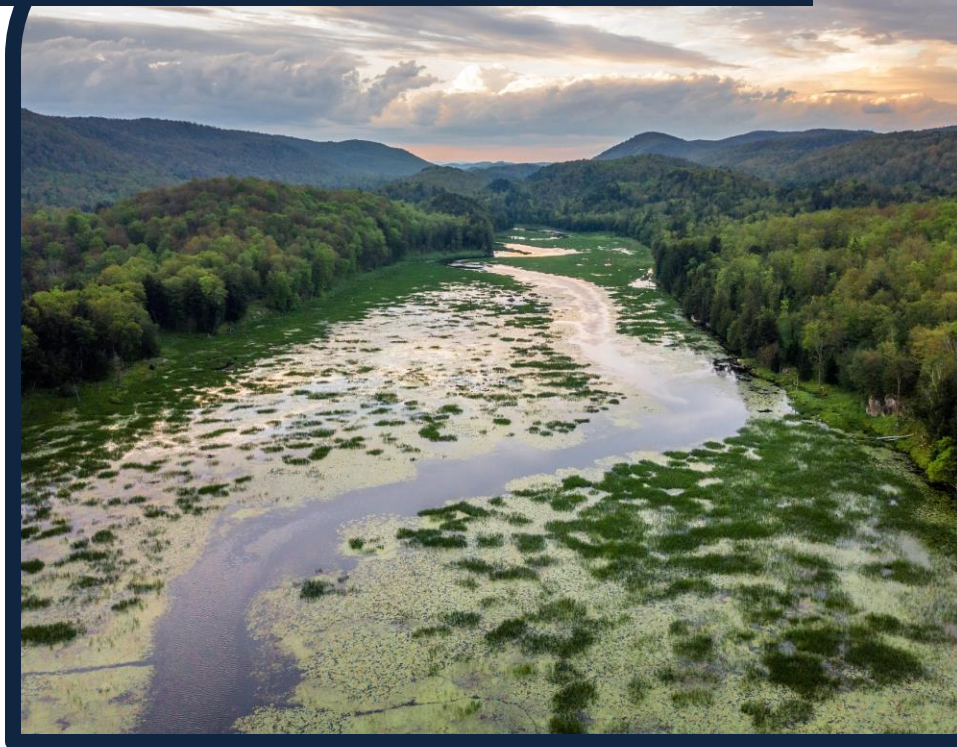




Kenauk Institute – 2022 Annual Report



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www.kenaukinstitute.org

Liane Nowell
December 31, 2022

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Executive Summary

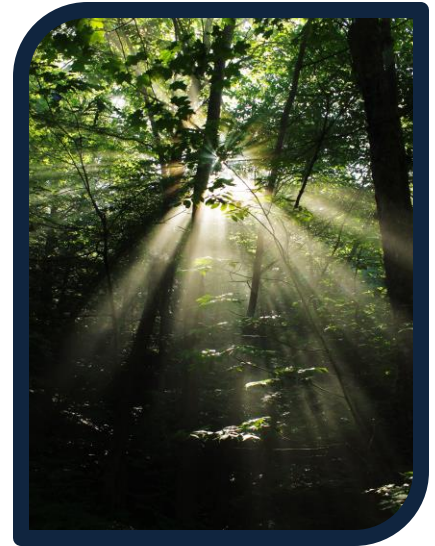
The Kenauk Institute is a charitable organization and the long-term custodian of the Kenauk property. Its mission is to: 1) Support, coordinate and supervise recreational activities and scientific research on the property and its surrounding area, 2) Promote environmental education both locally and with key partner Universities, 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 2022 we accomplished 25 successful research projects and 5 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.

The Kenauk Institute's educational programs included our internship program, junior internship program, camp Kenauk, the grade 7 program from Bishops College School (BCS) and the WILD Outside program from the Canadian Wildlife Federation. We look forward to many new collaborations in 2023 and welcoming our returning educational programs after the Covid-19 pandemic. Additionally, we have added a new educational program manager position to the Kenauk Institute structure. This position will be filled by Jessica Turgeon, one of the first graduates from our internship program who also holds masters' degrees in science and education.

The Kenauk Institute conference was another success; held on September 24th at Fairlight Chalet, it was an opportunity for sharing, learning and discovering with our unique research projects and partnerships. [CLICK HERE FOR THE CONFERENCE RECAP VIDEO](#)



Board of Directors

- Mr. Doug Harpur – Chair
- 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

Executive Director

- Liane Nowell – B.Sc., M.Sc.

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. To date, we have commitments for \$15 million of the \$20 million and hope to close the campaign by next fall.



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](#)

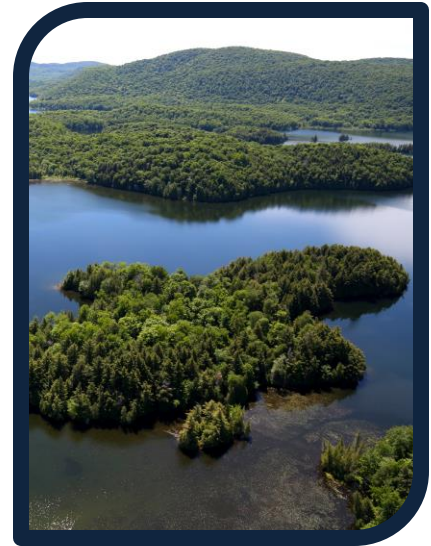


TO REGISTER FOR OUR NEWSLETTER

[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, and; Kenauk Canada ULC., the forestry operations.



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.

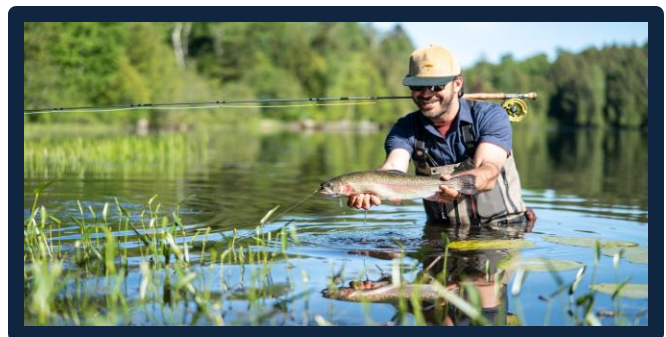
Activities include hunting and fishing, both operating with quotas under the supervision of the Kenauk Institute with the goal to promote sustainable long-term wildlife management. Many of the lakes operate catch and release fishing, while some are stocked with the fish from our own hatchery, for the benefits 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 recycle water and protect wild populations of fish, ensuring our anglers enjoy a sustainable fishing experience year-round.

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).



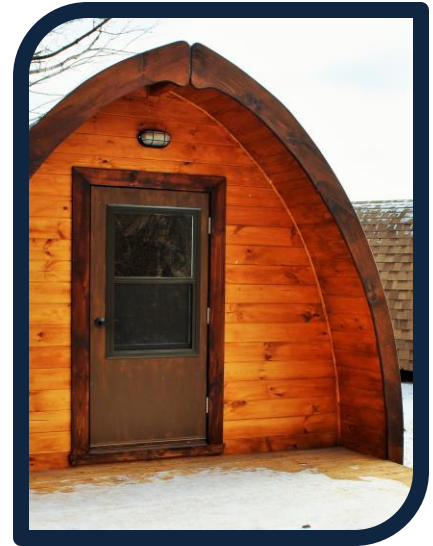
Facilities

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

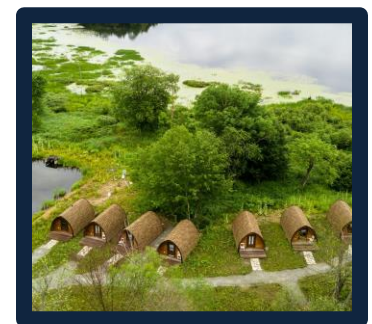
The Kenauk Institute is fortunate to have the existing Kenauk Nature L.P. outfitting facilities at our disposal. Chalets are available for rent by educational programs as well as potential in-kind contributions for research project grants such as the use of fishing boats and the marina, storage space,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

Astronomy Observatory

The completion of an astronomy observatory is targeted for summer 2023. The site will be used for star gazing and space exploration; an asset and new discovery activity for educational programs.

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.



2022 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](#)

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. Camp Kenauk

Camp Kenauk 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, sustainability, and environmental considerations. 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, guided hikes, canoeing/kayaking, wilderness survival activities and many lessons on the local flora and fauna. It is an opportunity for students to get a taste of the scientific process and learn about real career opportunities in environmental sciences.

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.



2022 Research Projects

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

University / Organization: The Nature Conservancy of Canada

Researchers: Marie-Andrée Tougas-Tellier, Joel Bonin 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.

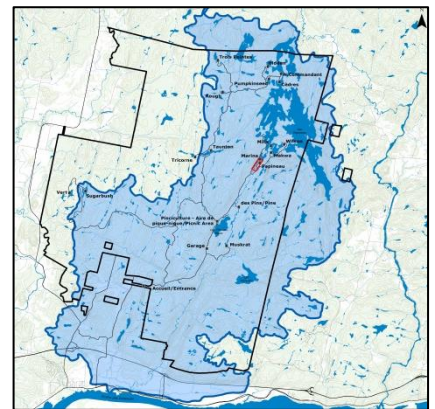


Figure 1. Kinonge watershed.

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.

Status: This inventory will continue in 2023. Extensive species lists have been created which will facilitate long term monitoring, conservation and future research.

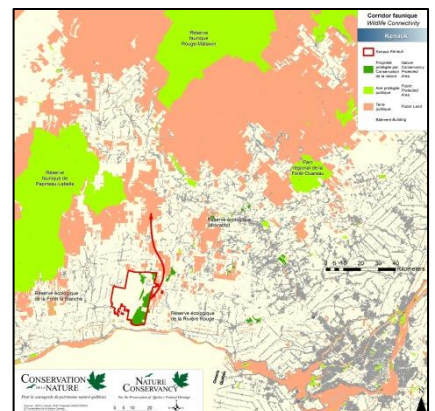


Figure 2. The wildlife corridor.

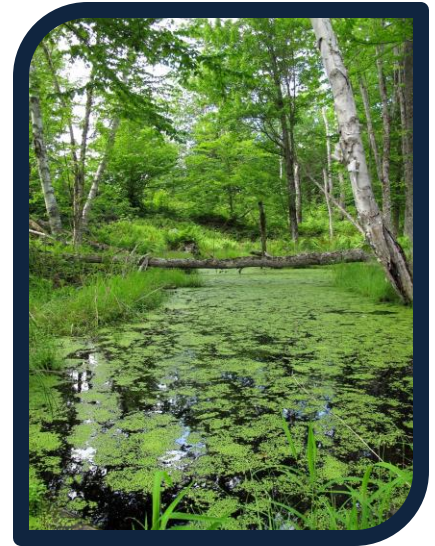
2. Vernal Pool Hydrology Project (#2016-1.2)

Title: Hydrological monitoring of vernal pools.

University / Organization: Université du Québec à Montréal (UQAM)

Researchers: Prof. Marie Larocque and Marjolaine Roux (UQAM)

Description: Vernal pools are geographically, and hydrologically isolated wetlands commonly found in temperate forests. They fill at their maximum in the spring following snowmelt and experience dry periods during the summer, which affects the composition and reproduction of amphibians. However, despite their ecological importance, there is still very little known about these habitats. The goals of this project are 1) to gain a better understanding of the water budget of vernal pools, as well as the links between their hydroperiod and pool morphology, in order to identify the hydrological processes that regulate them; and 2) provide recommendations to decrease the impact of silviculture on vernal pools. For this project, 41 vernal ponds were morphologically characterized and hydrologically monitored to better understand the hydrological processes controlling their hydroperiod and to develop hydrological models used to simulate climate change scenarios.



Results Summary:

- Hydroperiods are highly variable depending on both the pool morphology and the meteorological conditions in late winter, spring, and early summer. The net precipitation from February to June as well as the maximum perimeter of each pool are significantly correlated with the hydroperiod.
- There is groundwater input in the spring and autumn and there is infiltration of surface water towards the water table in summer.
- The hydrological models have established that the water budget is influenced by precipitation, evapotranspiration, and infiltration.
- Because vernal pools are not hydrologically isolated from the local water network, conservation of the ecosystem within the immediate watershed of vernal pools is essential to preserve their integrity.

Status: Hydrological monitoring will continue in three pools to observe long-term hydrological changes. Piezometers were installed in the fall of 2022 to record variations in the rock water table.

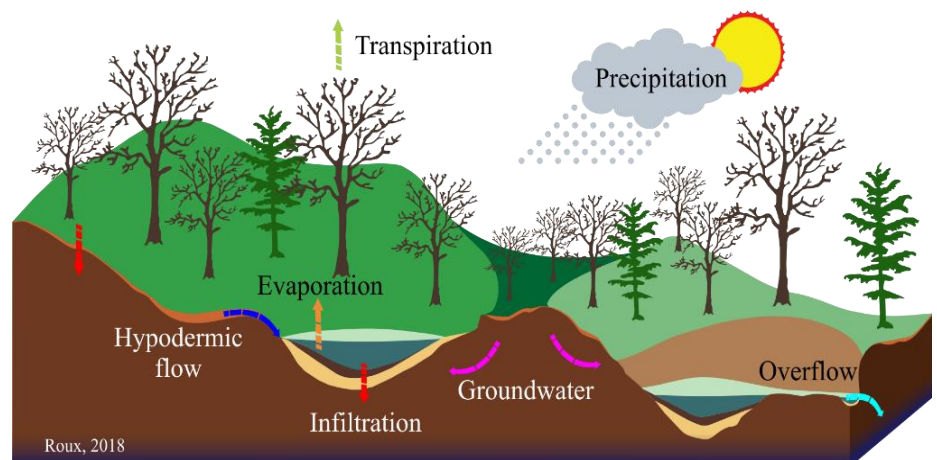


Figure 3. Conceptual vernal pool hydrological model (Roux, 2018).

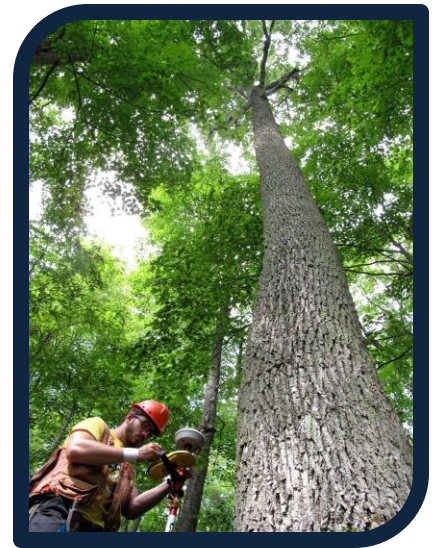
3. Tree Growth and Productivity Project (#2016-1.3)

Title: Effects of even-aged vs uneven-aged silviculture on tree growth and forest productivity.

University / Organization: Université de Québec à Montréal (UQAM), Université de Québec en Outaouais (UQO) and Centre d’Enseignement et de Recherche en Foresterie (CERFO)

Researchers: Philippe Nolet (UQO), Guy Lessard (CERFO), Dr. Christian Messier (UQO/UQAM)

Description: The aim of this project includes assessing the effects of even vs. uneven forestry approaches compared to unmanaged stands on: 1) forest productivity and regeneration; 2) floristic and soil biodiversity; 3) verify whether forest productivity and regeneration (Obj. 1) is related to floristic and soil biodiversity (Obj. 2); and 4) identify the advantages of each approach in terms of forest resilience to global change. This project will contribute to the permanent sample plot network at Kenauk. Each plot provides detailed information on the various parameters identified in Objectives 1 and 2. Specifically, forest productivity will be assessed through growth ring analyses and resilience through an evaluation of functional diversity and tolerance to drought (the most important risk related to climate change) of seedlings found in the sample plots.



Results Summary:

- 150 plots (in 50 sites) were sampled for tree, shrub and plant diversity, structure and composition. The 50 sites were distributed amongst old growth, even and uneven forests.
- **Trees:** Differences in tree species dispersion, abundance and composition, but not richness, was found between all forest types.
- **Plants:** Many important plant species are affected by forestry; some do not recover (30+) years after forestry. Species richness and abundance is highest in old growth forests.

Figure 4. A) Even-aged forestry; strip or clear cutting. B) Uneven-aged forestry; selective cutting.

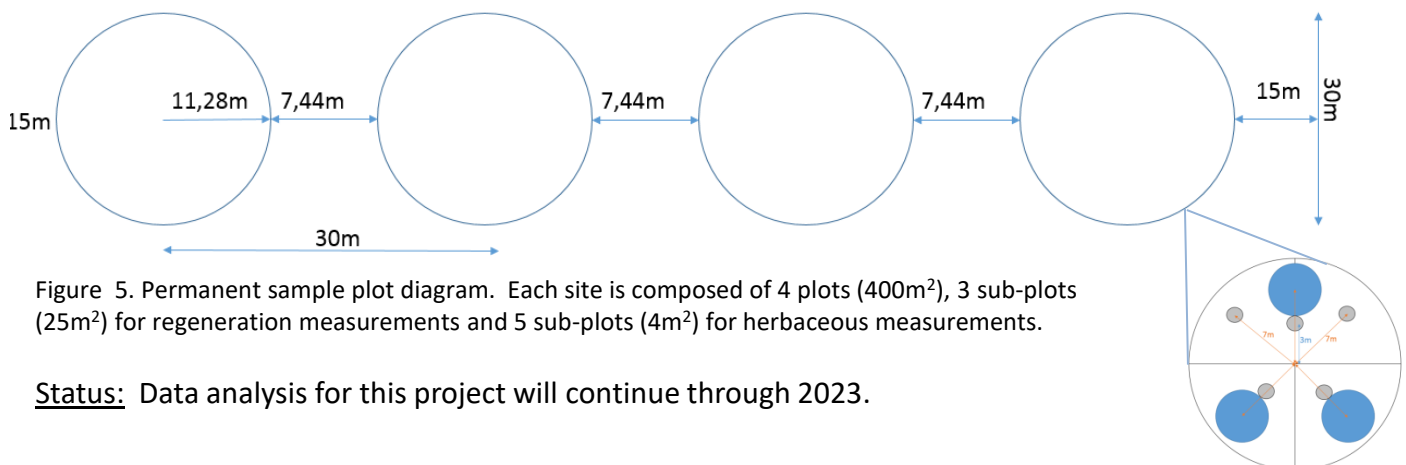


Figure 5. Permanent sample plot diagram. Each site is composed of 4 plots (400m²), 3 sub-plots (25m²) for regeneration measurements and 5 sub-plots (4m²) for herbaceous measurements.

Status: Data analysis for this project will continue through 2023.

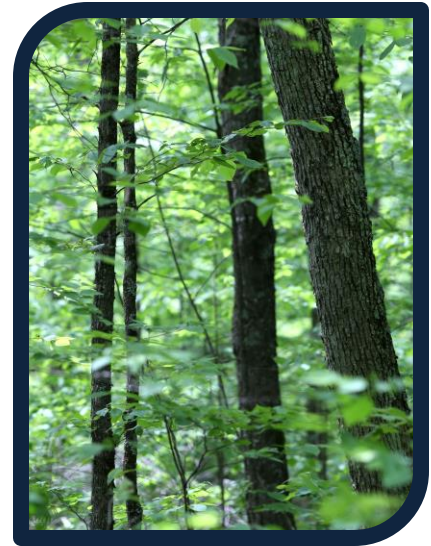
4. Beech Tree Invasion and Maple Stands Project (#2020-3.1)

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

University / Organization: Université du Québec en Outaouais (UQO), Ministère des Forêts, de la Faune et des Parcs du Québec

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

Description: In southern Quebec, the temperate forest faces 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 land LiDAR and aerial LiDAR. Managers will thus be able to better take this issue into account in forest planning. Second, the project will study the effect 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.



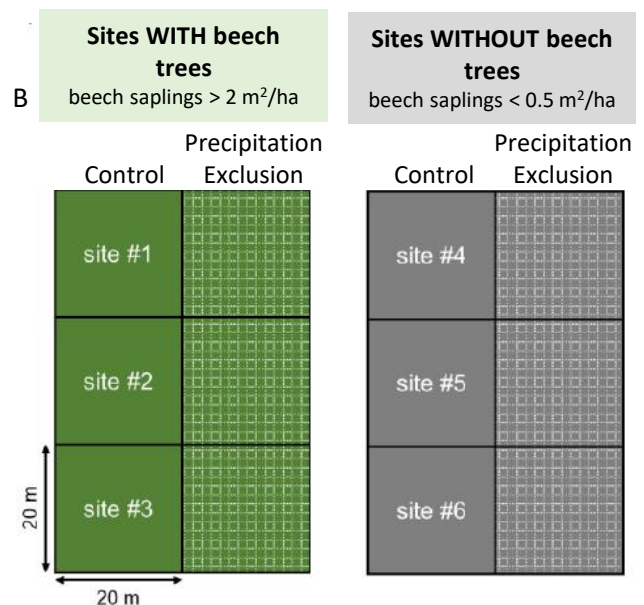
Results Summary:

- 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 6).
- Also collected was soil nutrients, soil samples, sap flow, canopy leaf samples, tree cores, and LiDAR.

Status: Data collection will continue in 2023.



Figure 6. A) Photo of the precipitation exclusion device. B) Experimental design of sites with and without beech proliferation and with and without precipitation exclusion.



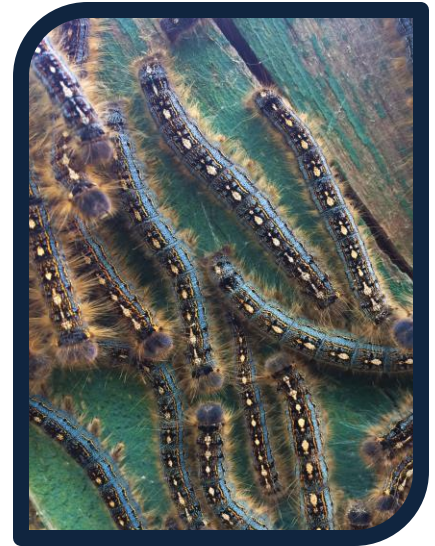
5. Herbivore Damage Patterns Project (#2021-44.1)

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

University / Organization: Concordia University

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

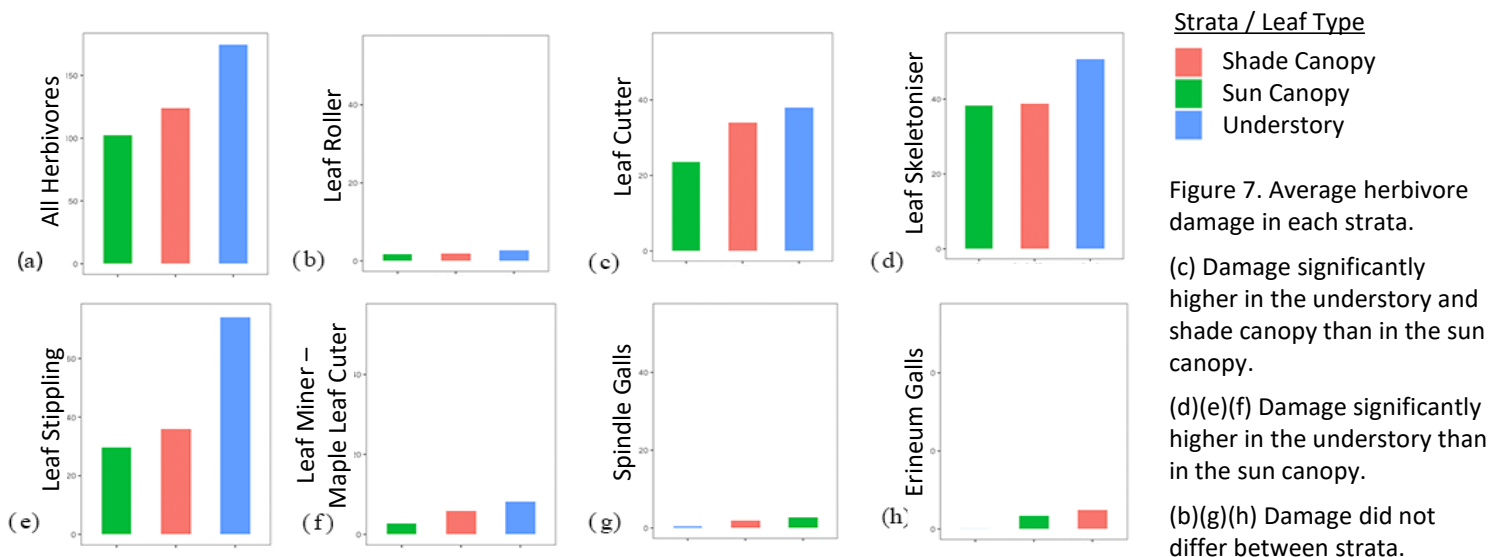
Description: Insect herbivores have long been recognized as important drivers of forest ecosystems by damaging leaves, weakening, or even killing trees and decreasing forest productivity. Sugar maple (*Acer saccharum*) forests in Quebec are declining. First, this project will evaluate the extent to which herbivores may contribute to this decline and second to document insect biodiversity supported by maples that could be threatened by this decline. The distribution of herbivorous insects in forests is expected to vary due to different biotic and abiotic factors associated with forest structure. One important but poorly studied aspect of structural diversity of temperate forests is the vertical gradient which provides several microhabitats with different levels of light, temperature, humidity, leaf quality and predator activity. Therefore, the objectives of this project are: 1) determine if vertical stratification affects herbivory, 2) understand how this stratification effect 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 decreased moving up the vertical gradient from the understory to the shade canopy and sun canopy. Individual herbivore damage per strata can be seen in Figure 7.
- Moving from the understory to the sun canopy, light intensity and leaf thickness increased, making leaves harder for herbivores to feed on; variation in leaf traits (a bottom-up force on herbivory).

Status: Sampling and data analysis for this project will continue through 2023.



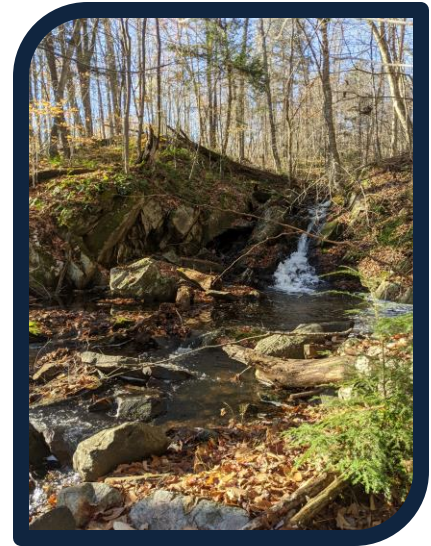
6. Connectivity of Ecosystems Project (#2021-1.1)

Title: Connectivity of forest lotic ecosystems

University / Organization: Université du Québec à Montréal (UQAM), Université du Québec en Outaouais (UQO), Institut national de recherche scientifique (INRS-ETE) and 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)

Description: The goal is to understand how hydrological and structural connectivity, biodiversity and the functioning of lotic ecosystems in the temperate forest 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 this 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 9).
- Thermographs to record water temperatures have been installed in all rivers (Figure 8).
- All watersheds have been equipped with piezometers to monitor groundwater levels.
- Meteorological stations have been installed near the limnimetric water level stations (Figure 9).

Status: Hydrological modeling started in the winter of 2022. Hydrometeorological monitoring will continue throughout the duration of the project. The component of the project targeting biological indicators of connectivity will begin in the spring of 2023.

Figure 8. A diagram of the equipment installed for each hydrometric station.

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

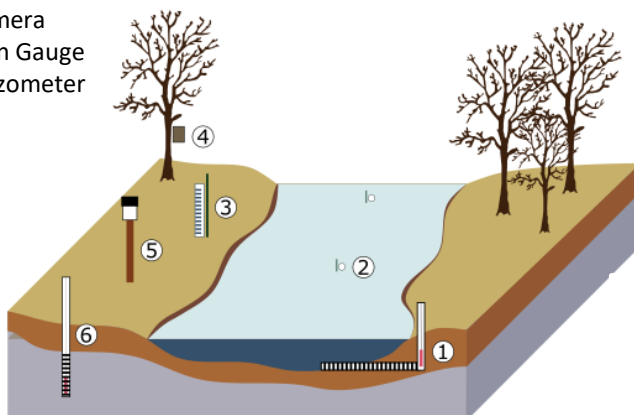
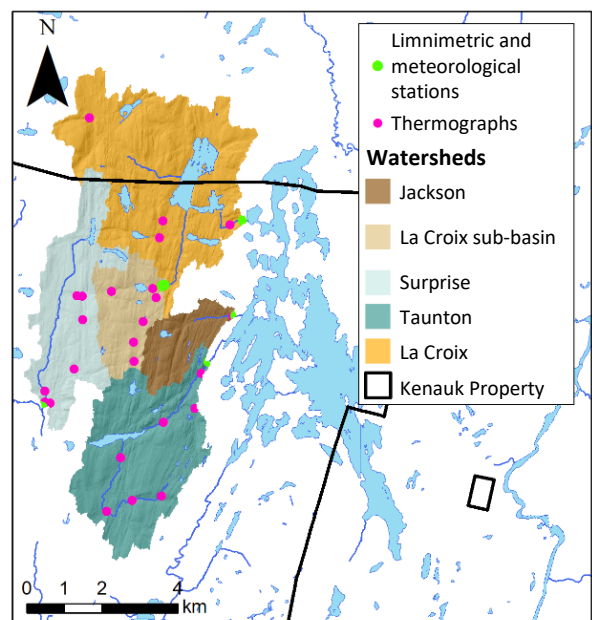


Figure 9. A map of the 5 watersheds being monitored for the project.



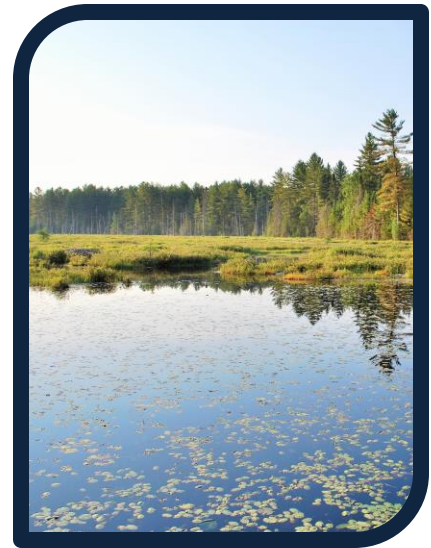
7. Papineau Lake Hydrology Project (#2016-2.1)

Title: Dynamics and long-term resilience of a lake and its wetlands.

University / Organization: Université de Québec à Montréal (UQAM), Université de Québec à Trois Rivières (UQTR), Montreal Botanical Gardens (IRBV), The Nature Conservancy of Canada (NCC), The Ouranos Consortium

Researchers: Prof. Marie Larocque (UQAM), Prof. Raphaël Proulx (UQTR), Prof. Stéphanie Pellerin (IRBV), and countless students

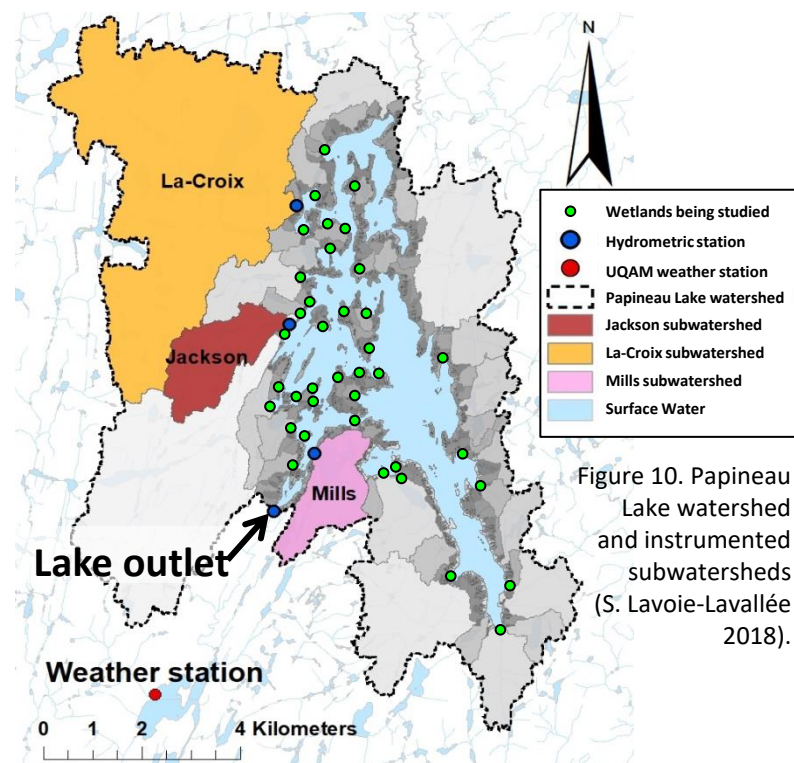
Description: The goal of this project is to understand the hydrologic dynamics of Papineau Lake and how those dynamics are related to shoreline wetlands using three specific objectives. 1) Establish a monitoring network and hydrological alert system around Papineau Lake (Figure 10). Quantifying the lake's hydrodynamics will allow an estimation of how the lake will be affected in the long-term by land use changes and climate change. Probes that measure water levels and inflow/outflow volumes were installed throughout the lake for long-term monitoring as well as a weather station. A hydrological model is also being developed to understand the processes regulating the lake's hydrology and the watershed but also to simulate the impacts of future scenarios, such as climate change. 2) Locate and characterize the lake's shoreline wetlands and identify the anthropogenic pressures they face. Indicator species, species at risk and insect bioacoustic signatures will be identified in these areas so as to designate them as protection zones. The natural and anthropogenic pressures these wetlands face will be identified, with a specific focus on shoreline thermal regimes and shoreline erosion by waves. 3) Create a list of recommendations to prevent / mitigate the negative effects of these pressures on the wetlands of Papineau Lake. An eco-nautical map of Papineau showing areas of specific concern will be created along with a set of regulations to help reinforce the conservation of the entire lake and watershed.



Results Summary:

- The quantification of the lake's water budget has established that groundwater contributes 5% of the lake.
- Climate change scenarios indicate significant increases in temperature and precipitation that will induce spring floods and a slight increase (+10 cm) in the winter levels of the lake.
- Wetland resilience (37 total) to different water level change scenarios shows that peatlands and alder swamps appear more resilient while ash swamps can be greatly affected.
- Each type of wetland supports distinct ecosystem functions and services and harbors rare species that may be sensitive to hydrological changes.

Status: This project is now complete.



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

Title: Towards sustainable recreational fisheries on Papineau Lake

University / Organization: Carleton University, University of Waterloo, University of Vermont, University of Illinois 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 (U of Illinois), 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, rainbow trout and black bass in Papineau Lake. This project will provide the data and tools to identify sustainable conservation strategies that will help ensure high quality fishing on Papineau Lake while protecting its natural assets for future generations. Five specific objectives will contribute to this goal. 1) Identify the life history characteristics for lake trout specific to different sub-populations and/or ecotypes. 2) Characterize how adult lake trout and bass use different habitats (ex. depth and thermal habitat) on a seasonal basis (ex. spawning and overwintering locations). 3) Identify the level of reproductive success for lake trout and bass. 4) Determine why most lake trout in Papineau Lake fail to attain body mass greater than ~2kg. 5) Document the level of angler effort/harvest and their preferences and opinions for different management strategies.

Results Summary:

- Tags have been implanted in 66 lake trout and 56 bass.
- 4 spawning sites have been identified in the lake.
- 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 have indicated two different life histories (slow growing and fast growing) with the youngest fish sampled being 3 years old and the oldest being 25 years old.
- Diet has indicated differences in prey types based on the basin fish were captured in and predominantly occupy (Figure 11).
- Results will be shared with community members to promote sustainable recreational fisheries management.

Status: Analysis of ageing structures, diet and spatial habitat use is ongoing.

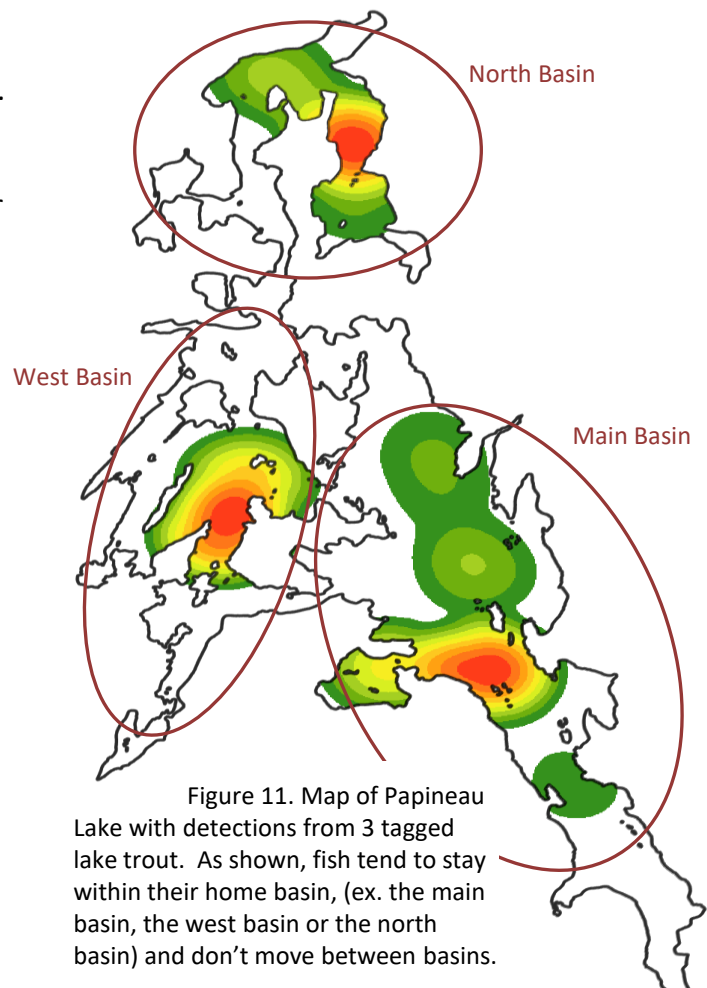


Figure 11. Map of Papineau Lake with detections from 3 tagged lake trout. As shown, fish tend to stay within their home basin, (ex. the main basin, the west basin or the north basin) and don't move between basins.

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.

University / Organization: McGill University, Le ministère des Forêts, de la Faune et des Parcs (MFFP)

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

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 roosts and hibernacula and analyze large-scale population trends for bat species across Quebec. A protocol will be developed using BatWatch, GIS, and drone-based acoustics to aid land managers who face difficult decisions when managing land use and wildlife conservation.



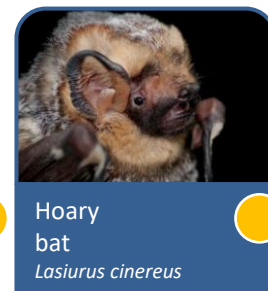
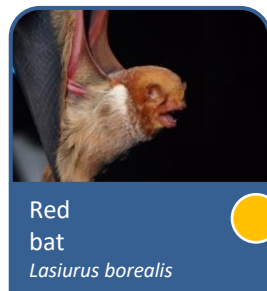
Results Summary:

- Since 2021 the MFFP and Kenauk have monitored two important summer roosts at Kenauk hosting more than 40 bats each (now registered in the BatWatch program for annual monitoring).
- The little brown bat was confirmed, one of the most-affected species by White Nose Syndrome.
- Jade Legros and Amelie Fontaine also found that bats selected 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 (urban centers & agriculture) within 2 km, suggesting bats are sensitive to disturbances before, during, and after hibernation. Overall, protecting natural habitats, especially vegetated water edges, which are good foraging grounds for bats will help bat populations recover from the White Nose Syndrome.

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](#)).

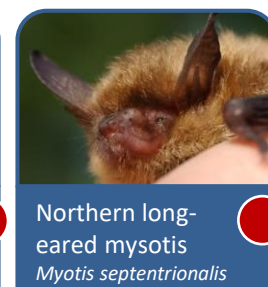
Figure 12. The eight bat species found in Quebec and their provincial status.

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.

University / Organization: Canadian Museum of Nature (CMN), Laval University

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

Description: The regular and irregular outbreaks of micro-mammals (body mass <100 grams) are a stimulating 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 micro-mammals 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.



Results Summary:

- Since 2020, 6 trapping grids with 60 live capture traps have been deployed annually.
- In 2022, 421 small mammals were captured; a clear increase compared to 231 captures in 2021.
- The capture of 3 new woodland voles at two different sites (Figure 13) confirms the presence of at least 2 populations; this species has never before been found in the Outaouais region.
- Compared to 2021, populations of red-backed voles have slightly increased, mice of the genus *Peromyscus* have increased substantially, and large shrews remain stable (Figure 14).

Status: Data collection will continue in 2023.

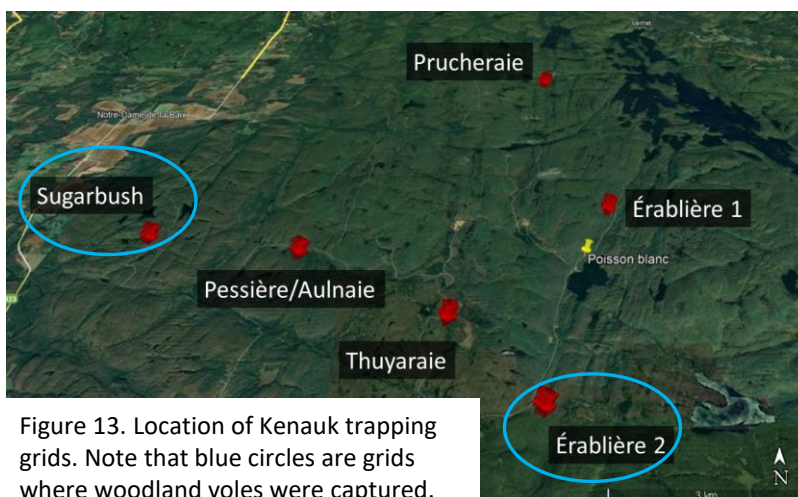
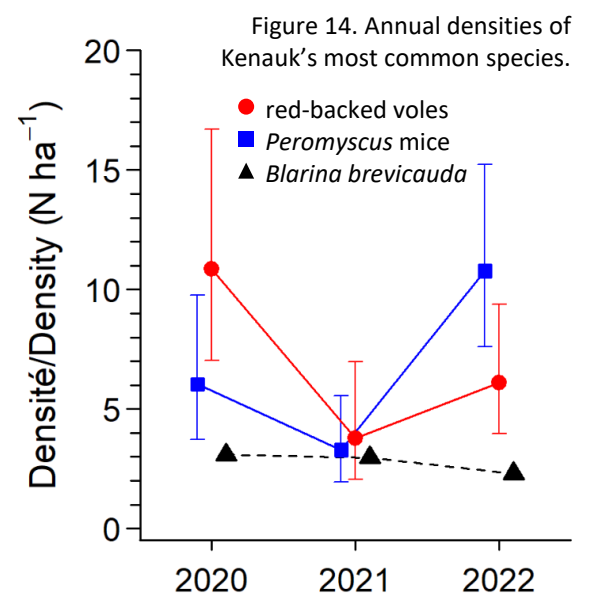


Figure 13. Location of Kenauk trapping grids. Note that blue circles are grids where woodland voles were captured.



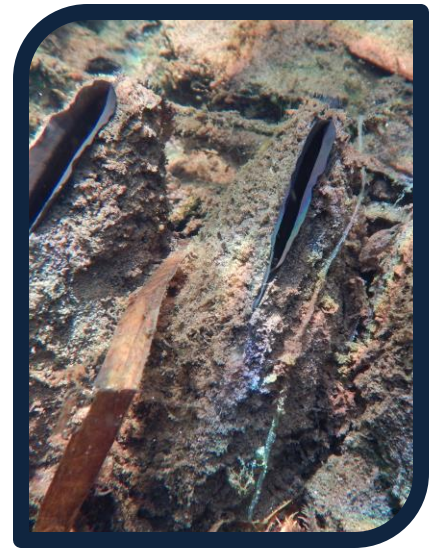
11. Mussel Inventory Project (#2018-3.1)

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

University / Organization: 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 2023.

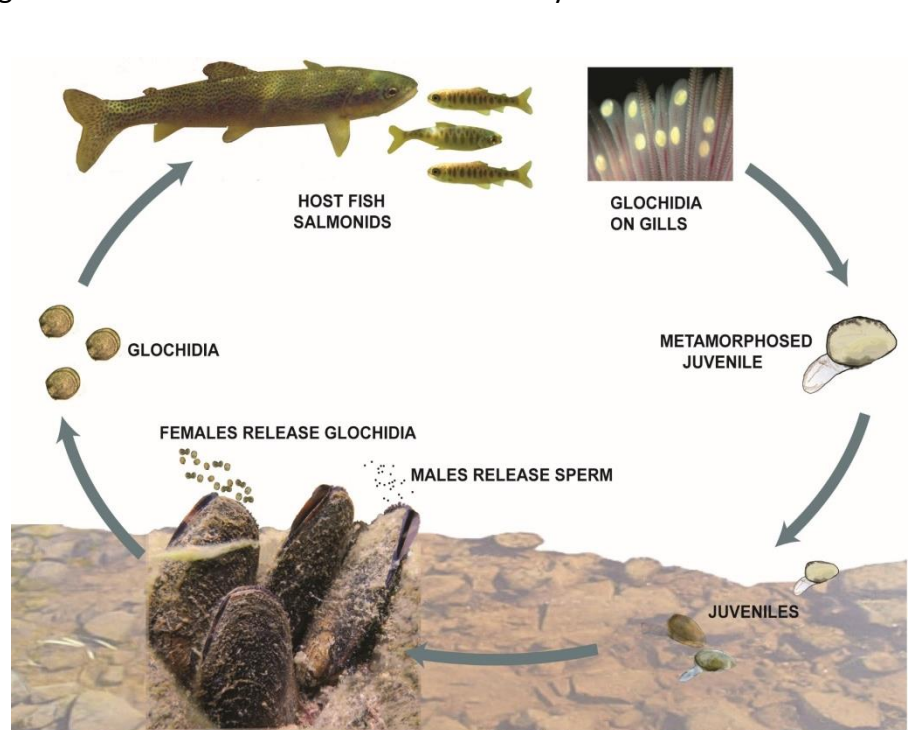


Figure 15. The life cycle of Pearlshell Mussels (Freshwater Mollusc Conservation Society). They can grow 10-13cm in length and live an average of 93 years, although the oldest Pearlshell mussel was found to be 280 years old.

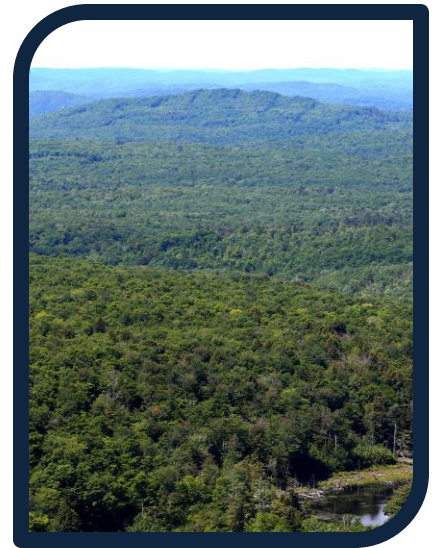
12. Carbon Reserves Through Phenology and Ontogeny in Sugar Maple Trees Project (#2021-3.1)

Title: Study of the interaction between ontology and phenology on non-structural carbohydrates in sugar maples, *Acer saccharum*.

University / Organization: Université de Québec en Outaouais (UQO), Université du Québec à Chicoutimi (UQAC)

Researchers: Prof. Sylvain Delagrange (UQO), Prof. Yann Surget Groba (UQO), Arthur Danneels (UQO), Annie Deslauriers (UQAC)

Description: We know that the development in size (ontogeny) leads to great modifications in the structure and functioning of trees. The goal of this project is to study the variation of sugar content in the tissues of sugar maple trees and its allocation to growth according to its stage of development (age) and to the season. This will allow us to broaden our understanding of carbon management in trees, the potential for maple syrup production as well as the ability of the tree to respond to stressors throughout its life (from sapling to adult). To complete this project, trees of different stages (ages) in a gradient of light conditions were tested. These trees can be found in the old forestry strip cuts present at Kenauk. Measurements included taking leaf, branch and trunk samples, approximately once a month for the next year to measure the sugar content in the different parts of the tree across the four seasons.



13. Forest carbon dynamics and wood products of Quebec (#2022-1.1)

University / Organization: Université Laval / Sciences du bois et de la forêt

Researchers: Prof. Évelyne Thiffault (U Laval) and many more

Description: The goal of this project is to compile and link empirical data from Quebec related to the dynamics of forest carbon stocks and fluxes, fluxes of other greenhouse gases (GHGs) and the radiative balance, for two major carbon reservoirs: (i) the land, which includes forest ecosystems and non-forest sites that can be forested, and (ii) wood products used in construction. The objective is to create a dashboard on forest carbon, GHGs and the impact of global warming on Quebec forests. This project represents an unprecedented concerted effort by universities and research centers in Quebec, covering a unique range of ecological (boreal, temperate), territorial (forests, peatlands, non-forest sites, urban environment) and conceptual conditions (ecosystems, wood products, real estate markets). In 2022 an inventory of aboveground and belowground carbon stocks was performed at Kenauk in forest stands with different silvicultural practices.



Status: Data analysis will continue in 2023, but otherwise these projects are complete.

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

University / Organization: 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 16), 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 2022, two observation stations were established that each identified possible nests to be tracked in 2023.



Figure 16. Pictures of the bee tracking technique.

15. Piliated Woodpecker Project (#2022-3.1)

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

University / Organization: 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 17). 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 three stations, but activity was low.

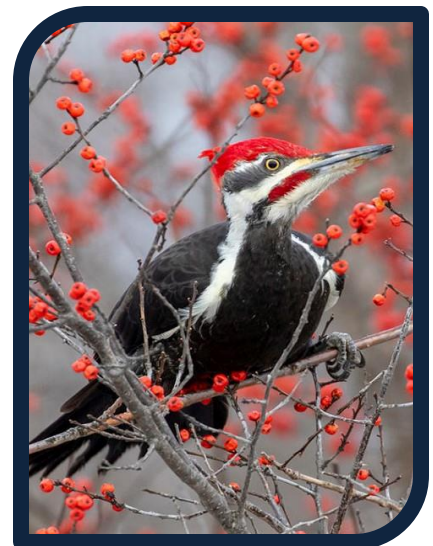


Figure 17. Picture of a bioacoustic logger and pileated woodpecker nesting cavity.

Status: Data collection and analysis will continue in 2023.

16. Milfoil Inventory Project (#2020-5.1)

Title: Invasive Eurasian Milfoil Inventory and Removal Project.

University / Organization: Nature Conservancy of Canada (NCC),
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. 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 18). In 2022 we continued our milfoil removal efforts, set buoys around major colonies, and intern Ashley Hoblyn led a project on the effects of milfoil on dissolved oxygen. [Click here for project video](#)



17. 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.

University / Organization: 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).

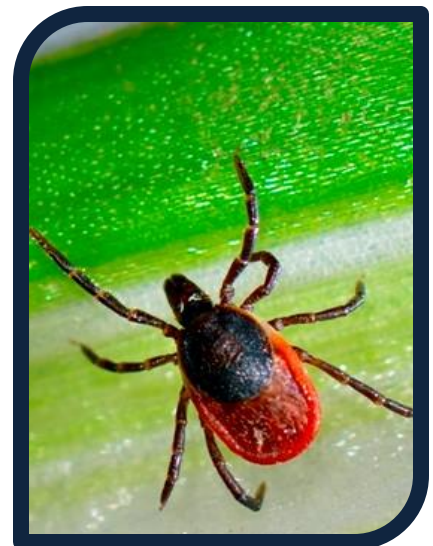


Figure 19. The number of ticks genetically tested every year and the percentage of positive results for lyme disease and other pathogens such as Babesia odocoilei. Note that 2022 numbers are lower due to sampling effort and results are still pending.

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	126	pending	pending

Status: Data collection will continue in 2023.

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

University / Organization: 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.

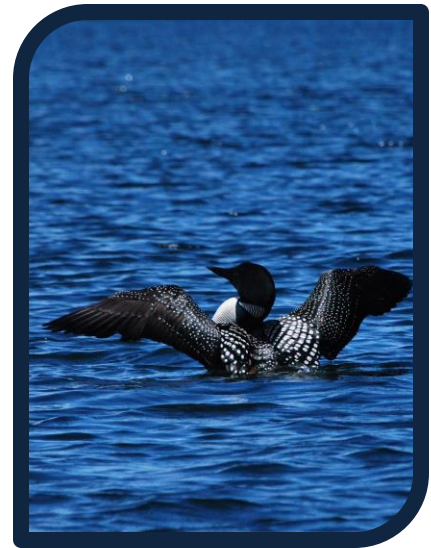
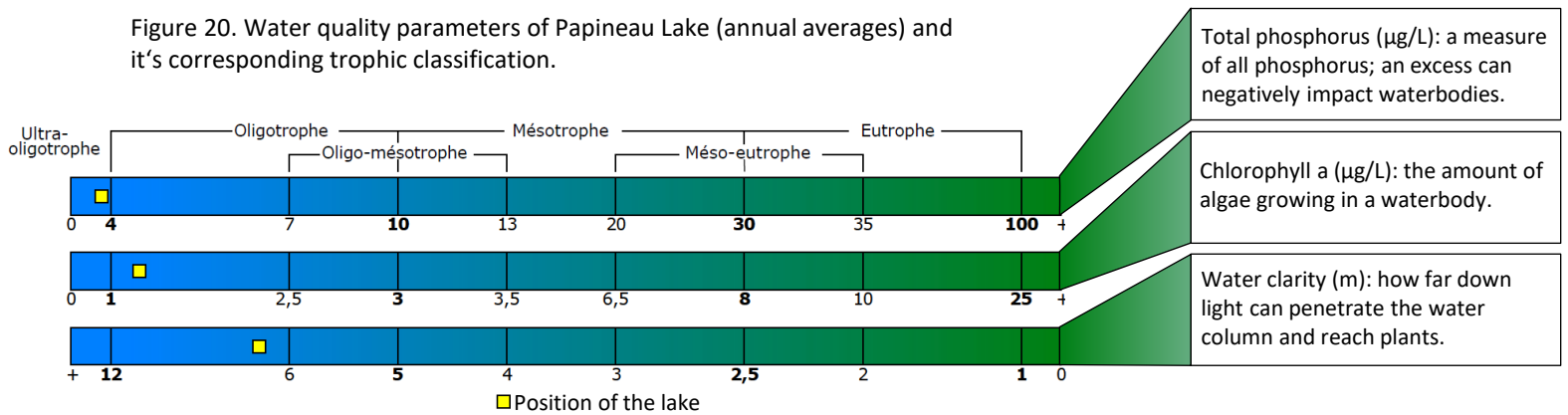


Figure 20. Water quality parameters of Papineau Lake (annual averages) and it's corresponding trophic classification.



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

University / Organization: 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:

- Only 3 successful loon pairs to have chicks.
- Loon I chick survival doubtful, hatched very late.
- Nest D & A had no loons observed all summer.

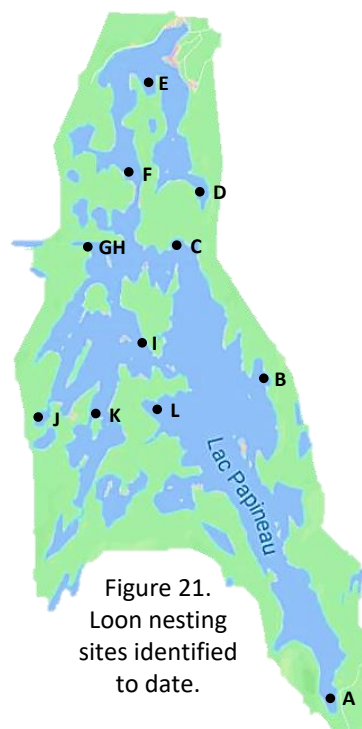


Figure 21. Loon nesting sites identified to date.

Figure 22. Loon observations 2022.

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

Status: Data collection will continue in 2023.

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

University / Organization: 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.

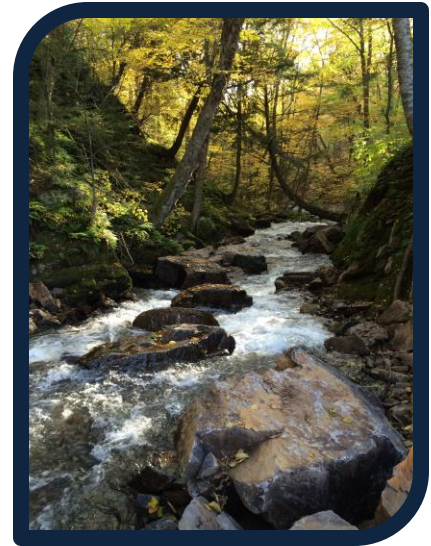


Figure 23. Annual variations in water depth and water temperatures at the weir.

Results Summary:

	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.

21. Weather Station Data (#2016-3.1)

University / Organization: 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:

	2017	2018	2019	2020	2021	2022
Max Temperature (°C)	32.6	33.6	32.7	34.7	32.3	32.1
Mean Temperature (°C)	5.80	5.45	4.92	8.62	6.69	5.99
Min Temperature (°C)	-31.5	-33.6	-29.7	-25.7	-29.3	-36.8
Max Wind Speed (m/s)	11.6	11.0	11.5	9.92	10.6	10.1
Max Rain / Day (mm)	47.5	67.1	29.2	44.7	44.5	41.4
Total Rain / Year (m)	0.90	1.13	0.83	0.87	0.50	0.42
Max Snow Depth (m)	0.68	0.75	0.90	0.65	0.83	0.66
Mean Relative Humidity (%)	76.7	75.8	74.2	72.4	73.1	73.0

Figure 24. Annual variations in weather parameters measured by the Kenauk weather station.

Status: Data collection will continue in 2023.

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