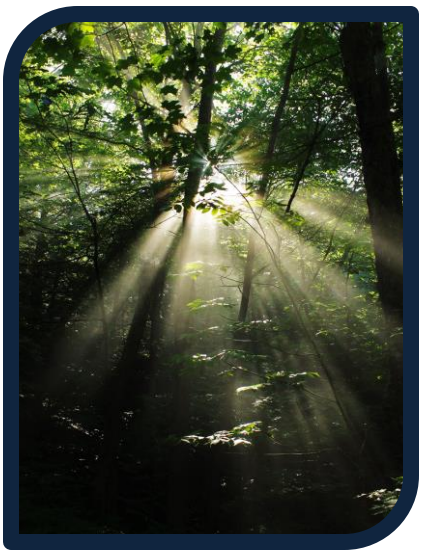
Kenauk Institute – 2018 Annual Report

1000 Chemin Kenauk
Montebello, QC, J0V 1L0
www.kenaukinstitute.org

Liane Nowell
December 31, 2018

Table of Contents

Executive Summary



The mission of The Kenauk Institute is to support, coordinate and supervise scientific research, involve local schools in environmental education, and connect Kenauk with the broader community. The vision is to establish a baseline inventory of biodiversity and monitor the property with a 100 year time horizon. With time, Kenauk will become a laboratory for monitoring climate change and human impacts.

Kenauk has proven to be an ideal location for a research institute 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 properties unique history provides endless possibilities for research and education.

Throughout 2018, The Kenauk Institute has seen a lot of progress towards becoming an established and permanent center for ecological studies that includes 24 research projects and 8 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 73 rare and endangered species being validated so far. Our researchers have found pearlshell mussels, all 8 known bat species in Quebec, 70 species of dragonflies and so much more which is all a testament to Kenauk's uniqueness. The historical and environmental significance of Papineau Lake as a pristine watershed and conservation priority continues through our hydrology and wetland research, water quality monitoring, loon surveys, and lake trout research. 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 continued to expand in 2018. Programming included the Outward Bound / YMCA group, a field trip from the Saint-Michel elementary school, Tohoku University from Japan, the ISFORT M.Sc. program, as well as our internship program. We were also happy to include a new grade 7 program from Bishops College School (BCS), professional development for science teachers as well as a junior internship program for high school students from both Westover and BCS. We look forward to many of these programs returning as well as future collaborations.

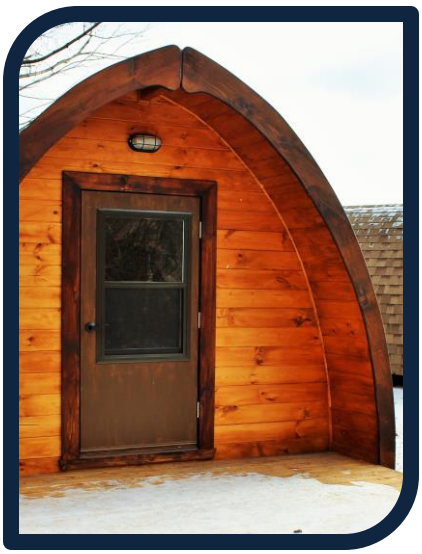
Board of Directors

- Mr. Doug Harpur – Chair
- Mr. Patrick Pichette – B.A., M.A.
- 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. Christopher Buddle – B.Sc., M.Sc., PhD

Research Coordinator

- Liane Nowell – B.Sc., M.Sc.

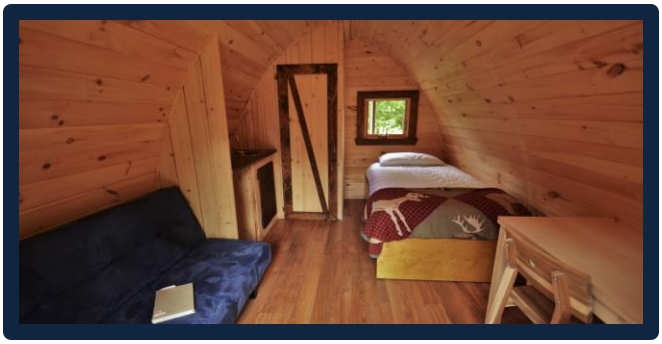
Facilities



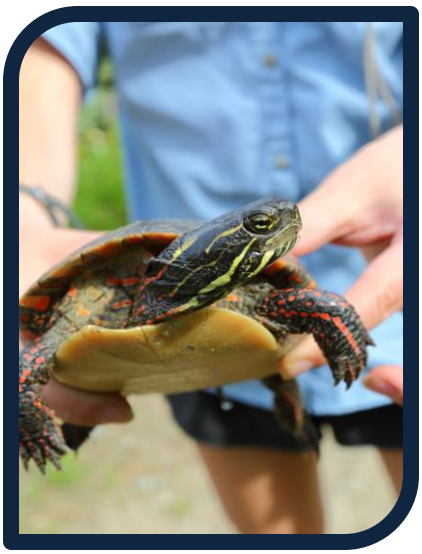
Seven pods are installed at Whitefish Lake and act as our researcher accommodations. These pods include both professor and student accommodations. The guide shack (an existing and nearby building) includes the washroom and kitchen facilities.

In the long term we hope to build a research center to act as the main building for all research activities as well as increase our researcher accommodations and expand our capacity for hosting educational programs.

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



2018 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 will serve 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. Kenauks' conservation planning will therefore include 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.

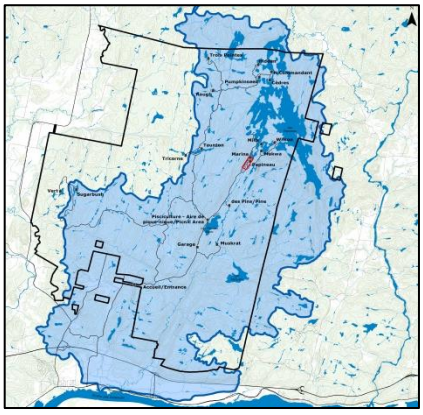


Figure 1. Kinonge watershed.

Results Summary:

- So far the presence of over 73 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 Canada warbler and the wood thrush were also identified.
- Channel darters and pearlshell mussels were also found, indicator species for the quality of the riparian environment.

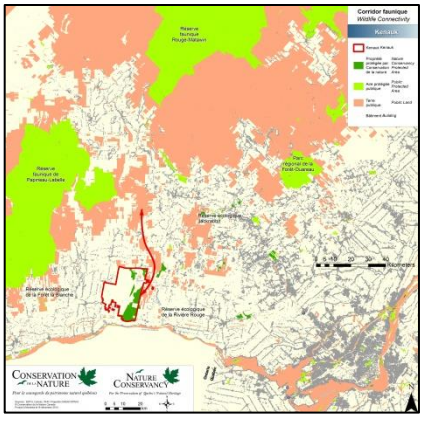


Figure 2. The wildlife corridor.

Status: This inventory will continue in 2019. Extensive species lists have been created which will facilitate long term monitoring, conservation and future research.

Forestry Projects

The first four projects fall under one overarching forestry initiative with the goal of comparing various forestry techniques (strip cutting vs. selective cutting vs. no cutting) in terms of its impact on increasing the overall resilience of the forest to global change.

2. Biodiversity Project (part 1 of forestry project) (#2016-1.1)

Title: Effects of even-aged vs uneven-aged silviculture and resulting landscape quality on biodiversity.

University / Organization: McGill University, Guelph University, and Université de Québec en Outaouais (UQO)

Researchers: Dr. Christopher Buddle, Dr. Kyle Elliot and Jessica Turgeon (McGill), Dr. Alex Smith (Guelph), Dr. Yann Surget Groba and Dr. David Rivest (UQO), Dr. Christian Messier (UQO/UQAM)

Description: Biodiversity is central to human well-being, and to the resilience and health of our ecosystems. This is especially relevant today as we face unprecedented environmental challenges, from climate change to invasive species. In north-eastern North America, forest ecosystems, such as Kenauk, harbor immense biodiversity, much of which is largely unexplored. From insect pollinators to carbon-capture, critical ecosystem functions are provided by the flora and fauna which inhabit Kenauk. As we adapt to changing environments, and prepare for the future, benchmarking this biodiversity is essential, as is studying the ways this biodiversity is best maintained and conserved for future generations. This research focuses on quantifying how the biodiversity of flora and fauna at Kenauk has adapted to past harvesting (ie. strip cutting) and is positioned for future changes in the forest. The focal study organisms for the first phase of this research will include arthropods (insects and spiders) living from the forest floor to the canopy.

Results Summary:

- Beetle/spider diversity and community structure respond to forest height differences but not forest management.
- Forest management and vertical stratification are connected through canopy cover (effects on diversity and community structure) and canopy removal (eliminates unique arthropod communities in this stratum).
- Canopies are a reservoir of diversity and an important component of sampling.

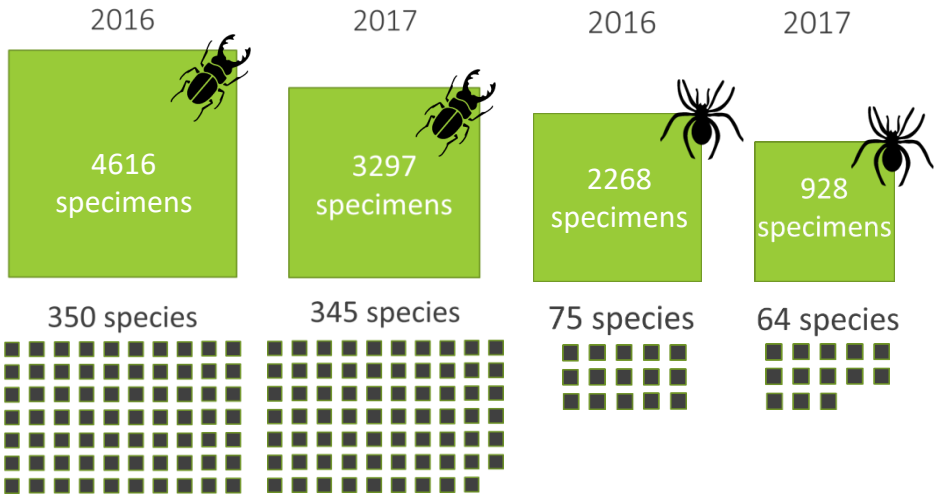
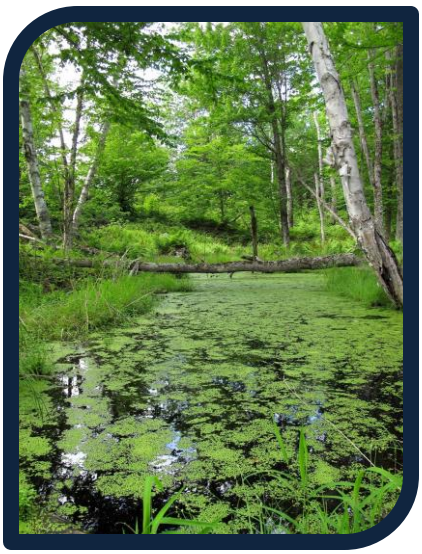


Figure 3. Spiders and beetles collected. Objective 1) determine the effect of forest management age on arthropod communities (2016) and objective 2) determine the effect of forest management type on those same communities (2017).

Status: This project is complete.

3. Vernal Pool Hydrology and Herpetology Project (part 2 of forestry project) (#2016-1.2)



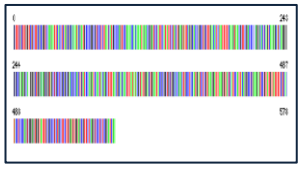
Title: Effects of even-aged vs uneven-aged silviculture and landscape quality on the hydrology and biodiversity of vernal pools.

University / Organization: Université du Québec à Montréal (UQAM) and Université du Québec en Outaouais (UQO)

Researchers: Prof. Marie Larocque and student Marjolaine Roux (UQAM) (sub-project 1), Dr. Philippe Nolet and Yann Surget Groba (UQO) (sub-project 2)

Description: Vernal pools are geographically and hydrologically isolated wetlands commonly found in temperate forests of northeastern North America. They fill at their maximum in the spring following snowmelt and become completely dry during the summer; this hydroperiod affects faunal composition and reproduction. Vernal pools consist of very rich ecosystems and are essential to the life cycle of many organisms. Despite their ecological importance, there is still very little known about these habitats. In order to accomplish this project, it has been divided into multiple sub-projects: 1) gain a better understanding of the water budget of forest vernal pools, as well as the links between their hydroperiod and pool morphology, in order to identify the hydrological processes that regulate them; 2) evaluate the impact of even-aged and uneven-aged silvicuture on vernal pool herpetofauna diversity, abundance and connectivity; and 3) provide recommendations to decrease the impact of silviculture on vernal pools and their associated herpetofauna. For sub-project 1 sixteen vernal pools in the Kenauk Nature reserve were identified, characterized, and have been monitored since April 2016. For sub-project 2 environmental DNA is being used to estimate herpetofauna diversity and abundance.

Figure 4. Example of DNA sequence to identify vernal pool species.



Results Summary (sub-project 1):

- Hydroperiods are highly variable depending on meteorological conditions in late winter, spring and early summer. There is groundwater input in the spring and autumn. In the summer, pool water infiltrates the water table.
- The water budget varies seasonally but is mainly 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.

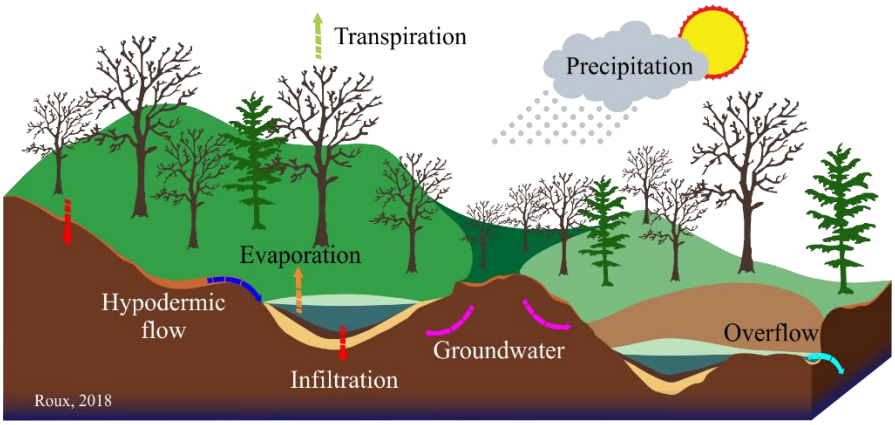


Figure 5. Conceptual vernal pool hydrological model (Roux, 2018).

Status: Hydrological monitoring and data analysis for this project will continue through 2019.

4. Tree Growth and Productivity Project (part 3 of forestry 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 will provide 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 6. A) Even-aged forestry; strip or clear cutting. B) Uneven-aged forestry; selective cutting.

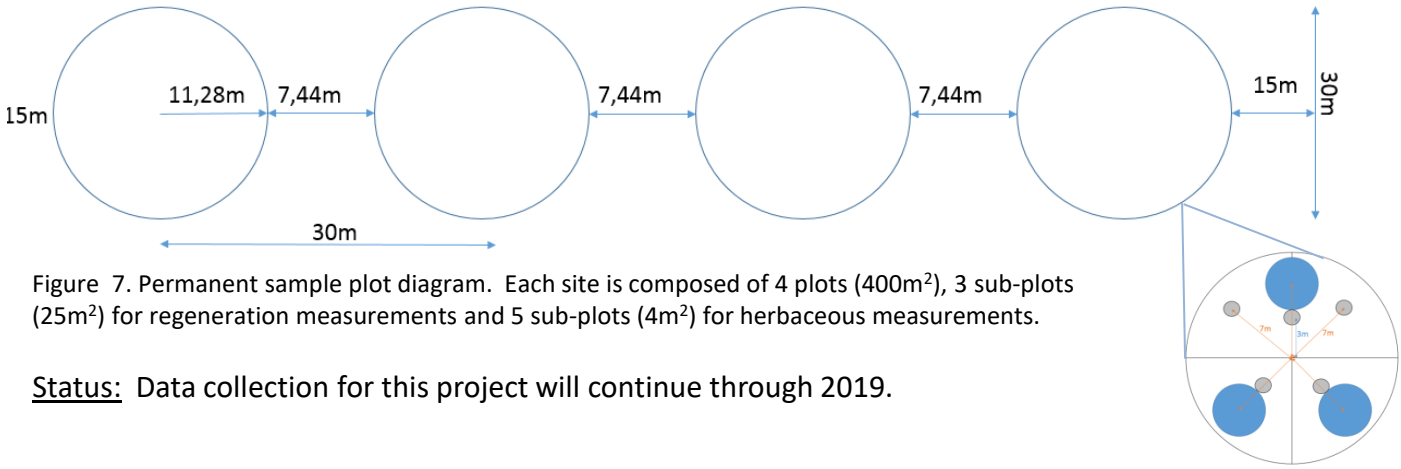


Figure 7. Permanent sample plot diagram. Each site is composed of 4 plots (400m^2), 3 sub-plots (25m^2) for regeneration measurements and 5 sub-plots (4m^2) for herbaceous measurements.

Status: Data collection for this project will continue through 2019.

5. Forest Resilience Project (part 4 of forestry project) (#2016-1.4)

Title: Determine the best management strategies that increase the overall resilience of forests to invasive pests, disease and climate change.

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

Researchers: Dr. Christian Messier (UQO/UQAM), Dr. Frédérick Doyon, Philippe Nolet and Rebeca Cordero Montoya (UQO), Guy Lessard (CERFO)

Description: Forests are increasingly being managed for a multitude of ecosystem services occurring at both the stand and landscape scales. However, these services are being threatened by rapidly changing biotic and abiotic factors such as invasive diseases, insects and climate change. For example, in the last 40 years the Kenauk forests have been invaded by dutch elm, beech bark and ash-borers which are decimating important tree species. Many more insects and diseases, already found in the north-eastern US, are also likely to move into Kenauk in the next 40 years. This is occurring simultaneously with rapidly changing climates and increasing human demands. To respond to these challenges, forest managers are required to develop new management strategies aimed at maintaining or increasing the overall resilience of the forest to sustain their vital ecosystem services. Based on the theory of complexity science, this project will use simulation models to evaluate the best management strategies to ensure forests will continue to provide ecosystem services at both the stand and landscape scale. To ensure an effective adaptation strategy, the following steps will be followed: 1) develop a vulnerability assessment for invasive diseases, insects and climate change; 2) plan and develop long-term scenarios using new analytical tools and models that specifically acknowledge the prevalence of highly uncertain social, economic, climatic, and ecological conditions; and 3) test silvicultural practices that favour optimum tree species diversity with the right balance of functioning traits to ensure a high resilience to disturbances and stressors that are predicted for this region.

Results Summary:

- As per project #3, the network of permanent sample plots has been established for this project.

Status: Data collection for this project will continue through 2019.

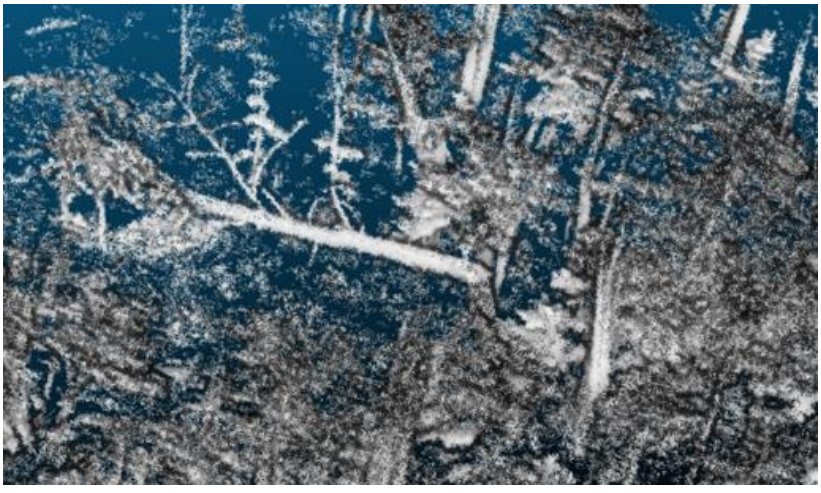


Figure 8. A diagram of the portable LiDAR (Velodyne/VPL-16) used to compare the resistance of even-aged and uneven-aged forest stands in response to environmental stressors.

6. Integrated Forestry Planning Project (#2017-1.1)

Title: Validation of an annual forest planning approach which integrates LiDAR.

University / Organization: Centre d'Enseignement et de Recherche en Foresterie de Sainte-Foy (CERFO), Kenauk Canada ULC and Les Conseillers Forestiers de L'Outaouais (LCFO)

Researchers: Guy Lessard, Gilles Joanisse, Philippe Bournival, Donald Blouin (CERFO), Pascal Audet (LCFO)

Description: This project will include the validation of an annual forest planning approach which incorporates airborne LiDAR technology. The goal is to keep forestry companies competitive using evidence-based planning while adhering to all certification and accountability requirements as well as prioritizing forest ecosystem services and regeneration. This project will compare forestry methods to promote the restoration of desired species in a profitable context. Three types of irregular progressive cuts will be studied for feasibility, conformity, resilience, sustainability, short term effects on tree type, composition, spacing and cover, effects on regeneration (notably for hardwoods), impacts on biodiversity, fauna, productivity and related costs (Figure 9).

Results Summary:

The three types of irregular progressive cuts compared in this project are (Figure 10):

- By microstand with positive (remained) tree marking
- By microstand without tree marking (operators choice)
- By permanent cover with negative tree marking

Status: Data collection for this project will continue through 2019.

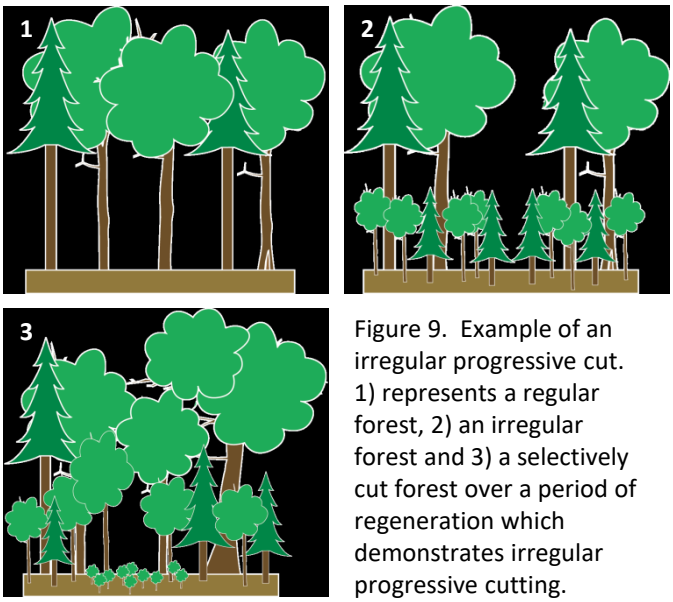


Figure 9. Example of an irregular progressive cut. 1) represents a regular forest, 2) an irregular forest and 3) a selectively cut forest over a period of regeneration which demonstrates irregular progressive cutting.

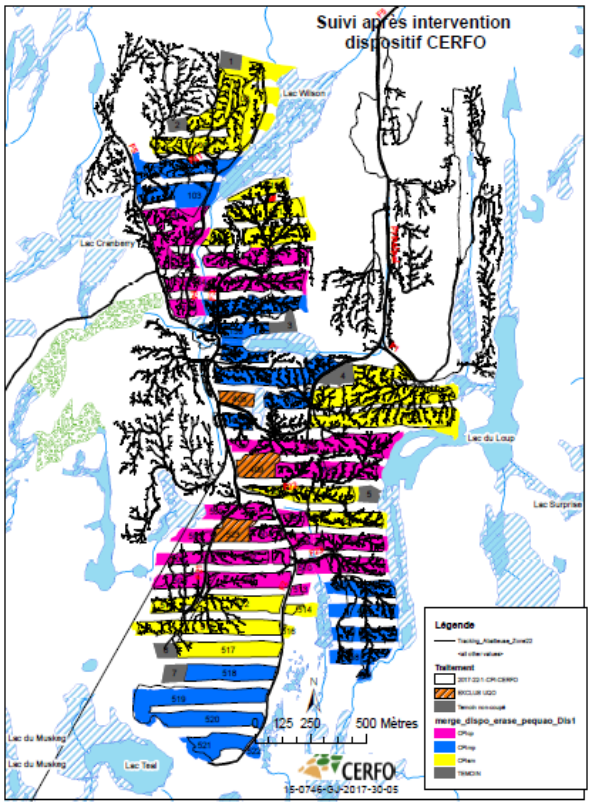
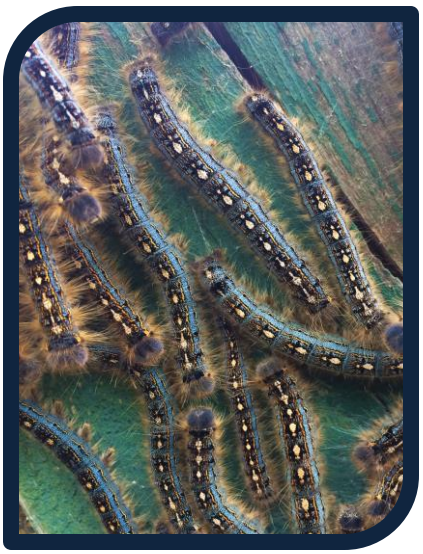


Figure 10. The three types of irregular progressive cuts.

7. Forest Tent Caterpillar Project (#2018-1.1)



Title: Interaction between forest tent caterpillars and forest composition: Role of predation in outbreak dynamics and effects on litter, soil and tree regeneration.

University / Organization: Université de Québec en Abitibi-Témiscamingue (UQAT), Université de Québec à Montreal (UQAM), and Concordia University

Researchers: Dr. B. Lafleur (UQAT), Dr. E. Despland, Dr. J.P. Lessard and Anne-Sophie Caron (Concordia), Dr. T. Handa (UQAM)

Description: The forest tent caterpillar (FTC) (*Malacosoma disstria*) is a frequent and significant defoliator of hardwood forests across Canada. Historically, severe outbreaks have occurred at ~10 year intervals and lasted 1-3 years (Figure 11). They cause a reduction in tree growth, an increase in tree mortality, a decrease in forest productivity, accelerated forest succession and influence stand composition. With the potential for increases in the frequency and severity of outbreaks from climate change, more than ever we need to understand the factors that regulate the dynamics of FTC populations and the effects of FTC outbreaks on forest ecosystems. The objectives of this project are to: 1) measure the role of predation in controlling FTC population dynamics in both the forest canopy and understory and 2) characterize the effects of FTC outbreaks on soil ecology and forest regeneration. In the long term, this project will contribute to the development of silvicultural approaches that take into account the trophic effects of FTC outbreaks.

Results Summary:

- In the first year of the project both the forest canopy and understory have been sampled for FTC predators and each sampling site has been characterized for environmental variables.
- To come are chemical analyses of leaves, the expansion of study sites to follow FTC outbreaks, parasitoid experiments at each FTC larval stage, and systematic sampling of ants and predators.

Status: Data collection for this project will continue through 2019.

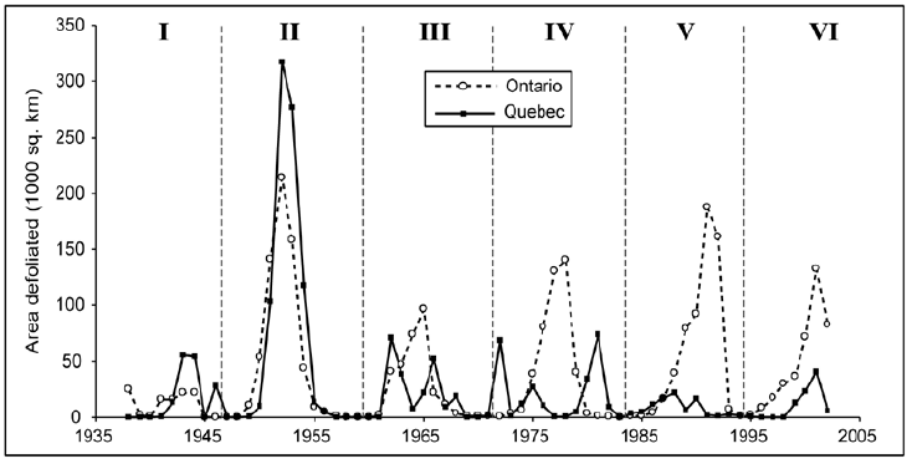


Figure 11. The distribution of FTC defoliation during six outbreak cycles in Ontario and Quebec (Cooke, Lorenzetti and Roland 2009).

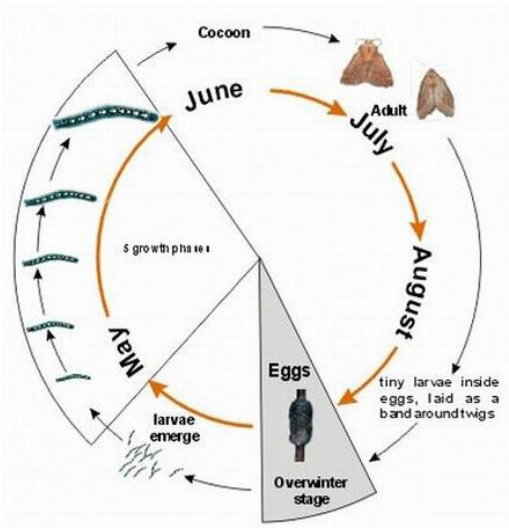
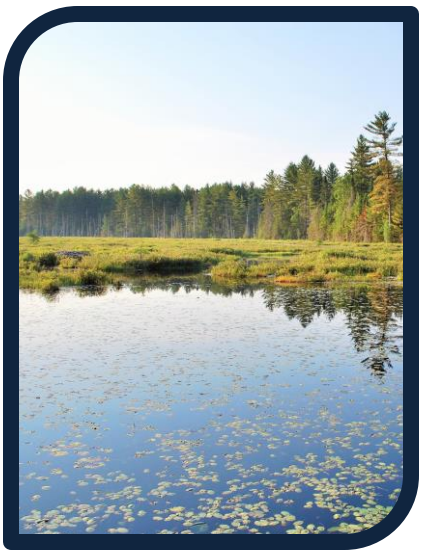


Figure 12. FTC life cycle.

8. 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: Dr. Marie Larocque (UQAM), Dr. Raphaël Proulx (UQTR), 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. Three specific objectives will contribute to this goal. 1) Establish a monitoring network and hydrological alert system around Papineau Lake (Figure 13). Quantifying the lakes 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 will be installed throughout the lake for long term monitoring as well as a weather station. This objective will also include developing a hydrological model of the watershed for simulating future scenarios, such as climate change. 2) Locate and characterize the lakes shoreline wetlands and identify the anthropogenic pressures they face. Indicator species, species at risk and insect bioacoustics 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:

- There are 4 concurrent graduate students working on 4 research aspects of this project.
- A wealth of information has been collected on Papineau Lake including lake volumes, the identification and characterization of all its wetlands (there are over 100), equipment of inflows, weather station data, lake levels, surface runoff, daily and monthly hydrological reports, equipped all the wells surrounding the lake, horizontal and vertical temperature profiles and much more. It was also validated that vegetation is the most accurate factor for determining wetland type.

Status: Data collection for this project will continue through 2019.

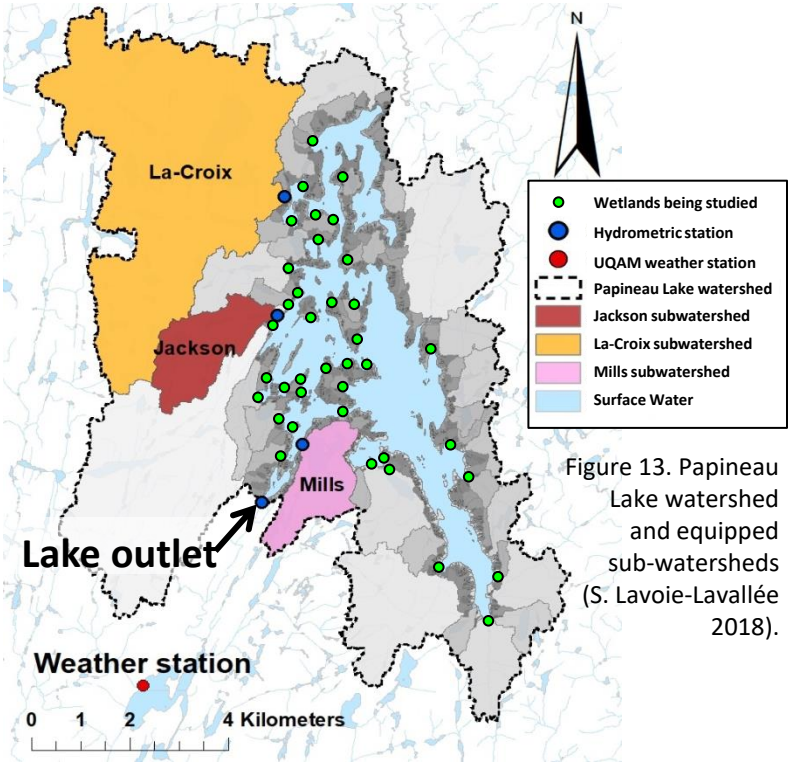


Figure 13. Papineau Lake watershed and equipped sub-watersheds (S. Lavoie-Lavallée 2018).

9. 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 and Benjamin Hlina (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:

- Acoustic telemetry is being used to record the location of individually tagged fish, including their depth and temperature. To date tags have been surgically implanted in 45 lake trout as well as 40 bass.
- Project results will be regularly shared with community members to promote the need for management strategies that support sustainable recreational fisheries.

Status: Data collection for this project will continue through 2019.

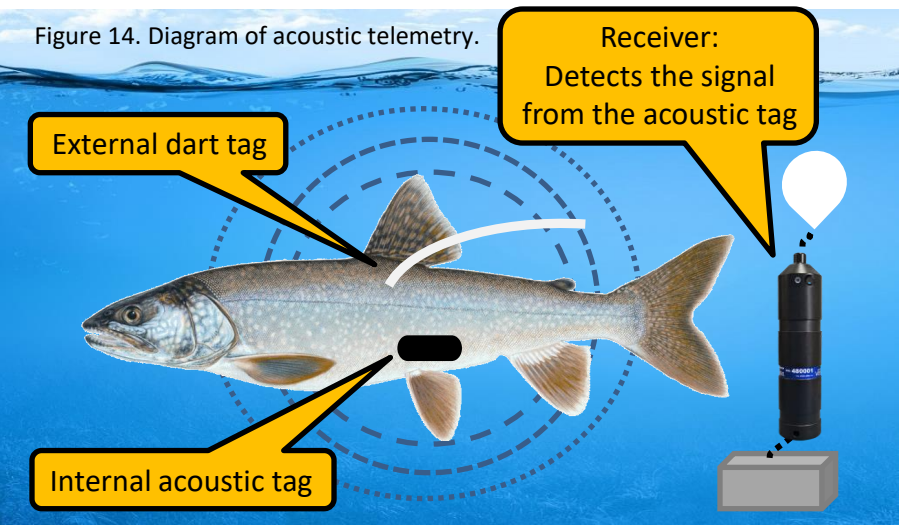
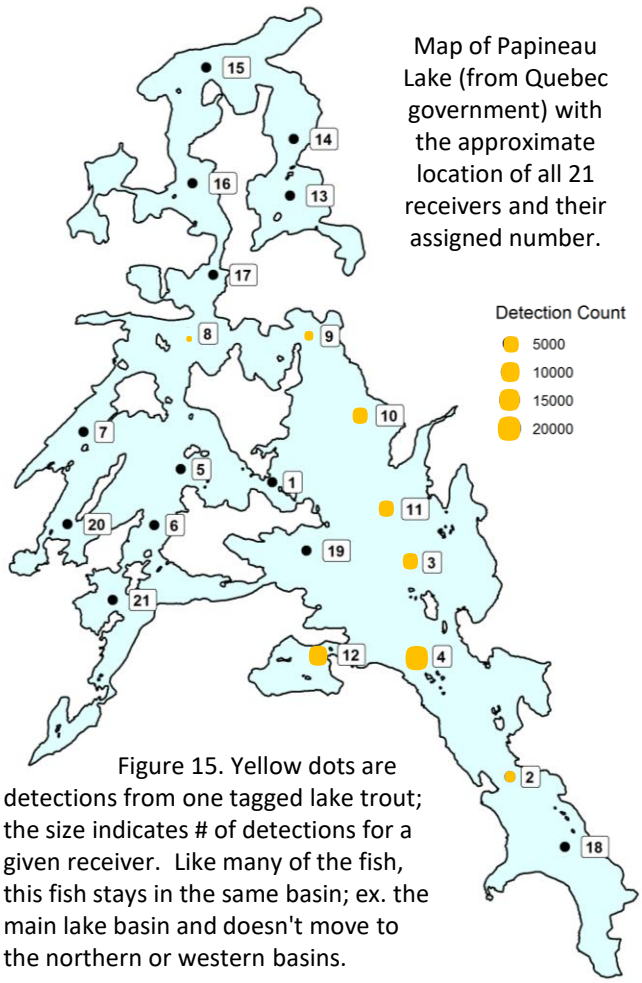


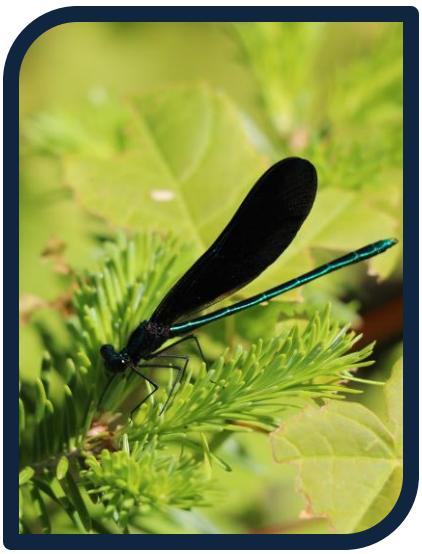
Figure 14. Diagram of acoustic telemetry.



Map of Papineau Lake (from Quebec government) with the approximate location of all 21 receivers and their assigned number.

Figure 15. Yellow dots are detections from one tagged lake trout; the size indicates # of detections for a given receiver. Like many of the fish, this fish stays in the same basin; ex. the main lake basin and doesn't move to the northern or western basins.

10. Dragonfly Project (#2018-2.1)



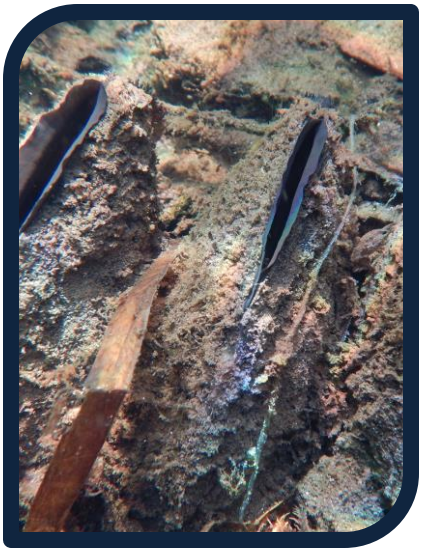
Title: The effects of fish predation on the community composition of odonate larvae and the parasitism of adults.

University / Organization: Concordia University

Researchers: Kelly MacDonald, Serena Mohamed, Dr. Jean-Philippe Lessard (Concordia)

Description: The goals of this project are to 1) examine the effects that rainbow trout predation have on the species of dragonfly larvae found in lakes and 2) determine the effects of this predation on the parasitism of adults by mites throughout the summer. Dragonfly larvae were sampled from 15 lakes of similar size at the beginning of the summer, half of which contained fish. It was hypothesized that though the number of species would be similar between lakes with and without fish, predation would have a significant role in determining the types of species present. As well, every two weeks for the remainder of the summer, one fish and one fishless lake were sampled, in order to determine whether or not the presence of fish affected parasitism on adult dragonflies. This project will determine whether fish predation is the main determinant of community composition and dynamics for dragonfly or whether another mechanism is responsible. In 2018, 70 species from 29 genera were found as larvae in Kenauk lakes. It was also determined that the presence of fish drastically reduces the amount of parasitism on adult dragonflies and damselflies.

11. Mussel Inventory Project (#2018-3.1)



Title: A survey of native freshwater mussels (superfamily: Unionacea) and fishes (family: Cyprinidae, Salmonidae) at Kenauk

University / Organization: Canadian Museum of Nature

Researchers: André Martel, Noel Alfonso and Jacqueline Madill

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 among the most threatened faunal groups globally, with nearly 30% of Canada's species considered at risk. The main causes of the decline of 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 River. We will also aim to determine whether brook trout are the host fish used by pearlshells for metamorphosis and dispersal.

Status: Data collection for both projects will continue through 2019.

12. Canada Warbler and Forestry Project (#2018-4.1)

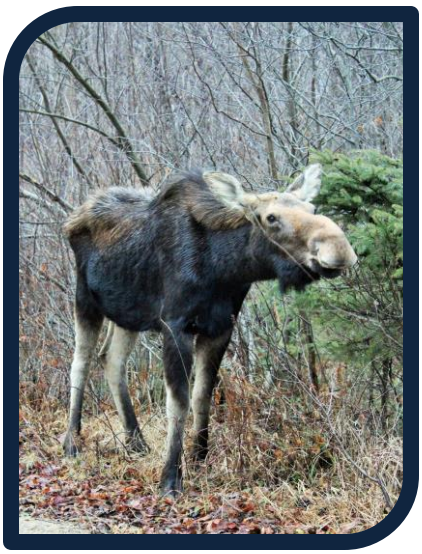
Title: Modelling habitat quality for the Canada Warbler using LiDAR technology on the forest shrub layer.

University / Organization: Dendroica Environnement et Faune, Centre d'Enseignement et de Recherche en Foresterie de Sainte-Foy (CERFO), Nature Conservancy of Canada (NCC)

Researchers: Carl Savignac (Dendroica), Mathieu Varin (CERFO), Marie-Andrée Tougas-Tellier and Catherine Colette (NCC), and many volunteers from the Club des Ornithologues des Outaouais

Description: The Canada Warbler (CW), an endangered species in Canada, nests on the ground in riparian forests and swamps where the shrub layer is dense. The primary objective of this project is to create and validate the first habitat quality index model for this species by incorporating accurate measurements of shrub layer density and height from airborne LiDAR technology. The second objective is to compare Canada Warbler habitat use with the structure and composition of riparian forest nesting bird communities between three riparian forest treatments: 1) unmanaged (≥ 30 years), 2) young partial cuts (2-10 years) and 3) older partial cuts (11-20 years). In 2018, 94 listening stations in 3 treatments were visited twice to identify all breeding birds. Nine vegetation parameters were also measured at 44 listening stations (22 with the presence of CW, 22 without). Preliminary results suggest that the species is relatively abundant in the riparian forests of Kenauk, and possibly most common in older partial cut forests.

13. Moose Tick Project (#2018-5.1)



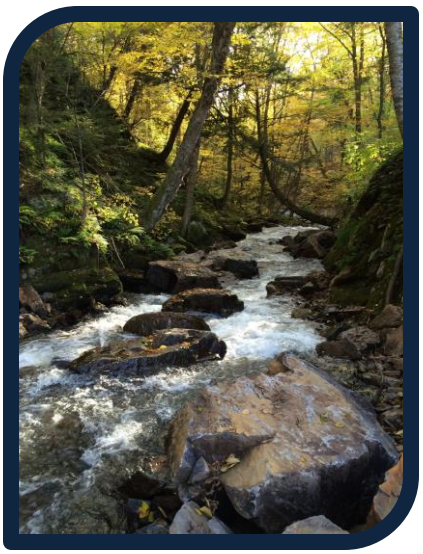
Title: Development of a partnership research project on the role of winter ticks in the ecology of moose populations.

University / Organization: Université Laval, Ministère des Forêts, de la Faune et des Parcs Quebec

Description: The winter tick is a common moose parasite which when combined with other stressors can have a significant impact on moose populations. Global warming, particularly through early springs and late winters, is likely to favor tick infestations on moose in northeastern North America. It is therefore essential to identify the environmental conditions that increase the rate of infestation and the parasite load of moose to ensure the healthy management of this species. A telemetry tracking and moose health data collection program will be established, with a specific focus on calves and moose recruitment. Topics include evaluating 1) the role of winter ticks on the health, population dynamics and ecology of moose populations, 2) the biology and epidemiology of winter ticks, and 3) the proactive management of moose in a climate change context.

Status: Data collection for both projects will continue through 2019.

14. 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 used to locally modify the hydraulic characteristics of rivers. They 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 physical and chemical condition of the river for fish spawning and circulation in terms of ideal flow rates, water depths, oxygenation and habitat diversity. The goals of this project include monitoring: 1) fish movement between the Kinonge River and Papineau Lake, 2) spawning grounds, 3) the number of fish that return to Papineau Lake and 4) fish circulation and sustainability. In order to monitor the success of the weir in maintaining water levels; a probe has been installed above the weir that measures water depth hourly throughout the year. Comparisons between water level fluctuations before and after the weir installation will allow Kenauk to monitor the success of the weir as well as contribute to the overall monitoring of the Kinonge watershed.

Results Summary:

- 2016: Temperature range = 1.2 – 26.8°C
  Variation in depth = 1.03m
- 2017: Temperature range = 1.3 – 23.8°C
  Variation in depth = 0.47m

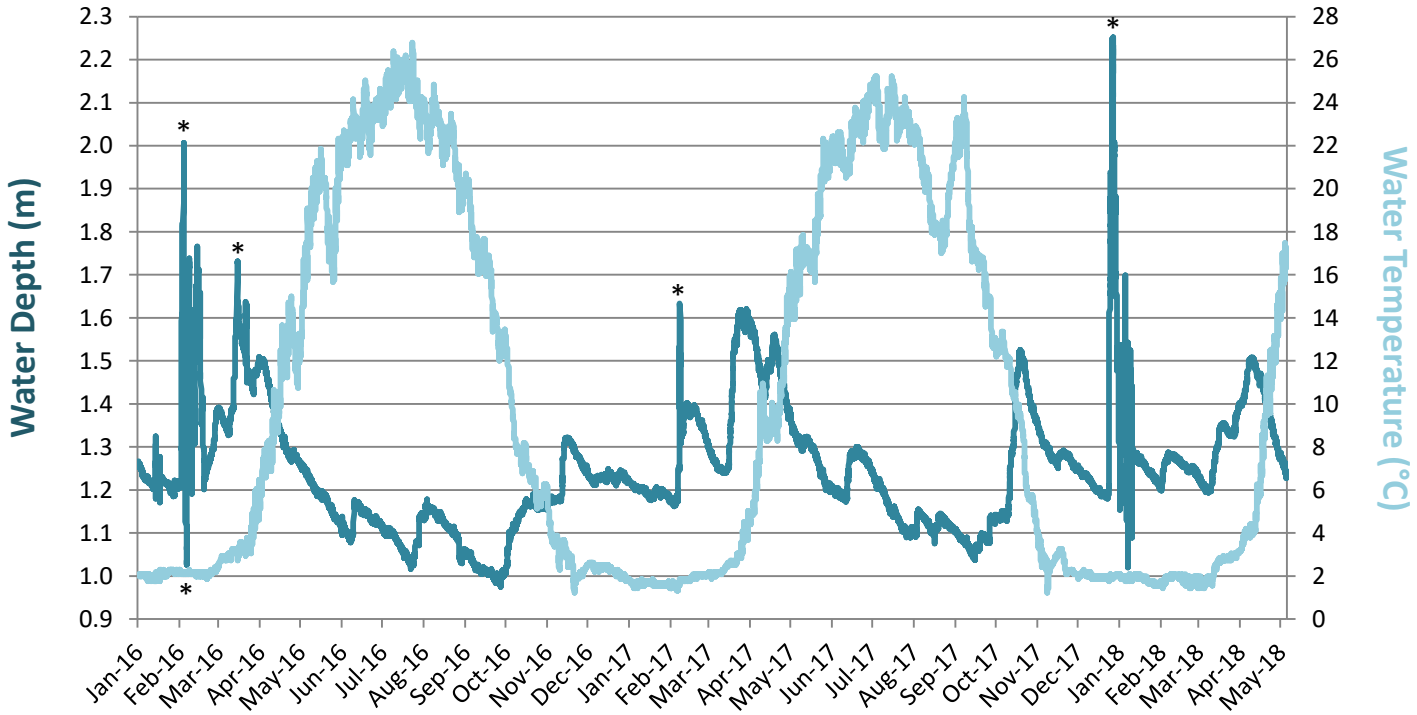
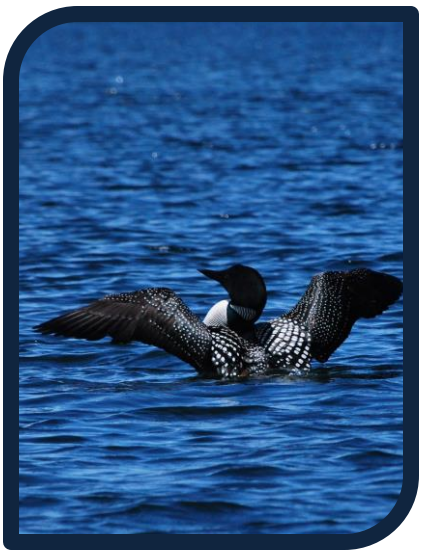


Figure 16. Water depth and temperature above the weir. *Note that water depth was compensated for barometric pressure; however extreme storm events in January and February still affected data and these spikes are therefore exaggerated.

Status: Data collection for this project will continue through 2019.

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



University / Organization: The Kenauk Institute

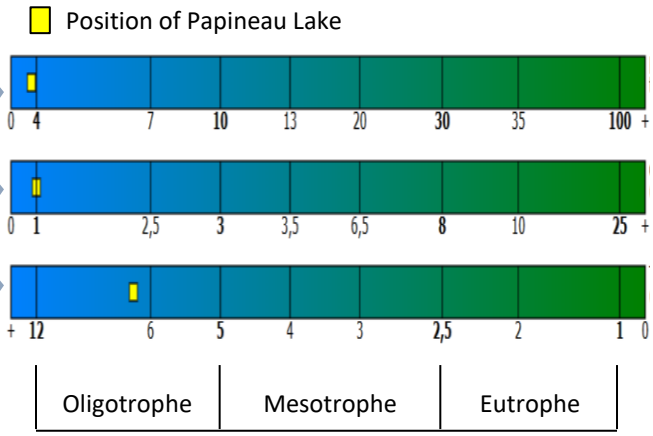
Description: Papineau Lake is a registered lake in the Volunteer Lake Monitoring Program (VLMP) of the Government of Quebec. The Kenauk Institute will periodically take water samples throughout each summer with the goal to establish a long term monitoring protocol for water quality with annual comparisons.

Results Summary:

- 2018 results are pending, see below for 2017 results.
- Based on multiple factors including the high water transparency, Papineau Lake is classified oligotrophic; it has few to no signs of eutrophication and warrants protection. Preventative measures are needed to limit anthropogenic nutrient.

Table 1. Water quality parameters of Papineau Lake (annual averages) and it's corresponding trophic classification.

	2014	2015	2016	2017
Total Phosphorus (µg/L)	6.00	5.18	3.50	3.05
Chlorophyll a (µg/L)	1.30	0.87	1.45	1.20
Secchi (m)	6.13	6.20	6.30	6.90
Organic Dissolved Carbon (mg/l)			3.65	3.30



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

University / Organization: The Kenauk Institute

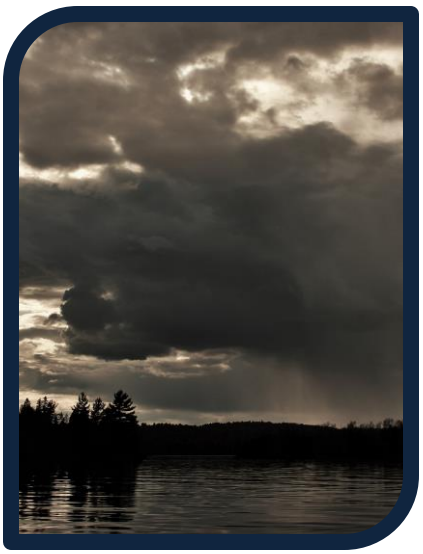
Description: While loon populations are currently stable, a number of threats loom, including human encroachment and pollution. Regional declines have occurred at the southern edge of their range and in some areas loons have disappeared from breeding sites entirely. Loons select nest sites in quiet, 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 protect these sites.

Results Summary:

- Only 9 of 11 known loon pairs were identified on Papineau Lake in 2018. This may have been due to particular weather conditions in 2018 so we hope all 11 pairs will return in 2019.

Status: Data collection for both projects will continue through 2019.

17. Weather Station Data (#2016-3.1)

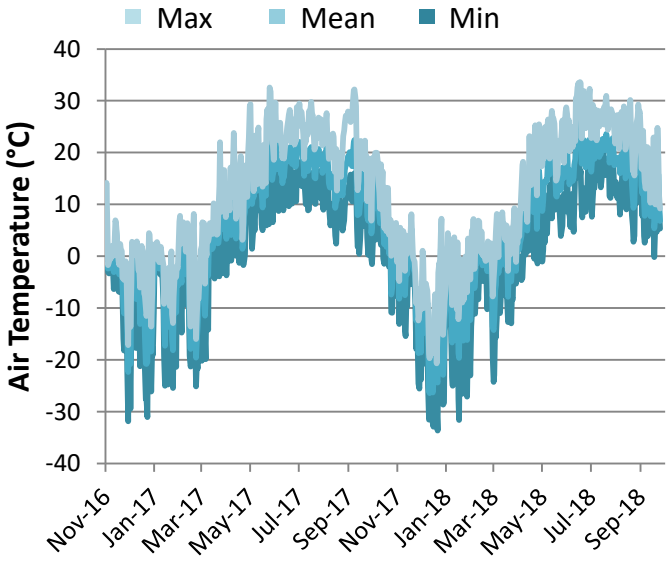


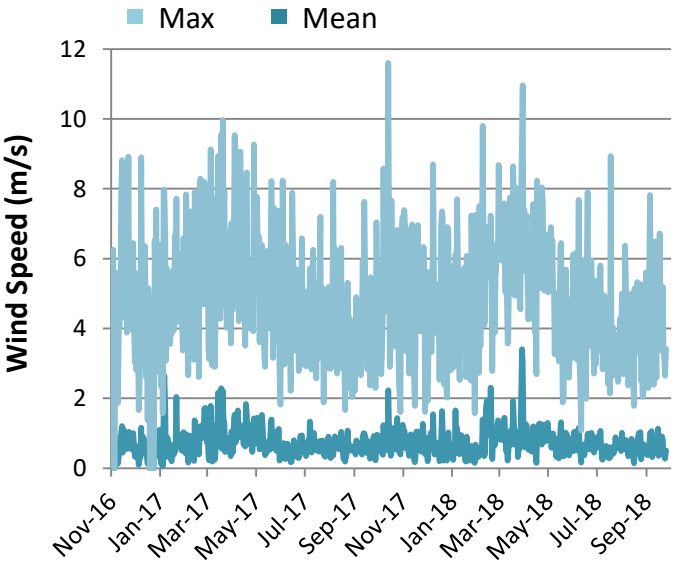
University / Organization: Université de Québec à Montréal (UQAM), The Kenauk Institute

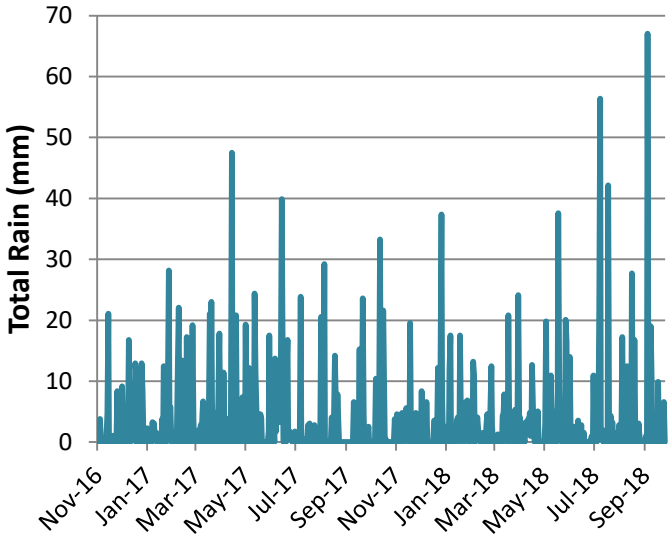
Description: In partnership with UQAM, Kenauk now has a weather station installed at Whitefish Lake. This weather station collects hourly data on temperature, relative humidity, net radiation, wind speed and direction, barometric pressure, rain and snow. Having property-specific data on weather factors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

Results Summary:

- See graphs below for data collected by the weather station.



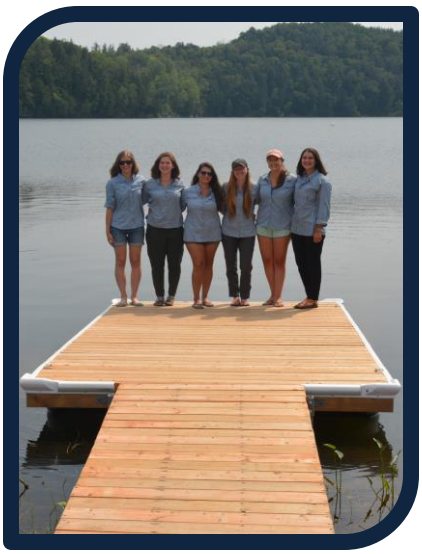




	2017	2018
Max Temp (°C)	32.57	33.59
Mean Temp (°C)	5.80	7.71
Min Temp (°C)	-31.54	-33.62
Max Wind Speed (m/s)	11.60	10.96
Max Rain in a Day (mm)	47.49	67.06
Total Rain / Year (mm)	1142.70	938.01
Max Snow Depth (m)	0.68	0.75

Figure 17. Various weather parameters as measured by the weather station.

Kenauk Institute Intern Projects



18. Comparison of microplastic quantities between pristine and human affected ecosystems. (#2018-6.1)
– Emma Gillies (McGill University)

Microplastics originate from sources such as synthetic clothing fibers and plastic packaging. They have been found everywhere, from agricultural soils to Arctic ice sheets. However, there is a lack of information regarding freshwater microplastics, given that evidence suggests that they negatively affect ecosystems and human health. The goal of this project was to compare microplastic quantities found in the surface waters of an undisturbed ecosystem, like Kenauk, with those found in sections of the Ottawa and St. Lawrence Rivers, that are heavily affected by agriculture and industry.

19. Bat acoustic transect survey at Kenauk. (#2018-7.1)
– Gabrielle Ednie, Amélie Fontaine, Dr. Kyle Elliott (McGill University)

In recent years, the fungal White-Nose syndrome has severely affected hibernating bat species which may have shifted the population dynamics of the eight bat species found in Quebec. This project aims to gather baseline data on the bat populations in southwestern Quebec by studying population tendencies to live in open and closed habitats. Active transects were performed at Kenauk where bat echolocation calls were monitored using an acoustic device (Anabat SD2). It was concluded that the diversity of bat populations in open canopy habitats was higher than in closed canopy habitats but some variability between habitat type in the nocturnal activity of each species existed. However, many inconclusive results highlight the need for further population monitoring as well as technological advancements to accurately measure bat populations as the White-Nose syndrome progresses.

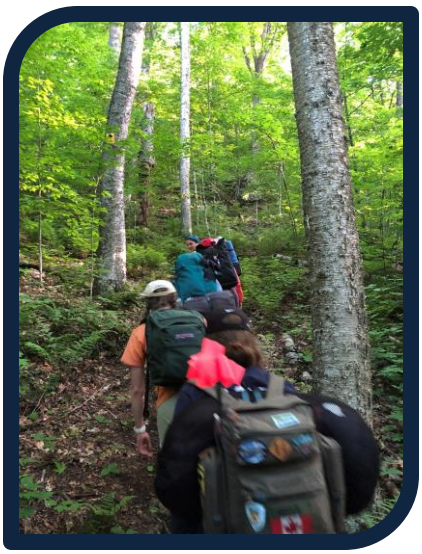
20. Pollinator community comparison between remote and suburban forests. (#2018-8.1)
– Mercy Harris, Dr. Christopher Buddle (McGill University)

This project aims to compare the pollinator communities of the contiguous forest at Kenauk with a suburban forest on the Island of Montreal. The goal of the project is to identify any differences in pollinator diversity and abundance, and how any differences relate to existing literature on the impacts of fragmentation and development on insect communities. Identification of the insect specimens collected during the summer is ongoing and identification to lower taxonomic levels has focused primarily on Dipterans (flies).





Kenauk Institute Intern Projects



21. Effects of chemical and visual prey cues of dragonfly nymphs (*Cordulegaster*) on fish foraging behaviour. (#2018-9.1)
– Nia Krasteva, Dr. JP Lessard (Concordia University)

Climate change-induced temperature increases may cause disease vectors, such as mosquitoes, to not only persist as a threat, but to spread to previously unoccupied areas. As we learn more about the effects of chemicals, like pesticides, on our ecosystems, organizations and governments are opting for more natural mosquito control methods. Such methods however, also require extensive research before implementation to ensure their success and effectiveness. One such method is the use of dragonfly populations as mosquito larval control through predation. Unfortunately, not much is known about the factors and interactions that allow a dragonfly population to persist within an aquatic community. The goal of this project was to determine the predator-prey interactions between generalist species of fish and the aquatic dragonfly nymphs in freshwater lakes. More specifically, what triggers initiation of foraging behaviour in fish resulting in potentially lethal predation.

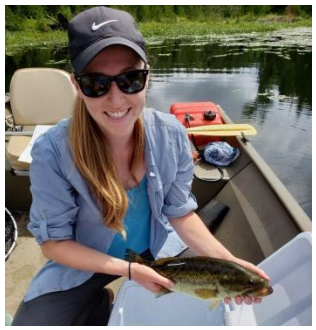
22. Interaction Between Angler Experience and Bait Size During Catch-and-Release Angling of Largemouth Bass (*Micropterus salmoides*). (#2018-10.1)
– Shannon Clarke, Dr. Steve Cooke (Carleton University)

Catch-and-release (C&R) angling is an important management strategy that has been employed to manage recreational fisheries around the world. The basis of C&R angling lies in the assumption that a large proportion of the fish survive post-release and only experience very limited fitness consequences. However, the use of different gear and bait types, and the level of experience of an angler, can greatly influence the rates of hooking injury and mortality. These relationships have been documented amongst a variety of fish species, but few studies have focused on the interactions between angler experience, gear type, and bait type. The aim of this study was to assess the interaction between angler experience and bait size on a variety of lethal and sublethal outcomes in an important sportfish in Canada, the Largemouth Bass (*Micropterus salmoides*). These results will allow for informed recommendations for future management of sustainable C&R fisheries.

Status: All intern projects are now complete.







2018 Educational Programs

Eight educational programs were successfully completed in 2018.

1. Outward Bound and YMCA Program

The Outward Bound Youth Challenge Programs are designed for young people experiencing difficulties at home, at school or in their community. The experience removes them from their usual environment and thrusts them into an exciting and adventurous challenge. Given the opportunity to reconnect with their true selves, change the way they deal with others and get their first taste of leadership within a safe environment, these teens transform their attitudes, behaviors and self-beliefs and come away with a renewed sense of their own potential. Each program provides Montreal youth with the opportunity to experience a 10 day hiking expedition where they are challenged both mentally and physically and learn that they are capable of more than what they believed possible. The expeditions include hiking, a canoe and portage portion, solos and a research/service day with the Kenauk Institute.

2. École Saint-Michel – Montebello Elementary School

École Saint-Michel is the local Montebello elementary school for which the Kenauk Institute provides free annual field trips for the grade 5 and 6 class. This is an opportunity for young students to get out 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. These field trips include guided hikes, canoeing/kayaking, wilderness survival activities and many lessons on the local flora and fauna.

3. Tohoku CHaNGE – Canadian Heritage and Nature Group Experience - Summer Program

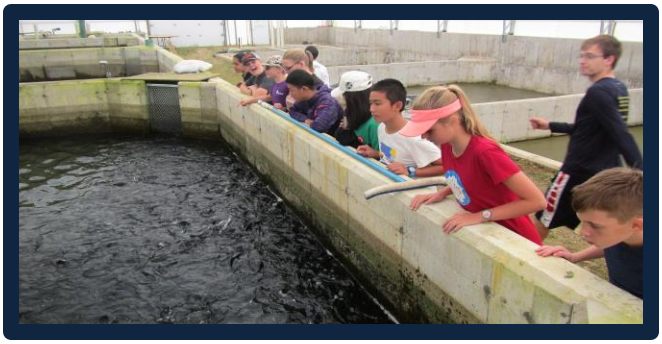
The Tohoku University CHaNGE program is a faculty-led study program from Japan for University students. It included a two week discovery tour of Canada's historical and natural heritage with environmental and climate change themed visits to McGill University, Ottawa University and the Kenauk Institute. At the Kenauk Institute, students went on guided hikes, canoeing/kayaking and a wilderness adventure tour where they learned about local flora and fauna.

4. ISFORT M.Sc. Program

The ISFORT M.Sc. program is a professional masters degree in the sustainable management of forest ecosystems offered jointly by UQAM, UQO and UQAT. It's specialized for people who are interested in studying the relationships and interactions between humans and forests. Topics include flora, wildlife, ecological functions, ecosystem services and the cultural value of forests. The Kenauk forestry company, Kenauk Canada ULC, provides valuable on-site data to support the program. This program is two weeks long and repeated annually, it has been held at Kenauk twice in the past.

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

The BCS grade 7 program is an opportunity for students to start the school year by getting to know each other outside of the classroom. This program included team building, 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 biology and the sciences. Students are encouraged to continue using the knowledge gained during this program to contribute to research projects conducted at BCS throughout their high school experience.



6. Science Teacher Professional Development

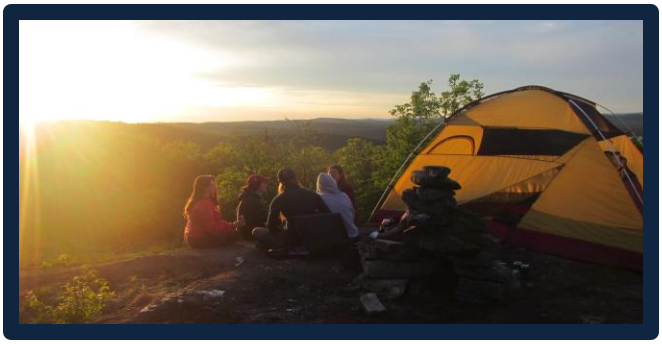
The Kenauk Institute invited science teachers from the Bishops College School and Westover School to learn about our research projects and collaborate on new lessons that could be brought back to their respective schools. The science programs at these schools are already distinguished, but this was an opportunity to gain fresh perspectives from researchers and share ideas between schools.

7. Kenauk Institute Internship Program

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, contributing to 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. Professional development sessions are held throughout the internship.

8. Kenauk Institute Junior 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. Students can use the data they collect for an independent research project or thesis, in accordance with their schools curriculum. They are also encouraged to continue their research back at their home schools.



Research and Educational Partnerships

CERFO

Québec

Carleton UNIVERSITY

Université Concordia University

Fisheries Conservation Foundation

canadian museum of nature
nature
musée canadien de la nature

McGill

Nature Conservancy Canada

The University of Vermont

University of Guelph

Université de Montréal

ISFORT

UQÀM

Centre d'études nordiques
CEN Centre for Northern Studies

Sustainable Forestry Initiative

Illinois
University of Illinois at Urbana-Champaign

Ouranos

Université du Québec à Trois-Rivières
UQTR

University of Waterloo

Kenauk Nature

Université Laval

UQAT
Université du Québec en Abitibi-Témiscamingue

UQO

IRHMAS
Institut de recherche en histoire maritime et archéologie subaquatique

Outward Bound

the YMCA
For Youth Development®
For Healthy Living
For Social Responsibility

Westover School

Tohoku University

BCS Bishop's College School

École St-Michel