

KENAUK INSTITUTE

2023



ANNUAL REPORT

Research | Education | Conservation



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Executive Summary

The Kenauk Institute is a charitable organization and the long-term custodian of the Kenauk property. Its mission is to: 1) Support, coordinate and supervise recreational activities and scientific research on the property and its surrounding area, 2) Promote environmental education both locally and with partner Universities and schools, and 3) Connect Kenauk with the broader community. The vision is to establish a baseline inventory of biodiversity and monitor the property for climate change and human impacts with a 100-year time horizon. We commit to accomplishing this mission and vision in a manner that is accessible, rights-based, gender-responsive, culturally appropriate, and inclusive.

Kenauk has proven to be an ideal location for our organization because of its extensive size, its uniqueness as a pristine watershed and as a wildlife corridor. The abundance and diversity of flora and fauna in combination with the property's unique history provides endless possibilities for research and education. In 2023 we accomplished 23 successful research projects and 9 inspiring educational programs.

The foundations of our long-term monitoring mission are firmly in place with our own weather station and 150 permanent sample plots established throughout the property. Inventories of the property continue to surprise us with over 112 rare and endangered species being validated so far which is a testament to Kenauk's uniqueness. The historical and environmental significance of Papineau Lake as a pristine watershed and conservation priority also continues. We look forward to future successful partnerships, the results from our new projects and more innovative projects from incredible interns.

This year, the Kenauk Institute hosted 9 education programs reaching 170 students. Programs ranged from day trips to summer-long internships. We look forward to many new collaborations in 2024 and welcoming our returning educational programs. [CLICK HERE FOR A KENAUK INSTITUTE INTERN VIDEO](#)

The Kenauk Institute conference was another success; held on September 23rd at Fairlight Chalet, it was an opportunity for sharing, learning and discovering between our unique research projects and partnerships. [CLICK HERE FOR THE 2022 CONFERENCE RECAP VIDEO](#)

Board of Directors

- Mr. Doug Harpur – Chair
- Ms. Marie-Andrée Tougas-Tellier – B.Sc., M.Sc.
- Ms. Sara Lydiatt – B.A., M.A.
- Dr. Altaf Kassam – B.Sc., PhD, M.B.A.
- Dr. Christian Messier – B.Sc., M.Sc., PhD
- Dr. David Philipp – B.Sc., M.Sc., PhD
- Dr. Kyle Elliott – B.Sc., M.Sc., PhD
- Mr. Patrick Pichette – B.A., M.A.

Members

- Mr. Doug Harpur
- Mr. Patrick Pichette
- Mr. Dominic Monaco
- Mr. Mike Wilson

Management

- Liane Nowell – Executive Director
- Jessica Turgeon – Education Programs Director
- Jordan Harpur – Treasurer



Capital Campaign – Keep Kenauk Wild

The Kenauk Institute (KI) and the Nature Conservancy of Canada (NCC) are both charitable organizations that have partnered in a unique capital campaign with the objective of making Kenauk the world's largest temperate forest dedicated to research and education.

A strategic conservation partnership of this magnitude is critical to Canada's fight against climate change. Our research and education initiatives will benefit Canadians for generations to come.

[CLICK HERE TO VIEW THE KENAUK VIDEO](#)

The campaign goal is to raise \$50 million to protect and care for Kenauk. We have already secured \$20 million in land gifts from the partnership and \$10 million from the government. The remaining \$20 million is being raised from private sources. 2023 has seen terrific progress in reaching out to private donors, and we expect to announce the campaign's completion in early 2024.



CONSERVATION WITH NCC: \$5M

Endowment fund to pay land taxes and lead conservation programs at Kenauk

RESEARCH & EDUCATION WITH THE KENAUK INSTITUTE: \$15M

Endowment Fund \$12M | Kenauk Institute Pavilion \$3M

Donations will:

- Ensure the long-term protection of Kenauk and the survival of countless species.
- Protect the foundation of one of the last significant wildlife corridors on the continent; critically important for the survival of wildlife facing climate change.
- Go toward building the Kenauk Institute's very first pavilion dedicated to research and education.
- Provide stewardship resources for the custodians of the land (the Kenauk Institute).
- Expand the Kenauk Institute's free educational programs to reach more young students.



TO LEARN MORE AND DONATE

[DONATE NOW](#)



TO REGISTER FOR OUR NEWSLETTER

[The Kenauk Institute Website](#)

Kenauk Companies

Kenauk is a 65,000-acre private property nestled in the pristine forest found between Ottawa and Montreal. Several companies exist on the property, where daily operations require a unique approach to management that supports the integration of multiple industries. The Kenauk Institute is the custodian of the property and, as such, informs the activities of all other Kenauk companies to ensure conservation is always a priority. The other companies that operate at Kenauk include: Kenauk Nature L.P., a high-end outfitter with eco-tourism activities and chalets for rent; Kenauk Agriculture Inc., an on-site fish hatchery used for stocking lakes; Kenauk Canada ULC., the forestry operations, and; Kenauk Properties, the roads and land management company.

Kenauk Nature L.P. - www.kenauk.com

Kenauk Nature L.P. is an outfitter that offers 23 off-grid luxurious chalet rentals as well as year-round outdoor adventure activities. Activities include hunting and fishing, both operating with quotas under the supervision of the Kenauk Institute with the goal to promote sustainable long-term wildlife management. Many of the lakes operate catch and release fishing, while some are stocked with the fish from our own hatchery, for the benefit of our patrons.

Kenauk Agriculture Inc. - www.pisciculturekenauk.com

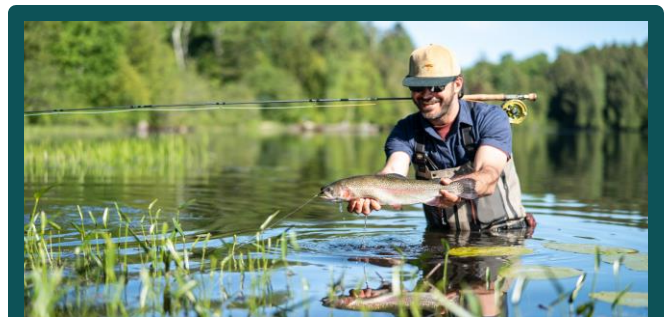
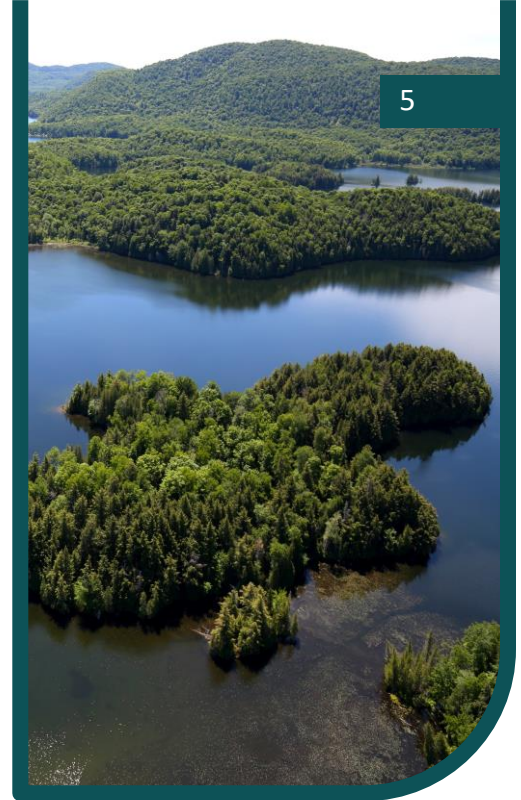
The fish stocked at Kenauk are raised in our own hatchery: a facility capable of producing 25 tons of rainbow, speckled, and brown trout every year (over 100,000 fish). Fish are only stocked into lakes with no native fish species to prevent competition. This land-based hatchery allows Kenauk to protect wild populations of fish, ensuring our anglers enjoy a sustainable fishing experience year-round. The hatchery also sells sustainable high-quality fish to restaurants in Montreal and Kenauk Nature guests.

Kenauk Canada ULC.

Kenauk Canada ULC is dedicated to the development of a fully sustainable forestry operation with long term conservation and research initiatives. This mission includes building a profitable business that sustains local employment, fosters long-term environmental study, and allows for the recreational enjoyment of its forests. Kenauk Canada ULC manages its operations to meet the requirements of their Sustainable Forestry Initiative (SFI) certification (www.forests.org).

Kenauk Properties L.P.

Kenauk Properties L.P. is owned by the Kenauk Institute members. This company owns most of the key roads at Kenauk (with adjacent set back areas), most of the lakes and the Kinonge river corridor. It is committed to permanently protecting the vast majority of its land and has already donated most of the land surrounding the key headwater lake on the property, Papineau Lake.



Facilities

Pods

Seven pods are installed at Whitefish Lake and act as our researcher accommodations for both professors and students.

Nature House

The Nature House, also located at Whitefish Lake, provides space for intern accommodations. It also acts as the Kenauk Institute office and includes a meeting space. We would like to recognize the members who contributed to this purchase and for their continued support in all of the Kenauk Institute's endeavors.

Kenauk Nature L.P. Partnership

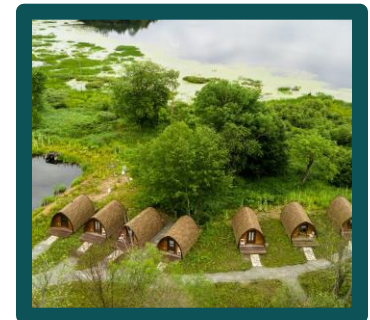
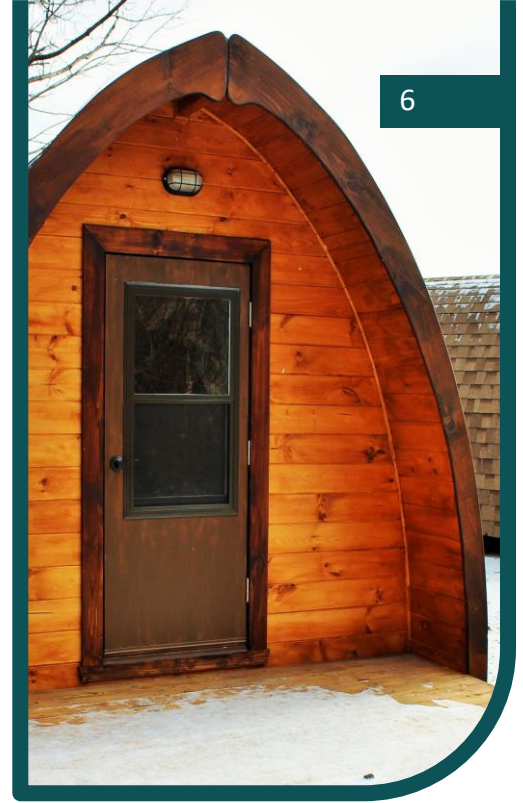
The Kenauk Institute is fortunate to have the existing Kenauk Nature L.P. outfitting facilities at our disposal. Chalets are available for rent by educational programs as well as potential in-kind contributions for research project grants such as the use of fishing boats and the marina, storage space, mapping data, equipment and assistance from knowledgeable personnel.

Astronomy Observatory

We are excited to announce the recent completion of an astronomy observatory. The site will be used for star gazing and space exploration; an asset and new discovery activity for educational programs made possible by the lack of light pollution and dark skies at Kenauk.

Kenauk Institute Research and Education Center

We plan to build a center to act as the main pavilion for all research activities as well as increase our accommodations and expand our capacity for hosting educational programs.



2023 Educational Programs

The Kenauk Institute offers educational programs for elementary schools and high schools, as well as undergraduate and graduate University classes with lessons and activities focused on every groups' needs. Students come away engaged in the environment as active eco-citizens, with new practical skills and abilities such as autonomy and responsibility while developing self-esteem, resilience, leadership, and perseverance. By combining environmental learning with time outside and play we hope to fuel a curiosity and passion for the environment while giving students valuable knowledge and skills.

1. Kenauk Institute Internship Program – [click here to view the internship video](#)

The Kenauk Institute has committed to providing undergraduate internships and a graduate senior internship for students studying biology in university. Interns are expected to juggle a variety of responsibilities that include contributing to multiple research projects, helping organize day-to-day operations, leading our educational programs as well as managing their own individual research project. The field experience gained during this internship is invaluable and will help individuals narrow down their research interests, as well as help them pursue their academic and career goals.

2. Kenauk Institute Junior Internship Program – [click here to view the junior internship video](#) Funded by the Dr. Eleanor MacKenzie Harpur WISE Internship Program

The junior internship program targets senior female high school students with a keen interest and passion for the biological sciences. It is an opportunity for students to experience real hands-on data collection, learn about the scientific process, meet other young professionals studying biology, and learn about the various fields related to ecology and conservation biology.



3. Kenauk Institute Nature Discovery Program

The Nature Discovery Program is an innovative environmental education program focused on providing local young children the opportunity to connect to nature and the wild spaces around them. The goal is for these kids to grow up with the understanding, attitudes, and motivations to make informed decisions and take responsible actions that incorporate conservation and sustainability. Our focus is on cultivating a unique and engaging experience for each child to learn and enjoy.

4. Bishop's College School (BCS) Grade 7 Program

The BCS grade 7 program is an opportunity for students to get outside of the classroom and experience the outdoors. By combining basic biology, wilderness survival, time outside and play, we hope to fuel a curiosity and passion for the environment while giving these students valuable knowledge and skills. This program includes team building, kayaking, wilderness survival activities, and many lessons on the local flora and fauna. It is also an opportunity to get real hands-on experiences collecting scientific data – this year we added a water parameters component, whereby the students took water samples while learning about the importance of repetition in science.

5. WILD Outside Program – Canadian Wildlife Federation

WILD Outside is a national conservation-based youth leadership program designed for youth ages 15 to 18. The program is open to all regardless of physical or economic barriers. The goal of the program is to inspire participants to develop their passion for conservation, awareness of their natural environment and a deeper appreciation for wildlife while providing opportunities for personal growth, outdoor adventure, and immersive nature experiences.



6. Sunshine Montessori School Program

The Sunshine Montessori School Program is an innovative program that provides students with a wide variety of learning experiences. The goal is to get the students outdoors to learn about natural history, experience the scientific method, partake in data collection, and immerse in the local Montebello community. The program includes three days of activities: Montebello Day, where students learn about the rich history of the town and enjoy an afternoon on a guided tour at Park Omega, Whitefish Day, where students learn about the local fauna and flora, and Science Day, where students learn about real career opportunities in biology and the sciences, all while actively participating in data collection.

7. St-Coeur-de-Marie Elementary School Program

The St-Coeur-de-Marie program is an excursion that combines outdoor play, natural history, and science all in one. Students come away with valuable insights about the nature of science and the connections between science and the environment. The goal is for these students to learn about the different branches of science while having a fun day outdoors. This year, activities included a tour of the fish hatchery and bone collection, a guided kayak with lessons on local fauna and flora, and an entomology lesson that included hands-on insect collection.

8. Adrien-Guillaume Elementary School Program

The Adrien-Guillaume program is a trip to get students outside at the end of the school year to enjoy nature. The goal is to fuel the students' curiosities for nature and the environment in such a way that they connect with it long-term. This program combines outdoor play with wilderness survival skills to ensure that students have a positive experience with the outdoors.

9. Polyvalente Le Carrefour High School Program

The Polyvalente Le Carrefour Program is an opportunity to partner with a school that already has an outdoor program in place that allows students to go on field trips to nearby natural spaces. Students therefore already have some knowledge and experience with the outdoors, leading to a more advanced program at Kenauk. The goal of this program is to provide students with an increased knowledge of local flora and fauna and an opportunity to perfect their outdoors skills, such as wilderness survival techniques.



2023 Research Projects

1. NCC Biodiversity Inventory Project (#2015-1.1)

Institution: The Nature Conservancy of Canada

Researchers: Annie Morrisseau, Charlene Melancon and countless NCC volunteers

Description: In 2014, the Nature Conservancy of Canada (NCC) began a series of inventories on the property of Kenauk. This work aims to document the rich biodiversity of this vast and iconic property, to exemplify its value and manage it accordingly (ex. identification of areas with high conservation potential, forest corridors, etc.). Research conducted in collaboration with biological specialists have confirmed the exceptional ecological richness of this site. The initial results of this inventory and a review of the scientific literature have allowed NCC to produce a species database including a list of concrete recommendations for land stewardship and the management of its natural resources. This document serves as a framework for planning target species management and conservation action plans for Kenauk.

NCC is also prioritizing the preservation of Kenauk's ecological features to ensure its dynamic role within the landscape-scale ecosystem. Kenauk's conservation planning therefore includes a larger scale objective to protect the Kinonge watershed (Figure 1) and the wildlife corridor to the North (Figure 2). The continuous forest cover to the North of Kenauk provides suitable conditions for wildlife movement and migration. Continuous forest is important for large mammals, forest interior birds, indigenous plants and amphibians with limited dispersal capacity. The objective is to maintain landscape connectivity for free dispersal of those groups.

Results Summary:

- So far, the presence of over 112 species at risk have been validated, including amphibians, vascular plants, arthropods, mammals, birds, fish and reptiles.
- Kenauk is home to the four-toed salamander, the walking fern and the largest black maple stand listed in Quebec.
- Old forest fragments that foster several bird species such as the eastern whip-poor-will were also identified.
- Channel darters and pearlshell mussels were also found, indicator species for the quality of the riparian environment.
- Recently, the rare conophilis plant was also discovered to have one of the largest colonies in the province of Quebec.

Status: This inventory will continue in 2024. Extensive species lists have been created which will facilitate long term monitoring, conservation and future research.

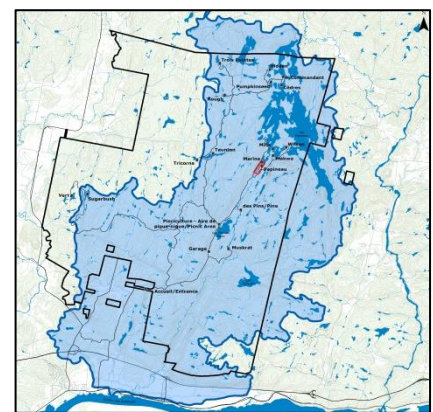
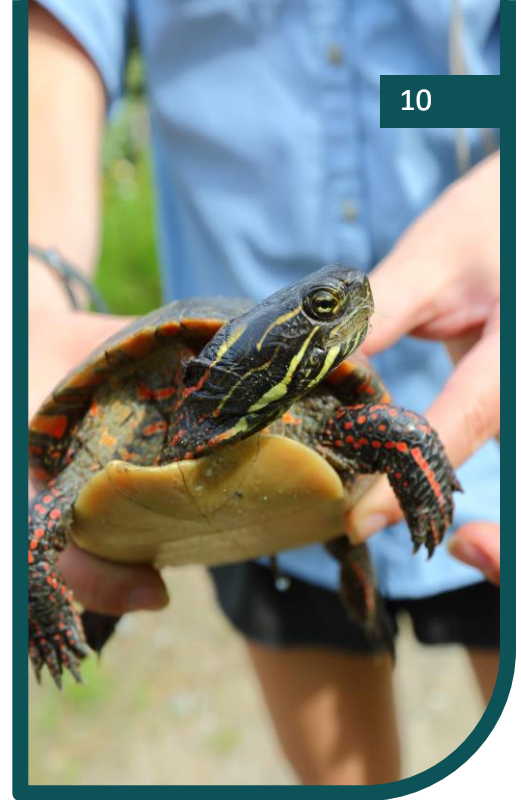


Figure 1. Kinonge watershed.

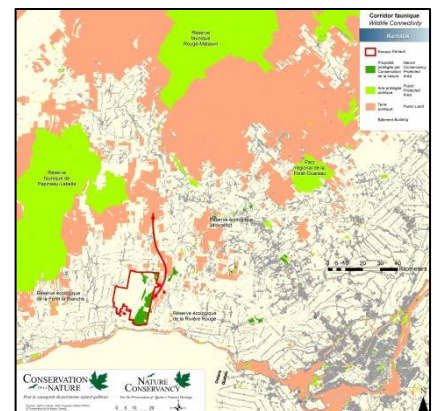


Figure 2. The wildlife corridor.

2. Pan Canadian Forest Resilience Project (#2023-1.1)

Title: Nationwide testing of a forest management approach based on functional diversity and connectivity to foster social acceptability and forest resilience to global change.

Institution: Université du Québec en Outaouais (UQO)

Researchers: Prof. Christian Messier and many others

Description: The pan-Canadian DIVERSE project aims to study and improve the resilience of Canada's forests. The forestry sector currently faces many problems: rapid climate change, increased frequency, intensity, and duration of natural disturbances, forest fragmentation, and changing demands. A novel forward-thinking approach to forestry is required to address these uncertainties. This proposal aims to test innovative new approaches to improve forest resilience faced with global change stressors through field trials and modelling by a coordinated national network of experts using six fully integrated research themes (Figure 3).

Theme 1 – The Forest Resilience and Vulnerability Portrait will evaluate the change in Canada's forest resilience to climatic and biotic disturbances over the past 40 years (using permanent sample plots).

Theme 2 – Identification of Suitable Tree Species to Grow will determine a pool of potential tree species that can be introduced that are better adapted to current and future global environmental conditions.

Theme 3 – The Functional Complex Network (FCN) will quantify forest resilience at the stand and landscape scales of each Forest Management Unit (FMU) using network theory.

Theme 4 – The Evaluation of Various Forest Management Approaches under global stressors using forest landscape models for each FMU: (i) Business-As-Usual (BAU), i.e., the current or historic forest management approach, (ii) Climate-Smart Forestry (CSF), which uses silviculture to promote climate-adapted species and maximize carbon storage in forests, and (iii) Functional Complex Network (FCN), which in addition, promotes forest resilience through functional diversity of species and spatial configuration of stands to enhance connectivity and modularity.

Theme 5 – Socio-Economic Conditions will evaluate the feasibility of implementing these approaches.

Theme 6 – Implementation of Alternative Silvicultural Treatments and Multi-Species Plantations will design and test treatments and plantations following the analyses conducted in Themes 1 to 5. These boots-on-the-ground tests will be established throughout the 17 FMU sites to become demonstration sites to learn from and engage with forest practitioners and showcase various silvicultural approaches aimed at adapting forests to climate change, while increasing their functional diversity.

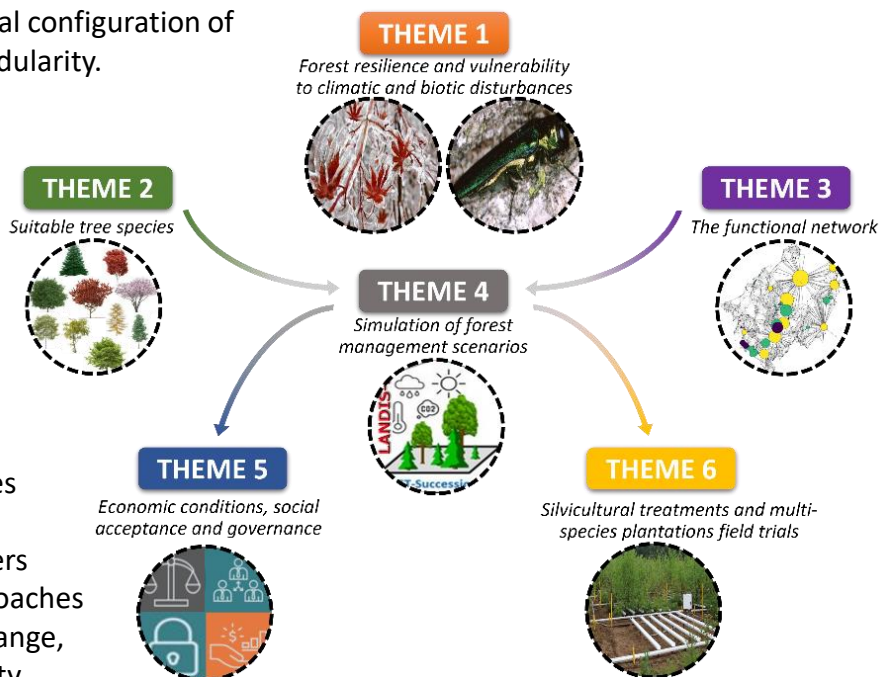


Figure 3. Integrated research themes.

3. Beech Tree Invasion and Maple Stands Project (#2020-3.1)

Title: The management of sugar maple tree stands in southern Quebec when faced with the beech tree invasion and drought.

Institution: Université du Québec en Outaouais (UQO), Ministère des Forêts, de la Faune et des Parcs du Québec (MFFP)

Researchers: Audrey Maheu, David Rivest, Philippe Nolet, Frédérik Doyon (UQO)

Description: In southern Quebec, temperate forests face two threats: the large-leaved beech invasion of maple groves and the expected increase in the frequency and severity of droughts with climate change. This research project aims to: 1) identify areas of beech invasion, 2) understand the effects of that invasion on resource availability in a changing climate, and 3) assess the effects of development on beech invasion. First, the project will develop tools for detecting areas of beech invasion using mobile and aerial LiDAR. Second, the project will study the effects of beech invasion on regeneration, hydrological flows and soil properties. A precipitation exclusion system will also be put in place to simulate severe drought conditions and better understand the joint impact of beech invasion and drought. Finally, the project will identify the conditions and disturbances associated with the stagnation of forest ecosystems using field surveys and remote sensing data and will model the risk of ecosystem collapse with climate change. The knowledge and tools acquired will enable stakeholders in the forest industry involved in planning or harvesting to set up a management strategy for beech invasion adapted to climate change.

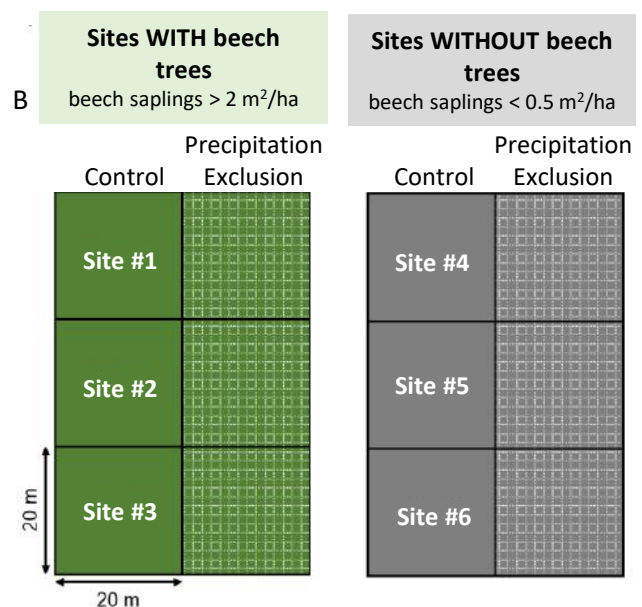
Results Summary:

- Tree transpiration and canopy interception of precipitation were monitored at 3 maple stand sites invaded by beech trees and 3 control sites not invaded. Each site is subdivided into two 20 x 20 m plots that include a control plot and a plot with >75% precipitation exclusion (Figure 4).
- Also collected was soil nutrients, soil samples, sap flow, canopy leaf samples, tree cores, and LiDAR.

Status: Data collection will continue in 2024. Phase 2 of the project is also being organized to examine the delayed effects of drought.



Figure 4. A) Photo of the precipitation exclusion device. B) Experimental design of sites with and without beech proliferation and with and without precipitation exclusion.



4. Herbivore Damage Patterns Project (#2021-44.1)

Title: What drives insect herbivory patterns in a sugar maple forest?

Institution: Concordia University

Researchers: Dr. Emma Despland, Mahsa Hakimara (PhD), Colette Ethier, Isabel Fournier, Marielle Affognon, Lilah Eldar

Description: Insect herbivores are important drivers of forest ecosystems by damaging leaves, weakening, or even killing trees and decreasing forest productivity. Sugar maple (*Acer saccharum*) forests in Quebec are declining. This project will evaluate the extent to which herbivores may contribute to this decline and document insect biodiversity supported by maples that could be threatened by this decline. One important but poorly studied aspect of structural diversity of temperate forests is the vertical gradient which provides several microhabitats for herbivorous insects with different levels of light, temperature, humidity, leaf quality and predator activity.

Therefore, the project objectives are: 1) determine if vertical stratification affects herbivory, 2) understand how this stratification varies between different herbivore guilds and 3) show how this vertical stratification affects bottom-up (plant traits as the herbivore host) and top-down (predators and parasitoids) trophic relationships that shape herbivory patterns in a tree. The methods include assessing environmental factors, herbivory damage and leaf quality in three strata (sun canopy, shade canopy, and understory) of 12 sugar maple trees.

Results Summary:

- Overall herbivory damage increased moving down the vertical gradient from the sun canopy, shade canopy and understory (Figure 5).
- Stratified leaf physical traits (bottom-up factor) contribute to herbivory patterns; with higher water content, higher specific leaf area, and less thickness in understory leaves.
- Insect herbivore predation rate varied across the three strata, with higher arthropod predation in understory, higher bird predation in both sun and shade canopy and higher mammal predation in shade canopy.

Status: Data analysis will continue through 2024.

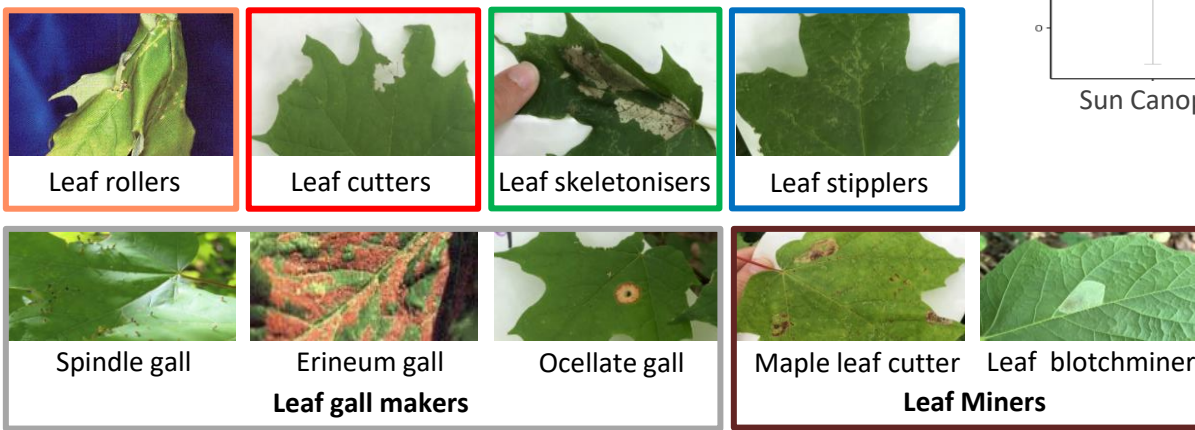
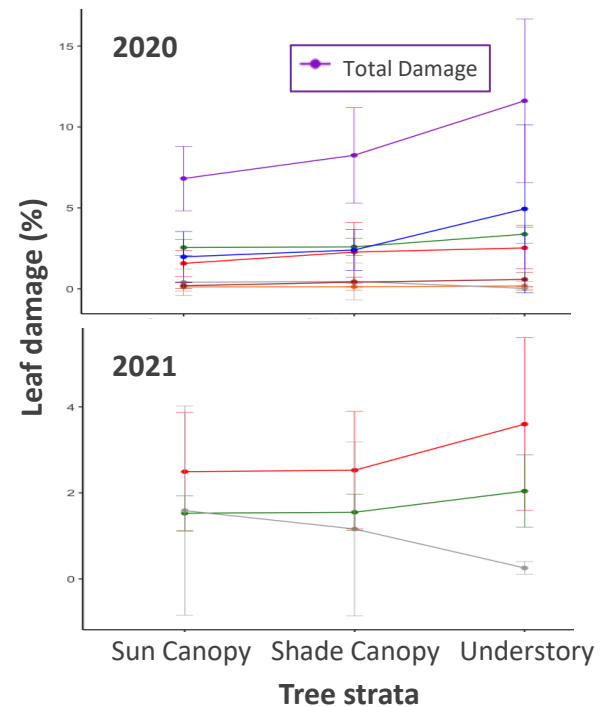
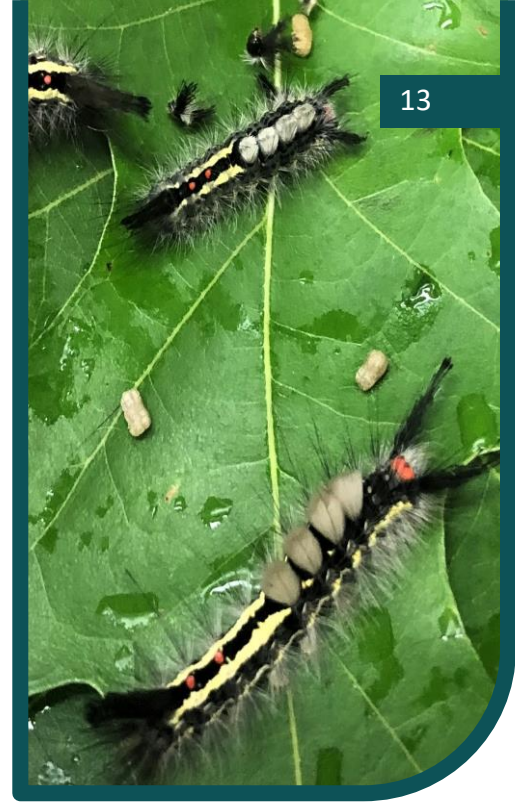


Figure 5. Insect herbivory damage from different insect guilds (seen to the left) on three strata of sugar maple trees.

5. Connectivity of Ecosystems Project (#2021-1.1)

Title: Connectivity of forest lotic ecosystems

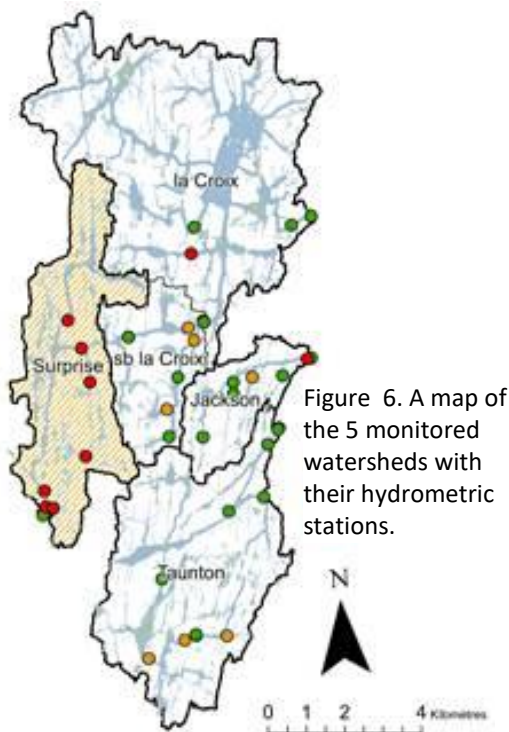
Institution: Université du Québec à Montréal (UQAM), Université du Québec en Outaouais (UQO), Institut national de recherche scientifique (INRS-ETE), Université du Québec à Trois-Rivières (UQTR)

Researchers: Prof. Marie Larocque, Audrey Maheu (UQO), Katrine Turgeon (UQO), Éric Harvey (UQTR), André St-Hilaire (INRS-ETE), Laureline Berthot (post-doc UQAM), Mathieu Auffray (PhD UQAM), Matteo Babinski (MSc UQTR), Cecilia Estable (MSc UQO), Baptiste Xavier Nelaton (PhD UQO)

Description: The goal is to understand how hydrological and structural connectivity, biodiversity and the functioning of lotic ecosystems in the temperate forests of the Canadian Shield are affected by forestry and climate change. This project will provide recommendations for concrete actions to include water connectivity in forest management and restore connectivity under current and future conditions in Canada and other similar regions.

Results Summary:

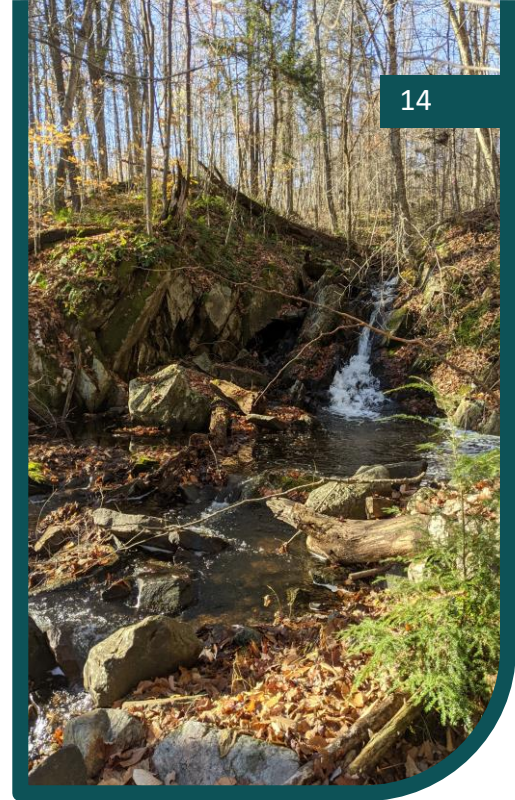
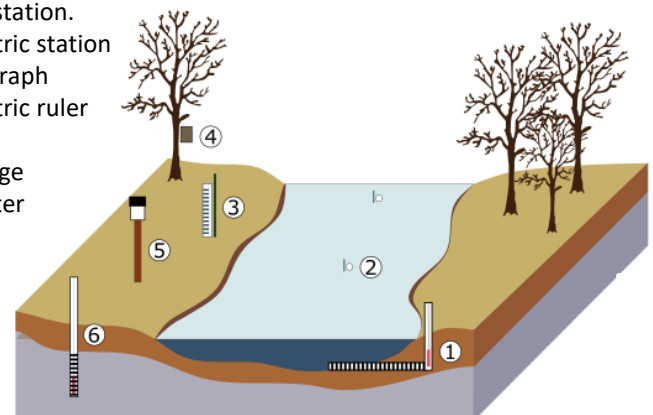
- The project was launched in spring 2021 and will run for four years. During the first summer, five watersheds (Surprise, Taunton, Jackson, La Croix and La Croix sub-basin) in the north-west of the Kenauk property were instrumented with hydrometric stations for monitoring flow rates (Figure 6).
- Thermographs to record water temperatures have been installed in all rivers (Figure 7).
- All watersheds have been equipped with piezometers to monitor groundwater levels.
- Weather stations were installed near the limnometric water level stations at each watershed outlet.
- In 2023, extreme weather events and flooding had a significant impact on some of the rivers studied.



Status: Hydrological modeling and hydrometeorological monitoring will continue throughout the duration of the project. The component of the project targeting biological indicators of connectivity began in 2023.

Figure 7. A diagram of the equipment installed for each hydrometric station.

- ① Limnometric station
- ② Thermograph
- ③ Limnometric ruler
- ④ Camera
- ⑤ Rain Gauge
- ⑥ Piezometer



6. Papineau Lake Telemetry Project (#2017-2.1)

Title: Towards sustainable recreational fisheries on Papineau Lake

Institution: Carleton University, University of Waterloo, University of Vermont, and the Fisheries Conservation Foundation (FCF)

Researchers: Dr. Steven Cooke, Benjamin Hlina, Danny Glassman (Carleton U), Dr. Ellen Marsden (U of Vermont), Dr. David Philipp (FCF), Julie Claussen (FCF), Dr. Mike Power (U of Waterloo)

Description: The goal of this project is to understand the spatial ecology, population dynamics and fishery for lake trout and black bass in Papineau Lake. This project will provide the data and tools to identify sustainable conservation strategies to help ensure high quality fishing on Papineau Lake while protecting its natural assets for future generations. The objectives of this project include: 1) Identify the life history characteristics for lake trout sub-populations and/or ecotypes. 2) Characterize their use of different habitats (ex. depth and thermal habitat) on a seasonal basis (ex. spawning and overwintering). 3) Identify their level of reproductive success. 4) Determine why most lake trout in the lake fail to become greater than ~2kg.



Results Summary:

- Tags have been implanted in 66 lake trout and 56 bass.
- 4 spawning sites have been identified in the lake.
- Movement patterns indicate that lake trout tend to stay within their capture basin (Figure 8).
- Small and large lake trout have been identified. Large lake trout seem to be solely cannibalistic while smaller lake trout feed on zooplankton and aquatic insects.
- Ageing structures show two life histories (slow and fast growing); the fish sampled were 3 to 25 years old.
- Stable isotope and gut content analysis indicate differences in lake trout prey based on their home basin.
- Bioenergetic models indicate that seasonal thermal habitat availability influences the amount of energy lake trout have to move, grow, reproduce, and survive.
- Overall, in Papineau Lake, body size and condition of lake trout appear to be limited by prey types (i.e., predominately zooplankton and aquatic insects), warm-water species, and thermal habitats. These factors influence growth and survival. Recommendations to ensure lake trout in the system are to protect vital spawning habitat, reduce angling pressure and harvest, prevent and mitigate aquatic invasive species, and ensure stability and connectivity of thermal habitats by limiting development and anthropogenic disturbances.

Status: This project is now complete.

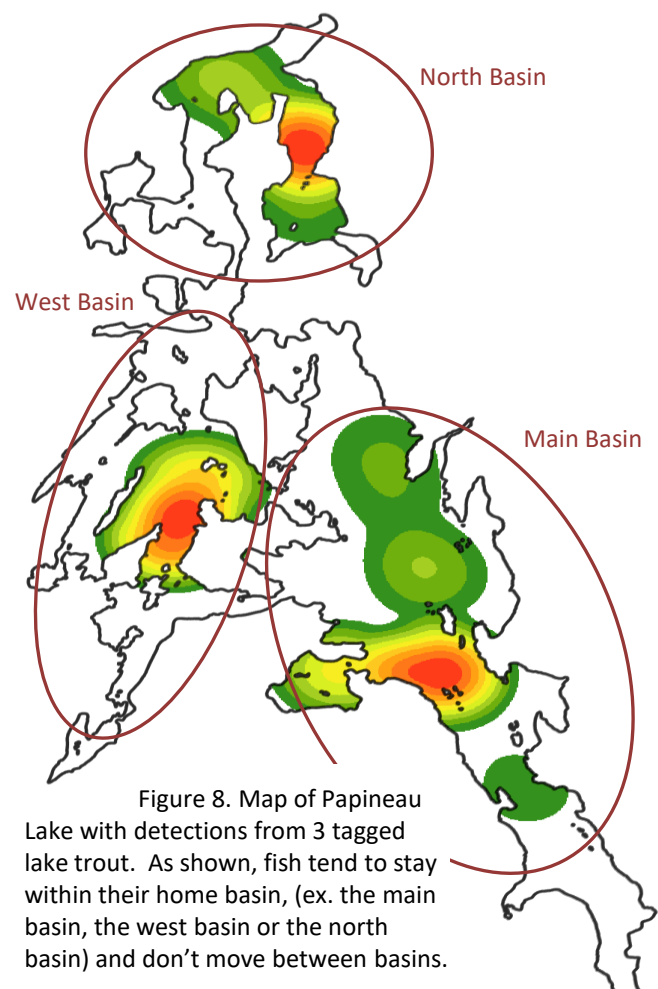


Figure 8. Map of Papineau Lake with detections from 3 tagged lake trout. As shown, fish tend to stay within their home basin, (ex. the main basin, the west basin or the north basin) and don't move between basins.

7. Stocking Optimization and Recreational Fisheries Project (#2023-2.1)

Title: Thermal Biology and the Management of Recreational Fisheries Resources at Kenauk

Institution: Carleton University, Ottawa University, Canadian Museum of Nature (CMN), Trent University

Researchers: Dr. Steven Cooke, Dr. Kathleen Gilmour, Dr. Graham Raby, Declan Burton, Brittany Bard, Kara Scott (Carleton), Dr. Andre Martel (CMN)

Description: We have long known that water temperature means everything to fish. Temperature controls enzymatic processes, rates of development and growth, locomotion, digestion, and so on. Importantly, temperatures that approach or exceed thermal tolerances for a given fish will result in sublethal fitness impairments (e.g., reductions in growth, impaired swimming) and eventually lead to death. Water temperature interacts with applied fisheries issues in several ways, all of which are salient to Kenauk. The goal of this project is to analyze the relevance of trout thermal biology to the management of fisheries resources at Kenauk. The objectives of this project are 1) to better understand how rainbow trout (*Oncorhynchus mykiss*) and brook trout (*Salvelinus fontinalis*) (Figure 9) utilize their thermal habitat year-round, and 2) to see if chronic stress alters the use of these thermal habitats during the hot summer months for rainbow trout only. Chronic stress has been linked to lowering upper thermal tolerance in rainbow trout. However, it remains unknown whether chronic stress will also hinder their ability to behaviourally thermoregulate, when exposed to naturally occurring temperatures. With suitable summer thermal habitats becoming limited due to increasing temperatures, it becomes important to know how stressed fish may cope with their environment. This project will also allow us to track seasonal habitat-use, which will further our understanding of the thermal biology of these stocked species. This information can help inform management for future welfare and stocking decisions.

Results Summary:

- This study was completed using hatchery fish implanted with bio-loggers that measure temperature and depth. Temperature and dissolved oxygen sensors were also placed in each lake, to be able to link environmental conditions to trout habitat use.
- In 2023, 30 rainbow trout were implanted with bio-loggers in Otter lake and 15 brook trout were implanted with bio-loggers in Collins lake.

Status: Data collection for this project will continue in 2024. Analysis of temperature and depth profiles from Summer 2023 is on-going.

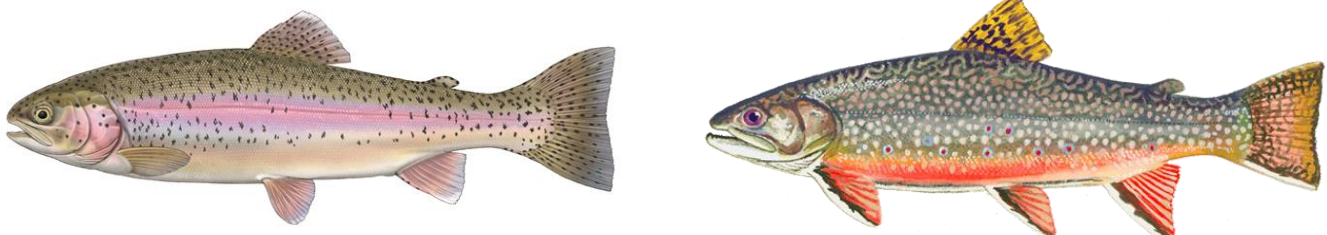
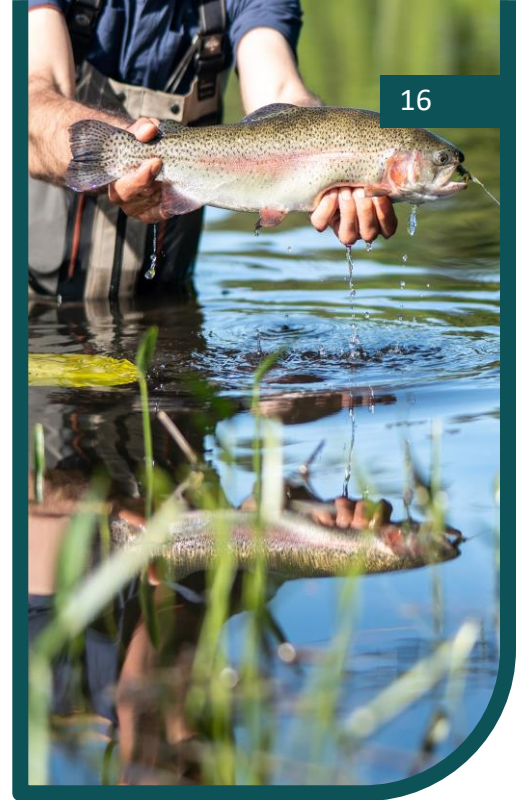


Figure 9. Rainbow Trout (*Oncorhynchus mykiss*) (left) and Brook Trout (*Salvelinus fontinalis*) (right).



8. Mussel Inventory Project (#2018-3.1)

Title: A survey of native freshwater mussels (superfamily: Unionacea) and fishes comprising six families at Kenauk

Institution: Canadian Museum of Nature (CMN), Technische Universität München (TUM), Ministère des Forêts de la Faune et des Parcs du Québec (MFFP)

Researchers: André Martel, Noel Alfonso, Jacqueline Madill (CMN), Jürgen Geist, Sofie Hemprich (TUM), Annie Paquet, Guillaume Canac-Marquis (MFFP)

Description: Freshwater mussels play vital ecological roles in river and lake ecosystems, including nutrient cycling, water filtration, substrate oxygenation and providing habitat. Freshwater mussels and fishes are linked in two significant ways: fish are an essential link in mussel life history and both groups face significant conservation pressures. Freshwater mussels are amongst the most threatened faunal groups globally, with nearly 30% of Canada's species considered at risk. The main causes of the decline for both groups include habitat loss, fragmentation and degradation, overexploitation, non-native species, and climate change. This project will survey Kenauk for mussel and fish species with an emphasis on the Eastern pearlshell recently discovered in the Kinonge Main and the Kinonge West Branch Rivers. We will also aim to determine whether brook trout are the host fish used for metamorphosis and dispersal.



Results Summary:

- Major discoveries about Eastern Pearlshell mussels at Kenauk to date
 - Genetic analysis: a distinct population in North America
 - Distribution: this is the western-most population in Canada for this species
 - Host fish for reproduction: presumed to be brook Trout
 - Kinonge River West Branch: the only branch in the Kinonge river where brook trout were found, along with the highest densities of Pearlshell mussels – a key area for conservation
- Fish inventories were carried out in the two rivers to better understand the links between freshwater mussels and fishes at Kenauk. Approximately seven new fish species were inventoried.

Status: Data collection for this project will continue in 2024.

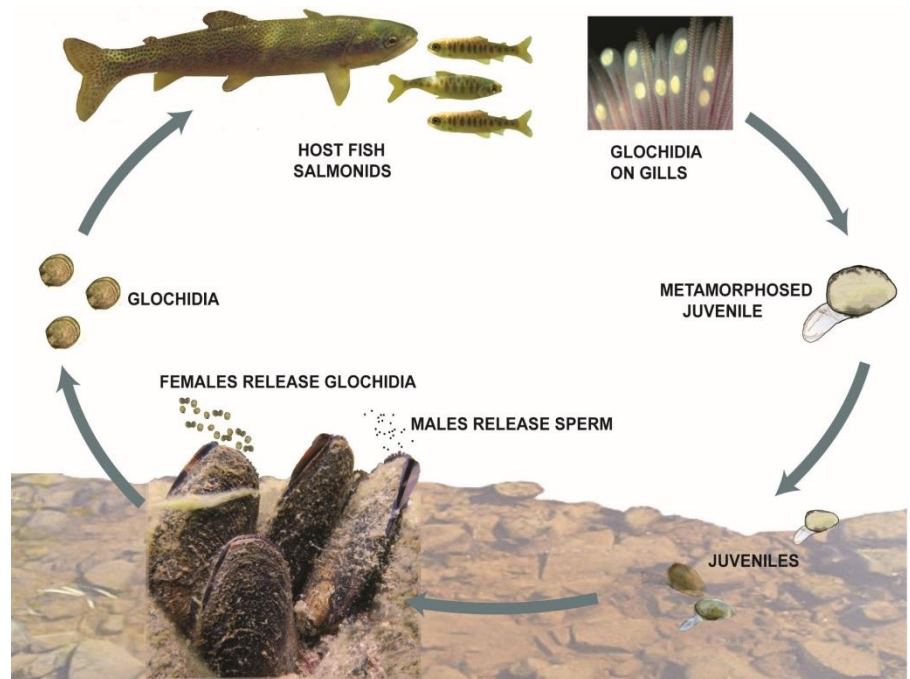


Figure 10. The life cycle of Pearlshell Mussels (Freshwater Mollusc Conservation Society). They can grow 10-13cm in length and live an average of 93 years, although the oldest Pearlshell mussel was found to be 280 years old.

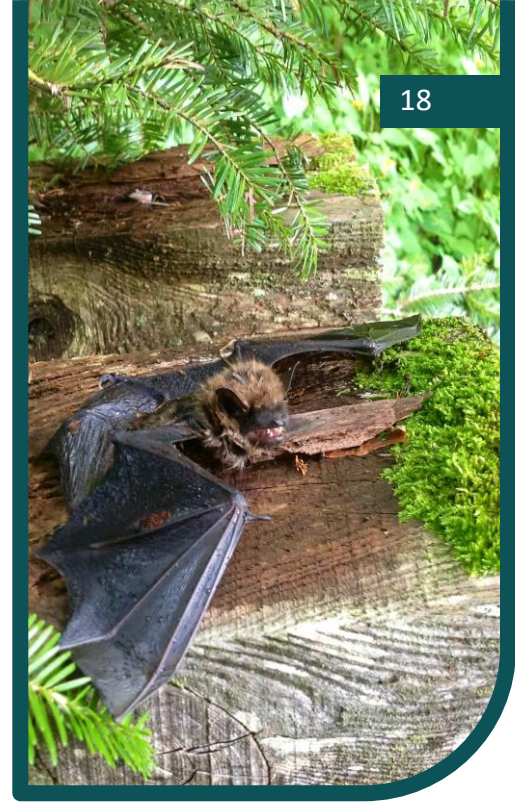
9. Multiscale Bat Habitat Selection and Population Trends (#2020-7.1)

Title: Multiscale bat habitat selection and population trends at maternity roosts and hibernacula in Southwestern Quebec.

Institution: McGill University

Researchers: Jade Legros (MSc), Amelie Fontaine (PhD), Dr. Kyle Elliott, Lauren Dobie

Description: Bats are important in their ecosystems for pollinating flowers, dispersing seeds and consuming insect pests. The white-nose syndrome, a fungal disease, has caused a decline of up to 90% of bat populations in North America. With no existing cure, the protection of remnant populations and their habitat is critical. Thus, conservation of maternity roosts (where bats reproduce), hibernacula (where bats hibernate over winter), and their surrounding habitats are essential. This project will evaluate landscape scale habitat selection by bats at maternity and analyze large-scale population trends for bat species across Quebec. A protocol will be developed using BatWatch, GIS, and drone-based acoustics to help manage land use and wildlife conservation.



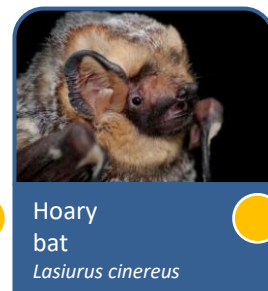
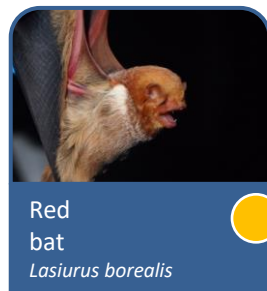
Results Summary:

- Annual monitoring of identified summer roosts at Kenauk using the BatWatch program.
- The identification of all eight bat species found in Quebec at Kenauk (Figure 11), including the little brown bat; one of the most-affected species by White Nose Syndrome.
- Jade Legros and Amelie Fontaine found that bats select summer roosts close to water and with a high density of vegetated water edges within their foraging range (2 km). Moreover, during winter, bats frequented hibernacula with less human modified habitat, suggesting bats are sensitive to disturbances before, during, and after hibernation. Therefore, protecting natural habitats, especially vegetated water edges, will help bat populations recover.
- Pioneered a new sampling method using drones, leading to more efficient and effective population surveys. See our [instructional video on bat sampling with drones here](#).

Status: The next step is to merge the drone-based insect sampling with the drone-based bat surveys to get fine scale information on bat and insect habitat use ([publications](#)).

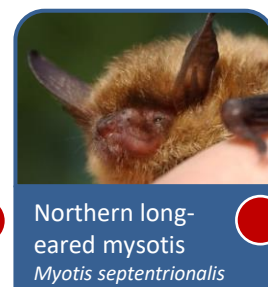
Figure 11. The eight bat species found in Quebec and their provincial status.

MIGRATE



Yellow = vulnerable, Red = critically endangered
Credit: batwatch.ca

HIBERNATE



10. Small Mammal Monitoring Project (#2020-1.1)

Title: Population dynamics of small rodents in the mixed forests of eastern Canada.

Institution: Canadian Museum of Nature (CMN), Laval University

Researchers: Dr. Dominique Fauteux (CMN, principal investigator), Dr. Pierre Legagneux (U Laval, collaborator)

Description: The regular and irregular outbreaks of micro-mammals (body mass <100 grams) are a dynamic component of ecosystems, especially the most northern ones. In the Arctic, the cycles of lemming abundance occurs every 3-4 years and is known to create faunal pulsations through their beneficial effect on predators and on other prey that share the same predators. Few studies have been carried out in the eastern part of the country in both boreal and temperate forests where long-term time series in vole abundances are rare. The objective of this study is to carry out long-term monitoring of the annual densities of voles and forest mice at Kenauk and thus better understand the population dynamics of these species in southern Quebec and their impact on their predators. This project will conduct inter-site comparisons to gain a better understanding of the role of small rodents in the functioning of forest ecosystems in Eastern Canada. It will also compare the observed fluctuation patterns to those of Bylot Island, Nunavut, where the mechanisms leading to lemming abundance cycles have been studied for nearly 30 years. Additionally, continuous monitoring will make it possible to detect population changes in the context of rapid global climate change.



Results Summary:

- Since 2020, 6 trapping grids with 60 live capture traps have been deployed annually (Figure 12).
- In 2023, 94 small mammals were captured; a significant decrease compared to 2021 (231 captures) and 2022 (421 captures). It is hypothesized that this decline is due to a particularly rainy summer.
- In 2023, 15 wood jumping mice (*Napaeozapus insignis*) were captured; a species not found in 2022. However, for common species such as the red-backed voles and deer mice, their captures decreased dramatically in 2023. See Figure 13 for annual densities from 2020-2022.

Status: Data collection will continue in 2024.

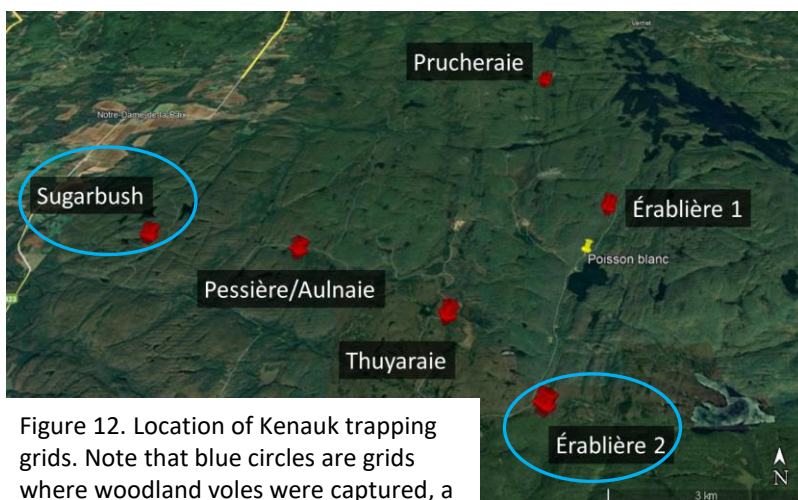
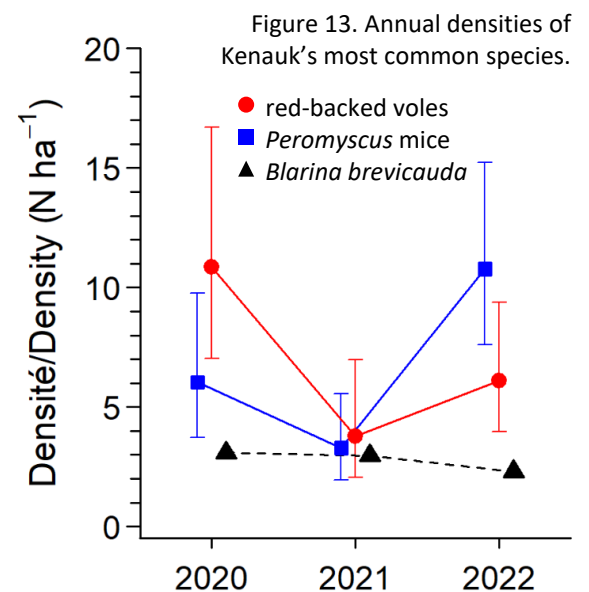


Figure 12. Location of Kenauk trapping grids. Note that blue circles are grids where woodland voles were captured, a new species for the Outaouais region.



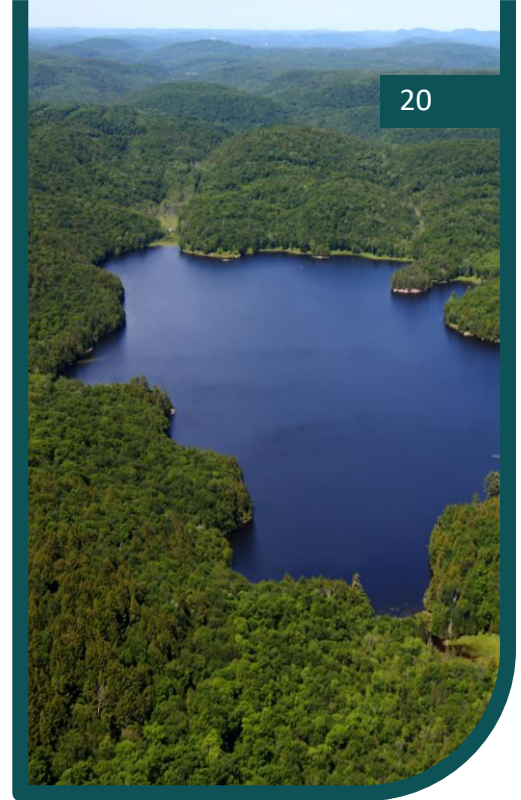
11. Ecological Comparison Between Reservoirs and Natural Lakes Project (#2023-3.1)

Title: Comparison of biodiversity and food web complexity between reservoirs and natural lakes.

Institution: Université de Québec en Outaouais (UQO)

Researchers: Prof. Katrine Turgeon and many others

Description: In Canada and Quebec, hydroelectricity represents 63% and 97%, respectively, of energy production. However, dams are recognized as one of the main threats to biodiversity, food web stability and ecosystem functions of aquatic ecosystems. Dams transform rivers (lotic ecosystems) into reservoirs (lentic ecosystems) and generate variations in water levels which go well beyond natural ranges. They also represent barriers to migratory organisms. These changes to the quality, diversity and access to key habitats can harm some species and favor others to disrupt the food web balance. The objective of this project is to quantify how dams impact biodiversity and food webs, as well as ecosystem functions. This includes quantifying the biodiversity of zooplankton, macroinvertebrates and fish as well as evaluating the interactions between species by examining the stomach contents of fish and taking biopsies for stable isotope analysis. Papineau Lake represents one of the natural lakes being used in this project's comparison.

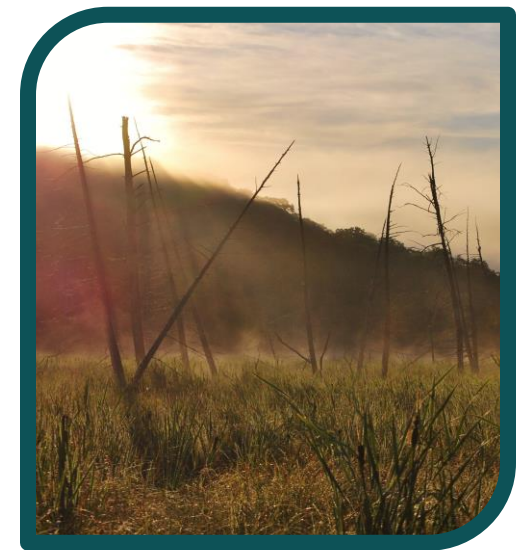


12. Quantification of Carbon Reservoirs in Wetlands Project (#2023-5.1)

Institution: MELCCFP, Université de Québec à Montréal (UQAM)

Researchers: Simon Lamoureux and many others

Description: Besides the well-known fact that peatlands are excellent carbon reservoirs, there is no database on the carbon reservoirs stored by wetlands in Quebec. This makes it difficult to make informed conservation decisions on the subject. This project, in partnership with Michelle Garneau's laboratory at UQAM, is part of the MELCCFP Green Economy Plan. Using a methodology aimed at quantifying carbon reservoirs in different wetlands, the MELCCFP will supervise multiple inventory stations in 2023 across different sectors, including Kenauk. The objective of the project is to collect data from soil and above-ground biomass in several wetlands spread across the south of the province. The data collected will be used to design a map of carbon reservoirs in southern Quebec which will, ultimately, be accessible to the public and a useful tool for conservation efforts.



Status: Data collection and analysis will continue in 2024.

13. Survey of Wild Honeybee Populations Project (#2022-2.1)

Institution: Collectif Apicole Apicentris

Researchers: Daniel Hamelin, Vincent Bouhéret (Apicentris)

Description: It is thought that over time, colonies of non-native honeybees have escaped from apiaries and since become wild in the forests of northeastern North America. We hypothesize that in the absence of any human intervention, these bees have evolved new behavioral and genetic characteristics to defend themselves against disease and parasites. The goals of this project are 1) to confirm the presence of wild honeybee colonies at Kenauk, 2) systematically identify them using a technique called bee tracking (Figure 14), and 3) lay the foundation for future research on the genetics of these bees. Bee tracking consists of attracting bees using a sugary bait, observing their trajectory back to their nest, and measuring the time it takes them to return to the bait. By gradually shifting operations in the bees observed trajectory you can locate the nest. In 2023, one nest was located, and one observation station was established to be used in 2024.



Figure 14. Pictures of the bee tracking technique.

14. Piliated Woodpecker Project (#2022-3.1)

Title: Development and validation of a method for protecting Pileated Woodpecker nesting cavities.

Institution: Environment and Climate Change Canada (ECCC), Comité SFI Québec (CSFIQ), Boreal Avian Modelling Project (BAM)

Researchers: Junior Tremblay (ECCC, BAM)

Description: The objective of this project is to help the industry in the protection of pileated woodpecker (*Dryocopus pileatus*) nesting cavities by establishing an approach and creating a guide to identify tree stands where they actively nest. In the spring of 2022, 37 bioacoustic loggers were deployed in conducive nesting habitats in the Outaouais, Mauricie, and Abitibi regions (10 loggers deployed at Kenauk) (Figure 15). The loggers recorded from mid-April to the end of May to cover the species' nesting period. Select recordings were then analyzed to identify pileated woodpecker calls and drumming. Sectors with significant activity were visited in the fall to locate and characterize nesting cavities. In total, 7 cavities in the Mauricie region were designated as used or potentially used and in need of protection. At Kenauk, pileated woodpecker presence was noted at 3 stations, but activity was low.



Figure 15. Picture of a bioacoustic logger and pileated woodpecker nesting cavity.

Status: Data collection and analysis will continue in 2024.

15. Invasive Eurasian Milfoil Inventory Project (#2020-5.1)

Title: Invasive Eurasian Milfoil Inventory and Removal Project.

Institution: Nature Conservancy of Canada, The Kenauk Institute

Researchers: The Kenauk Institute interns and many volunteers

Description: Eurasian milfoil (*Myriophyllum spicatum*) is an invasive aquatic plant introduced to North America in the 19th century. Today it's one of the most widespread invasive plants on the continent and brings with it a suite of negative impacts for humans and ecosystems. Milfoil invades the coastal zone of lakes, impeding swimming, water sports, water quality and biodiversity.



Figure 16. Papineau Lake; milfoil colonies in red.

Papineau Lake has been invaded by milfoil, so in an effort to protect the lake and the rest of the watershed, the invasive plant colonies were inventoried and mapped (Figure 16). In 2023, we continued our milfoil removal efforts; 6 large colonies were tarped using 24 tarps and over 1200 sandbags to cover an area of 3,612m² of milfoil, and 9 colonies were also manually removed by divers for a total of 850lbs of milfoil removed from the lake.

[Click here for project video](#)



16. Impact of Invasive Eurasian Milfoil on Fish Project (#2022-4.1)

Title: Impact of Invasive Eurasian Milfoil, *Myriophyllum spicatum*, on fish and their habitat.

Institution: Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs (MELCCFP)

Researchers: Julie Deschênes, Carolane Riopel-Leduc, Marie-Claude Gratton

Description: This is a province-wide project with the MELCCFP. Invasive Eurasian milfoil is becoming an increasingly significant issue; it is therefore important to understand how this aquatic plant affects fish communities. The goal of this project is to characterize the fish communities associated with Eurasian milfoil colonies and compare them with colonies of native aquatic plants. This project will include sampling 4 sites per lake, 2 distinct areas with at least 80% Eurasian milfoil and 2 other distinct areas with at least 80% native plants. Electrofishing and fyke nets will be used to sample fish.



Status: Data collection will continue in 2024.

17. Factors to Predict Spongy Moth Outbreaks Project (#2023-4.1)

Title: Factors to predict spongy moth reservoirs between outbreaks - historic outbreak severity and forest composition

Institution: Concordia University

Researchers: Noa Davidal, Carly Ziter, Dr. Emma Despland

Description: The spongy moth (*Lymantria dispar dispar*) is an invasive pest that can destroy trees by eating their leaves. This moth is native to Europe but is now unfortunately found across Canada. Outbreaks of this pest are cyclical, typically occurring about every seven to ten years. The most recent outbreak that peaked in 2021 was the largest on record in Ontario and Quebec. During severe outbreaks, trees and shrubs are completely defoliated over large areas; despite the trees' ability to produce a new crop of leaves over the summer, the damage causes substantial growth loss. Defoliation also makes trees more susceptible to secondary pests, drought, and poor growing conditions. Combined with compounding stressors such as climate change, defoliation can be a significant stressor on trees and forest health. Following the most recent outbreak of spongy moths, this project is investigating possible factors that may help predict spongy moth reservoirs between outbreaks. The goal of the project is to determine if forest composition data (specifically the presence of oak trees) and historical spongy moth density data can help to predict locations of spongy moth reservoirs between outbreaks.



18. Tick Inventory Project (#2019-2.1)

Title: Education about the prevention and risks of Lyme disease as well as inventorying ticks (*Ixodes scapularis*) at Kenauk.

Institution: The Kenauk Institute

Description: The objective of this project is to inform people on the preventative measures for Lyme disease, to sample *Ixodes scapularis* ticks on the property of Kenauk to monitor local risk as well as contribute to the National Lyme Disease Surveillance Program. The ticks collected are genetically tested for 6 pathogens: General Borrelia, Borrelia burgdorferi ss (lyme disease), Borrelia miyamotoi, Anaplasma phagocytophilum, Babesia microti, and Babesia odocoilei (Geneticks.ca).



Figure 17. The number of ticks genetically tested every year and the percentage of positive results for lyme disease and other pathogens such as Babesia odocoilei. Note that 2023 results are still pending.

Year	# Ticks Tested	# Ticks Tested Positive	
		Lyme Disease	Babesia odocoilei
2020	34	2 (6%)	2 (6%)
2021	268	10 (3.7%)	9 (3.4%)
2022	128	12 (9.4%)	9 (7%)

Status: Data collection will continue in 2024.

19. Papineau Lake Water Quality Monitoring Project (#2015-3.1)

Institution: The Kenauk Institute

Description: Papineau Lake is a registered lake in the Volunteer Lake Monitoring Program (VLMP) of the Government of Quebec. The Kenauk Institute will periodically take water samples throughout each summer with the goal to establish a long-term monitoring protocol for water quality with annual comparisons.

Results Summary:

- The water parameters measured annually are total phosphorus, chlorophyll a, water clarity, and organic dissolved carbon.
- Papineau Lake is classified oligotrophic; it has few to no signs of eutrophication and warrants protection. Preventative measures are needed to limit anthropogenic nutrient input.

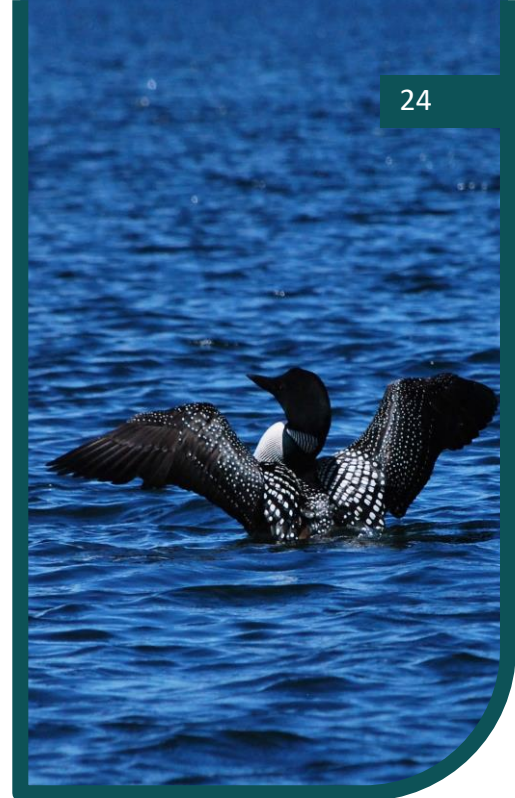
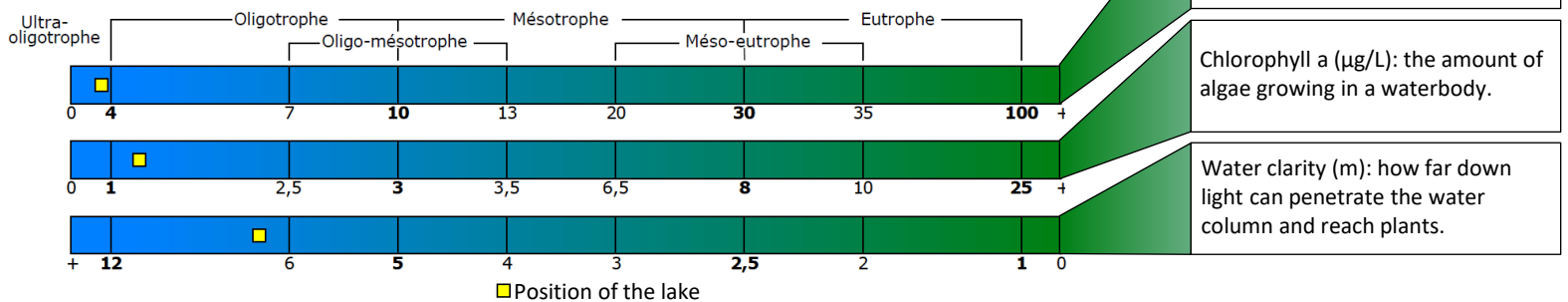


Figure 18. Water quality parameters of Papineau Lake and its corresponding trophic classification.



Total phosphorus (µg/L): a measure of all phosphorus; an excess can negatively impact waterbodies.

Chlorophyll a (µg/L): the amount of algae growing in a waterbody.

Water clarity (m): how far down light can penetrate the water column and reach plants.

20. Papineau Lake Loon Nesting Project (#2015-4.1)

Institution: The Kenauk Institute

Description: While loon populations are currently stable, many threats loom, including human encroachment and pollution. Loons select nest sites in quiet, protected areas along shorelines and often reuse the same nesting site annually which makes them particularly sensitive to boat traffic. By mapping nesting loons, we hope to monitor and protect their population. [Click here for project video](#)

Results Summary / Observations:

- 4 successful loon pairs to have chicks.
- Loon E chick survival doubtful, injured leg*.
- New loon pair observed, nest M, no chicks.

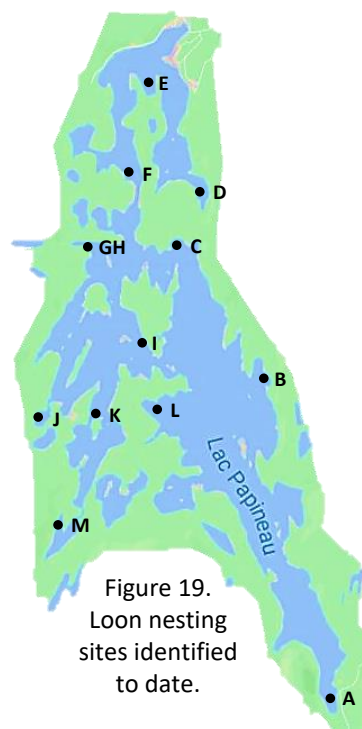


Figure 19. Loon nesting sites identified to date.

Figure 20. Loon observations 2023.

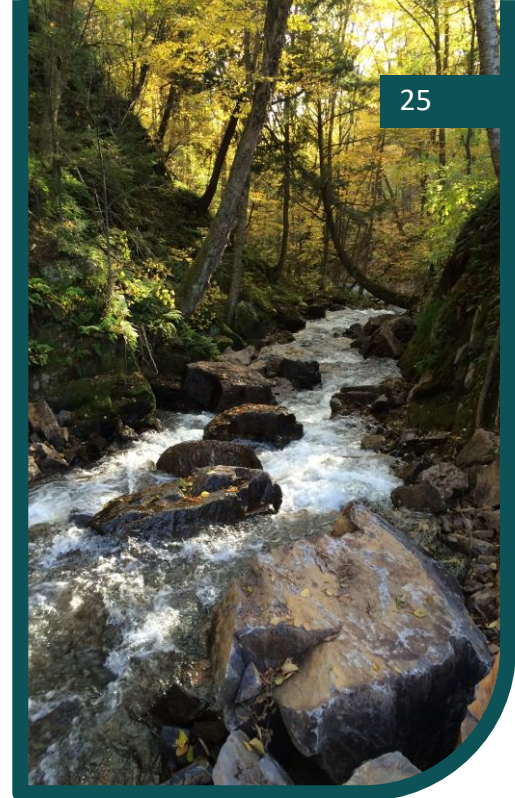
Nest ID	Loon Pair	# of Chicks
A	√	2
B	√	1
C	√	0
D	-	-
E	√	1*
F	√	2
GH	√	0
I	√	0
J	√	0
K	√	0
L	√	0
M	√	-

Status: Data collection will continue in 2024.

21. Papineau Lake Weir Monitoring Project (#2015-2.1)

Institution: The Kenauk Institute

Description: In 2015 the Papineau lake dam was converted into a weir to improve fish access and aquatic habitats. A weir is a low dam structure that can be used to increase the availability of quality habitats for fish reproduction, foraging, and spawning by facilitating fish passage while still maintaining water levels. This weir will improve the river for fish spawning and circulation in terms of ideal flow rates, water depths, oxygenation and habitat diversity. In order to monitor the Kinonge watershed, as well as the success of the weir in maintaining water levels, a probe was installed above the weir that measures water depths hourly throughout the year.



Results Summary:

Figure 21. Annual variations in water depth and water temperatures at the weir.

	2016	2017	2018	2019	2020	2021	2022
Temperature Range (°C)	1.2 – 26.8	1.3 – 25.9	1.5 – 27.8	0.9 – 27.1	0.6 – 28.3	1.6 – 28.1	X – 25.8
Variation in Depth (m)	0.66	0.53	0.49	0.95	0.70	0.97	* 0.24

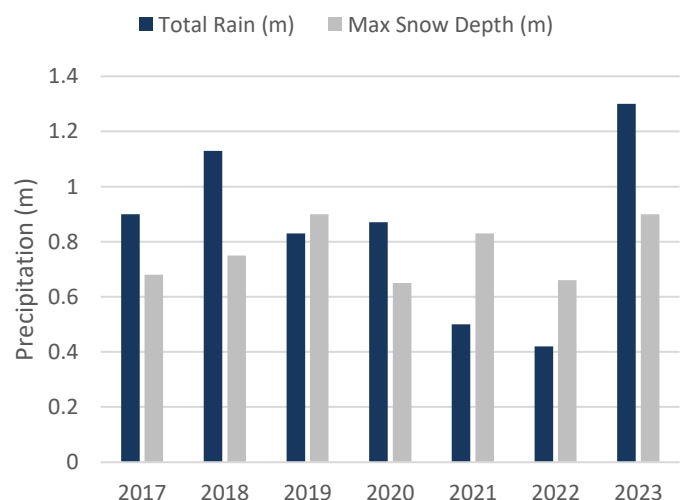
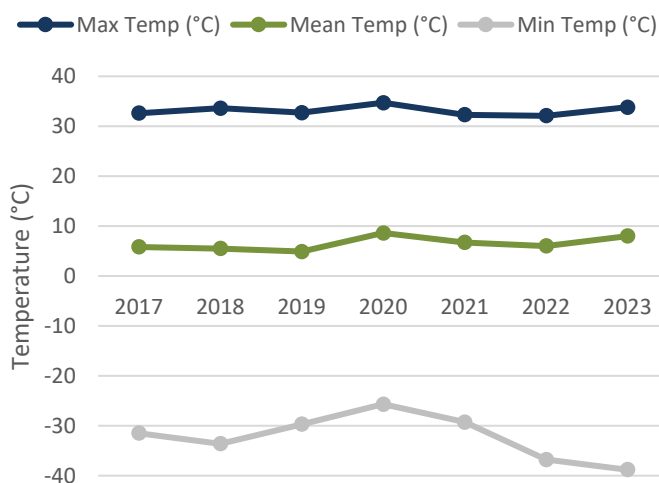
* Note data is missing from January to May 2022.

22. Weather Station Data (#2016-3.1)

Institution: Université de Québec à Montréal (UQAM), The Kenauk Institute

Description: The weather station at Whitefish Lake collects hourly data on temperature, relative humidity, net radiation, wind speed and direction, barometric pressure, rain and snow. Having property-specific data on weather factors benefits all the research projects associated with the Kenauk Institute and supports our long-term monitoring mandate.

Results Summary:



Status: Data collection will continue in 2024.

Figure 22. Annual variations in weather parameters. A note that December is missing from the 2023 data.

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