Final V-2024-01-30

Program Abstracts
21st Annual

RAINY-LAKE OF THE WOODS
WATERSHED
2024 FORUM

March 6 - 7, 2024

Minnesota North College, Rainy River Campus
501 U. S. Hwy 71, International Falls, MN

Final V-2024-01-30

Forum Partners – Sponsors

The organizing committee thanks our 2024 sponsors for assisting with the 21st annual International Rainy-Lake of the Woods Watershed Forum. This event would not be possible without them:

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- Jefferson National Parks Association in cooperation with Voyageurs National Park
- Lake of the Woods District Stewardship Association
- Rainy Lake Conservancy
- Voyageurs Conservancy

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Program At A Glance

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		Traditional Welcome: Fred Desjarlait, Spiritual Advisor, Red Lake Nation **Opening Remarks:** Parliamentary Secretary to the Prime Minister and Special Advisor for Water, Terry Duguid **Greetings:** Consul Marylin Gayton **Opening Remarks:** Joshua Jones, Red Lake DNR
		Session 1: Water Governance (Moderator: Lucas King)
9:30	0:20	IJC / International Rainy-Lake of the Woods Watershed Board Update IRLWWB Co-chairs
9:50	0:20	Objectives, Alert Levels and Core Monitoring Project Update Teika Newton
10:10	0:20	Protecting international waters in the heart of North America: The role of civil society movements on transboundary water quality Becky Rom
10:30	0:30	**BREAK**
		Session 2: Ecosystem Modeling (Moderator: Teika Newton)
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11:20	0:20	Anishinaabe performance indicators for adaptive management of the Rainy–Namakan Rule Curves Johann Strube and TBD
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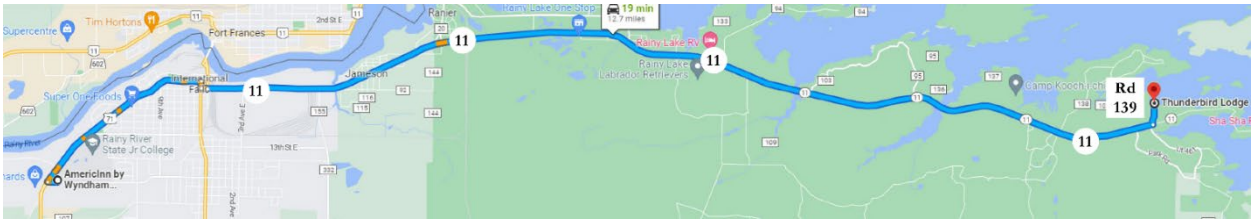
12:00	1:30	**LUNCH**
		Session 3: Contaminants & Mining (Moderator: Doug Franchot)
13:30	0:20	Assessing the vulnerability of waters to mining in the Rainy–Lake of the Woods watershed Aliesha Krall et al.
13:50	0:20	Groundwater–surface water model for the Canada–United States Rainy–Lake of the Woods transboundary watershed Hazan Russel et al.
14:10	0:20	Sulfate in the Rainy River Headwaters: A survey of background conditions in the watershed, as well as the tributary discharges to, and downstream transport of sulfate from Birch Lake, in Lake and Saint Louis counties, Minnesota (69-0003-00) Matt Norton
14:30	0:30	**BREAK**

Sesson 4: Ecological Interactions (Moderator: Chris Herc)		
15:00	0:20	Grand Council Treaty #3 environmental stewardship Michaela Novak & Laine Fyke
15:20	0:20	Looking back and thinking ahead: How aquatic invasive species have altered zooplankton communities in the Rainy–Lake of the Woods Watershed Kylie Cattoor et al.
15:40	0:20	Invasive cattail removal in boreal lake systems as a means of improving wildlife habitat Steve K. Windels et al.
16:00	0:20	Using mesocosms to assess greenhouse gas production and carbon sequestration by native wild rice (Zizania aquatica) Blake Cooney et al.
16:20	0:40	**Travel to Thunderbird Lodge**
17:00		**Reception and buffet dinner at Thunderbird Lodge on Rainy Lake** Guest speaker TBD • Kallemeyn Award • Wilson Stewardship Award

AmericInn &College → **12 miles / 20 minutes** → **Thunderbird Lodge**
Highway 11 East **Rd 139**



DAY 2 – MARCH 7

Start	Min	Symposium Sessions March 7
8:50	0:10	Day 2 Welcome and Introductions
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9:00	0:20	Contrasting patterns of algal, cyanobacterial, and cyanotoxin production in Lake of the Woods and Upper and Lower Red Lake Mari Leland et al.
9:20	0:20	Does internal loading of phosphorus drive cyanobacteria blooms in remote Minnesota lakes? Lienne Sethna et al.
9:40	0:20	Enhanced monitoring of Lake of the Woods highlights nitrogen dynamics and stratification as potential triggers of cyanobacterial blooms Adam Heathcote, *Mark Edlund et al.
10:00	0:20	Nitrogen dynamics and fixation control cyanobacterial abundance, diversity, and toxicity in Lake of the Woods (USA, Canada) Cody Sheik et al.
10:20	0:30	**BREAK**
Session 6: Science to Watershed Actions (Moderator: Mike Kennedy)		
10:50	0:10	Presenter & Panel Introductions and Instructions Mike Kennedy
11:00	0:20	Presentation: Science to Action in Minnesota Jeff Hrubes, Tara Solem and Mike Hirst[3]
11:20	0:20	Presentation: Environment & Climate Change Canada Lake of the Woods Nutrients Update Daniel Rokitnicki
11:40	0:20	Panel Discussion with Attendees Panelists: Jeff Hrubes (BWSR), Tara Solem (Lake SWCD), Mike Hirst (LoW SWCD), Daniel Rokitnicki (ECCC-CWA), Becca Reiss (N. St. Louis SWCD), Pam Tomevi (Koochiching SWDD) Moderator: Mike Kennedy
12:00	1:30	**LUNCH**

(Afternoon Sessions – See over)

Session 7: Nutrient & Sediment Load Tracing (Moderator: Jesse Anderson)		
13:30	0:20	Sediment mapping and progress toward understanding legacy phosphorus in the Rainy River corridor Anna Baker et al.
13:50	0:20	Tracking sediment sources in the Little Fork River using sediment fingerprinting Anna Baker et al.
14:10	0:20	A case for considering nitrogen in monitoring and management efforts in the Lower Rainy River basin Catherine Eimers et al.
14:30	0:20	Rainy River nutrient and sediment water quality trends, from ECCC and MPCA long-term monitoring programs Diana Fred, Jesse Anderson et al
14:50	0:30	**BREAK**
Session 8: Monitoring Program Updates (Moderator: Ryan Maki)		
15:20	0:20	Progress Update: MPCA's Intensive Watershed Monitoring efforts in the Lake of the Woods Watershed Wesle Sigl
15:40	0:20	**E**ffects of lake levels on nutrient conditions and HABS and cyanotoxin production in Lake Kabetogama James Larson et al.
16:00	0:20	ECCC update on water quality monitoring in the Lake of the Woods Rainy River Basin Diana Fred
16:20	0:10	**Closing Remarks - Forum Ends approximately 4:30**

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Day 1 – March 6, 2024

Session 1 – Watershed Governance

IJC / International Rainy-Lake of the Woods Watershed Board Update

Co-Chairs: Michael Goffin[1] and Karl D. Jansen, Alternate for Col. Eric R. Swenson[2]

[1]Environment and Climate Change Canada; [2]U.S. Army Corps of Engineers

Abstract

The presentation reviews the International Joint Commission's International Rainy-Lake of the Woods Watershed Board mandate and provides updates on the Board's activities from April 2023 to date. The role and activities of the Water Levels Committee will be discussed, with particular focus on how water levels are managed across the watershed. This presentation will also cover the Board's aquatic ecosystem health endeavors, with a special focus on working with the International Joint Commission and Governments to reduce phosphorus and address toxic algae. Current International Watershed Initiative projects such as Phase 2 of the Objectives and Alerts Project and Core Monitoring Program, the South Shore Erosion investigation, and the adaptive management of the Rainy – Namakan boundary waters will be discussed.

Brief Bio

Michael Goffin is a Special Advisor on Freshwater to the Canada Water Agency (CWA). Prior to this assignment, Mr. Goffin served as the Director of Freshwater Policy and Engagement, leading the establishment of the CWA, and advancing the transition of the Agency from a branch within Environment and Climate Change Canada, to a stand-alone agency. Within Environment and Climate Change Canada, Mr. Goffin served for many years, as the Regional Director General for Ontario, responsible for leading Canada's efforts to restore and protect the water quality and ecosystem health of the Great Lakes.

In 2012, Michael Goffin was lead negotiator for Canada responsible for the negotiation of the Canada-United States Great Lakes Water Quality Agreement. Mr. Goffin has been a long serving member of the International Joint Commission's Great Lakes Water Quality Board, and also currently serves as Canadian Co-Chair of the International Joint Commission's International Rainy Lake of the Woods Watershed Board. Over the course of his more than thirty-year career in the Public Service of Canada, Mr. Goffin has been engaged in policy development and program delivery in areas which include environmental protection, wildlife management, meteorology, water and ecosystem management, intergovernmental affairs and community outreach and engagement.

Colonel Eric R. Swenson is the Commander and District Engineer, U.S. Army Corps of Engineers – St. Paul District and is on assignment to Maui for the wildfire recovery efforts. Karl Jansen (former Commander of the St. Paul District and Co-Chair of the International Rainy-Lake of the Woods Watershed Board, the Water Levels Committee, the International Lake of the Woods Control Board, and the International Red River Watershed Board. He was also an alternate member of the International Souris River Board) now serves as the St. Paul District deputy district engineer and is the IJC appointed Alternate to COL Swenson on IJC Boards. The district serves the American public in the areas of navigation, flood risk management, environmental enhancement, water and wetlands regulation, recreation sites and disaster response.

Karl Jansen is a registered professional engineer and certified project management professional. He earned a bachelor's degree in environmental engineering from the United States Military Academy, a master's degree in civil engineering from the University of Washington, and a master's degree in strategic studies from the U.S. Army War College. Prior to joining the St. Paul District in August 2023 as a member of the Army civilian corps, Jansen served as an active-duty Army engineer officer for more than 25 years. Within the Corps of Engineers, he previously served as the 66th commander of the St. Paul District; executive officer to the Corps' Commanding General in Washington, D.C.; 72nd commander of the Buffalo District; and operations officer in the Seattle District. He also contributed to numerous hurricane and flood response operations nationwide.

Location of Study

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

Objectives, Alert Levels and Core Monitoring Project Update

Teika Newton

IJC

Abstract

In 2018, the International Rainy Lake of the Woods Watershed Board (IRLWWB) initiated a project to focus on its Directives to develop recommendations for water quality and aquatic ecosystem health Objectives and select and establish Alert Levels, relevant to priority issues in the basin. Phase I of the project, completed in late 2019, identified that existing Water Quality Objectives (WQO) for the Rainy River are obsolete and should be replaced, and that phosphorus is the only parameter significant enough to warrant internationally agreed-upon WQOs. Phase I recommended developing a set of total phosphorus objectives for various segments of the Lake of the Woods and the Rainy River, while other priority issues could be addressed by Alert Levels,

Phase II of the project began in late November 2023, with the goal of developing specific recommendations for WQOs for phosphorus, to select and establish Alert Levels for a priority short list of other substances and aquatic ecosystem health indicators, and to provide a technical scoping of an international monitoring program network to support progress reporting and future adaptive management. This presentation will provide a progress update on this work and preview of directions to date for discussion with the Forum participants.

Brief Bio

Teika Newton works for the Canadian section of the International Joint Commission, supporting IRLWWB activities and projects, including the Board's Adaptive Management Committee projects, as well as leading and coordinating the Phase II Objectives, Alerts, and Core Monitoring Project. As the International Watershed Coordinator, Teika also supports watershed coordination activities through the Lake of the Wood Water Sustainability Foundation.

Location of Study

Lake of the Woods, Rainy River and broader watershed

Protecting international waters in the heart of North America: The role of civil society movements on transboundary water quality

Becky Rom

Campaign to Save the Boundary Waters and Northeastern Minnesotans for Wilderness, 3100 Hartley Point Road, Ely, MN 55731 USA. Rebecca.rom49@gmail.com

Abstract

In April 2023 Becky Rom, National Chair, Campaign to Save the Boundary Waters, presented at the 5th Annual Water and Peace Seminar in The Hague, Netherlands. The Seminar was hosted by the Institute for Water Education under the auspices of UNESCO. Rom's presentation was on the role of civil society movements on transboundary water quality. She proposes to make a similar presentation at the Rainy-Lake of the Woods Watershed 2024 Forum.

The Campaign to Save the Boundary Waters advocates for a permanent ban on sulfide-ore copper mining in the Rainy River Headwaters of northeastern Minnesota. The Campaign is a program of Northeastern Minnesotans for Wilderness, a United States non-profit organization. Water pollution from mines in the Rainy River Headwaters would flow northward through the Boundary Waters Canoe Area Wilderness in Minnesota into Quetico Provincial Park in Ontario and Voyageurs National Park in Minnesota. Beginning in 2013 and continuing to the present date, the Campaign has engaged extensively with U.S. federal departments and agencies over three administrations (Obama, Trump, and Biden); the U.S. Congress; U.S. federal and state courts; and Minnesota's executive branch and administrative agencies over two administrations (Dayton and Walz). Public support for a ban on sulfide-ore copper mining in the Rainy River Headwaters is clear; federal and state agencies in the United States received 675,000 comments in opposition to such mining. Further, the Campaign has engaged representatives of the Canadian government, Canadian First Nations communities, and the International Joint Commission. As a consequence of this collaborative work over a 10-year period, in January 2023 the Biden Administration issued a 20-year mining ban (the maximum allowed under current statutes) on federal lands in the Rainy River Headwaters of northeastern Minnesota.

Brief Bio

Becky Rom is the National Chair of the Campaign to Save the Boundary Waters, which is a coalition of more than 400 conservation organizations, hunting and fishing groups, and businesses. The coalition works to gain permanent protection of the Rainy River Headwaters in the United States from sulfide-ore copper mining. The waters from this region flow downstream in the Rainy River Drainage Basin, a large transboundary watershed lying in the heart of North America, immediately west of the Great Lakes. Becky lives in the Rainy River Headwaters near Ely, Minnesota, in proximity to the Boundary Waters Canoe Area Wilderness. Working as a volunteer, Becky has advocated for the protection of public lands in the United States for 50 years. She has served on the Governing Council of The Wilderness Society since 1996, including as Chair from 2002-2006.

Location of Study

Rainy River Headwaters of northeastern Minnesota

Session 2 – Ecosystem Modeling

Coming back to Rainy-Namakan: Updating the Rainy River and Rainy-Namakan Integrated Ecosystem Response Models (IERMs) into the Integrated Social Economic and Environmental (ISEE) system

Marianne Bachand*, Jean Morin, Olivier Champoux, Patrice Fortin, Audrey Moffett

Hydrodynamic and Ecohydraulic section, National Hydrological Services, Environment and Climate Change Canada, 801-1550 Ave d'Estimauville, Québec, QC, G1J 5E9, CANADA

Abstract

During the 2013-2018 Rainy-Namakan 2000 Rule Curve (2000RC) Study, ECCC developed two Integrated Ecosystem Response Models (IERM) used to evaluate environmental impacts of water management plans on Rainy River and Rainy and Namakan chain of lakes. In recent years, the ISEE system was built by the same team from the IERM legacy. It is a similar tool but faster, modular, and shareable. Like the IERM, the ISEE system is designed to quantify the benefits and drawbacks of alternative plans using Performance Indicators (PIs). The ISEE system allows calculation of PIs for assessing flood impacts, not just on the ecosystems like the IERM, but also on economics (e.g. damage to buildings, flooded roads, etc.) and social issues (social and territorial sensitivity). It uses a georeferenced database and a collection of open-source Python scripts designed to model PIs in aquatic and riparian areas and to evaluate scenarios that consider long-term hydrological variability. ISEE relies solely on free open-source Python libraries, thus facilitating migrations, updates, sharing and collaboration with partners and organizations.

During the two years of the project, the two IERMs of the Rainy River and Rainy-Namakan system will be migrated into the ISEE system framework. This includes the validation of all PI results to make sure they are consistent with those of the 2000RC Study and the evaluation of the expected benefits of the 2017RC. PIs will be updated, and eventually new ones will be developed if needed, by integrating new data gathered from current parallel projects of the Adaptive Management Committee (AMC). This could allow, for instance, to produce an updated digital elevation model for specific wetland sites that were poorly cover in term of bathymetric data during the 2000RC study, to validate active use of spawning areas of emblematic fish species such as Walleye, Lake Whitefish, and Lake Sturgeon, and to better take into account priorities and needs of Rainy-Namakan communities regarding water management.

Brief Bio

Dr. Bachand is a Project Coordinator for the Hydrodynamic and Ecohydraulic section of Environment and Climate Change Canada (ECCC). In 2013, she obtained her Ph.D. in plant biology from Université Laval after studying the resilience of boreal forest facing deer overabundance and moved to ecohydraulic modeling for her postdoc. She then developed several habitat models for different species and a wetland model that were used in the evaluation of the 2000 Rule Curves of Rainy Lake and Namakan Reservoir System. She has been in her current role since 2016 and has developed several other habitat and wetland models for water bodies spanning the Canada-U.S. border including Lake Champlain-Richelieu River Basin, St. Marys River, St. Lawrence River and Lake Ontario. Those models are used in water-level management, climate change impact evaluation and in assessment of flood mitigation measures.

Location of Study

Rainy River and Rainy and Namakan chain of lakes

Anishinaabe performance indicators for adaptive management of the Rainy–Namakan Rule Curves

Johann Strube and additional speaker tbd

Zhaagimaa Waabo Territorial Planning Unit. Grand Council Treaty #3. PO BOX 1720, Kenora, ON P9N 3X7

Abstract

The International Joint Commission (IJC)-governed regulation of Rainy and Namakan Lakes has had devastating effects on Anishinaabe First Nations. Funded by the IJC International Watershed Initiative, Grand Council Treaty #3 engaged First Nations in the Rainy-Lake of the Woods Watershed to a) review existing and prospective new performance indicators for rule curve operation and b) to facilitate relationships through which Anishinaabe values, knowledge, and perspectives inform water management. Between November 2023 and January 2024, we conducted engagement sessions, interviews, and focus groups with staff, leadership, and Traditional Knowledge Holders of seven First Nations.

The initial findings reaffirm grievances First Nations have expressed for decades. Existing rule curve performance indicators cover the main interests of Treaty #3 First Nations (with some exceptions), but Anishinaabe Traditional Knowledge and observation are needed to improve their accuracy. Some communities expressed interest in sharing their knowledge, but others request that the IJC must first commit to understand the Anishinaabe relationship with nibi (water) and to undo colonial water governance practices. Ultimately, the IJC will need to invest in building relationships with each First Nation in the basin to ensure that Anishinaabe interests, knowledge, and worldviews are reflected in its governance of Rainy and Namakan Lakes.

Brief Bio

Johann Strube is an environmental policy analyst with Grand Council Treaty #3. He received his PhD in Rural Sociology from The Pennsylvania State University, researching the impacts of transboundary water governance on Manoomin and the Anishinaabe Nation in the Rainy Lake area.

Location of Study

Lake of the Woods, Rainy River, Rainy Lake, Namakan Lake (North of US-Canadian boundary)

Lake of the Woods Southern Shore Barrier Island Erosion Investigation: Status report

Zachary Morris[1] and Craig Taylor[2]

[1]AMI Consulting Engineers, P.A., 3276 Fanum Road, Suite 100, St. Paul, MN 55110.
[2]LimnoTech, 7300 Hudson Blvd, Suite 295, Oakdale, MN 55128

Abstract

This presentation will provide an overview of the geomorphology for the Pine & Curry, and Sable Islands located in the Lake of the Woods. These barrier islands have degraded over the last century and there is significant community interest in determining cause(s) for the erosion, as well as providing options on ways to restore the islands. This presentation will focus on the development of a lake-wide circulation model, which is a key initial step in understanding lake sedimentation processes and erosion of the islands. This project is currently in progress and is planned for completion by September 2024.

Brief Bio

Zac Morris has extensive experience designing waterfront structures and stabilizing shorelines. He has a deep understanding of coastal designs given his hands-on construction experience and design expertise. He frequently leads scientific studies such as wave and sediment transport analyses, seafloor mapping, and underwater inspections. Zac has a knack for applying theoretical concepts and models while remaining practical to ensure constructability. He enjoys challenging projects and serves as the Coastal and Riverine Department Manager for AMI.

Craig Taylor is a hydraulics and restoration specialist. Craig has over 15 years of professional experience in restoration design, physical hydraulics, sediment transport, and H&H modeling. Craig has a passion for water and has been a long-time fan of Lake of the Woods. Craig also serves as an instructor at the University of Virginia's Landscape Architecture graduate program.

Location of Study

Lake of the Woods & Rainy River.

Session 3 – Contaminants & Mining

Assessing the vulnerability of waters to mining in the Rainy–Lake of the Woods watershed

Aliesha Krall[1], Hazen Russel[2], Eric Boisvert[2], Matt Pyne[2], and Victoria Glenn Christensen[1]

[1]U.S. Geological Survey – Upper Midwest Water Science Center
[2]Geological Survey of Canada

Abstract

The U.S. Geological Survey and Geological Survey of Canada were selected to compile available data and participate in a data gap analysis associated with the cumulative impacts of mining across the Rainy-Lake of the Woods (RLOW) transboundary basin. Relevant data include: mine locations (past, present, and proposed), surface water water-quality, aquatic community, mineral potential, and surface water and groundwater flow hydrology. Sources of data include: state agencies, federal agencies, and tribes.

This presentation will describe the status of what is known, what is unknown, and additional data needed for the assessment of the vulnerability of waters to mining in the RLOW basin. The presentation will also describe progress on data identification, compilation, harmonization, and standardization along with challenges, intricacies, and workloads within the context of international best practices. A fully integrated, physically based numeric model has been developed to provide a tool that can be used to analyze transboundary groundwater-surface water concerns. Results of this study are intended to support future water availability assessments of the RLOW basin and may serve as an example for future basins.

Brief Bio

Aliesha Krall is a physical scientist with the U.S. Geological Survey – Upper Midwest Water Science Center studying aquatic contaminants.

Hazen Russel is a sedimentologist with the Geological Survey of Canada working in the Groundwater Geoscience Program. He is co-lead for the Canada1Water project modelling the water cycle of Canada.

Location of Study

International Rainy-Lake of the Woods Watershed

Groundwater–surface water model for the Canada–United States Rainy–Lake of the Woods transboundary watershed

H.A.J. Russell[1], S.K. Frey[2,3], O. Khader[2], S. Xu[2], and A. Krall[4]

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[2] Aquanty Inc. 564 Weber Street North, Waterloo, ON N2L 5C6
[3] University of Waterloo, Department of Earth and Environmental Sciences, 200 University Avenue West, Waterloo, ON, N2L 3G1
[4]U.S. Geological Survey – Upper Midwest Water Science Center, 2280 Woodale Drive
Mounds View, MN 55112

Abstract

Transboundary watersheds between Canada and the United States cover 2 million square kilometres, divided approximately equally between the two countries. Over 60 million people live within these watersheds, and extensive agricultural, mining and industrial activities are also present. With broad acknowledgment of current and legacy environmental stressors, along with the increased interest in electrification and strategic mineral supply, there is mounting concern related to the impact of past, present and future mining activities on both groundwater and surface water in transboundary watersheds. During 2023–2024, the International Joint Commission (IJC) is supporting a pilot study in the Rainy–Lake of the Woods watershed (shared between Minnesota, Ontario, and Manitoba) to assess the vulnerability of waters to mining via a gap analysis of dataset availability and harmonization opportunity and issues.

A component of this study has been the development of a physically-based fully-coupled groundwater–surface water model using the HydroGeoSphere (HGS) modelling software. The project has heavily leveraged the Canada1Water modelling initiative, which includes all transboundary watersheds in its continental scale modelling domain. To support concerns in the Rainy–Lake of the Woods watershed, a regional scale HGS model that resolves Strahler order 2+ streams has been constructed for the watershed. The model's irregular finite element mesh incorporates three distinct levels of spatial discretization: i) illustrative mine sites (50-800 m), ii) surface water features (800-1500 m), and iii) interfluve areas (< 3000 m). The climate, landcover, and hydrostratigraphy have been adopted from harmonized, standardized, classified, and parameterized Canada1Water datasets, and have facilitated a rapid and inexpensive data framework solution for the IJC study. Initial input datasets range in scale from the 30 m Digital Elevation Model (DEM) resolution to 1:5,000,000 scale geological datasets. A seven-layer hydrostratigraphic model has been implemented, consisting of 2 soil layers, 3 surficial geology layers, and 2 bedrock layers. Model calibration has incorporated surface water flow stations from across the watershed as well as lake surface areas and elevations. The model is currently in the final stage of calibration, for which the latest results will be reported on.

Brief Bio

Hazen Russel is a sedimentologist with the Geological Survey of Canada working in the Groundwater Geoscience Program. He is co-lead for the Canada1Water project modelling the water cycle of Canada.

Location of Study

International Rainy-Lake of the Woods Watershed

Sulfate in the Rainy River Headwaters: A survey of background conditions in the watershed, as well as the tributary discharges to, and downstream transport of sulfate from Birch Lake, in Lake and Saint Louis counties, Minnesota (69-0003-00)

Matt Norton

Northeastern Minnesotans for Wilderness, 16 N. 1st Ave. E.,Ely, MN 55371.

Abstract

Northeastern Minnesotans for Wilderness (NMW) has built and operated a professional water quality monitoring program that has produced extensive water quality data since 2020. The scope of the program's data collection has shifted occasionally as new questions arise. To date, the area of interest to NMW's monitoring program has centered on a portion of the Rainy River Headwaters watershed including Birch Lake and its tributaries, the White Iron chain of lakes, and the Kawishiwi River, the largest river system in the Rainy River-Headwaters watershed.

NMW's water quality program manager has been properly trained to follow appropriate field data and sample collection methods. The equipment NMW uses is the same as used by the MPCA and EPA, NMW follows all MPCA and EPA SOPs for QA/QC, and a state-certified testing lab has analyzed water samples using accepted analytical methods.

As a consequence, NMW has produced a large quantity of reliable water quality data in and around Birch Lake, which data are essential to provide science-based answers to important water quality questions. The MPCA has given NMW's water monitoring work a project designation, NMW's sampling locations state IDs. NMW's lab is submitting sulfate results directly to the state water quality database, EQuIS, and the MPCA is using the submitted data in its 303d determinations. MPCA's determination in Nov., 2023 that Birch Lake (a wild rice lake) is impaired for sulfate was based substantially on lab results from NMW's 2020 – 2022 sampling.

The presentation will include monitoring results to contrast average sulfate concentrations in Rainy River-Headwaters subwatersheds free of mining history with subwatersheds marked by mining-affected land, will show 2020 – 2022 sulfate averages in Birch Lake, and demonstrate that Birch Lake's sulfate contributions are sufficient to elevate sulfate concentrations in the Kawishiwi River system above background levels far downstream.

Brief Bio

Matt Norton is Policy & Science Director for Northeastern Minnesotans for Wilderness (NMW) and Save the Boundary Waters, and oversees NMW's water monitoring program. Matt has undergraduate and master's degrees in biology and forest science from Yale University, and a law degree from the University of Michigan Law School. Matt has worked since 2002 to protect Minnesotans' air, water, and public lands, including with NMW since 2016, and previously with the Minnesota Environmental Partnership and the Minnesota Center for Environmental Advocacy.

Location of Study

Birch Lake and its tributaries, the White Iron chain of lakes, and the Kawishiwi River

Session 4 – Ecological Interactions

Grand Council Treaty #3 environmental stewardship

Michaela Novak and Laine Fyke

Grand Council Treat #3 Territorial Planning Unit

Abstract

Grand Council Treaty #3's Territorial Planning Unit (TPU) helps protect and preserve the traditional waters of the Anishinaabe Nation through environmental stewardship. The TPU leads environmental monitoring across the territory, where water quality and chemistry, and invasive species data are collected. The Community-Based Monitoring program has been operational since 2018 to develop monitoring capacity across the territory, collect baseline data, and prioritize youth engagement. The data collected includes basic water quality parameters, and samples for the concentration of heavy metals and nutrients, and coliform density. Expanding on the invasive *Phragmites.* monitoring that began in 2022, leaf samples were collected from main roads across Treaty #3 territory for DNA identification and all sightings were mapped. High traffic waterbodies were sampled for the presence of invasive zebra mussel veligers; priority locations were those of significance to Treaty #3 communities and high-traffic public boat launches. Of 73 unique sites sampled in Treaty #3, veliger presence was confirmed at three. The purpose of all data collected by the TPU is to strengthen Treaty #3 communities' capacity for environmental management, to support policy changes, and to hold all industries and proponents accountable.

Brief Bio

Michaela Novak is an Environmental Monitoring Coordinator with the Territorial Planning Unit of Grand Council Treaty #3. She coordinates invasive species monitoring and assists with water quality monitoring across the Treaty #3 territory. Before joining the TPU, she earned a B.Sc. in Biology and a Certificate in Indigenous Studies from Dalhousie University, where she focussed her education on aquatic life and conservation through a holistic perspective.

Laine Fyke is an Environmental Monitoring Coordinator with the Territorial Planning Unit of Grand Council Treaty #3. She coordinates the Community Based Water Monitoring Program with the Treaty #3 communities to assess water body health across the territory and assist in invasive species monitoring. Previously, she assisted in the rearing and release of walleye and trout for Manitoba fisheries. Laine earned a B.Sc. in Physical Geography, focused on hydrology, climate science, and environmental data collection and compilation.

Location of Study

Anishinaabeg of Naongashiing, Ojibways of Onigaming, Mishkosiminiziibiing, Rainy River First Nations, Northwest Angle #33 First Nation, many waterbodies across Treaty #3 territory.

Looking back and thinking ahead: How aquatic invasive species have altered zooplankton communities in the Rainy–Lake of the Woods Watershed

Kylie Cattoor, Heidi Rantala, Jodene Hirsh and Gary Montz

Minnesota Department of Natural Resources, Division of Ecological and Water Resources, 500 Lafayette Road, St. Paul MN 55155. Kylie.Cattoor@state.mn.us

Abstract

Zooplankton are highly sensitive to stressors in their environment and are useful indicators of change in aquatic ecosystems. Spiny waterflea, an invasive zooplankton, directly predates native zooplankton that can then alter lake productivity and energy flow within a system. In the last 20 years, spiny waterflea has invaded several oligotrophic lakes in northern Minnesota, including the large (>25,000 acres) walleye lakes that are monitored by the MN DNR Large Lake Program and Voyageurs National Park. Using existing data, we conducted a retrospective analysis to examine the impacts of spiny waterflea on zooplankton densities, communities, and productivity. We examined data from Lake of the Woods, Lake Vermilion, Rainy Lake, and Lake Kabetogama. Over ~1,000 water samples (via. vertical plankton tows) were collected from 2001-2021. We observed significant declines in zooplankton densities, biomass, productivity, and changes in species composition overtime. More recently, invasive zebra mussels were introduced to two of these lakes. We discuss their potential impacts and other scenarios where zebra mussels interact with spiny waterflea populations.

Brief Bio

Kylie Cattoor is an aquatic biologist with the Minnesota Department of Natural Resources (MN DNR). She serves as the statewide zooplankton specialist where she provides taxonomy and ecology to resource partners and professionals. Prior to this, she worked as an Invasive Species Specialist for 7 years. She continues to be interested in AIS and their impacts to lake ecosystems.

Location of Study

Lake of the Woods, Lake Kabetogama, Rainy Lake, Lake Vermilion

Invasive cattail removal in boreal lake systems as a means of improving wildlife habitat

Steve K. Windels[1], Jerry W. Warmbold[1], Adam A. Ahlers[2], Reid Plumb[3], Bryce T. Olson[4], Joshua Carpenter[1]

[1]Voyageurs National Park;
[2]Kansas State University
[3] U.S. Forest Service
[4] Ressurs Consulting LLC

Abstract

Non-native (hybrid) cattails disrupt wetland ecosystems by creating dense monotypic stands which displace native species and reduce biological diversity. Hybrid cattail is the dominant plant species in many lacustrine wetlands in Voyageurs National Park, MN, an 88,000 ha protected area in the Southern Boreal Forest region along the US-Canada border. We initiated the Voyageurs Wetland Restoration Project in 2016 to reduce cattail abundance and restore wetlands to more spatially and botanically diverse habitats in the park. Using an Adaptive Management framework, we've tested various methods of cattail removal and re-seeding techniques to better understand the most cost-effective means to restore lacustrine wetlands. Annual monitoring of wetland plants, secretive marshbirds, and semi-aquatic mammals has been conducted in treated and control sites since the project was initiated. We report here on short-term response (1-5 years post-treatment) of these 3 taxonomic groups to cattail removal/wetland restoration as indicators of overall wetland health.

We report here on short-term response (1-5 years) of wetland plants, secretive marshbirds, and semi-aquatic mammals to various restoration techniques we've employed.

Brief Bio

TO COME

Steve Windels is a wildlife biologist at Voyageurs National Park, MN, USA. He conduct 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 also hold adjunct faculty positions at University of Minnesota Fisheries, Wildlife and Conservation Biology Graduate Program and University of Minnesota-Duluth in the IBS program. Amongst his other achievements, Steve was the recipient of the 2023 Distinguished Moose Biologist Award. Steve holds a: PhD from Michigan Tech University, a MS from Texas A&M University-Kingsville, and a BS from the University of Minnesota.

Location of Study

Voyageurs National Park

Using mesocosms to assess greenhouse gas production and carbon sequestration by native wild rice (Zizania aquatica)

B Cooney, J Kimball, B Hardy, and V Palace

IISD-Experimental Lakes Area

Abstract

Wild Rice (Zizania aquatica) is an important staple in diet, economy, and culture of indigenous communities and local harvesters across Canada and the United States. There are many factors that threaten wild rice and its native habitat such as invasive cattail, shoreline development, pollution, and climate change. For this reason, we want to better our understanding of the function and characteristics of wild rice. At the IISD-Experimental Lakes Area we are aiming to study specific impacts and traits of wild rice in a controlled environment. In 2023, we grew different strains of wild rice in 12 mesocosms to assess nutrient uptake and plant success. In summer 2024, using mesocosms and starting from stratified seed we will grow wild rice in saturated soil. Five mesocosms will have cattail seeds (Typha latifolia) competing with wild rice, five will be seeded with established cattail bulbs and wild rice, and five will have only wild rice. One unplanted mesocosm will serve as reference. We will assess plant success and nutrient uptake by both plant species. One of our major goals in this study will be to assess greenhouse gas emissions from each mesocosm. By measuring carbon dioxide and methane gas exchange, carbon in sediments, surface water, and plant mass, we will quantitatively determine carbon dioxide sequestered by both species and produce detailed carbon budgets for the mesocosms. These studies will improve understanding of greenhouse gas production for application to growing operations at larger scales across the boreal region.

Brief Bio

Blake Cooney is a Chemist I with IISD Experimental Lakes Area, working on a variety of chemical analyses in the chemistry lab. Blake frequently assists with other tasks such as fish and zooplankton sampling, as well as meteorological and hydrometric monitoring. He holds a Bachelor of Science (Honours) from Carleton University and is pursuing a master's degree in environmental chemistry from the University of Manitoba.

Location of Study

IISD-Experimental Lakes Area

Session 5 – Nutrient Dynamics: Drivers of Cyanobateria and Cyanotoxin Production

Contrasting patterns of algal, cyanobacterial, and cyanotoxin production in Lake of the Woods and Upper and Lower Red Lake

*Marie Leland[1], K. Bowe[2], S. Bowe[2], J. Anderson[3], J. Hadash[3], L. Sethna[1], A.J. Heathcote[1], M.B. Edlund[1]

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[2]Red Lake Department of Natural Resources, Red Lake, Minnesota
[3]Minnesota Pollution Control Agency, Duluth and St Paul, Minnesota

Abstract

Lake of the Woods and the Red Lakes can experience significant cyanobacterial blooms despite minimal watershed disturbance in the Red Lakes and extensive point source management in Lake of the Woods. Both systems share similar basin characteristics such as average depth and watershed area:lake surface area ratios, highlighting the role of in-lake processes in driving cyanobacterial blooms. For example, past research has shown internal phosphorus (P) loading in Lake of the Woods is the primary source of P during the summer growing season. Increases in the availability of P relative to other nutrients, such as nitrogen (N) and silicon (Si), may promote the growth of cyanobacteria over other algal taxa such as green algae and diatoms. Using multiple years of water quality monitoring on Lake of the Woods and the Red Lakes, coupled with an intensive sampling year in 2023 targeting cyanotoxins and potential limiting nutrients, we sought to characterize the relationships between nutrient availability, algal community composition, and cyanotoxin production. We use dissolved and total nutrient data, nutrient ratios including N, P, and Si, algal biomass and relative community composition, and lake physical properties to assess the controls on cyanobacterial blooms in these systems. We document the spatial and temporal variation in algal and cyanobacterial proliferation, toxin production rates, and toxin types in relation to nutrient availability throughout both lake basins. Although Red Lakes and Lake of the Woods share an origin in glacial Lake Agassiz, they have experienced significantly different recent anthropogenic histories affecting nutrient loading. Evaluating patterns in seasonal nutrient concentrations in the context of algal production and cyanotoxins in these contrasting large lakes can provide insights into the impact of inherent lake characteristics versus external influences and inform strategies for effective cyanobacterial bloom prediction and mitigation.

Brief Bio

Mari Leland is the Biological Laboratory Technician at the St Croix Watershed Research Station. Her research interests include lake stoichiometry controls of primary and secondary production, impacts of salinity on temperate lakes, and freshwater invasive diatoms.

Location of Study

Lake of the Woods and the Red Lakes, Minnesota

Does internal loading of phosphorus drive cyanobacteria blooms in remote Minnesota lakes?

*Lienne R.Sethna, A.J. Heathcote, M.B. Edlund, A. Wilson-Jackson, A. Fedie, A. White

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Abstract

Despite billions of dollars directed towards combatting harmful algal blooms by cyanobacteria (cyanoHABs) worldwide, the frequency, intensity, and ubiquity of these blooms in freshwaters are increasing. Historically, cyanoHAB management has relied heavily on nutrient reduction strategies, specifically reducing inputs of nitrogen (N) and phosphorus (P) from agriculture and point sources; however, cyanoHABs have been documented in remote lakes in the relatively pristine waters of northern Minnesota, whose catchments are relatively protected from human landscape modifications. This has prompted a paradigm shift in our understanding of the drivers of cyanoHABs and a need to study environmental factors beyond watershed nutrient inputs. In this study, we examined eight lakes representing a gradient of depth and watershed size within the Superior National Forest and the Upper Basin of the Lake of the Woods watershed. We paired high-resolution temperature and dissolved oxygen profiles with monthly measurements of nutrients and algal abundance to assess the relationship between thermal structure, oxygen depletion rates, and the abundance of algae, including cyanobacteria. We found that cyanobacteria abundance was correlated to total P concentrations , which in turn were related to how frequently the lakes thermally stratified and subsequently mixed. This relationship implicates internal P loading as the primary mechanism for cyanobacterial growth. We also found that lakes that experienced the most intense cyanoHABs frequently had hypoxic or anoxic bottom waters, providing ideal conditions for the anaerobic release of Iron-bound P. Taken together, these results suggest that even in our most protected regions, shallow lakes experiencing polymictic thermal regimes may support cyanoHABs through increased internal P loading. As stratification regimes continue to be altered under warmer climate scenarios, improving our understanding of the linkages between cyanoHABs and internal P loading in these remote lakes will allow us to better focus management efforts in the future.

Brief Bio

Lienne Sethna is an Assistant Scientist at the St. Croix Watershed Research Station. Her research interests include nutrient biogeochemistry, freshwater harmful algal blooms, and historic and contemporary wild rice ecology

Location of Study

Eight lakes within the Superior National Forest and the Upper Basin of the Lake of the Woods watershed

Enhanced monitoring of Lake of the Woods highlights nitrogen dynamics and stratification as potential triggers of cyanobacterial blooms

A.J. Heathcote[1], M.B Edlund[1]*, K. Bowe[2], S. Bowe[2], C. Hernandez[3]

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[2]Red Lake Department of Natural Resources, Red Lake, Minnesota
[3]Minnesota Pollution Control Agency, Detroit Lakes, Minnesota

Abstract

The southern basin of Lake of the Woods (LoW) has been designated as an impaired water due to elevated nutrients, chlorophyll, and the persistence of harmful algae blooms (HABs). These blooms continue to occur despite major reductions in point-source nutrients inputs. Previous research has identified lake physics (temperature and oxygen) and nutrient recycling (nitrogen [N], phosphorus [P]) as likely drivers of blooms. We did enhanced monitoring of southern LoW from 2019-2021 using high-frequency water column monitoring buoys to determine thermal structure, anoxia, phycocyanin, and sediment resuspension coupled with intensive monitoring for water quality parameters, including nutrient concentrations, algal biomass, water column profiles, and cyanotoxins.

The LoW was sampled a total of 24 times over the 3-year period, including 1 winter sampling event and 7-8 open water sampling events in each year. Data are summarized as both annual and a 3-year time series covering the entire project. These data reinforce the need to better understand nitrogen-cycling in LoW and what drives dissolved inorganic nitrogen:total phosphorus ratios seasonally. In particular, the importance of measuring low concentration dissolved nitrogen species may be key to understanding bloom triggering conditions. Four different cyanotoxins were measured during each sampling event in LoW. Cyanotoxin data indicate that microcystin concentrations routinely exceed drinking water standards in the central bay of southern LoW and found anatoxin-a concentrations above drinking water standards for the first time during the 2019 season. No toxin concentrations exceeded Minnesota Pollution Control Agency (MPCA) or the United States Environmental Protection Agency (EPA) recommendations for recreational use.We synthesized monitoring buoy results to calculate the frequency and duration of stratification, the depletion of oxygen during these events, and the resulting loadings of phosphorus to the water column to fuel algal production. Sediment traps that were deployed alongside buoys revealed a strong East to West gradient in sediment particles across LoW that may be driven by the proximity to the mouth of the Rainy River.

Brief Bio

Mark Edlund is a Senior Scientist at the St. Croix Watershed Research Station. He has been working on water quality issues in the Rainy Watershed and Lake of the Woods for a long time. He's never met a diatom he didn't like, but can't say as much about cyanobacteria.

Location of Study

Southern basin of Lake of the Woods

Nitrogen dynamics and fixation control cyanobacterial abundance, diversity, and toxicity in Lake of the Woods (USA, Canada)

Cody Sheik[1,4], Kaela E. Natwora[1], Adam J. Heathcote[2], Mark B. Edlund[2], Shane E. Bowe[3], Jake D. Callaghan[1]

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[3]Red Lake Department of Natural Resources, Red Lake, MN USA;
[4]Biology Department, University of Minnesota Duluth, Duluth, MN, USA.

Abstract

Our understanding of drivers of cyanobacterial harmful algal blooms (cHABs) is evolving, but it is apparent that not all lakes are created equal. Nitrogen (N) is an important component of all cHABs and is crucial for cyanotoxin production. External nitrogen inputs are generally assumed to be the primary N source for cHABs. However, in northern lakes, nitrogen inputs are typically low and suggest that internal nitrogen cycling, through heterotrophic organic matter decomposition or nitrogen fixation, may play a significant role in cHAB development and sustainment. Using Lake of the Woods as a testbed, we quantified nutrients, cyanotoxins, nitrogen fixation, and the microbial community in the southern extent of the lake. During our temporal study, inorganic nitrogen species (NO3-+NO2- and NH4+) were either at very low concentrations or below detection, while phosphorus was in excess. These conditions resulted in nitrogen-deficient growth and thereby favored nitrogen-fixing cyanobacterial species. In response, nitrogen fixation rates increased exponentially throughout the summer, coinciding with the Aphanizomenon sp. bloom. Despite nitrogen limitation, microcystin, anatoxin, saxitoxin, and cylindrospermopsin were all detected, with microcystin being the most abundant cyanotoxin. Microcystin concentrations were highest when free nitrogen was available and coincided with an increase in Microcystis. Using a metatranscriptomic sequencing approach, the majority of microcystin genes expressed belonged to either Microcystis or Planktothrix spp. Our work suggests that internal nitrogen dynamics are responsible for the dominance of nitrogen-fixing cyanobacteria and that nitrogen additions may increase the likelihood of other cyanobacterial species, currently at low abundance, to increase growth and cyanotoxin production.

Brief Bio

Dr. Cody Sheik is an Associate Professor at the Large Lakes Observatory, University of Minnesota Duluth. He is a microbial ecologist who focuses on how microorganisms, especially cyanobacteria, cycle elements in freshwater ecosystems. The Sheik Lab uses DNA and RNA-based approaches to identify microorganisms and elucidate the functional roles they mediate in the environment. His lab integrates genome-based data with environmental data to dissect nutrient cycles. His work has primarily focused on the Great Lakes but recently has extended to cyanobacterial blooms across Minnesota. Here, they use the cyanobacteria genomes to identify cyanotoxin-producing vs non-toxin-producing species, aiming to identify the culprits and their growth cycles.

Location of Study

Lake of the Woods

Session 6 – Science to Watershed Actions (Panel Discussion)

Presentations: Science to Watershed Actions

Science to Action in Minnesota

Jeff Hrubes[1], Tara Solem[2], Mike Hirst[3]

[1]Bureau of Soil and Water Resources; [2]Lake Soil and Water Conservation District, [3]Lake of the Woods Soil and Water Conservation District

Overview

This presentation will provide a brief overview of the watershed planning efforts taking place by the State of Minnesota with their local partners, Soil and Water Conservation Districts, bringing science to action. A virtual tour of the watershed, upstream to downstream, will highlight actions in each major watershed in the Rainy-Lake of the Woods Basin within Minnesota. The six major watershed planning areas are in various states of science, planning, and action addressing the water quality goals specific to each watershed.

Environment and Climate Change Canada Lake of the Woods Nutrients Update

Daniel Rokitnicki

Canada Water Agency – Environment and Climate Chage Canada

Overview

Environment and Climate Change Canada is implementing a renewed program for Lake of the Woods as one of 8 Freshwater Ecosystem Initiatives in Canada. The Lake of the Woods Freshwater Ecosystem Initiative will continue core programming on science, communication, and engagement, with an expansion to supporting action to reduce phosphorus loads to the lake. This presentation will provide an update on progress in the delivery of a renewed and expanded program in Lake of the Woods.

Panel Discussion: Science to Watershed Actions

Panel Discussion

Panel: Jeff Hrubes[1], Tara Solem[2], Mike Hirst[3], Daniel Rokitnicki[4], Becca Reiss[5], Pam Tomevi[6]. Moderator: Mike Kennedy[7]

[1]Bureau of Soil & Water Resources;
[2]Lake Soil & Water Conservation District;
[3]Lake of the Woods Soil & Water Conservation District;
[4]Canada Water Agency – Environment and Climate Change Canada;
[5]North St. Louis Soil & Water Conservation District;
[6]Koochiching Soil & Water Conservation District;
[7]Minnesota Pollution Control Agency.

Overview

This session provides an opportunity for all to discuss watershed planning and watershed actions in the Rainy-Lake of the Woods basin, including focus on activities to address nutrient load targets and allocations. Participants will have the opportunity to explore examples of organizational / institutional models for successful implementation, opportunities, and challenges in developing watershed plans and actions with experts engaged in planning and implementation from local landowner and counties, to provincial/state and federal jurisdictions.

Brief Bios

Jeff Hrubes has worked for the Minnesota Board of Water and Soil Resources (BWSR) as a Clean Water Specialist since May of 2006 with the Clean Water Legacy program and the transition to the Clean Water Fund. Prior to that, Jeff served two stints with the Minnesota Pollution Control Agency (MPCA) as a water plan liaison and Clean Water Partnership/ TMDL/ Section 319 project manager for Central Minnesota counties. In between, Jeff was a Board Conservationist for BWSR in North-Central Minnesota from Wadena to Canada.

Jeff spent nearly 10 years with the Beltrami Soil and Water Conservation District before starting employment with the State of Minnesota. In a previous life, he managed retail stores in the Twin Cities and Park Rapids for 10 years. Jeff has a Bachelor's degree from Bemidji State University with majors in Aquatic Biology and Business Administration.

About BWSR: The board is the state's administrative agency for soil and water conservation districts, watershed districts, metropolitan watershed management organizations, and counties responsible for land and water management. The board sets a policy agenda designed to enhance conservation delivery through these governmental partners and works to improve and protect Minnesota's water and soil resources by working in partnership with local organizations and private landowners. BWSR program and operations grants provide funding to local units of government to deliver soil and water conservation services to their communities.BWSR program and operations grants provide funding to local units of government to deliver soil and water conservation services to their communities.

Tara Solem is the Manager and Water Planner for the Lake Soil & Water Conservation District (SWCD) and is coordinating the planning and implementation efforts for the Rainy River Headwaters Vermillion River Watershed along with Lake County, Cook County and SWCD, St. Louis County and North St. Louis SWCD, Houston Engineering, and the Minnesota Board of Water and Soil Resources.

Mike Hirst is the Resource Conservationist for the Lake of the Woods Soil & Water Conservation District (SWCD) and is a watershed planning coordinator for the Rainy-Rapid Watershed and the Lake of the Woods Watershed along with Koochiching, Beltrami and Roseau SWCDs and Counties, Warroad Watershed District and the Minnesota Board of Water and Soil Resources.

Daniel Rokitnicki is a Program Coordinator in the Freshwater Management Division - Ontario Region of the newly formed Canada Water Agency (currently housed within Environment and Climate Change Canada as it transitions to a stand-alone organization). Daniel coordinates activities for the CWA's new Lake of the Woods Freshwater Ecosystem Initiative (FEI), which is focused on the most pressing challenge affecting water quality and aquatic ecosystem health in this Rainy-Lake of the Woods basin: preventing toxic and nuisance algae. In this role, Daniel coordinates activities related to program implementation, partner engagement, and administering the new funding stream that supports taking action to reduce phosphorus loads to Lake of the Woods. He is also a former Canadian secretary to the IJC's International Rainy-Lake of the Woods Watershed Board.

Becca Reiss is the Community Conservationist for the North St. Louis Soil & Water Conservation District (SWCD) and is helping steer the planning effort for the Rainy Headwaters-Vermilion River Watershed along with Lake and Cook SWCDs and Counties, Houston Engineering, and the Minnesota Board of Water and Soil Resources.

Pam Tomevi is the Administrator for the Koochiching Soil & Water Conservation District (SWCD) and is coordinating the planning effort for the Rainy River-Rainy Lake Watershed along with Koochiching County, City of Ranier, City of International Falls, Houston Engineering, and the Minnesota Board of Water and Soil Resources.

Mike Kennedy is a Project Manager with the Minnesota Pollution Control Agency. Mike's watershed areas include the Little Fork, Lower Rainy River, and Rapid River Watersheds. Mike's career started out in environmental education.

Session 7 – Nutrients and Sediment Load Tracing

Sediment mapping and progress toward understanding legacy phosphorus in the Rainy River corridor

Anna Baker[1], Faith Fitzpatrick[1], Paul Reneau[1], Collin Roland1, Will Lund[1], Sam Soderman[2], Joe Vrtacink[3], Adam Heathcote[4], Mark Edlund[4], Mike Kennedy[5], Jesse Anderson[5], Kevin Stroom[5]

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[2]Koochiching County Soil and Water Conservation District;
[3]Lake of the Woods Soil and Water Conservation District;
[4]St. Croix Watershed Research Station
[5]Minnesota Pollution Control Agency

Abstract

Lake of the Woods is a vital cultural, ecological, and economic resource for all who share its waters, and the recurrent harmful algal blooms that occur there threaten its vitality. Management of these blooms is primarily focused on reducing nutrient contributions to Lake of the Woods, especially phosphorus. Previous studies have indicated that the Rainy River contributes 45-75% of the phosphorus entering Lake of the Woods, but little is known about the phosphorus chemistry of sediments being transported and stored by the Rainy River and its tributaries.

In an effort to address this gap, a research team is working to evaluate the distribution of sediment-bound phosphorus storage in Rainy River and Fourmile Bay, and to monitor fluxes of sediment-bound phosphorus from three major U.S. tributaries: the Little Fork, Big Fork, and Rapid Rivers. The 2023 monitoring season included mapping the extent and thickness of soft fine grained sediment deposits in Rainy River and Fourmile Bay, and the testing of methods for collection of suspended sediments from Little Fork, Big Fork, and Rapid Rivers. This work sets the stage for a broad evaluation of the phosphorus chemistry of suspended sediments contributed by the Little Fork, Big Fork, and Rapid Rivers, and of bed sediments being stored and later remobilized through the Rainy River corridor to Lake of the Woods. This presentation will describe results of preliminary efforts and plans for the 2024 field season.

Brief Bio

Anna Baker is a hydrologist with the USGS Upper Midwest Water Science Center, and has been working in Minnesota since 2017. She obtained her Masters in Water Resources Science at the University of Minnesota in 2018.

Location of Study

Lower Rainy River and Fourmile Bay

Tracking sediment sources in the Little Fork River using sediment fingerprinting

Anna Baker[1], Faith Fitzpatrick[1], Sam Soderman[2], Phil Norvitch[3], Mike Kennedy[4], Jesse Anderson[4], Kevin Stroom[4], Matt Gutzmann[5], Jim Blount[1], Shelby Sterner[1], Krimson Anderson[1], Karen Gran[6] and Andy Kasun[6]

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[2]Koochiching County Soil and Water Conservation District;
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[4]Minnesota Pollution Control Agency;
[5]Itasca County SWCD
[6]University of Minnesota Duluth

Abstract

The Little Fork River in Minnesota is a major source of sediment and phosphorus to downstream Rainy River and has large sections with sediment related impairments. Total Maximum Daily Load regulations for reduction of sediment loads have been established by the Minnesota Pollution Control Agency (MPCA), however, to target these efforts, detailed information describing the dominant sources of sediment throughout this 4,850 square kilometer basin is needed. The U.S. Geological Survey (USGS), in partnership with the MPCA and the Soil and Water Conservation Districts of Koochiching, North St. Louis, and Itasca Counties, is working to evaluate sediment sources throughout the basin. Last year, the results of a sediment budget for stream-corridor erosion were presented, and this year, the results of a sediment fingerprinting evaluation will be shared.

Sediment fingerprinting uses tracers such as elemental chemistry to determine landscape sources of a given fluvial suspended sediment or streambed sediment sample. A sediment fingerprinting tool developed by the USGS and approved by the U.S. Environmental Protection Agency for sediment source delineation was used to evaluate sediment sources within the Little Fork River basin. The tool establishes a “fingerprint” for each source category, and these fingerprints are used by an un-mixing model to provide the relative apportionment of distinct sources comprising each fluvial sample. For the Little Fork River, upland source categories were evaluated, including mature and harvested forest, agriculture, and roadways, along with channel network sources such as streambanks and ravines. This presentation will share the preliminary results of this evaluation.

Brief Bio

Anna Baker is a hydrologist with the USGS Upper Midwest Water Science Center, and has been working in Minnesota since 2017. She obtained her Masters in Water Resources Science at the University of Minnesota in 2018.

Location of Study

Little Fork River basin

A case for considering nitrogen in monitoring and management efforts in the Lower Rainy River basin

Catherine Eimers[1], Jesse Anderson[2], Diana Fred[3], Andrew Williams[1]

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[2]Minnesota Pollution Control Agency
[3]Environment and Climate Change Canada

Abstract

Nitrogen (N) may play a role in explaining why harmful algal blooms continue to plague the binational Lake of the Woods, despite declines in phosphorus (P) loading to the lake. Here we describe P and N inputs to the Rainy River from seven tributaries that drain the US and Canadian portions of the Lower Rainy River Basin and compare them with longitudinal water quality patterns within the Rainy River itself. Total P concentrations at all seven tributaries are high and regularly exceed local water quality guidelines, whereas N concentrations are generally low, especially in the growing season months but routinely spike during the winter/spring. Notably, both TP and N concentrations were highest at the tributary with the greatest amount of upstream agricultural development. There were no clear seasonal patterns in TP or the organic form of N, whereas concentrations of inorganic N as nitrate (NO_3-N) were as much as 10-times higher in the colder season (Nov-Apr) compared with the growing season (May-Oct). Nevertheless, N levels across the basin remain low in comparison with other agricultural landscapes. Whereas TP concentrations in the Rainy River almost double downstream from Rainy Lake to the Lake of the Woods, organic N concentrations are relatively stable and NO_3-N actually declines downstream. Together, these results suggest that the inorganic form of N is highly bioavailable, and that monitoring in the growing season only will greatly underestimate true levels within the basin.

Brief Bio

Catherine Eimers is a professor at Trent University, School of the Environment and program coordinator for water sciences. She has been involved in a tributary and deposition loading study within the Canadian portion of the LoW basin since 2018.

Location of Study

Lower Rainy River watershed. Rainy River and seven of its tributaries including Little Fork, Big Fork, Rapid River, Everett Creek, Sturgeon River, La Vallee River, and Pinewood River.

Rainy River nutrient and sediment water quality trends, from ECCC and MPCA long-term monitoring programs

Diana Fred[1], James Jahnz[2], Kelli Nerem[2], Jesse Anderson[2], and Mike Kennedy[2], Arthur Friesen[1]

[1]Environment and Climate Change Canada
[2]Minnesota Pollution Control Agency

Abstract

ECCC and MPCA Rainy River long-term water quality monitoring data sets. Assessing the two data sets for differences and similarities, observing trends and influences. Discussion of observations and next steps for continued collaboration

Brief Bio

Diana Fred is a water quality specialist with Environment and Climate Change Canada. She is the lead for the Lake of the Woods/Rainy River Water Quality Monitoring program. For her graduate studies, Diana studied Lake Manitoba assessing nutrient loading, retention, and resuspension. She has 22 years of experience working in North American watersheds from Northern California to the high deserts of Colorado, 18 years of which has been in the Hudson Bay watershed.

James Jahnz is a Hydrologist for the Minnesota Pollution Control Agency currently serving as the Lead Hydrologist for the Long-Term Surface Water Data Unit. Following his undergraduate studies in Geology & Geography at the University of Wisconsin-Madison, James earned his Master's Degree at the University of Kentucky, where he studied fluvial geomorphology on the Kentucky River. In his nine years at the MPCA James has focused on water quality data analysis for the Watershed Pollutant Load Monitoring Network, with an emphasis on trend analysis.

Jesse Anderson is a Research Scientist with the MPCA. For over twenty years, Jesse has had key roles in the MPCA's monitoring and research in the Rainy-Lake of the Woods watershed, including the detailed studies leading to publication of the Lake of the Woods Monitoring and Assessment Report in 2016 and the development of the Lake of the Woods TMDL

Mike Kennedy is a Project Manager with the Minnesota Pollution Control Agency. Mike's watershed areas include the Little Fork, Lower Rainy River, and Rapid River Watersheds. Mike's career started out in environmental education.

Arthur Friesen is a policy analyst with Environment and Climate Change Canada's Lake Winnipeg Basin Program. He coordinates water quality reporting and analysis, and state-of-the-basin reporting efforts within the Lake Winnipeg Basin. Arthur obtained his M.S. degree in applied economics at the University of Minnesota in 1995.

Location of Study

Rainy River

Session 8 – Monitoring Program Updates

Progress Update: MPCA's Intensive Watershed Monitoring efforts in the Lake of the Woods Watershed

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Abstract

The Minnesota Pollution Control Agency (MPCA) and local partners conduct an intensive study of major lakes and streams in each of the state's 80 watersheds every ten years to detect any changes in water quality. This intensive monitoring approach involves assessing the health of fish and macroinvertebrate (bug) communities as well as water chemistry data to gauge water quality. The MPCA conducted monitoring in the Lake of the Woods Watershed in 2012 and again in 2023. This presentation will summarize the findings from monitoring in 2012 as well as the preliminary findings from monitoring in 2023 with an emphasis on changes observed between the two sampling events. The results of monitoring will ultimately be used to inform restoration and protection efforts throughout the watershed.

Brief Bio

Wesley Sigl is an Environmental Specialist with the Minnesota Pollution Control Agency (MPCA) specializing in biological monitoring and aquatic macroinvertebrate biology. See signature below for contact information.

Location of Study

Lake of the Woods Watershed- HUC8 09030009. Monitoring in this watershed includes data from the Lake of the Woods itself as well as its direct tributaries within the USA (i.e., Willow Creek, Warroad River, Zippel Creek etc.)

Possible influence of water level management on nutrient flux in near-shore sediments (Lake Kabetogama, MN, USA)

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Abstract

Lake water level fluctuations are an important factor driving variation in many ecosystem processes. The nearshore sediments that are periodically exposed and re-inundated can develop distinct physical and chemical characteristics, especially in relationship to the organic matter content and the particle size distribution. These sediment characteristics in turn can alter the flux of nitrogen (N) and phosphorus (P) from sediments into the water column when sediments are inundated. Here we used intact sediment core experiments across a range of sediment inundation frequencies to estimate the effect of drying and re-wetting on sediment nutrient flux in Lake Kabetogama, MN. Lake Kabetogama is a large lake that occasionally experiences harmful algal blooms, often in littoral areas and embayments, which could be influenced by sediment flux of N and P in nearshore areas. Water levels in the lake are managed for multiple purposes, including hydropower, and the management regime is regularly reviewed and updated. We used structural equation modeling to include the effects of drying and rewetting directly on sediment nutrient flux, as well as indirect effects via changes in the sediment properties. In these models, inundation frequency had a moderate effect on organic N and P flux from sediments, but a minimal effect on inorganic N and P. Other factors, such as surface water nutrient concentrations and ratios also influenced all forms of N and P flux. We used our parameterized structural equation model to estimate how earlier water level management policies compare to the current water level management in Lake Kabetogama. These models suggest that water level management regimes with larger annual fluctuations would have greater release of organic N and P. Nearshore sediment flux could sustain and influence harmful algal blooms that occur in this lake, and this data supports the hypothesis that these fluxes are influenced by water level management.

Brief Bio

James Larson is a Research Fisheries Biologist with the USGS Upper Midwest Environmental Sciences Center.

Location of Study

Lake Kabetogama, Minnesota

ECCC update on water quality monitoring in the Lake of the Woods Rainy River Basin

Diana Fred

Environment and Climate Change Canada

Abstract

The annual update on the ECCC water quality monitoring in the Lake of the Woods – Rainy River Basin. Parameters and observations of note will be discussed. A brief overview of the ECCC Data Catalogue, and how to access the publicly available data.

Brief Bio

Diana Fred is a water quality specialist with Environment and Climate Change Canada, responsible for real-time and long term monitoring on Lake of the Woods and Rainy River.

Location of Study

Lake of the Woods and Rainy River