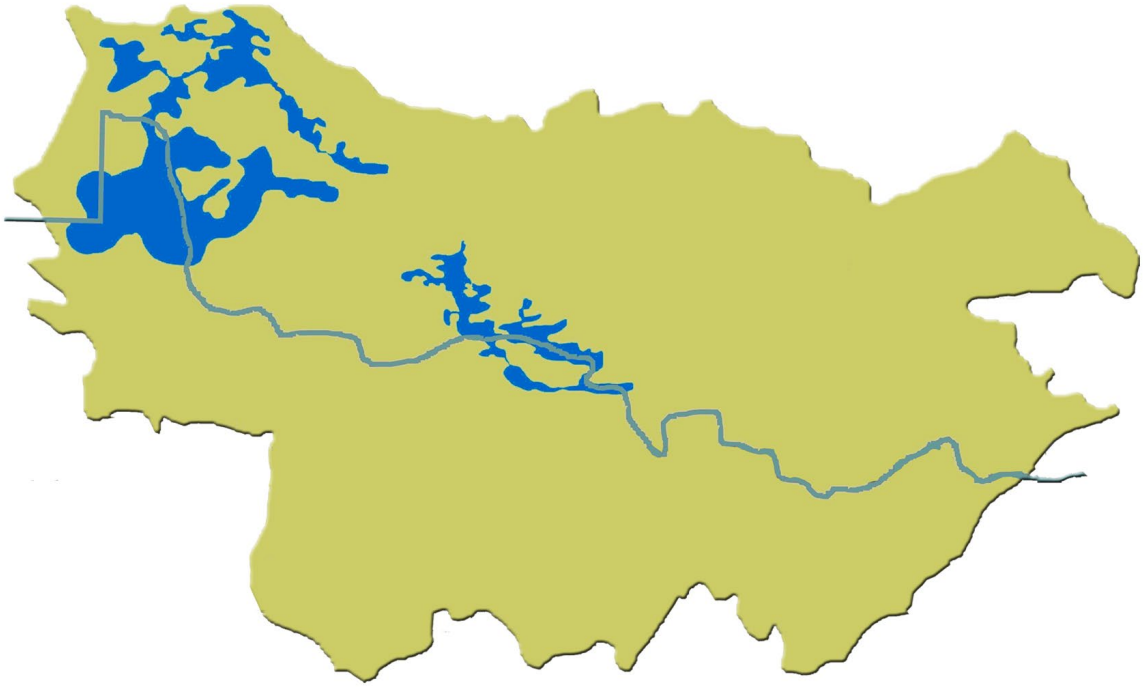
V-2022-03-01

# Program Abstracts
# 19th Annual



RAINY-LAKE OF THE WOODS
WATERSHED
2022 FORUM
March 9 - 10, Online

March 9 - 10, 2022
Virtual-Online Sessions

V-2022-03-01

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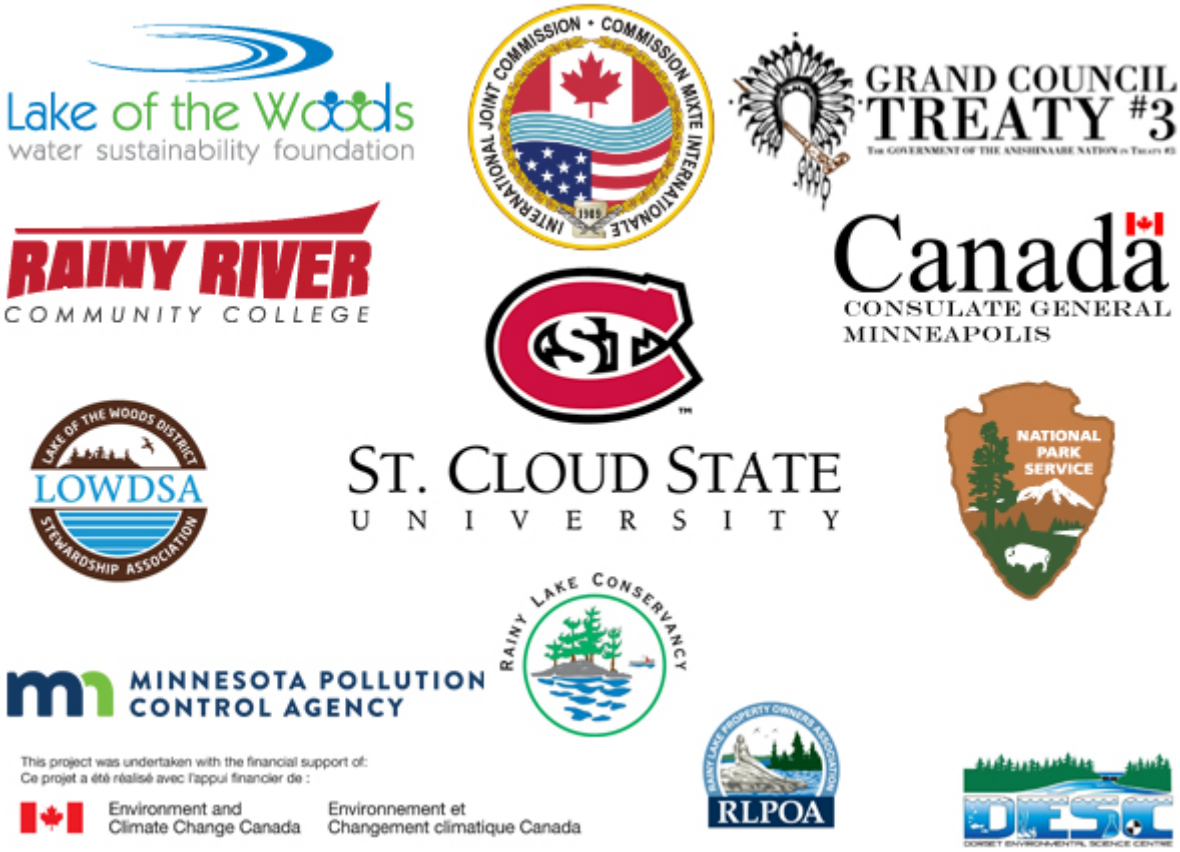


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| **13:20** | 0:18 | Manito Aki Inakonigaawin (MAI) and Nibi Declaration moving forward<br>Hailey Krolyk, Grand Council Treaty #3 |
| **13:40** | 0:18 | International Rainy-Lake of the Woods Watershed Board update<br>Michael Goffin and Col. Karl Jansen, Board Co-Chairs |
| **14:00** | 0:18 | Partnerships to manage the Red Lake Nation's and Minnesota's largest lakes<br>David Burge, S. Bowe, K. Bowe, J. Anderson, C. Hernandez, A. Heathcote, M. Edlund |
| **14:20** | 0:18 | Q&A with session presenters<br>ALL |
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| | | **Session 2 - State of the Basin (Moderator: Todd Sellers)** |
| **15:00** | 0:38 | Overview of the State of the Basin Report – 3rd Edition 2022 (Incl. Q/A period)<br>Bev Clark, Lucas King, Todd Sellers (Eds) |
| **15:40** | 0:18 | Long-term changes in Lake Ice Phenology in Northwestern Ontario<br>Scott Higgins, J. Van der Sanden, C. Desjardins, H. Drouin, K. Rühland, and C. Nelligan |
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| **16:40** | 0:18 | Q&A with session presenters<br>ALL |
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## DAY 2 – MARCH 10

| DAY 2 - MARCH 10 | | |
|---|---|---|
| **Central Time Zone** | | |
| Start | Length | |
| **8:15** | 0:15 | **Zoom session open for pre-logon - please logon before 08:30** |
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| | | **Session 3 - Nutrients 1 (Moderator: Jesse Anderson)** |
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| **9:20** | 0:18 | Phosphorus in atmospheric deposition - importance for lake vs. watershed budgets<br>M. Catherine Eimers, Shaun A. Watmough, Andrew J. Williams and Michael J. Paterson |
| **9:40** | 0:18 | Nitrogen fixation may offset nitrogen demands in Lake of the Woods cHABs<br>Kaela E. Natwora, Cody S. Sheik, Adam Heathcote, and Mark Edlund |
| **10:00** | 0:18 | Q&A - With Nutrient 1 session presenters<br>ALL |
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| **11:20** | 0:18 | Detachment, Dispersal, and Destinations of Floating Cattail Mats in Large Lake Environments<br>Steven K. Windels, Bryce T. Olson, Reid T. Plumb, Jerry Warmbold |
| **11:40** | 0:18 | Q&A - With Nutrient 2 session presenters<br>ALL |
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(Session 5 – Emerging Issues and Technologies 1 – starts at 13:10, see next page)

| | | |
|---|---|---|
| **Session 5 - Emerging Issues and Technologies 1 (Moderator: Scott Higgins)** | | |
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| **13:50** | 0:18 | Treaty #3 Geospatial Database<br>Raeshawn Parsons |
| **14:10** | 0:18 | Q&A - With session presenters<br>ALL |
| **14:30** | 0:20 | **Break** |
| **Session 6 - Emerging Issues and Technologies 2 (Ryan Maki)** | | |
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| **15:10** | 0:18 | Evaluating the impacts of Bythotrephes on the growth of young-of-year walleye and validation of a back-calculation method<br>Danielle Gartshore and Michael Rennie |
| **15:30** | 0:18 | Restoring hybrid cattail infested wetlands in Voyageurs National Park: What have we learned?<br>Reid T. Plumb, Jerry Warmbold, Steve K. Windels, and Bryce T. Olson |
| **15:50** | 0:18 | Aquatic Vertebrate By-Catch at the IISD-ELA: Historical distribution and trends<br>Lauren D. Hayhurst, C.M.C. Rodgers, S.M. Chalanchuk, D.J. Allan, S. J. Hecnar, M.D. Rennie |
| **16:10** | 0:18 | Emerging Technologies for Monitoring Nutrients, Algae, and Water Quality<br>Andrea Zappe |
| **16:30** | 0:18 | Q&A - with session presenters<br>ALL |
| **16:50** | 0:05 | **Closing Remarks - Forum Ends 5:00 pm Central Time** |

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# Day 1 – March 9, 2022

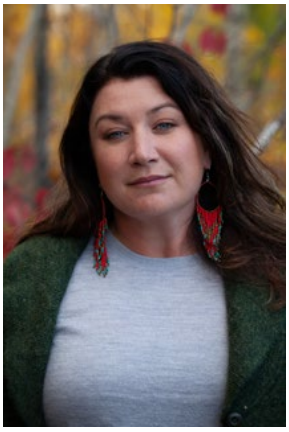
## Session 1 – Water Governance

**Plenary Keynote: Legal personhood, indigenous governance and relation to water**

Aimée Craft

University of Ottawa Research Chair Nibi miinawaa aki inaakonigewin: Indigenous governance in relationship with land and water

**Brief Bio**



Aimée Craft is an award-winning teacher and researcher, recognized internationally as a leader in the area of Indigenous laws, treaties and water. She holds a University Research Chair Nibi miinawaa aki inaakonigewin: Indigenous governance in relationship with land and water.

An Associate Professor at the Faculty of Common law, University of Ottawa and an Indigenous (Anishinaabe-Métis) lawyer from Treaty 1 territory in Manitoba, she is the former Director of Research at the National Inquiry into Missing and Murdered Indigenous Women and Girls and the founding Director of Research at the National Centre for Truth and Reconciliation. She practiced at the Public Interest Law Centre for over a decade and in 2016 she was voted one of the top 25 most influential lawyers in Canada. In 2021 she was awarded the prestigious Canadian Bar Association President's Award.

Prof. Craft prioritizes Indigenous-lead and interdisciplinary research, including through visual arts and film, co-leads a series of major research grants on Decolonizing Water Governance and works with many Indigenous nations and communities on Indigenous relationships with and responsibilities to nibi (water). She plays an active role in international collaborations relating to transformative memory in colonial contexts and relating to the reclamation of Indigenous birthing practices as expressions of territorial sovereignty.

*Breathing Life Into the Stone Fort Treaty*, her award-winning book, focuses on understanding and interpreting treaties from an Anishinaabe inaakonigewin (legal) perspective. *Treaty Words*, her critically acclaimed children's book, explains treaty philosophy and relationships.

She is past chair of the Aboriginal Law Section of the Canadian Bar Association and a current member of the Speaker's Bureau of the Treaty Relations Commission of Manitoba.

**Manito Aki Inakonigaawin and Nibi Declaration moving forward**

Hailey Krolyk

Grand Council Treaty #3

## Abstract

Treaty #3 territory is governed by Anishinaabe law, called Manito Aki Inakonigaawin (Great Earth Law), and the Nibi declaration. Manito Aki Inakonigaawin represents respect, reciprocity, and responsibilities with all relations in regards to Mother Earth. The law signifies the duty to respect and protect lands affected by over-usage, degradation, and unethical processes. The law is unique to Treaty #3 territory and passed on through our elders and knowledge keepers.

The Nibi Declaration represents respect, love, and the sacred relationship with nibi (water) and the life that it brings. It is based on teachings about water, lands, other elements like air and wind, and creation. The declaration is meant to preserve and share knowledge with youth and future generations. The declaration guides us in our relationship with nibi so we can take action individually, in our communities, and as a nation to help ensure healthy, living nibi for all creation.

Through interviews with Elders and Knowledge Keepers, we look at how both Manito Aki Inakonigaawin and the Nibi declaration are moving forward today.

## Brief Bio

Hailey Krolyk was born and raised in Kenora, Ontario, in Treaty #3. She studied Political Economy at the University of Manitoba and community development at Trent University. Hailey now works at Grand Council Treaty #3 as a Policy Analyst, focusing on Anishinaabe Inakonigaawin. She has been developing a Manito Aki Inakonigaawin toolkit, which shares the key principles that guide us in decision-making in the Treaty #3 Territory, helps to further our understandings of our responsibilities to the land and provides guidance for government, communities, leadership and proponents upon entering the Treaty #3 territory. She is the project lead on the Manito Aki Inakonigaawin and Nibi Declaration Pathways forward project, which focuses on interviewing Elders/Knowledge keepers in regards to both laws to understand where they want the laws going in the future, while acknowledging past history and barriers.

## Location of Study

Entire Treaty # Territory

## International Rainy-Lake of the Woods Watershed Board update

Michael Goffin* and Col. Karl Jansen, Board Co-Chairs

International Rainy-Lake of the Woods Watershed Board

### 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 2021 to date. In addition to describing the role of the Water Levels Committee, water levels forecasts and new adaptive management work are also be highlighted. The Board's aquatic ecosystem health endeavors are also be discussed, with a special focus on recent recommendations to the International Joint Commission and Governments related to phosphorus reduction to address toxic algae. Current International Watershed Initiative projects such as the Objectives and Alerts Project, the Aquatic Invasive Species Coarse Scale Risk Assessment Project and the Rainy-Lake of the Woods State of the Basin Report 3rd Edition are also detailed.

### Brief Bio

**Michael Goffin, Environment and Climate Change Canada**

In 2020, Mr Goffin took on a special assignment as Director General Canada Water Agency Project within Environment and Climate Change Canada.

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.

For more than a decade, Mr Goffin has been responsible for leading Canada's efforts to restore and protect the water quality and ecosystem health of the Great Lakes and in 2012 he 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.

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

Rainy-Lake of the Woods Basin

## Partnerships to manage the Red Lake Nation's and Minnesota's largest lakes

David Burge[1,3]*, Shane Bowe[2], Kayla Bowe[2], Jesse Anderson[5], Cary Hernandez[4], Adam Heathcote[1], Mark Edlund[1]

[1]St. Croix Watershed Research Station, Science Museum of Minnesota, 16910 152nd St North, Marine on St. Croix, MN 55047
[2]Red Lake Department of Natural Resources, 15761 High School Dr., Red Lake, MN 56671
[3]Natural Resources Research Institute, University of Minnesota Duluth, 5013 Miller Trunk Hwy, Duluth, MN 55731 USA
[4]Minnesota Pollution Control Agency, 714 Lake Ave., Detroit Lakes, MN 56501
[5]Minnesota Pollution Control Agency, 525 S Lake Ave, Duluth, MN 55802

### Abstract

State and tribal jurisdictional boundaries can provide challenges in assessing and protecting water quality. However, they can also provide opportunities for partnerships and improvements in relationships. A partnership between the Red Lake Nation, the Minnesota Pollution Control Agency, and the Science Museum of Minnesota was created to address water quality issues affecting the region's largest lakes. These projects provide strong examples of how an improved understanding of tribal sovereignty and jurisdictional boundaries can result in an effective partnership that benefits all parties.

The group first tackled the Red Lake Nation's and Minnesota's Upper and Lower Red Lakes, which experience extensive algal blooms and routinely exceed the regional water quality criteria for total phosphorus, Secchi, and chlorophyll-a. However, 20 years of water quality data show no significant trends. In Minnesota, when lakes exceed water quality standards, either remediation plans are developed and implemented, or in cases where it is determined that the regional standard is not appropriate, a site-specific standard may be developed. Paleolimnology was used to provide a longer historical context on these two large shallow lakes. Sedimentation rates, phosphorus, biogenic silica, diatom community analysis, and algae pigments from ten sediment cores revealed complex sedimentation dynamics within these large shallow basins and a subtle increase in limnological productivity over the 150-year reconstruction of the lakes' history. Diatom-inferred phosphorus showed historical total phosphorus values are within the range of modern monitored values and no significant changes among the sediment cores. Because the paleolimnological evidence suggests little change to the Red Lakes aquatic ecology over the last 150 years and monitoring data show regular exceedance and no trend in the last 20 years, the group recommends site-specific water quality standards for these unique large and shallow northern lakes.

The Red Lake Nation has a historical interest in protecting water quality at the Lake of the Woods (LoW) and retains ownership of over 85% of the NW Angle, MN. The Red Lake Department of Natural Resources has conducted water quality monitoring there since 2004 and has voluntarily contributed data in support of the LoW Total Maximum Daily Load (TMDL) Study. Recognizing the value of the existing partnership, we leveraged our relationships to develop an effectiveness monitoring strategy for LoW in support of the recently approved TMDL. The group makes regular water quality monitoring visits to three southern LoW sites for major nutrients, chlorophyll, phycocyanin, and cyanotoxins to track progress toward our collective water quality goals. High-frequency monitoring buoys measure water column temperature, phycocyanin, and dissolved oxygen and their link to meteorological drivers, nutrient cycling, and bloom formation. Only through this cooperative framework can the interests and needs of the project partners and our stakeholders be met.

### Brief Bio

David Burge, PhD is an aquatic ecologist working at the Science Museum of Minnesota' St Croix Watershed Research Station and the Natural Resources Research Institute. In addition to addressing the Red Lakes nutrient criteria, David is working on paleolimnology and biomonitoring of Isle Royale National Park's lakes, diatom biomonitoring of the Great Lakes, and understanding invasive species in north shore streams.

### Location of Study

Upper and Lower Red Lakes and Lake of the Woods

# Session 2 – State of the Basin

## Overview of the State of the Basin Report – 3rd Edition 2022

Bev Clark[1]*, Lucas King[2]*, Todd Sellers[3] (Eds)

[1]Bev Clark Consultant, [2]Territorial Planning Unit -Grand Council Treaty #3, [3]Lake of the Woods Water Sustainability Foundation

### Abstract

The 3rd Edition of the State of the Basin Report is now complete. The report outlines changes that have occurred with respect to key concerns since the last report was published in 2014. In most cases there have been no substantial changes. However, it is clear that we now have many tools to deal with key issues that were previously not available. These include more precise nutrient budgets, satellite tools to describe algal bloom metrics and better estimates of internal loads and P loads due to erosion. This Edition includes Indigenous perspectives and a section devoted to human health.

### Brief Bio

### Location of Study

Rainy-Lake of the Woods Basin

## Long-term changes in Lake Ice Phenology in Northwestern Ontario

Scott N. Higgins[1]*, Joost Van der Sanden[2], Cyndy Desjardins[1], Hugo Drouin[2], Kathleen Rühland[3], and Clare Nelligan[4]

[1]IISD Experimental Lakes Area, [2]Natural Resources Canada, [3]Queens University, [4]Minnow Environmental

### Abstract

We examined the long-term trends (1969-present) in lake-ice phenology for a 50 ha boreal lake at the IISD-Experimental Lakes Area (Lake 239) and quantified the relationships between seasonal air temperatures and ice-on and ice-off dates. Over the 50-year period, the duration of ice-cover has declined by ~4 days/decade and there were strong relationships between seasonal air temperatures and ice-on and ice-off dates. In addition to the long-term trends, year-to-year variability in the duration of ice-cover has nearly doubled since 1969. During the winters of 2016-2018 we used a combination of ground-based observations and remote sensing (RADARSAT-2) to examine spatial variation in ice-phenology and its drivers across a gradient of lake sizes (4-2600 ha). As expected, lake size had strong effects on ice-on dates, with larger lakes freezing 30-45 days later than the smallest lakes. Lake size also influenced ice-off dates, with larger lakes thawing 10-21 days later than the smallest lakes. The relationship between lake size and ice-off date appeared to be driven by lake fetch, which influenced snow thickness and ice growth rates. While larger lakes froze later, they had less snow cover and developed thicker ice, requiring additional time to melt during the spring. We will also discuss relationships between ice phenology metrics at the ELA and Whitefish Bay, Lake of the Woods. Whitefish Bay ice records were logged since 1964, but collection of these data stopped in recent years, coinciding with the retirement of volunteers. Remote sensing (MODIS) was therefore used to estimate ice phenology metrics for these missing data. A comparison of long-term lake ice phenology trends for ELA and Whitefish Bay show interesting similarities and may be useful for forecasting and hindcasting purposes, highlighting the value of maintaining long-term monitoring records.

### Brief Bio

Dr. Scott Higgins brings extensive experience and diverse skills to his position as Research Scientist. Prior to joining the International Institute for Sustainable Development, he worked for Fisheries and Oceans Canada as research scientist for the Experimental Lakes Area, focusing on algal ecology, primary production, climate change and the effects of invasive species on freshwater ecosystems. As a graduate student and post doctoral fellow at the University of Waterloo, Higgins researched on water quality in the Laurentian Great Lakes and Lake Malawi, Africa for the University of Waterloo and the Ontario Ministry of the Environment, and on the ecological effects of invasive species on aquatic ecosystems for the University of Wisconsin's Center for Limnology.

Dr. Higgins has had his research findings published in numerous ecology and freshwater science journals, reports, and books. His scholarly presentations and teaching experiences have been far-ranging: he has presented his research findings at numerous scientific conferences and given guest lectures at numerous universities. Dr. Higgins research has received awards from the Fisheries and Oceans Canada, the International Association for Great Lakes Research, and the Canadian International Development Agency.

### Location of Study

IISD-ELA lakes and Whitefish Bay Lake of the Woods

## An Examination of Total Phosphorus Variability in Lake of the Woods

Bev Clark[1]*, T. Sellers[2], T. Mosindy[3]

[1]Bev Clark Consultant, [2]Lake of the Woods Water Sustainability Foundation, [3]Ontario Ministry of Natural Resources (retired)

### Abstract

Total phosphorus concentrations throughout Lake of the Woods are highly variable both from place to place and seasonally in any one location. This makes it difficult to collect representative phosphorus data to characterize water quality and to link algal blooms to nutrient concentrations or to test the efficacy of nutrient reduction efforts. Here we suggest that ice-free means in multiple locations would be required. Ice free means, however, are difficult to observe and it may be more useful to utilize satellite technology to assess the links between bloom severity and in-lake conditions and to assess the progress of nutrient reduction efforts.

### Brief Bio

### Location of Study

## ECCC Water Quality Monitoring in the Rainy River / Lake of the Woods Watershed

Diana Fred

Environment and Climate Change Canada, 150 Main Street, Winnipeg, MB R3C 4W2 diana.fred@ec.gc.ca

### Abstract

In 2008, Environment and Climate Change Canada (ECCC) initiated a monitoring program in the Lake of the Woods basin as part of broader efforts to investigate algal blooms in the lake. Developed by the Water Quality Monitoring and Surveillance (WQMS) 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 a summary of past work and data collected to date.

### Brief Bio

Diana Fred is a water quality scientist with the Water Quality Monitoring and Surveillance Division at Environment and Climate Change Canada. She is the Project Lead for Lake of the Woods. She holds a Master of Science in Biological Sciences from the University of Manitoba.

### Location of Study

Lake of the Woods and the Rainy River

# Day 2 – March 10, 2022

## Session 3 – Nutrients 1

### Erosion in the Little Fork River – accounting for near-channel and watershed sources of sediment and sediment-bound phosphorus using sediment budget and fingerprinting methods

Anna Baker[1]*, Faith Fitzpatrick[2], Mike Kennedy[3], Sam Soderman[4], Phil Norvitch[5], Andy Kasun[6], Karen Gran[6], Jesse Anderson[3], Kevin Stroom[3]

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[4] Koochiching Soil and Water Conservation District, 501 3rd St. #201, International Falls, MN 56649.

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[6] University of Minnesota - Duluth, Earth and Environmental Sciences Department, 1114 Kirby Drive, Heller Hall 229, Duluth, MN 55812.

**Abstract**

The Little Fork River represents a disproportionate source of sediment to the Rainy-Lake of the Woods Watershed. Turbidity and fish community impairments were identified for the Little Fork by the Minnesota Pollution Control Agency (MPCA), and the development of total maximum daily load regulations to address these impairments relies upon detailed information describing sediment sources. An ongoing collaborative study between the U.S. Geological Survey, Minnesota Pollution Control Agency, and the Soil and Water Conservation Districts of Koochiching, northern St. Louis, and Itasca Counties as well as the University of Minnesota-Duluth is working to identify the proportion of primary sources of sediment and sediment-bound phosphorus to the Little Fork using sediment fingerprinting and sediment budget techniques. Sediment fingerprinting methods use sediment geochemistry to tie fluvial sediment back to its sources in the landscape – from uplands to streambanks. The sediment budget techniques help determine the spatial extent and estimated loadings of sources along the river corridor, including bank erosion, valley side mass wasting, and gullying. These techniques have become widely used, EPA-certified tools for sediment source determination, bridging research and practical application to resource management.

During the summer and fall of 2021, data collection efforts to support sediment budget and sediment fingerprinting model development were carried out. Rapid geomorphic assessments were conducted along 46 reaches on the Little Fork mainstem, tributaries, and ravines throughout its watershed to estimate sources and sinks of sediment. Samples for sediment geochemistry were collected from both upland (mature and recently harvested forest, agricultural field, wetland, and road) and near-channel (streambank, valley side, and ravine) locations to support the development of a sediment fingerprinting model. Though 2021 was characterized by record low stream flow and few sediment loading events, fluvial suspended sediment and soft fine-grained bed sediment samples were also collected for evaluation of geochemical tracers and phosphorus concentrations which will be used in a sediment fingerprinting model. Fluvial suspended sediment will continue to be collected for geochemical analyses in the sediment fingerprinting model through 2022. An overview of the methods, data collected, and progress on the sediment budget and sediment fingerprinting model will be presented.

**Brief Bio**

Anna Baker has an M.Sc. in Water Resources Science and has been a Hydrologist with the USGS Upper Midwest Water Sciences Center in Minnesota since 2017; prior to that she was with the USGS in Baltimore, Maryland. Her recent work has focused on watershed nutrient loading to nearshore Lake Superior and sediment source delineation for the Little Fork watershed.

**Location of Study**

Little Fork River Basin

## Proposed Study of Rainy River sediment-bound phosphorus as a potential driver of Lake-of-the-Woods Algal Blooms

Anna Baker[1]*, Adam Heathcote[2], Mark Edlund[2], Faith Fitzpatrick[3], Mike Kennedy[4], Jesse Anderson[4], Kevin Stroom[4], Sam Soderman[5], Phil Norvitch[6], Mike Hirst[7], Paul Reneau[3]

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[7] Lake of the Woods Soil and Conservation District, 119 1st Ave NW, Baudette, MN 56623.

### Abstract

Despite major reductions in total-phosphorus (TP) concentrations entering Lake of the Woods (LoW), excess phosphorus and harmful algal blooms still threaten this vital ecosystem. The Rainy River comprises approximately 80% of the total drainage area to LoW and contributes 45-75% of the TP. Previous studies have described phosphorus loads contributed by the Rainy River and its tributaries to LoW, but we lack detailed information describing the sediment-bound phosphorus that has accumulated through current and historical loading in this river network, and its potential to be released and transported. A group of researchers and resource managers has collaborated to propose an investigation to address this gap by collecting detailed data describing where fine sediment and associated sediment-bound phosphorus is stored in the Rainy River and its tributaries, and whether it has the potential to become a long-term source of bioavailable phosphorus. This presentation will describe the proposed study. Results of this study would provide critical information to support local resource manager's efforts to find targeted reductions in TP loading to reduce noxious algae in LoW.

### Brief Bio

Anna Baker has an M.Sc. in Water Resources Science and has been a Hydrologist with the USGS Upper Midwest Water Sciences Center in Minnesota since 2017; prior to that she was with the USGS in Baltimore, Maryland. Her recent work has focused on watershed nutrient loading to nearshore Lake Superior and sediment source delineation for the Little Fork watershed. Rainy River and Fourmile Bay.

### Location of Study

Rainy River and Fourmile Bay, Lake of the Woods.

## Phosphorus in atmospheric deposition - importance for lake vs. watershed budgets

M. Catherine Eimers[1]*, Shaun A. Watmough[1], Andrew J. Williams[1] and Michael J. Paterson[2]

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[2]IISD-Experimental Lakes Area

### Abstract

Atmospheric deposition is an important component of lake phosphorus (P) budgets but is very difficult to quantify. We monitored P deposition in the Lake of the Woods watershed (LoW) over 2.5 years, at up to 7 stations located across the basin. Phosphorus inputs in deposition over the ice-free season were much higher than previous estimates (>> 20 mg/m$^2$) and varied greatly across space and time and were strongly influenced by dust and biological material, which are internal to the watershed. While dust and pollen are expected to fall out close to the shoreline and are typically excluded from lake budgets, this may be a problem in the LoW due to its abundant islands and convoluted shorelines. By contrast, P deposition in the winter was consistently low and similar across the basin and was not influenced by internal sources. We suggest that winter loads be used as a baseline for atmospheric deposition estimates, but these should be supplemented using ice-free measurements for all near-shore areas of the lake. Our results indicate that atmospheric deposition may be a more important source of P than previously thought, especially in the northern waters.

### Brief Bio

Catherine Eimers (PhD) is a professor at Trent University School of Environment. She has been leading a multi-year research program in the LoW watershed to improve estimates of nutrient loading to LOW via tributaries and atmospheric deposition. Her research and teaching focuses on the impacts of climate and land use changes on soil and water resources.

### Location of Study

Lake of the Woods watershed

# Session 4 – Nutrients 2

### Nitrogen fixation may offset nitrogen demands in Lake of the Woods cHABs

Kaela E. Natwora[1]*, Cody S. Sheik[1], Adam Heathcote[2], and Mark Edlund[2]

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**Abstract**

Cyanobacterial harmful algal blooms (cHABs) continue to threaten the natural, economic and recreational services supported by the waters of Lake of the Woods (LoW). Although the southern basin was rendered impaired, and phosphorous mitigation was implemented, cHABs are increasing in frequency and toxicity. One heavily supported trigger of cHABs is dual nutrient control of both phosphorus (P) and nitrogen (N). It has traditionally been assumed that freshwater systems are limited by P. However, not all systems are equal, and a "P-only Paradigm" has shifted to include the potential of co-nutrient limitation when understanding drivers of HABs, specifically N and P. Given that LoW experiences reoccurring, toxin producing cHABs and becomes N-limited prior to the peak of the blooms, we sought to quantify nitrogen fixation rates to understand the roles of nitrogen fixing cyanobacteria play in the proliferation of cHABs. Nitrogen fixation is a microbial mediated process in which atmospheric nitrogen ($N_2$) is fixed to ammonia ($NH_3$), which is then available to be incorporated into biomass. Nitrogen fixation is a lynchpin in the nitrogen cycle and is important in N-limited conditions as it turns inaccessible nitrogen ($N_2$) to bio-available nitrogen ($NH_3$). Interestingly, the cyanobacteria *Aphanizomenon* and *Dolichospermum* that dominate LoW cHABs are capable of producing toxins and fixing nitrogen. Together, we sought to quantify nitrogen fixation rates in the southern basin throughout a bloom season (June-October) and use 16S rRNA gene amplicon sequencing to identify the microbial communities associated with LoW blooms. Our finding suggest that nitrogen fixation may alleviate the N-demand during N-limitation ultimately supporting cHAB growth.

**Brief Bio**

Kaela Natwora is a Ph.D. student at the University of Minnesota-Duluth studying nitrogen dynamics and microbial community structure associated with harmful algal blooms. I work in Dr. Cody Sheik's geomicrobiology lab at the Large Lake Observatory. In summer of 2021, I collaborated with Drs. Heathcote and Edlund integrating nitrogen fixation quantifications and molecular techniques into their existing monitoring efforts on Lake of the Woods in hopes of telling the nitrogen story.

**Location of Study**

Southern Basin of Lake of the Woods (Muskeg Bay [39-0002-01-102], Big Traverse [SCWRS-BT5] and Big Traverse [MPCA-39-0002-01-101])

## Rainy River-Lake of the Woods Southern Basin Update from MPCA

Mike Kennedy, Lindsey Krumrie, Amy Mustonen

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### Abstract

Join staff from the Minnesota Pollution Control Agency (MPCA) for an overview of current monitoring, restoration, and protection projects work on within the Southern portion of the Rainy River Basin. Achievements, milestones, and next steps will be highlighted in an overview of the work being completed together with partners throughout the basin. This overview will be followed by a focus on two specific protection priorities in the Basin: the Dunka River subwatershed, and the spring survey protection project in the Big Fork River watershed.

### 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

Southern Rainy Basin with focus on the Dunka River subwatershed and the Big Fork River Watershed

## Environment and Climate Change Canada Nutrients Update

Daniel Rokitnicki-Wojcik* and Marie-Claire Doyle

Strategic Policy Branch – Ontario Region, Environment and Climate Change Canada

### Abstract

Environment and Climate Change Canada completed a 4-year science plan in 2020. In collaboration with partners, results of this effort were used to inform a proposed set of lake ecosystem objectives and phosphorus reduction scenarios for input from the public, Indigenous Peoples, non-governmental organizations, municipalities and local businesses. This presentation will provide an update on the input received from our engagement to date, current activities and planned next steps.

### Brief Bio

Daniel Rokitnicki-Wojcik is a Program Coordinator, Strategic Policy Branch – Ontario Region, Environment and Climate Change Canada. He has coordinated ECCC policy activities for Lake of the Woods for the last several years and is a former Canadian secretary to the IJC's International Rainy-Lake of the Woods Watershed Board.

### Location of Study

Canadian portion of the Rainy-Lake of the Woods Basin

## Detachment, Dispersal, and Destinations of Floating Cattail Mats in Large Lake Environments

Steven K. Windels[1*], Bryce T. Olson, Reid T. Plumb, Jerry Warmbold

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### Abstract

Non-native hybrid cattails (*Typha x. glauca*), the dominant plant species in most wetlands in Voyageurs National Park, MN, are known to create dense monotypic stands that displace native plant species, reduce biological diversity, and create floating mats. Floating cattails mats not only facilitate the vegetative spread of the invasive hybrid but also create navigational hazards that pose risks to Park visitors. Unfortunately, little is known about cattail mat development, drivers of detachment, or dispersal patterns. Using aerial imagery (1992-2019), we were able to delineate 673 cattail mats with 218 independent mat detachments and 455 dispersing mat polygons. Mat size averaged 964 $m^2$ but varied dramatically (range 9 – 25,299 $m^2$). Mats that successfully detached traveled on average 1 km (range 0 – 14 $km^2$). Floating mat development was mainly driven by fetch exposure with mat creation increasing in areas with less wind and wave action. Additionally, flood and drought periods were the most significant drivers of mat detachment with detachment increasing during flood periods. Understanding the conditions that allow for mat creation, increase detachment, and that direct their movement patterns can help managers identify areas where cattails should be preemptively managed, when the risk of detachment is greatest, and where floating mats may move over time.

### Brief Bio

Steven K . Windels is a wildlife biologist at Voyageurs National Park, MN, USA. 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. His research interests center around wildlife ecology and management, with particular interests in foraging ecology and space use of birds and mammals, predator-prey interactions, and wildlife conservation in protected areas. 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 has a from PhD Michigan Tech University. MS from Texas A&M University – Kingsville and a BS from University of Minnesota.

### Location of Study

Voyageurs National Park

# Session 5 – Emerging Issues and Technologies 1

## Treaty #3 Winnipeg River Drainage Basin Flood Vulnerability Study

Liam Kent

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### Abstract

Grand Council Treaty #3 (GCT #3), in collaboration with CES and 11 Treaty #3 communities, is currently undertaking a **Flood Vulnerability Study** (FVS) that combines traditional knowledge with the power of GIS to analyze flooding on a regional scale. Developed in response to the ongoing global climate crisis, the study examines the historical and potential impacts of flooding in the Winnipeg River Drainage Basin to create a strong foundation for future mitigation initiatives. From mapping out areas impacted by erosion, to identifying infrastructure loss, habitat destruction and increased health risks in communities, the FVS seeks to paint a picture of the effects of flooding in Treaty #3 territory.

The FVS has already begun producing tools and resources for each community and GCT #3 that help visualize flooding impacts across the region. A digital database of gathered community values, documented impacts, and future concerns will not only support informed community planning and management but help shape water governance across the Nation. In addition, bringing forward critical infrastructure and values at risk will help generate productive dialogue towards increased autonomy for GCT #3 and their member communities to protect and manage the water flowing through Treaty #3.

As the work enters its final year, we will continue to see new and exciting ways that the FVS positively supports Treaty #3 territory.

### Brief Bio

Liam Kent, is an Operations and Innovation Specialist at CE Strategies in Thunder Bay, ON. Liam joined CE Strategies with a background in natural resource management and an interest in driving community-based projects that promote stewardship of their lands & resources. Since then, he has assisted in developing community-driven land use plans, flood claims, and traditional knowledge data collection for many of our clients across Northwestern Ontario. He has refined his skills in operating advanced GIS and drone technologies to provide grounded, practical simulations and mapping for many innovative projects.

Liam brings his experience, along with his creativity, to each project he supports and can transform raw information into professional quality products that have far-reaching benefits. In addition, his drive to challenge himself and learn from his mentors supports his continued growth and development.

### Location of Study

Winnipeg River drainage basin.

## Characteristics and Importance of the Lower Winnipeg River Basin

Madeline Stanley[1]*, Marina Puzyreva[1]*, Jeff Simpson[2], Dimple Roy[1]

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### Abstract

The Winnipeg River is the largest contributor of water to Lake Winnipeg, receiving from parts of Ontario, Manitoba, and Minnesota. The river and surrounding watershed have significant cultural, social, environmental, and economic importance both locally and regionally. To encourage discussions around the importance of the river and surrounding communities, the International Institute for Sustainable Development (IISD) recently published a series of discussion sheets that explore the ecological and

socio-economic characteristics of the lower Winnipeg River basin, from hydrology to aquatic animals and habitat, and communities and demographics to its history. This exploration has led to further collaborations to better understand water quality and communities' connection to the basin. IISD has partnered with Aquatic Life Ltd on an adaptive monitoring pilot project, actively deploying sensors for higher frequency and real time monitoring of water to better understand water quality and improve decision making.

### Brief Bio

Madeline is a Policy Advisor with IISD's Water Program with a background in ecology, and is also a PhD Candidate at the University of Manitoba.

Marina is a Policy Advisor with IISD's Water Program with a background in economics and policy and has a M.A. in Economics from University of Manitoba.

### Location of Study

Lower Winnipeg River Basin, Manitoba

## Effects of microplastics on Yellow Perch (*Perca flavescens)* metabolic rates

Cody V. Veneruzzo[1]*, K. Bucci[2], D. Langenfeld[3,5], R. McNamee[4], L.D. Hayhurst[5], L.E. Hrenchuk[5], M.D.Rennie[1,5]

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[3]University of Manitoba
[4]University of Waterloo
[5]International Institute for Sustainable Development – Experimental Lakes Area

### Abstract

Microplastics (MP) are a complex emerging contaminant as they are beginning to be found in most freshwater ecosystems around the world. Their complexity stems from their potential to harm aquatic organisms both physically, from blockages or lacerations, and chemically due to leachates of chemical additives within the plastic itself, or from existing environmental contaminants that sorb to MP particulates. During an eleven-week mesocosm study at IISD-ELA, we exposed yellow perch to a variety of MP concentrations and measured their metabolic rates using respirometry. Preliminary results show a potential decrease in maximum metabolic rate (MMR) and aerobic scope (AS) at the highest concentration (29,240 particles/L). Conversely, there appears to be no change in standard metabolic rate (SMR). This suggests that MP have the potential to impact the maximum aerobic potential of freshwater fish which inherently lowers their overall fitness.

### Brief Bio

Cody Veneruzzo is a PhD student in Lakehead University's Community, Ecology and Energetics Lab studying the effects of microplastics on freshwater fishes.

### Location of Study

IISD-Experimental Lakes Area

**Treaty #3 Geospatial Database**

Raeshawn Parsons

Grand Council Treaty #3

## Abstract

Grand Council Treaty #3 has been working hard to help provide more information and tools to the communities to help them make their lives a little easier. One of the projects currently underway is the Treaty #3 Geospatial Database; an online interactive map where different forms of spatial information and data can be stored and viewed.

The Treaty #3 Geospatial Database (or Geoportal for short) is expected to bring digital maps to community fingertips, as well as supporting documents, reports, photos, already made maps, and other related data to each layer. Community members will be able to access an array of GIS layers such as lakes, abandoned mines, dams, tribal councils, hospitals, and many more that will be constantly updated and added. This presentation will introduce the key points of the Geoportal, progress to date, and the anticipated release date.

## Brief Bio

Hello, my names Rae (they/them) and I'm the Grand Council Treaty #3 GIS Specialist. I am from southwestern Ontario and have been with GCT3 since June of 2021. I have a background in Nature Conservations, GIS, and Horticulture. Basically, my job as a GIS Specialist is to make the maps everyone uses in monitoring, planning, researching, and spatial analysis.

## Location of Study

Treaty # 3 Territory

# Session 6 – Emerging Issues and Technologies 2

## Early Detection of Aquatic Invasive Species Using eDNA Methods in Minnesota Lakes

Anna Totsch*, Josh Dumke, Adelle Keppers, Chan Lan Chun

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### Abstract

Aquatic invasive species (AIS) are a threat to the ecological and economic integrity of over 800 Minnesota lakes. Unfortunately, AIS continue to invade new lakes, and Minnesota lacks a standardized monitoring protocol for early detection of new AIS into a lake. Physical surveys of AIS require effort, expense, and expertise, especially when AIS populations are low during early establishment (i.e., there are not many individuals to locate and capture). There is also the possibility that physical detections may lag years behind a species' first arrival into a new lake. Environmental DNA (eDNA) is organismal DNA that originates from cellular material shed by organisms into the environment which can be detected using molecular methods. eDNA is a tool which could be an effective AIS monitoring method for early detection of species across a broad geographical area because it would be easier to collect water samples from lakes than to search the same number of lakes with teams of AIS specialists. While the use of eDNA for AIS monitoring has become more widespread, the methods are not standardized and streamlined. In order to implement large scale eDNA surveillance, eDNA surveys must be designed to maximize the probability of detecting multiple AIS from each water sample. Thus, this study aims to test and compare different field and lab eDNA methods to determine which combinations maximize detection probability of our target AIS. Moreover, AIS detection from eDNA methods were compared with traditional AIS detection surveys to see how sensitive eDNA is and whether results were correlated to target AIS abundance at water collection points. Field sampling was conducted in five water bodies, St. Louis River estuary, Lake of the Woods, Shagawa Lake, Lake Vermilion, and Pike Lake. Our findings will provide guidance and recommendations to MN stakeholders who might consider eDNA as an AIS monitoring tool.

### Brief Bio

Anna Totsch is a Masters student in the Water Resources Science Program at the University of Minnesota Duluth campus. Attended the College of St. Scholastica for undergraduate degrees in Biology and Biochemistry with a minor in Psychology.

### Location of Study

Lake of the Woods, Pike Lake, Lake Vermilion, Shagawa Lake, St. Louis River Estuary

## Evaluating the impacts of *Bythotrephes* on the growth of young-of-year walleye and validation of a back-calculation method

Danielle Gartshore* and Michael Rennie

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### Abstract

Invasive species are a major threat to ecosystem structure and function. One invasive species that has been implicated as disruptive to aquatic ecosystems is *Bythotrephes longimanus* (*Bythotrephes* hereafter). *Bythotrephes* are an aggressive meso-predator often consuming more zooplankton than other zooplanktivores, including juveniles of economically and culturally significant fishes such as walleye (*Stizostedion vitreum*). Young-of-year (YOY) walleye are zooplanktivorous initially and have recently been shown to display reduced growth in *Bythotrephes*-invaded lakes. The aim of this study is to evaluate the impacts of *Bythotrephes* invasion on YOY walleye using the Fraser-Lee method to estimate back-calculated size-at-age from otoliths and dorsal spines, comparing changes in fish growth before and after *Bythotrephes* invasion, as well as among lakes with and without *Bythotrephes* present. Using growing degree days (GDD) to account for thermal growth induced by climate change, preliminary results support field observations elsewhere of reduced YOY walleye growth in the presence of *Bythotrephes.* To validate this method, back-calculated YOY walleye lengths will also be compared with measured YOY lengths reported elsewhere in Rainy Lake. Since growth is ultimately linked to reproduction, recruitment, and production, understanding the impacts of *Bythotrephes* on walleye growth rates is essential to support adaptive management.

### Brief Bio

Danni Gartshore is an MSc candidate at Lakehead University in Thunder Bay, ON. She hopes to improve our understanding of the long-term impacts that invasive species pose on freshwater ecosystems, particularly how Bythotrephes longimanus impacts the growth of fishes.

### Location of Study

## Restoring hybrid cattail infested wetlands in Voyageurs National Park: What have we learned?

Reid T. Plumb[1]*, Jerry Warmbold[1], Steve K. Windels[1], Bryce T. Olson[2]

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

### Abstract

Non-native hybrid cattails (*Typha x glauca*) are known to disrupt ecosystem balance by creating dense monotypic stands, displacing native species, and reducing biological diversity. Hybrid cattail is the dominant plant species in most large lake wetlands in Voyageurs National Park, MN. We initiated a restoration 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. Using 5 different treatment methods, we have treated a total of 75 acres of invasive cattails in Voyageurs National Park. We conducted pre- and post-treatment vegetation surveys of wetlands and compared percent vegetative composition for each treatment type. Total removal of cattail was the most effective treatment method for floating cattail mats with cattail being reduced from 98% composition to 0%. Underwater cutting of rooted cattail stands was also an effective method of removing cattail. We saw significant reductions of invasive cattail and increases in native vegetation from most treatment methods. Where remnant wild rice stands were present, we saw a significant increase in wild rice composition post cattail removal. Here we will present an overall project update, including project findings, management recommendations, and our direction of future work.

### Brief Bio

### Location of Study

Lakes in Voyageurs National Park

## Aquatic Vertebrate By-Catch at the IISD-ELA: Historical distribution and trends

Lauren D. Hayhurst, Chandra M.C. Rodgers, Sandra M. Chalanchuk, Douglas J. Allan, Stephen J. Hecnar, Michael D. Rennie

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### Abstract

Herpetological by-catch, has been recorded from trap net catches at IISD-Experimental Lakes Area (IISD-ELA) since 1983. Commonly encountered amphibian and reptile by-catch species include: Central Newt (*Notophthalmus viridescens louisianensis*), Snapping Turtle (*Chelydra serpentina*), and Western Painted Turtle (*Chrysemys picta bellii*). These species range from "Unlisted" (i.e., newts) to "Species of Special Concern" (i.e., turtles) under the committees on the Status of Species at Risk in Ontario and the Status of Endangered Wildlife in Canada. Trends and distribution of these aquatic vertebrate by-catch, in the Kenora Unorganized area, are the focus of this presentation. Reporting occurrences and subsequent CPUE and abundance estimates of these non-targeted and vulnerable species, across IISD-ELA's routinely monitored lakes, provides crucial data to identify changes in historical and current catches.

### Brief Bio

Lauren Hayhurst works as the Fisheries Research Biologist with IISD-ELA. Her background includes fisheries research of whole-lake studies, water quality sampling, bioenergetics modelling, and population estimation, with additional experience working on the nanosilver study and compiling datasets of historical newt and turtle sightings at IISD-ELA. She attributes her early interest in freshwater, fisheries, and herpetology records to her experiences and time spent at her family's island on Lake of the Woods.

### Location of Study

IISD-ELA and surrounding lakes, Kenora unincorporated territory.

## Emerging Technologies for Monitoring Nutrients, Algae, and Water Quality

Andrea Zappe

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### Abstract

Emerging technologies are coming out that have the potential to expand and broaden nutrient and algae data collection within the Rainy-Lake of the Woods Watershed. Spruce Lake, Ontario, a HAB affected lake within the watershed, will be monitored with some emerging new technologies in Spring of 2022 as part of a trial to help expose North America scientists to their capabilities. Specific technologies include “Lab-on-Chip” nutrient sensors that can provide continuous lab quality data in the field, a novel chlorophyll monitoring sensor that can also monitor cyanobacteria pigments and turbidity, as well as a brand new, simple, low-cost floating water quality platform that provides all standard baseline water quality parameters while also providing solar generated power to the sensors and smart telemetry for instant remote data access. As an aquatic sensor technologist and a stakeholder that lives on Spruce Lake, I would like to take this opportunity to share the technologies, while welcoming collaborative input on set-up approach. Live data can be made available to interested stakeholders once trial is up and running.

### Brief Bio

Andrea Zappe is an aquatic scientist / environmental water quality monitoring technologist who lives on Spruce Lake in Kenora at the northern part of the Rainy-Lake of the Woods Watershed. As Spruce Lake is directly affected by HABs, I have great appreciation for the collaborative work being done by this group as a direct stakeholder

### Location of Study

Spruce Lake, Ontario