduction scenarios and the response of total algal blooms in the lake and its sub-basins.

Brief Bio

Reza Valipour has been a Research Scientist with and Climate Change Canada since 2017. Reza's work focuses on creating three-dimensional models of lakes to simulate water circulation and water quality. He received a PhD in Civil Engineering from Queen's University in 2012 and worked in the private sector before joining ECCC in 2014. His current research focuses on modeling water circulation, sediment transport and water quality in the Lake of the Woods, which also includes extensive lake-wide field data collections and laboratory experiments. In addition, he is involved in other ECCC research projects on large lakes including Lake Erie, Lake Winnipeg, Lake St. Clair and Lake Ontario.

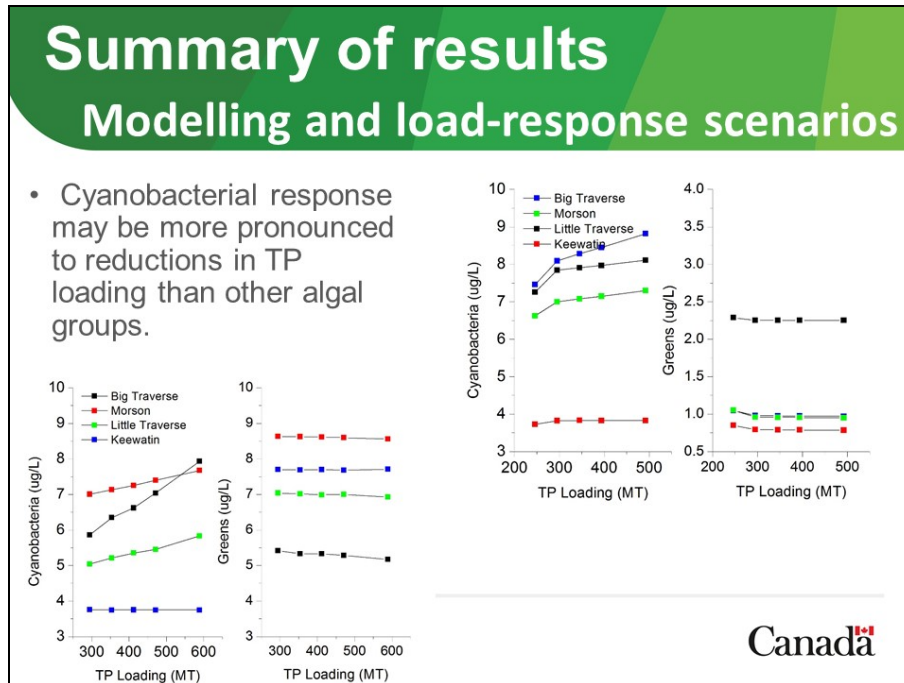
Location of Study

Lake of the Woods.

Summary and Synthesis of ECCC Science Presentations

Mohamed Mohamed

Environment and Climate Change Canada, Watershed Hydrology and Research Division, 867 Lakeshore Rd, Burlington, Ontario L7S 1A1



Abstract

We will review the session science presentations, providing a brief summary and conclusions from each, as well as key conclusions and management implications from the previous talks.

Brief Bio

Mohamed is the Research Program Manager in the Watershed Hydrology and Ecology Research Division of Environment and Climate Change Canada.

Location of Study

Lake of the Woods and Rainy River.

ECCC Policy: Path Forward

Michael Goffin

Environment and Climate Change Canada, Strategic Policy Branch, Ontario Region, 4905 Dufferin St, Office 2S635 Toronto, Ontario M3H 5T4 416-739-4804 michael.goffin@canada.ca

WHAT DOES THIS MEAN IN TERMS OF NEXT STEPS?

- Should Canada establish a phosphorus reduction target (or targets) for Lake of the Woods?
- If so, at what levels should a target(s) be set?
- Should Canada seek a commitment to a comparable phosphorus reduction target from the United States?
- What strategies should be pursued to achieve phosphorus reduction targets?
- Who should be responsible for implementing those strategies?
- What further science is needed, either to increase understanding of the Lake of the Woods algae problem, or to assess and report on progress towards achievement of targets?

Abstract

This presentation will provide an update on the next steps that will be taken to determine what phosphorus reductions are necessary to achieve desired water quality and ecosystem outcomes, and the actions that can help to achieve those reductions for the Canadian portion of the Rainy-Lake of the Woods Basin. While research scientists can advise on what conditions represent a healthy and sustainable ecosystem, the decision on desirable ecosystem outcomes are best informed by public and stakeholder input. Plans to engage Indigenous Peoples, stakeholders, and the public on appropriate ecosystem outcomes and the potential establishment of phosphorus targets based on Environment and Climate Change Canada's and partners' science for Lake of the Woods will be presented. In addition, current information on Canadian sources and potential actions to mitigate their impacts will be discussed.

Brief Bio

Michael Goffin, the Regional Director General for Environment and Climate Change Canada in Ontario has been engaged in policy development and program delivery, most recently focused on water and ecosystem management, intergovernmental affairs and community outreach and engagement.

For more than a decade, he has been responsible for leading Canada's efforts to restore and protect the water quality and ecosystem health of the Great Lakes and also serves as Canadian Co-chair of the International Rainy Lake of the Woods Watershed Board and as a member of the Aquatic Ecosystem Health Committee.

Location of Study

Canadian portion of the Rainy-Lake of the Woods Basin.

Panel Discussion: Opportunities moving forward: Building from the science to address ecosystem health

Panelists: Tricia Mitchell – Environment and Climate Change Canada (ECCC); Janette Marsh – United States Environmental Protection Agency (US EPA); Nicole Blasing – Minnesota Pollution Control Agency (MPCA); Jeff Hrubes, Minnesota Bureau of Water and Soil Resources (BWSR). Moderator: Michael Kennedy

The panel discussion session opened with panel introductions from moderator Michael Kennedy and an opening statement from each panelist. Tricia Mitchell summarized the outlook from ECCC for next steps, referring to the full presentation on policy directions presented earlier in the Forum program. Janette Marsh emphasized the strong and productive collaborations in the Basin and the US EPA approach for finding solutions at the most local level and that these local collaborations should be the long-term driver for actions moving forward with opportunities for focusing BMPs on nutrient hotspots. Nicole Blasing, MPCA noted the strong engagement of groups in the basin, summarized the MPCA TMDL-WRAPS approach and that she had been appointed to the IJC Rainy-Lake of the Woods Watershed Board. Jeff Hrubes spoke about how local agencies make up the board of BWSR and set policies for the state. The One Watershed One Plan initiative in Minnesota working towards a comprehensive management plan over the next decade. Discussion with the audience ensued. Discussion areas included:

- Whether common objectives are needed given that Lake of the Woods is a boundary water. Audience points were made about desirability of an international agreement – getting back to the discussions of several years ago about something similar to the provisions of Annex 4 on nutrients of the Great Lakes Water Quality Agreement.
- Challenges of delivery of land management and other programs for nutrient reduction in northwestern Ontario where much of the area is unincorporated territory.
- Questioning the long-term sustainability of informal arrangements and collaborations vs. formal agreements and institutions. It was noted that although much has been achieved in the basin through these informal “arrangements”, long-term sustainability of efforts was required and that these informal arrangements could be ephemeral and relied on the will of particular individuals to keep going.
- Questioning of whether actions and coordination of efforts long-term can be achieved without the IJC – not specifically related to water quality objectives but more generally to finding a long-term commitment and mechanism for collaborative work in the basin. Audience points were made about the need for a “persistence framework” and thus the community-driven efforts to get governments to give the IJC a mandate for Lake of the Woods and the Basin to provide a framework for all parties to work together, with the comment made that governments and their priorities come and go, the IJC has a constant focus grounded in the Treaty.
- That Ontario was not represented on the panel. Discussion points raised noted that Ontario had been invited but could not attend due to the situation of government travel restrictions for Ontario employees and that Forum attendance itself from Ontario was very sparse. Despite these caveats, emphasized was the importance of Ontario becoming actively engaged because when it comes to management actions, much of this will fall within provincial domains. Noted was that one year ago, the Ontario Minister of Environment put Lake of the Woods explicitly in the provincial environment plan, identified for action on working with partners to reduce phosphorus loads to Lake of the Woods but in the ensuing year it was not clear if or how this had been actioned. One comment was that the presence of the Minister's Parliamentary Assistant Andrea Khanjin at the Forum this year was a welcome effort and hoped to be a signal that Ontario will be become more engaged on Lake of the Woods.

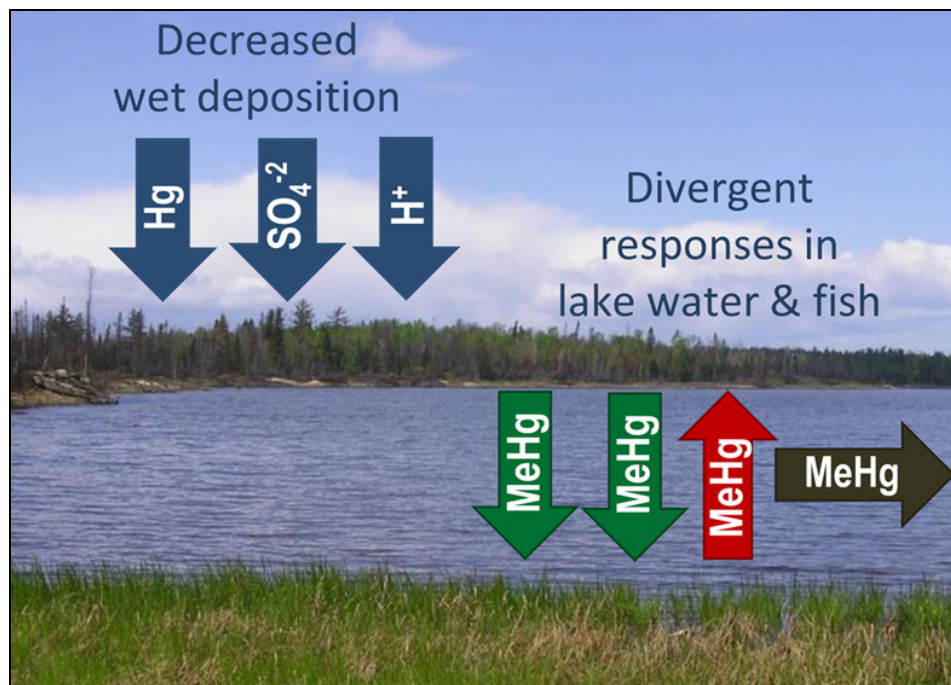
Poster Session Abstracts

Trends in regional wet mercury deposition and lacustrine mercury concentrations in four lakes in Voyageurs National Park—an update

Mark E. Brigham¹, David VanderMeulen², and Ryan Maki²

¹U.S. Geological Survey, 2280 Woodale Drive, Mounds View, MN 55112 (763) 783-3274 mbrigham@usgs.gov

²Voyageurs National Park, National Parks Service, 360 Highway 11 E, International Falls, MN 56649



Previously, we published the paper “Lacustrine Responses to Decreasing Wet Mercury Deposition Rates—Results from a Case Study in Northern Minnesota,” which examined methylmercury (MeHg) trends in four remote lakes in Voyageurs National Park in response to declines in wet deposition of mercury, sulfate, and acidic precipitation.

The current study updates the earlier work, adding six more seasons of data (through the 2018 field season). A manuscript is in review, and not available for distribution at this time. We will make it available to conference attendees when it is published.

The conference abstract is approved, and summarizes our findings:

Abstract

Although anthropogenic mercury (Hg) emissions to the atmosphere have been substantially lowered in the United States and Canada since 1990, concerns remain for elevated contamination in fish that inhabit lakes and rivers even in areas where atmospheric deposition is effectively the only source of mercury. The question arises: how have aquatic ecosystems responded? A previous analysis reported decreases in wet Hg deposition in northeastern Minnesota from 1998-2012, and mixed trends in Hg and methylmercury (MeHg) in lake water and fish from four remote lakes within Voyageurs National Park from 2001-2012 (Brigham, M.E. and others, 2014, *Environmental Science & Technology*, vol. 48, pp. 6115-6123. DOI: 10.1021/es500301a) [open access at: <https://pubs.acs.org/doi/10.1021/es500301a>]. Here, we report updated trends for the same study area for monitoring through 2018. Wet Hg deposition at two regional Mercury Deposition Network sites (Fernberg and Marcell, MN; <http://nadp.slh.wisc.edu/mdn/>) declined by an average of 22.5 percent from 1998-2018, with much of the decline occurring prior to 2011. In the four remote lakes, epilimnetic MeHg concentrations declined by an average of 42 percent and total Hg by an average of 27 percent.

Although the magnitude of trend in some lakes was small, it is noteworthy that for all the lakes both MeHg and total Hg show declines for the 2001-2018 time period. Epilimnetic MeHg may be responding both to a decline in atmospheric Hg deposition as well as a decline in sulfate deposition, which is an important co-driver of Hg methylation in the environment. Results from this case study suggest that regional-to continental-scale decreases in both Hg and sulfate emissions have benefitted aquatic resources, even in the face of global increases in Hg emissions

Brief Bio

Mark has degrees in Chemistry and Civil Engineering and has worked at the Minnesota office of the USGS since 1991. Mark Brigham's research focuses on contaminants in aquatic ecosystems.

Location of Study

Four remote lakes in Voyageurs National Park

Summary of Fish Responses to a Whole-Ecosystem Nanosilver Addition at IISD-Experimental Lakes Area

Lauren Hayhurst^{1,2}, Jonathan Martin³, Valerie Langlois⁴, Sarah Wallace^{4,5}, Brenden Slongo², Tyler Ripku², Chris Metcalfe³, and Michael D. Rennie^{1,2}

¹IISD Experimental Lakes Area, 111 Lombard Ave, Suite 325, Winnipeg MB, R3B 0T4, 204-218-5239

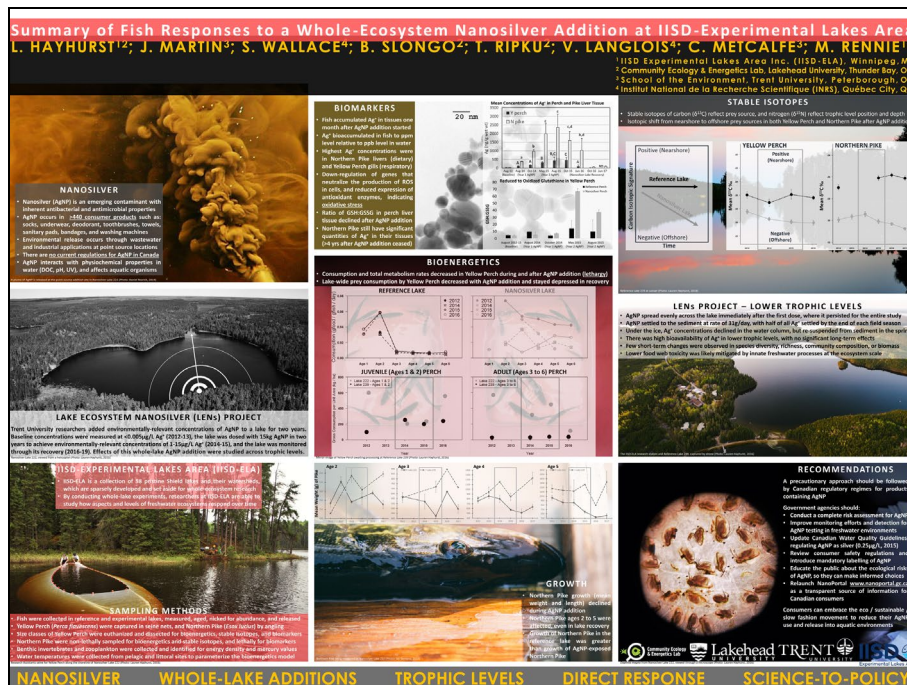
lhayhurst@iisd-ela.org

²Department of Biology, Lakehead University, Thunder Bay, ON., Canada

³The School of the Environment, Trent University, Peterborough, ON., Canada

⁴Institut National de Recherche Scientifique, Québec, QC., Canada

⁵Biology Department, Queen's University, Kingston, ON., Canada



Abstract

Nanosilver (AgNP) is an antibacterial agent with widespread commercial and industrial applications. As a result, AgNP has high potential for entering freshwater lakes at point source locations along their shorelines. As part of a collaborative study involving a whole-lake AgNP addition at environmentally-relevant (low ppb) concentrations, researchers evaluated biological responses across trophic levels (i.e., bacteria, algae, zooplankton, benthic invertebrates, fish, etc.) through baseline, two-year AgNP addition and lake recovery periods. Yellow Perch (*Perca flavescens*) and Northern Pike (*Esox lucius*) were monitored for multi-scale responses at the cellular (biomarker), individual (bioenergetics) and population levels. While there were minimal short-term effects at the lower trophic levels, fish were negatively affected from the start of the whole-lake manipulation to years after the AgNP additions ceased. At the cellular level, we found evidence of oxidative stress in the liver and gill tissues of perch and pike. At the individual level, bioenergetic models revealed significant changes in perch consumption, metabolism and activity, which declined during AgNP addition and remained depressed into whole-lake recovery. Furthermore, stable isotopes and growth analyses indicated that pike moved from feeding at nearshore locations to offshore prey sources and experienced reduced growth. At the population level, perch densities and gross prey consumption declined after AgNP was added to the lake, and pike experienced decreased survivorship. This whole-ecosystem multi-level and multi-scale response study of AgNP exposure revealed negative long-term impacts on fish, despite few short-term effects at lower trophic levels.

Brief Bio

Lauren Hayhurst is the Fisheries Research Biologist at International Institute for Sustainable Development – Experimental Lakes Area (IISD-ELA), having completed her M.Sc. (Biology) degree studying the effects of nanosilver on fish through Lakehead University in Thunder Bay. She is responsible for long-term fish populations monitoring efforts in the experimental and reference lakes at the IISD-ELA and resulting fisheries database. Lauren's background involves water quality sampling, bioenergetics modelling, ageing analysis and population estimation, with experience working on whole-lake manipulations and recovery efforts. She attributes her early and ongoing interest in freshwater and fish research to her weekends spent at her family's island on Lake of the Woods, ON.

Location of Study

Lake 222 (49.694587, -93.724398), IISD-ELA, Kenora District, ON.

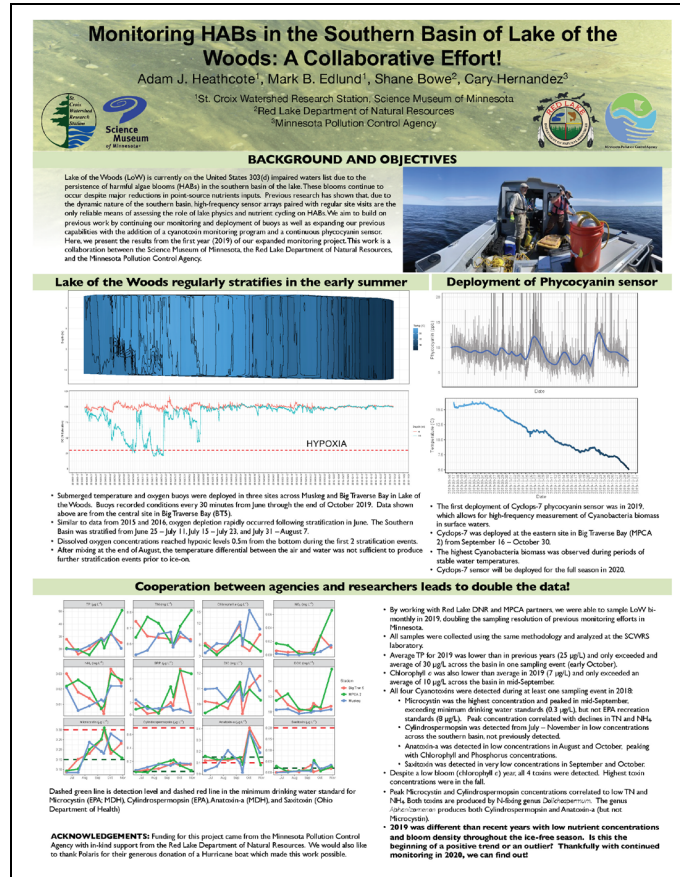
Monitoring HABs in the Southern Basin of Lake of the Woods: A Collaborative Effort!

Adam J. Heathcote¹, Mark B. Edlund¹, Shane Bowe², Cary Hernandez³

¹St. Croix Watershed Research Station, Science Museum of Minnesota, 16910 152nd St North, Marine on St. Croix, MN 55047 (651) 433-5953, aheathcote@smm.org

²Red Lake Department of Natural Resources, 15761 High School Dr, Red Lake, MN 56671

³Minnesota Pollution Control Agency, 714 Lake Avenue, Suite 220, Detroit Lakes, MN 56501



Abstract

Lake of the Woods (LoW) is currently on the United States 303(d) impaired waters list due to the persistence of harmful algae blooms (HABs) in the southern basin of the lake. These blooms continue to occur despite major reductions in point-source nutrients inputs. Previous research has shown that, due to the dynamic nature of the southern basin, high-frequency sensor arrays paired with regular site visits are the only reliable means of assessing the role of lake physics and nutrient cycling on HABs. We aim to build on previous work by continuing our monitoring and deployment of buoys as well as expanding our previous capabilities with the addition of a cyanotoxin monitoring program and a continuous phycocyanin sensor. Here, we present the results from the first year (2019) of our expanded monitoring project. This work is a collaboration between the Science Museum of Minnesota, the Red Lake Department of Natural Resources, and the Minnesota Pollution Control Agency.

Brief Bio

Adam Heathcote is a senior 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.

Location of Study

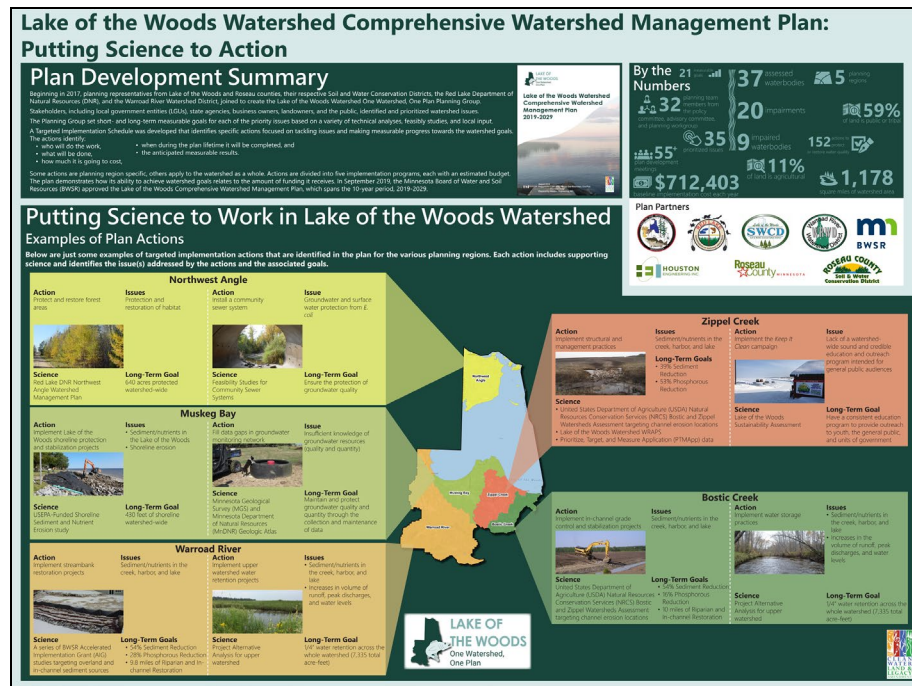
Lake of the Woods (Southern Basin)

Lake of the Woods Watershed Comprehensive Watershed Plan: Putting Science into Action

Jeremiah Jazdzewski¹ and Mike Hirst²

¹Houston Engineering, Inc., 7550 Meridian Circle North, Suite 120, Maple Grove, MN 55369 763-493-6689
jjazdzewski@houstoneng.com

²Lake of the Woods Soil and Water Conservation District, USDA Service Center, 119 1st Avenue, Baudette, MN 56623 218-634-1842 mike.hirst@mn.nacdn.net



Abstract

In 2017, representatives from Lake of the Woods and Roseau Counties, their respective Soil and Water Conservation Districts (SWCD), and the Warroad River Watershed District, organized to create the Lake of the Woods Watershed (LOWW) One Watershed, One Plan (1W1P) Planning Group. The purpose of the LOWW 1W1P Planning Group was to unite local entities—who would otherwise have separate local plans—under one Comprehensive Watershed Management Plan, creating a cohesive vision for implementing actions to improve locally prioritized water-related issues/concerns. The LOWW 1W1P Planning Group collaborated for the next two years to develop plan, which was adopted in the fall of 2019. The State of Minnesota is funding the implementation of actions identified in the plan through the Clean Water Legacy Amendment. This poster showcases the content of the plan and demonstrates how data and information gathered for the watershed will translate into actionable and measurable implementation over the 10-year lifetime of the plan.

Brief Bio

Jeremiah Jazdzewski is a licensed professional engineer with Houston Engineering, Inc. He has a B.A. in Physics from Gustavus Adolphus College and a M.S. in Civil Engineering from the University of Minnesota. He began working as a project manager with the Lake of the Woods Watershed Planning Group in 2016, facilitating the development of the Lake of the Woods Comprehensive Watershed Management Plan as part of Minnesota's One Watershed, One Plan (1W1P) program.

Mike Hirst is a Resource Conservationist with Lake of the Woods Soil and Water Conservation District in Baudette, MN. He has a B.S. in Geology and Water Resources from the University of North Dakota. He is one of the local coordinators for the Lake of the Woods One Watershed, One Plan effort.

Location of Study

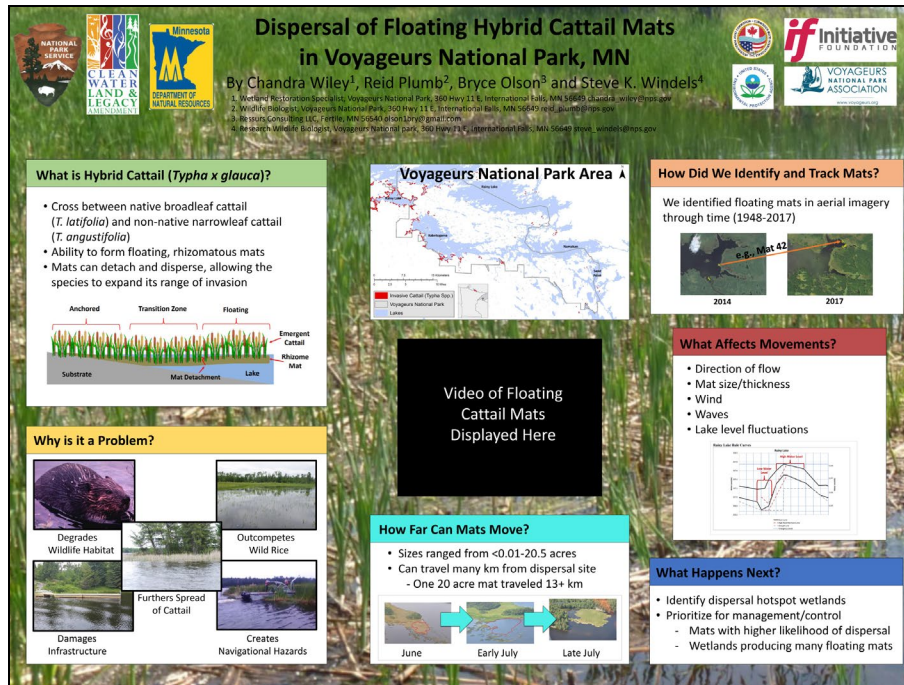
Minnesota Portion of the Lake of the Woods Watershed

Dispersal of Floating Cattail Mats in Rainy Lake, Minnesota

Chandra L. Wiley¹, Reid T. Plumb¹, Bryce T. Olson², Steve K. Windels¹

¹Voyageurs National Park, 360 Hwy 11 E, International Falls, MN 56649, chandra_wiley@nps.gov, 218-283-6622; reid_plumb@nps.gov, 218-283-6694; steve_windels@nps.gov, 218-283-6692

²Ressurs Consulting LLC, Fertile, MN 56540, olson1bry@gmail.com



Abstract

Hybridized cattail (*Typha x. glauca*) is a prolific invader of wetlands across the Great Lakes states, including those in Voyageurs National Park, MN. It is known for dominating native vegetation, reducing biological diversity, and forming dense, rhizomatous, floating mats. These mats can weaken over time, breaking away from their point of origin and floating throughout the lake system, resulting in navigational hazards for recreators. Once detached, a variety of factors including wind and wave action, water level fluctuations, and human interference can affect the direction and distance a floating mat may disperse. These movements can hinder recreational opportunities, impair cultural resources by damaging archeological sites or reducing wild rice habitat, and negatively affecting wildlife habitat by acting as an avenue for further colonization and spread. Using aerial imagery, we identified detached mats and manually tracked their movements through time to better understand factors influencing their trajectories. Determining the causal mechanisms of detachment and dispersal will allow managers to target cattail stands for treatment, reducing future recreational hazards and minimizing the spread of the species.

Brief Bio

Chandra Wiley is a biological science technician at Voyageurs National Park. She holds a Bachelor of Science in Environmental Science. At Voyageurs, she has worked on projects involving aquatic ecology, wetland restoration and air quality. She is currently involved in a wetland restoration project that aims to reduce hybrid cattail abundance within the park and promote the health of wetland ecosystems.

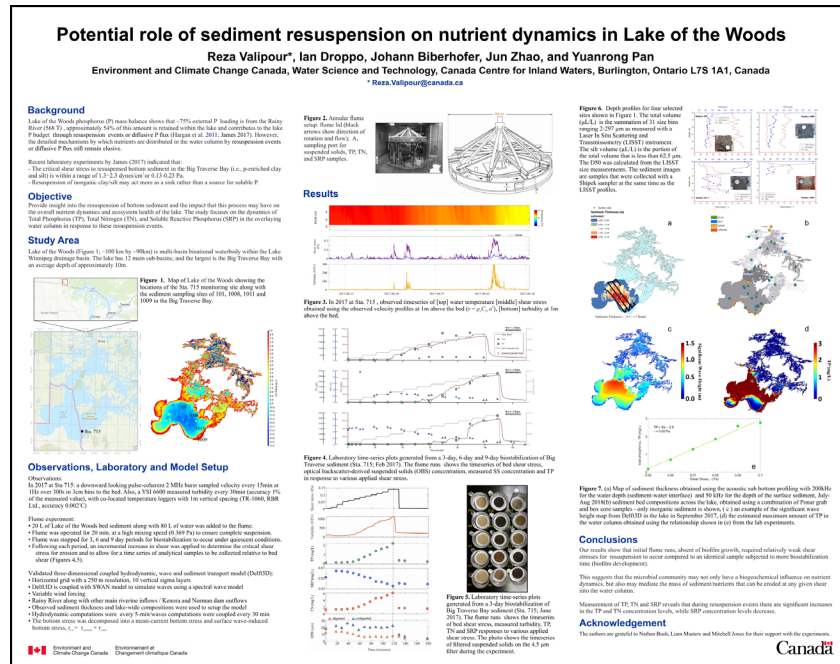
Location of Study

Voyageurs National Park

Potential role of sediment resuspension on nutrient dynamics in Lake of the Woods

Reza Valipour, Ian Droppo, Johann Biberhofer, Jun Zhao, and Yuanrong Pan

Water Science and Technology, Environment and Climate Change Canada, 867 Lakeshore Rd, 2nd Floor, Office R250 Burlington, Ontario L7S 1A1 905-319-7204 reza.valipour@canada.ca



Abstract

Results of field observations, laboratory experiments and a three-dimensional model of Lake of the Woods, provide insight into the resuspension of bottom sediment and the impact that this process may have on the overall nutrient dynamics and ecosystem health of the lake. The study focuses on the dynamics of Total Phosphorus (TP), Total Nitrogen (TN), and Soluble Reactive Phosphorus (SRP) in the overlaying water column in response to these resuspension events. In the field, we distinguished the observed resuspension events according to turbidity, fluorescence, acoustic and backscatter time-series. In the laboratory, we conducted a series of experiments using a 2-m annular flume containing bed sediment samples and bulk water from the Big Traverse to quantify the initiation of resuspension. Our results show that initial flume runs, absent of biofilm growth, required relatively weak shear stresses for resuspension to occur compared to an identical sample subjected to more bio-stabilization time (biofilm development). This suggests that the microbial community may not only have a biogeochemical influence on nutrient dynamics, but also may mediate the mass of sediment / nutrients that can be transported at any given shear into the water column. Measurement of TP, TN and SRP reveals that during resuspension events there are significant increases in the TP and TN concentration levels, while SRP concentration levels decrease. The lake-wide numerical sediment transport model using observed sediment samples and bed thicknesses in conjunction with laboratory results, can identify the lake-wide hotspots for resuspension, sediment transport, and their potential impacts on nutrient dynamics and lake-wide management plans.

Brief Bio

Reza Valipour has been a Research Scientist with and Climate Change Canada since 2017. Reza's work focuses on creating three-dimensional models of lakes to simulate water circulation and water quality. He received a PhD in Civil Engineering from Queen's University in 2012. His current research focuses on modeling water circulation, sediment transport and water quality in the Lake of the Woods. He is also involved in other ECCC research projects on large lakes including Lake Erie, Lake Winnipeg, Lake St. Clair and Lake Ontario.

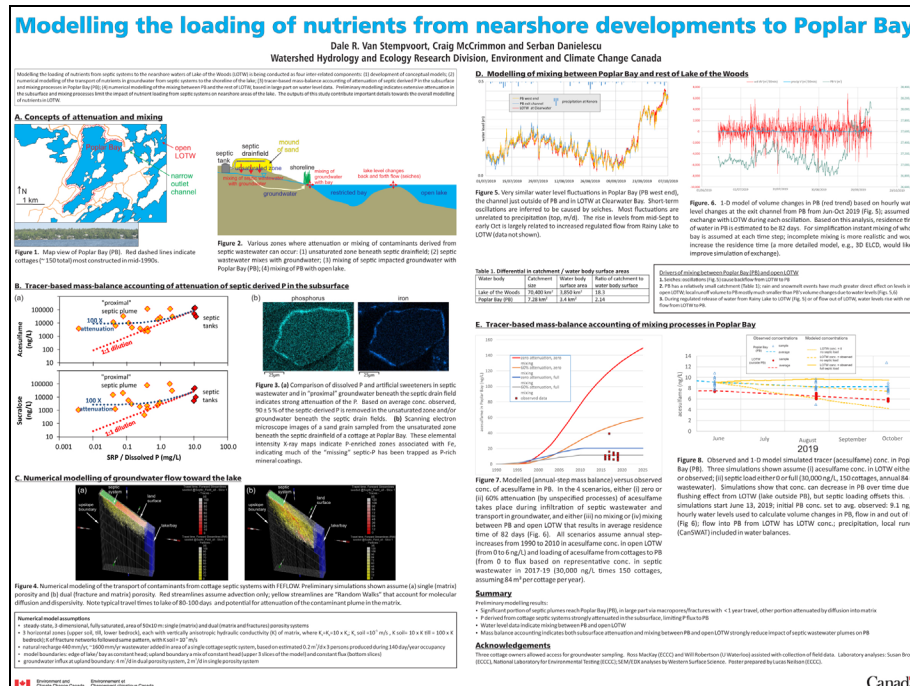
Location of Study

Big Traverse, Lake of the Woods and laboratory studies

Modelling the loading of nutrients from nearshore developments to Poplar Bay

Dale R. Van Stempvoort, Craig McCrimmon, Reza Valipour and Serban Danielescu

Watershed Hydrology and Ecology Research Division, Environment and Climate Change Canada



Abstract

Modelling the loading of nutrients from septic systems to the nearshore waters of Lake of the Woods is being conducted as four inter-related components: (1) development of conceptual models; (2) numerical modelling of the transport of nutrients in groundwater from septic systems to the shoreline of the lake; (3) tracer-based mass-balance accounting of attenuation of septic derived P in the subsurface and mixing processes in Poplar Bay; (4) numerical modelling of the mixing between Poplar Bay and the open lake, based in large part on water level data. Preliminary modelling indicates extensive attenuation in the subsurface and mixing processes limit the impact of nutrient loading from septic systems on nearshore areas of the lake. The outputs of this study contribute important details towards the overall modelling of nutrients in Lake of the Woods.

Brief Bio

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

Location of Study

Poplar Bay, Lake of the Woods.

Forum Week Overview: Meetings & Forum Symposium

Tuesday Mar 10 is reserved for specific groups meeting prior to the March 11-12 Forum sessions

	TUESDAY	WEDNESDAY	THURSDAY
	10	11	12
8 AM			
9	IMA WG & TAC Joint S119 9 am - 11 am	Forum Day 1 Starts 9:00 am Theatre - RR Community College	Forum Day 2 Starts 8:25 am Theatre RR Community College
10			
11	CAG S119 11 am - 12 pm		
	IAG SC-114 11 am - 12 pm		
12 PM			
1	CAG / IAG / IRLWWB S-119 12:30 pm - 1:30 pm		
2	IRLWWB S119 1:30 pm - 3:30 pm		
3			
4	Civic Engagement Workshop S-119 3:30 pm - 6:30 pm		Forum Ends 4:10 pm
5		Poster Set Up; Americdn 5:30 pm	
6		Reception & Poster Session Starts 6 pm Americdn 6 pm	
7	WLC Public Meeting Theatre RRCC 7 pm - 8 pm		
8			
9			

Acronyms

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

Appendix A: Organizations Represented at Forum

Coochiching First Nation	North St. Louis Soil & Water Conservation District
Cook Soil & Water Conservation District	Ontario Ministry of Environment Conservation & Parks
Environment and Climate Change Canada	Ontario Ministry of Natural Resources and Forestry
Global Affairs Canada	PCA Boise White Paper Mill
Houston Engineering, Inc.	Pennsylvania State University
IISD Experimental Lakes Area Inc.	Rainy Lake Conservancy
Independent Researcher	Rainy Lake Property Owners Association
International Joint Commission	Rainy Lake Property Owners Association
International Rainy Lake of the Woods Watershed Board	Rainy River Community College
IRLWWB Community Advisory Group	Red Lake Band
IRLWWB Community Advisory Group & Gun Lake Property Owners Association	RESPEC
IRLWWB Community Advisory Group & Rainy Lake Property Owners Association	St Croix Watershed Research Station, Science Museum of MN
Itasca Soil & Water Conservation District	St. Cloud State University
Koochiching Soil & Water Conservation District	The Grand Council Treaty #3
Lake County Soil & Water Conservation District	The Nature Conservancy of Canada
Lake of the Woods County - Land and Water Planning	Trent University
Lake of the Woods District Stewardship Association	Turtle Lake AIS
Lake of the Woods Soil & Water Conservation District	U.S. Consulate Winnipeg
Lake of the Woods Water Control Board	U.S. Geological Survey
Lake of the Woods Water Sustainability Foundation	University of Georgia
Métis Nation of Ontario	US Army Corps of Engineers
Minister's Office, Ontario Ministry of Environment Conservation and Parks	US Army Corps of Engineers St. Paul District
Minnesota Board of Water and Soil Resources	US EPA Region 5
Minnesota Department of Natural Resources	Voyageurs National Park
Minnesota Pollution Control Agency	Voyageurs National Park Association
Nature Conservancy of Canada	Wetlands Action Group
Niisaachewan Anishinaabe Nation	White Iron Chain of Lakes Association