



Kenauk Institute – 2017 Annual Report



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December 31, 2017

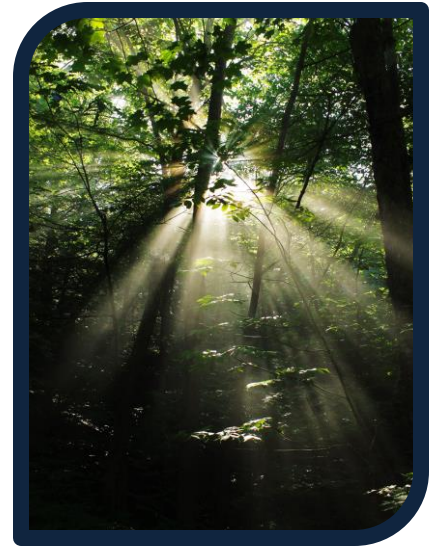
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Executive Summary

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 expansive 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 2017, The Kenauk Institute has seen a lot of progress towards becoming an established and permanent center for ecological studies that includes the successful completion of 16 research projects and 7 educational programs.

The presence of over 50 species at risk have now been validated on the property. Researchers found 4 species of slugs, two crayfish species, all 8 species of bat found in Quebec and more than 554 species of beetles and spiders, many of which are rare. The vernal pool project identified many previously unknown characteristics of vernal pool hydrology and we are now eagerly awaiting the results of the environmental DNA analyses. In addition, 150 permanent sample plots were installed and sampled which will not only help determine the effects of various forestry management techniques but will also be the foundation of our long term monitoring. We continue collecting information on Papineau Lake hydrology, loons and water quality which all suggest a very healthy lake system. Acoustic transmitters were also surgically implanted in 30 lake trout which will allow us to track their lake movements.

The Kenauk Institutes educational programs continued to expand in 2017. Programming included two outward bound / YMCA programs, two field trips from the Saint-Michel elementary school, a program from Tohoku University in Japan, the ISFORT M.Sc. program, the McGill University mammology field trip as well as our internship program. We look forward to many of these programs coming back in 2018 as well as future collaborations with the Bishops College School and Westover School.

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

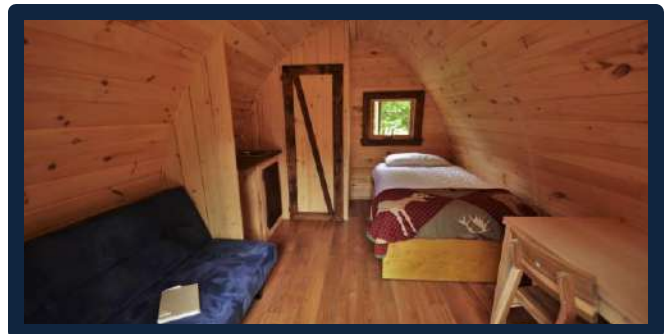
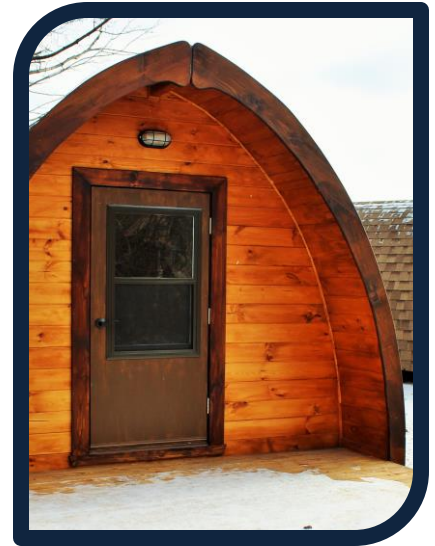
Research Coordinator

- 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 as well as one pod which acts as equipment storage. 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 and needs as well as increase our researcher accommodations and 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. Kenauk Nature has also generously provided in-kind contributions for some research project industrial grants including chalet accommodations, use of fishing boats and the marina, storage space, mapping data, equipment and assistance from knowledgeable personnel.



2017 Research Projects

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 impacts on increasing the overall resilience of the forest to global change.

1. Biodiversity Project (component 1 of forestry project)

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

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

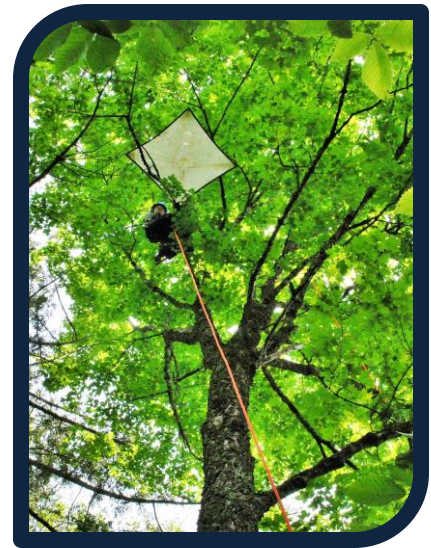
Researchers: Dr. Christopher Buddle, Dr. Kyle Elliot and Jessica Turgeon (McGill), Dr. Alex Smith (Guelph), Dr. Yann Surget Groba and Dr. David Rivest (UQO), Dr. Christian Messier (UQO/UQAM)

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-capturing trees, critical ecosystem functions are provided by the flora and fauna which inhabit Kenauk. As we adapt to our 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. Surveys will be completed in permanent sample plots, which will be the basis for long-term ecological monitoring at Kenauk. 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:

- Spiders 2016: 72 species, 2200 individuals, and 30 unique species; 1 species is potentially a new provincial record (*Agyneta serrata*), 1 species has only been found twice before in Quebec (*Elaver excepta*) and the 2nd most common Kenauk species is uncommon in Quebec (*Neoantistea magna*).
- Spiders 2017: 66 species, 928 individuals, and 24 unique species; 1 species is potentially a new provincial record (*Bassaniana versicolor*). In both 2016 and 2017 spider communities differed with height in the tree but not with forest management. There was also a big drop in abundance between the two years; perhaps because of weather.
- Beetles (in progress): In 2016 245 species and 1955 individuals were collected and in 2017 171 species and 1157 individuals were collected. The most common species are non-native (*Phylobius oblongus*, *Sciaphilus asperatus*, *Xylosandrus spp 1*), many (20+) are rare and uncommon (various longhorned beetles, soldier beetles) and 1 species is extremely rare (*Megapenthes rogersi*).

Next Steps / Deliverables: Data analysis for this project will continue through 2018.



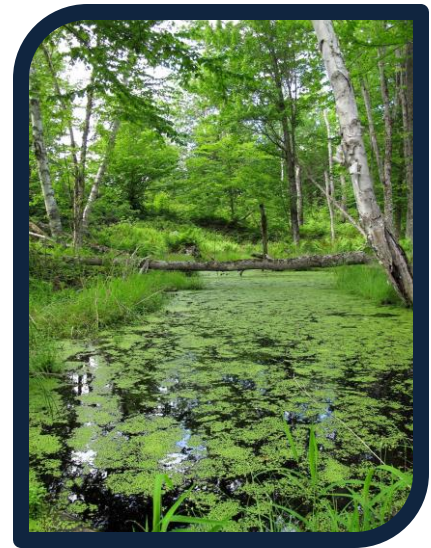
2. Vernal Pool Hydrology and Herpetology Project (component 2 of forestry project)

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

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

Researchers: Dr. Marie Larocque (UQAM), Dr. Angélique Dupuch and Dr. Yann Surget Groba (UQO)

Description: Vernal pools consist of very rich ecosystems and are essential to the life cycle of many organisms including threatened amphibians. Despite their ecological importance, these habitats are generally not mapped and are not taken into account in management plans because of their small size and temporary state. Currently the effects of forestry on vernal pool hydrology and herpetofauna are also unknown. The objectives include: 1) quantify the hydrological dynamics of vernal pools across different geomorphological contexts; 2) evaluate the impact of even-aged and uneven-aged silviculture on vernal pool hydrological dynamics, herpetofauna diversity, abundance and connectivity; and 3) provide recommendations to decrease the impact of silviculture on vernal pools and their associated herpetofauna. Fifty vernal pools will be selected for this study: unexploited forests, young (10-15 year-old harvest) and older sites (25-30 year-old harvest) with even-aged sylviculture, as well as young and older sites with uneven-aged sylviculture. All the pools will be surveyed regularly for their size, depth and hydroperiod. At all the sites, environmental DNA will also be analysed to estimate herpetofauna diversity and abundance. Among the 50 sites, a subset will be equipped with different sensors (water level, temperature, electrical conductivity, air temperature, precipitation) to assess the temporal evolution of their water budget and water quality.



Results Summary:

- June-November 2016, the vernal pools were active, ~52% of the time.
- Daily precipitation of at least 30mm is required to reactive a dry pool.
- Analyses indicate that surface runoff is a negligible component of pool hydrology, infiltration and evapotranspiration are the dominant controllers.
- Hydrologically, the protection of vernal pools must focus within a radius of 30m around each pool. From a wildlife point of view, the literature recommends a 30-230m buffer zone with minimal forestry.

Next Steps / Deliverables: Data analysis for this project will continue through 2018.

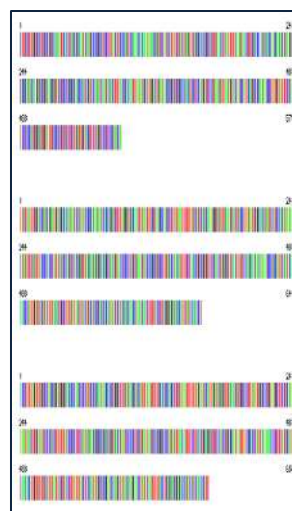


Figure 1. Example of DNA sequence to identify vernal pool species.

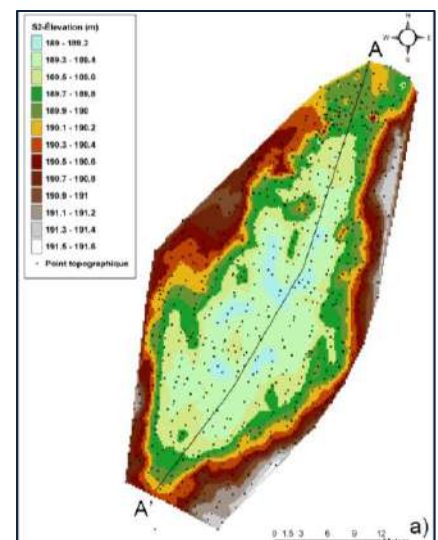


Figure 2. Example of vernal pool bathymetry.

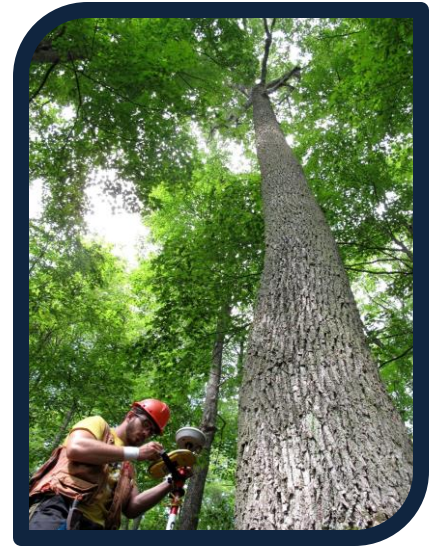
3. Tree Growth and Productivity Project (component 3 of forestry project)

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

University / Organization: Université de Québec en 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 objectives of this project include: 1) assess the effects of both forestry approaches (even vs uneven) on forest productivity and regeneration and compare them to unmanaged stands; 2) assess the effects of both approaches on floristic and soil biodiversity with a comparison to unmanaged stands; 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. More 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-aged and uneven-aged forests.
- **Trees:** Differences in trees species dispersion, abundance and composition was found between all forestry types. Tree species diversity (richness) is very similar among forest types.
- **Saplings:** Sapling density is quite different between forestry sites and old growth forests. All the sites have similar species richness.
- **Plants:** Many important plant species are affected by forestry. Species richness and abundance is highest in old growth forests but does increase with time after forestry. Some plant families however, do not recover and are negatively affected by forestry years later (30 years and longer).

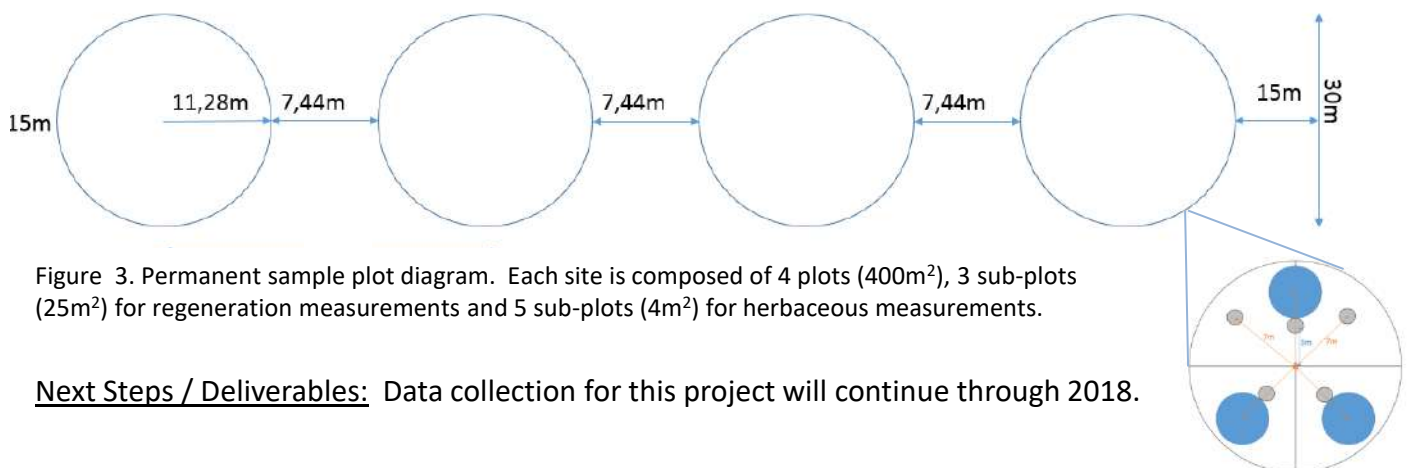


Figure 3. Permanent sample plot diagram. Each site is composed of 4 plots (400m²), 3 sub-plots (25m²) for regeneration measurements and 5 sub-plots (4m²) for herbaceous measurements.

Next Steps / Deliverables: Data collection for this project will continue through 2018.

4. Forest Resilience Project (component 4 of forestry project)

Title: Assessing the best management strategies in relation to increasing the overall resilience of forests to invasive pests, disease and climate change.

University / Organization: Université de Québec en 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 and Philippe Nolet (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 and beech bark diseases and more recently the ash-bore epidemic 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 so as to maintain its ability to continue providing vital ecosystem services. Based on the theory of complexity science, this project will evaluate at the stand and landscape scales, using simulation models, the best management strategies to insure forests will continue to provide ecosystem services. 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 as high a tree species diversity as possible with the right balance of functioning traits to insure as high a 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.

Next Steps / Deliverables: Data collection for this project will continue through 2018.



Figure 4. A) Even-aged forestry; strip or clear cutting which results in all trees being the same age. B) Uneven-aged forestry; selective cutting which results in trees being various ages.

5. Integrated Forestry Planning Project

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 Joannis, 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 5).



Results Summary:

▪ The three types of irregular progressive cuts compared in this project are (figure 6):

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

Next Steps / Deliverables: Data collection for this project will continue through 2018.

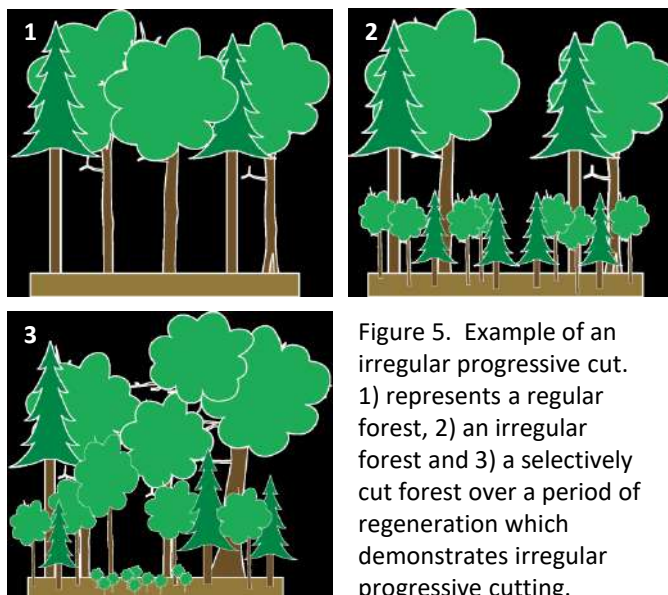


Figure 5. Example of an irregular progressive cut. 1) represents a regular forest, 2) an irregular forest and 3) a selectively cut forest over a period of regeneration which demonstrates irregular progressive cutting.

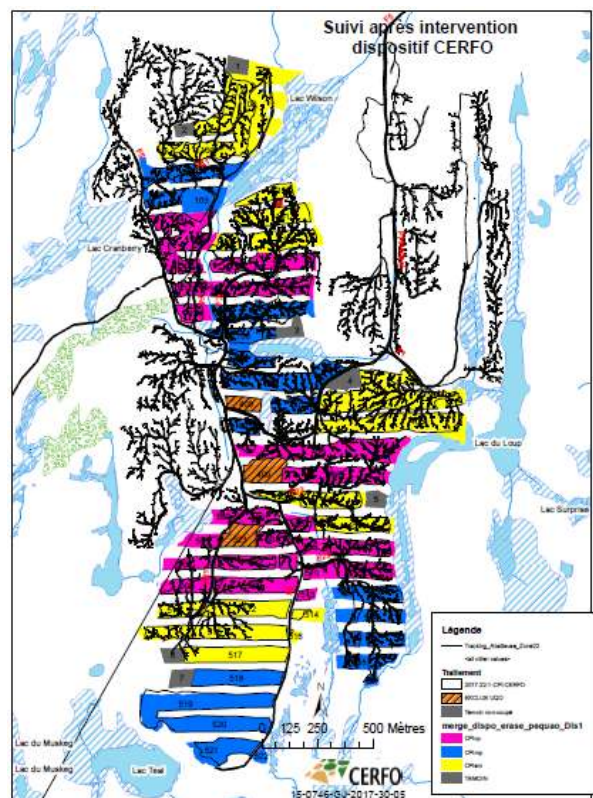


Figure 6. The three types of irregular progressive cuts.

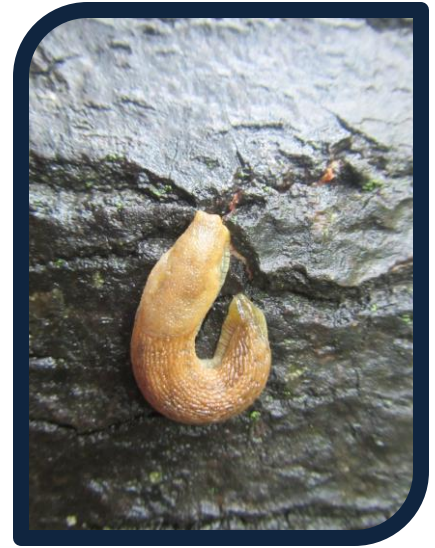
6. Invasive Slug Project

Title: How to explain the invasive success of introduced species in disturbed habitats?

University / Organization: Université de Québec en Outaouais

Researchers: Dr. Angélique Dupuch, Anna Mazaleyrat (UQO)

Description: The goal of this project is to determine the ecological factors that facilitate the successful invasion of non-indigenous slugs. In Canada there are 36 species of slugs, 17 of which are introduced non-indigenous species. This project will test whether disturbances, like logging, help invasive species proliferate by doing a comparison of the presence of native versus non-native slugs in the Outaouais region. On the property of Kenauk there are 4 slug species, 3 of which are native and 1 of which is invasive. Slugs are highly sensitive species to factors such as temperature and humidity, which results in specific preferred habitats. It is hypothesized that invasive species have wider behavioral and physiological tolerances compared to native species, allowing them to withstand the more extreme thermal and moisture conditions found in logging areas. This project will have three components: 1) an inventory of slug species in logged vs undisturbed forests; 2) vegetation surveys; and 3) determining slug displacement and feeding behaviors.



Results Summary:

- The species of slugs identified so far at Kenauk include: *Palifera dorsalis*, *Deroceras leave*, *Phylomicus carolinianus* (indigenous), and *Arion fuscus* (invasive).
- See figure 7 for hypothesis diagram. Preliminary results verify the hypothesis that invasive species have wider behavioral and physiological tolerances compared to indigenous species.

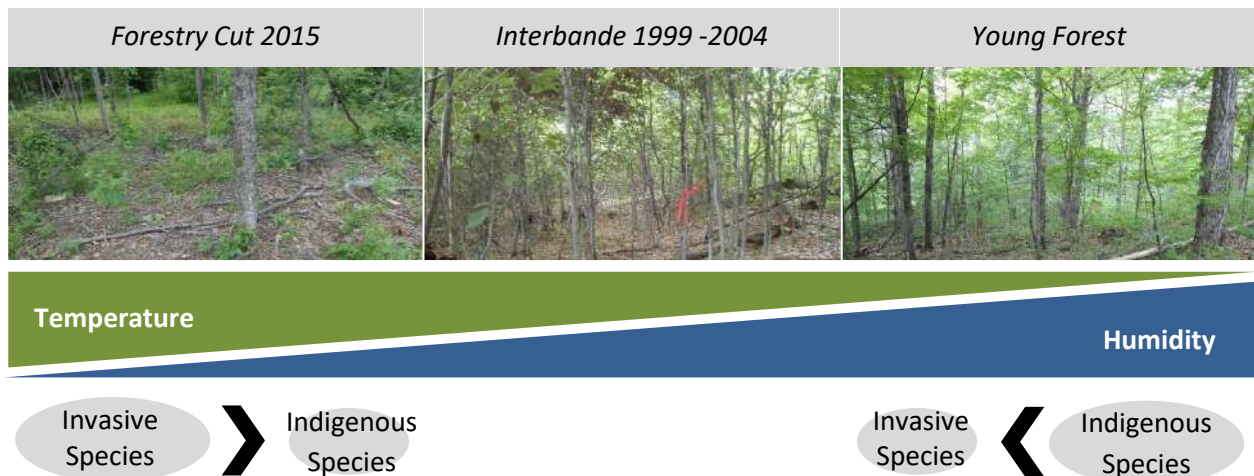


Figure 7. Characterizing slug communities in forest stands with various levels of forestry disturbance.

Next Steps / Deliverables: This project is now complete. It has provided valuable data on the slug species at Kenauk and also the relevant ecological factors that facilitate invasive species.

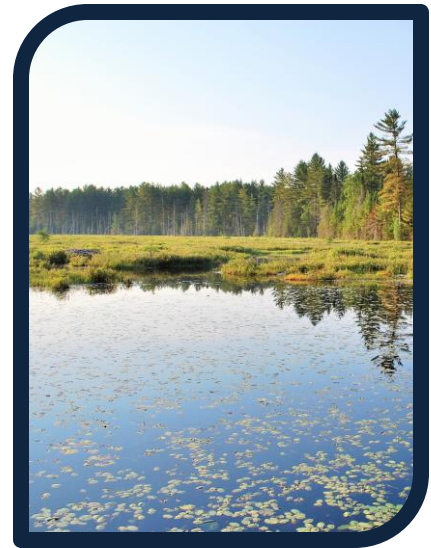
7. Papineau Lake Hydrology Project

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

University / Organization: Université de Québec en 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. 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:

- Throughout 2017 a wealth of information was collected on Papineau Lake including lake volumes, the identification and characterization of all its wetlands (there are over 100), equipped most inflows, collected and analyzed 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.
- Based on the vertical temperature profiles Papineau Lake seems to have two thermoclines at 4m and 6m (figure 8).
- The lakes level is higher than the outflow volumes which indicates a high inflow of subterranean water.

Next Steps / Deliverables: Data collection for this project will continue through 2018.

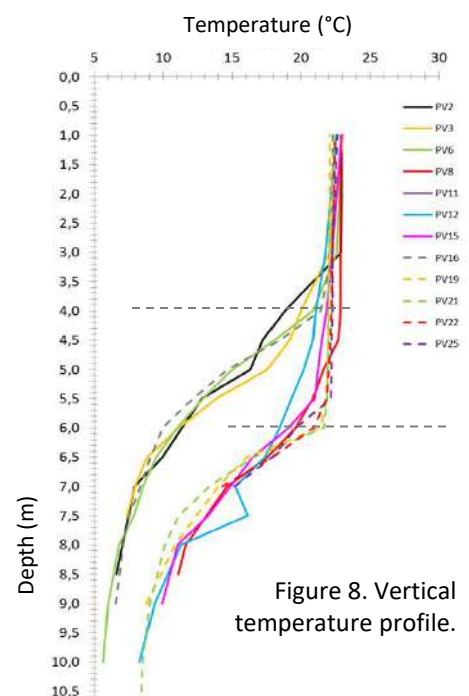


Figure 8. Vertical temperature profile.

8. Papineau Lake Telemetry Project

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 (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 generations to come. 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, largemouth bass, and smallmouth bass use different habitats (ex. depth and thermal habitat) on a seasonal basis (including spawning and overwintering locations). 3) Identify the level of reproductive success for lake trout, largemouth bass, and smallmouth 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.

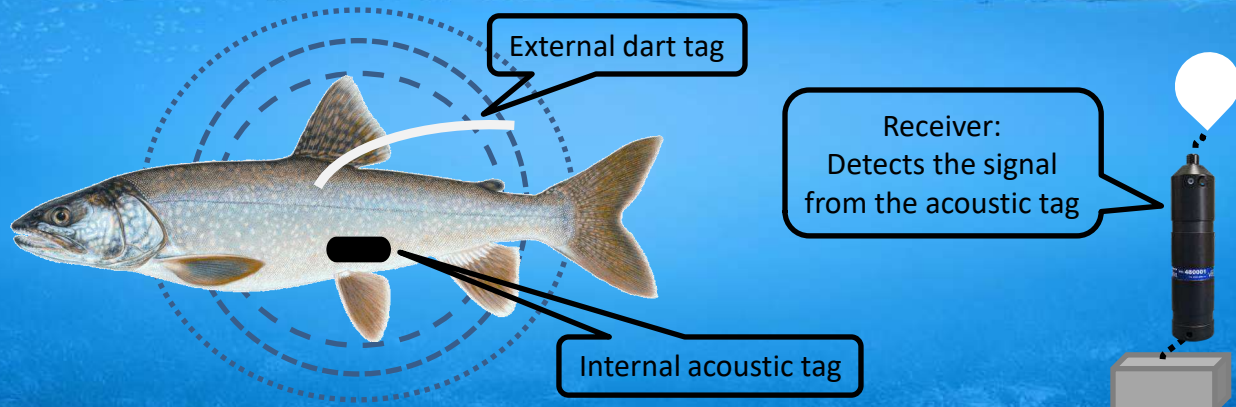


Results Summary:

- During the first stage of this project, acoustic telemetry is being used to record the location of individually tagged fish, including their depth and temperature. Receivers have been placed around the lake to record coded signals from tagged fish that swim in their vicinity. Acoustic transmitter tags were surgically implanted in over 30 mature Lake Trout in September which will allow us to track their movements throughout the lake over time.
- Project results will be regularly shared with community members in order to promote the need for management strategies that support sustainable recreational fisheries on the lake.

Next Steps / Deliverables: Data collection for this project will continue through 2018.

Figure 9. Diagram of acoustic telemetry.



9. NCC Biodiversity Project

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 territory of Kenauk. This work aims to document the rich biodiversity of this vast and iconic property, to exemplify its value and manage it accordingly (e.g., identification of areas with high conservation potential, establishment of 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 synthesis of knowledge on the flora and fauna of this sector and the needs of each species in terms of habitat. This territory inventory is accompanied by 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. Kenauk's conservation planning will therefore include a larger scale objective to protect the Kinonge watershed (figure 10) and the wildlife corridor to the North (figure 11). The continuous forest cover to the North of Kenauk provides suitable conditions for wildlife movement and migration. Continuous forest is important for large mammals, forest interior birds, indigenous plants and amphibians with limited dispersal capacity. The objective is to maintain landscape connectivity for free dispersal of those groups.

Results Summary:

- So far the presence of over 50 species at risk have been validated, including *Conopholis Americana*, the four-toed salamander, the walking fern and the largest black maple stand listed in the province of Quebec.
- Old forest fragments that foster several bird species such as the Canada warbler and the wood thrush were also identified.
- In terms of fish, channel darters were also found, an indicator species for the quality of the riparian environment.

Next Steps / Deliverables: This inventory will continue in 2018. Extensive species lists of flora and fauna have been created which will facilitate long term monitoring, conservation and future research. Species lists are posted on the website.

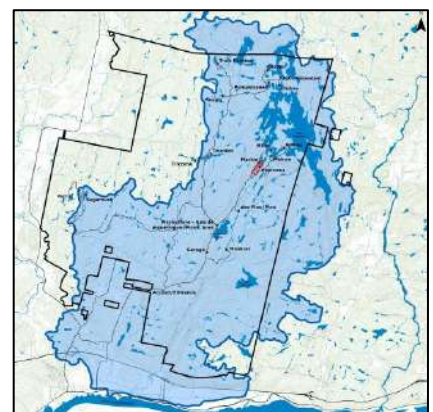
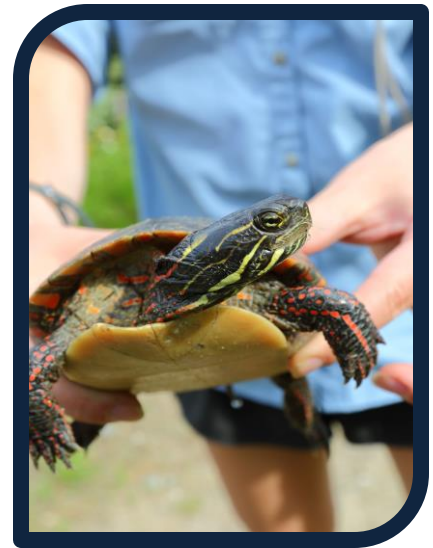


Figure 10. Kinonge watershed.

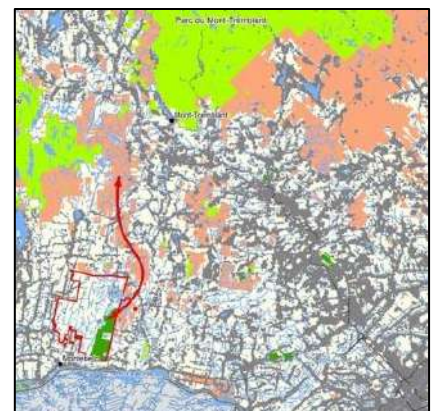


Figure 11. The wildlife corridor.

10. Crayfish Project

University / Organization: The Kenauk Institute

Researchers: Victoria Chicatun and Lise Coquilleau (2017 Interns)

Description: Crayfish play important roles in freshwater systems, including those of ecosystem engineers and bio-indicators of water quality and habitat. Crayfish are also a keystone species in the trophic web of lakes and streams due to their large size, mobility, behaviour, omnivory, and as an important prey item for birds, mammals, turtles and fish. Additionally, protected crayfish may act as an umbrella species for the conservation of communities. Currently 8 species are found in Quebec, two of which are highly invasive: the Rusty crayfish and Spinycheek crayfish. These non-indigenous species are known to displace native crayfish, decrease the abundance and diversity of aquatic plants and invertebrates, and reduce some fish populations.



The goals of this project were to 1) create a baseline inventory of the crayfish species at Kenauk, and 2) study the effect of predatory pressure on crayfish abundance and diversity. To do this lakes were categorized based on the present fish species, bass and pike, rainbow trout or no predatory fish, to represent different types of predatory pressure (bass and pike being avid consumers of crayfish). Crayfish were sampled at each lake using two methods: overnight traps baited with canned catfood and 45 min of active sampling at dusk, using flashlights and nets.

Results Summary:

- So far two species of crayfish have been found, both being native in this range: *Orconectes propinquus* (Northwestern clearwater crayfish), and *Orconectes virilis* (Virile crayfish). No non-indigenous species have been found yet.
- Results are not significant because of small sampling effort, but there is a decreasing trend in abundance with predatory pressure (table 1).
- Crayfish ranged in weight from 0.73grams to 39.85grams.

Next Steps / Deliverables:

This project will hopefully facilitate future crayfish projects on the property of Kenauk as well as contribute to our long term monitoring and inventory mandates.

Table 1. Distribution of crayfish in each of the study lakes.

Lake Category (Fish Present)	Lakes	# of Crayfish	Species of Crayfish	Total Crayfish
Bass and Pike	Maholey	1	O. Propinquus	4
	Whitefish	1	O. Virilis	
	Fabre	2	O. Propinquus	
Rainbow Trout	Taunton	6	O. Propinquus	35
	Collins	0		
	Twins	29	O. Virilis	
No Large Predatory Fish	Benjamin	0		0
	Puant	0		
	Perchaude	0		

11. Bat Inventory Project

University / Organization: McGill University, the Kenauk Institute

Researchers: Sebastien Levesque (2017 Intern)

Description: Bats play ecological roles that are vital to the health of ecosystems, including pest control, pollinating plants and seed dispersal. Since the white-nose syndrome epidemic, bat populations across North America have been affected in both abundance and distribution. In North America, most bat species belong to the suborder Microchiroptera which regroups bats that echolocate to navigate through obstacles and find prey. The discovery of echolocation and the advancements in bat call identification has enabled chiroptologists to characterize guilds of these creatures. Researchers can now distinguish hunting calls, social calls, and obstacle avoidance calls. In Quebec, five bat species live year round, and another three species are migratory.



The residential chiropterans are the big brown bat (*Eptesicus fuscus*), eastern small-footed bat (*Myotis leibii*), little brown bat (*Myotis lucifugus*), northern long-eared bat (*Myotis septentrionalis*), and tricoloured bat (*Perimyotis subflavus*). The migratory species are the eastern red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), and silver-haired bat (*Lasionycteris noctivagans*). The goal of this project was to identify the bat species present at Kenauk using the Wildlife Acoustics Echo Meter Touch module and associated Kaleidescope Pro software. Objectives included 1) conduct an inventory of bat species at Kenauk, 2) estimate the abundance and diversity of the species across different sites, and 3) begin to understand the relationship between sites, species and time of night.

Results Summary:

- Over 1600 recordings were collected. All 8 species found in Quebec were represented.

Table 2. Distribution of bat species activity at each site, in order of abundance.

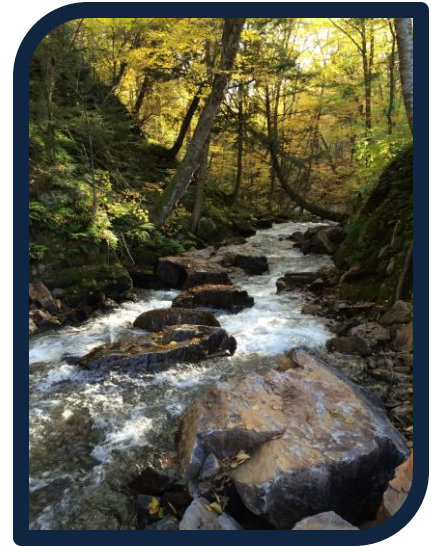
Species	Whitefish	Gate	Maholey	Benjamin	Puant	Total
MYOLUC	164	27	3	0	1	195
LASNOC	17	78	23	9	10	137
EPTFUS	32	19	5	9	0	65
LASCIN	7	4	25	3	1	40
LASBOR	8	13	0	0	1	22
PERSUB	0	9	0	0	0	9
MYOSEP	8	0	0	0	0	8
MYOLEI	2	0	0	0	0	2
Total	338	192	71	23	15	478

Next Steps / Deliverables: This project will serve as the foundation for another bat project conducted by McGill University using BatWatch, a citizen science website that tracks and monitors data on bats.

12. Papineau Lake Weir Monitoring Project

University / Organization: The Kenauk Institute and DFO

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: 1) allow fish movement between the Kinonge River and Papineau Lake, 2) improve spawning grounds, 3) increase the number of fish that return to Papineau Lake and 4) improve 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 effectiveness 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

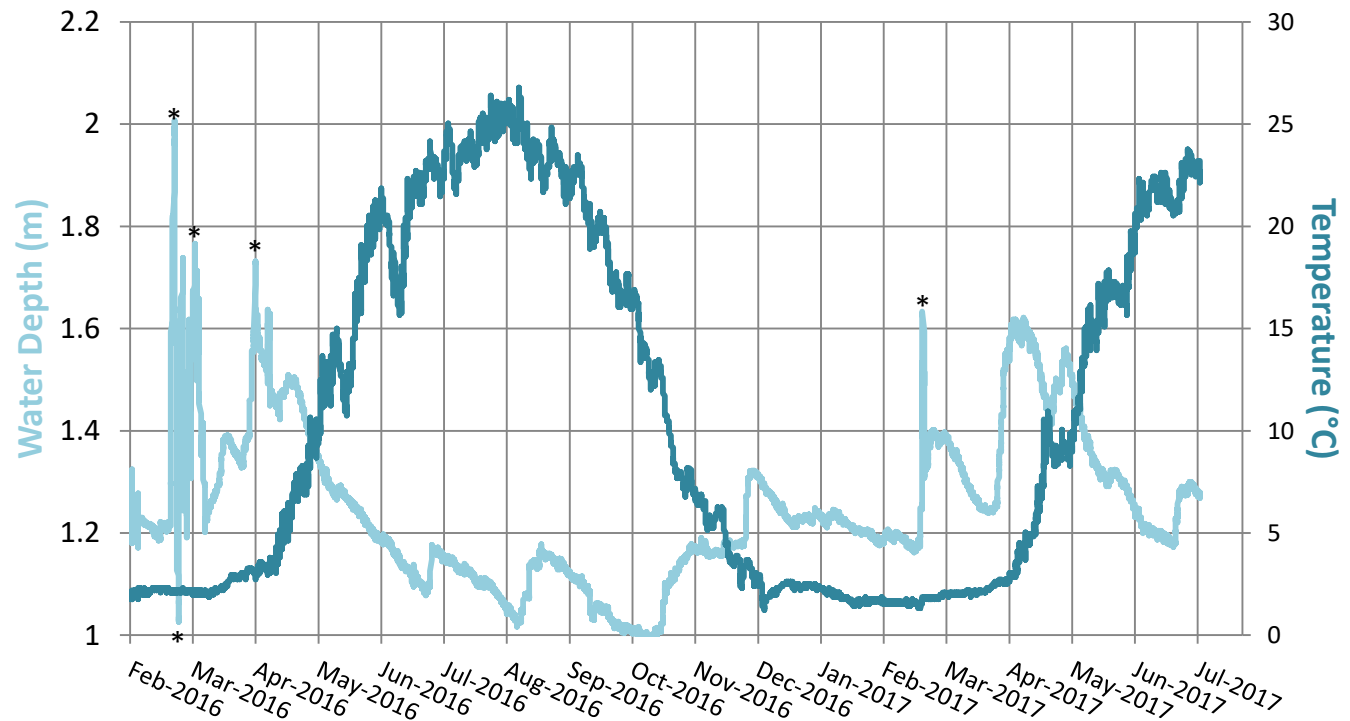


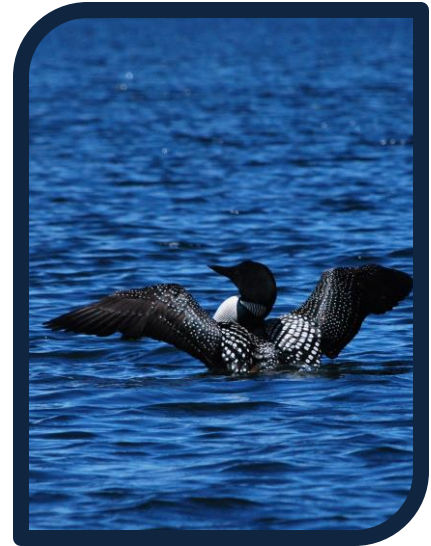
Figure 12. Water depth and temperature above the weir. Water depth was compensated for barometric pressure; however extreme storm events in February and March still affected data. *Note that these spikes in water depth are exaggerated.

Next Steps / Deliverables: Data collection for this project with continue through 2018.

13. Papineau Lake Water Quality Monitoring Project

University / Organization: The Kenauk Institute

Description: Papineau Lake is a member of the Volunteer Lake Monitoring Program (VLMP) with 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:

- 2016 physicochemistry results (2017 results are pending):
- The average concentration of chlorophyll a (1.45 µg/l) indicates a lake whose biomass of suspended microscopic algae is weak.
- The low phosphorus levels (3.5 µg/L) indicate that the water isn't very enriched by this nutrient.
- Based on all of these factors and the high water transparency, Papineau Lake is classified as oligotrophic. It has few to no signs of eutrophication which warrants protection. Preventative measures to limit the inflow of human activity nutrients is necessary.

Table 3. Water quality parameters for Papineau Lake (based on annual averages).

Year	Chlorophyll a (µg/L)	Total Phosphorus (µg/L)	Fecal Coliforms (UFC/100ml)	Temperature (°C)	Secchi (m)	Organic Dissolved Carbon (mg/l)
2016	1.45	3.5			6.30	3.65
2015	0.87	5.18	2.00	22.80	6.20	
2014	1.30	6.00	1.67	21.00	6.13	
2012		13.50		25.33	6.87	

14. Papineau Lake Loon Nesting Project

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:

- 11 loon pairs were identified and mapped on Papineau Lake in 2017 (as in previous years).

Next Steps / Deliverables: Data collection for this project will continue through 2018.

15. Papineau Islands Archeology Project

University / Organization: The Kenauk Institute

Researchers: Dr. Pierre Desrosiers

Description: For the past year archaeological research has been conducted at Kenauk, a first for the property. The goal of this new research is to identify and document Kenauk's cultural resources. The first phase of this project was conducted as an archaeological inventory by Pierre Desrosiers with the help of students from McGill University and the Université de Montréal. The research was conducted mainly on Indian Island, other small islands and portions of the area around Papineau Lake.



Results Summary:

- As part of this research, many surveys were dug and an archaeological site was discovered.
- In addition, surveys have documented the presence of old forest fires in some areas of the property.
- Clay deposits have also been discovered during several digs which will help determine the boundaries of the Champlain Sea, a sea present some 10,000 years ago in the region.
- Remnants from historical events were also found such as an airplane crash on Indian island.

Next Steps / Deliverables: The first phase of this project, which was essentially exploratory, will continue in 2018. Surveying known historical sites, such as former logging camps, will also be added to the projects mandate. This project will hopefully facilitate future archeology projects as well as contribute to the cultural heritage of the property.



Figure 13.
Remnants of an
old stove found.



Figure 14.
Remnants of an
ancient fire pit.



Figure 15.
Remnants of an
old plane crash.



Figure 16.
Students digging
for artefacts.

16. Weather Station Data

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

Description: In partnership with the Université de Québec en Montréal, 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 as well as facilitates our long term monitoring mandate.

Results Summary:

- Please see graphs and tables below for a summary of the data collected by the weather station to date.

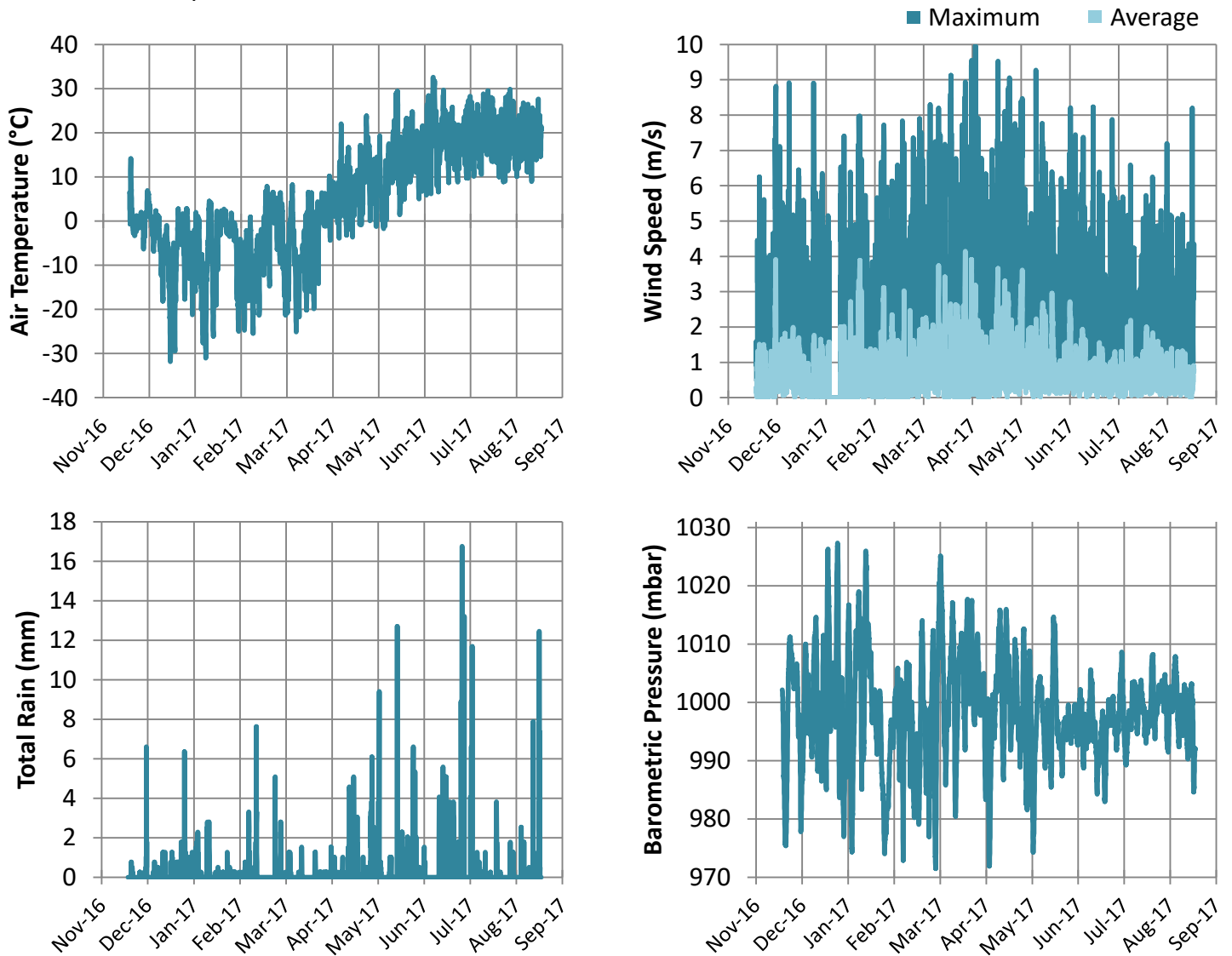


Figure 17. Various weather parameters as measured by the weather station.

2018 Upcoming Research Projects

Sixteen research projects are planned for 2018, many of which are continuations of our 2017 projects. Some projects are still tentative and some may still be added over the course of the year.

Continued Projects (from 2017)

1. Biodiversity Project
2. Vernal Pool Hydrology and Herpetology Project
3. Tree Growth and Productivity Project
4. Forest Resilience Project
5. Integrated Forestry Planning Project
6. Papineau Lake Hydrology Project
7. Papineau Lake Trout Telemetry Project
8. NCC Biodiversity Inventory
9. Papineau Weir Monitoring Project
10. Papineau Loon Nesting Project
11. Papineau Lake Water Quality Monitoring Project



New Projects

12. Forest Tent Caterpillar Project (Concordia University and UQAT)

Description: Determine the interactions between forest tent caterpillars and forest composition as well as the role of predation in outbreak dynamics and the effects on litter, soils and tree regeneration.

13. Landscape Scale Wildlife Corridor Project (Concordia University)

Description: The Adirondack – Laurentians ecological corridor boasts a wide variety of habitats that still maintain ecological integrity and are rich in biodiversity. This corridor is one of only five north-south wildlife corridors for animal movement in Québec, and thus, there is growing concern to identify and protect the connectivity of the landscape to ensure the preservation of the corridor.

14. Bat Project (McGill University)

Description: Using batwatch (batwatch.ca) this project will work to fill the data gaps between Gatineau and Montreal and identify bat maternity roosts at Kenauk.

15. Canadian Warbler and Forestry Project (NCC)

Description: This projects goal is to study the impact of partial cuts on the structure and composition of avian communities in riparian forest environments with a specific focus on Canada warblers.

16. Moose Tick Project (Laval University and the MFFP)

Description: A telemetry tracking and moose health data collection program will be established across the province, with a specific focus on calves and moose recruitment. Topics include 1) 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.

2017 Educational Programs

Seven educational programs were successfully completed in 2017.

1. Outward Bound and YMCA Program (2 summer programs)

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. Being 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 they learn they are capable of more than 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 (2 field trips)

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

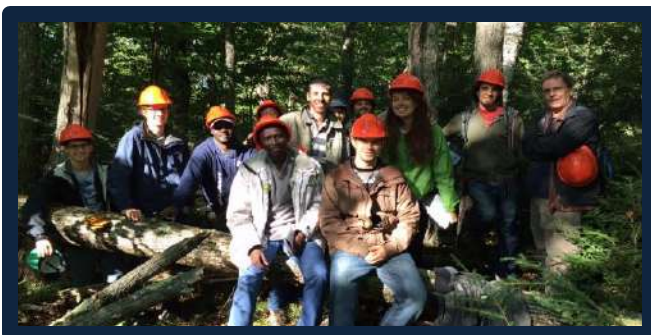
The Tohoku University CHaNGE program is a faculty-led study program in Canada for Japanese students. It included a two week discovery tour of Canada's historical and natural heritage with environmental and climate change themed visits to McGill University, Ottawa University and the Kenauk Institute.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

4. ISFORT M.Sc. Program

The ISFORT M.Sc. program is a professional masters in the sustainable management of forest ecosystems offered jointly by UQAM, UQO and UQAT. It's specialized for people who are interested in 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 facilitate the program. This program is two weeks long and repeated annually, it has been held at Kenauk in the past.

5. McGill University Mammology Class Field Trip

During the winter of 2017 Kenauk hosted the McGill University mammology class. Their field trip included snow shoeing around the property in search of animal prints and coyote scat. Students learned about local mammals and their winter biology by identifying and analyzing animal prints in the snow. They also searched for coyote prints and scat to supplement the data collection for an existing Kenauk Institute project on analyzing coyote diets based on DNA analysis of scat samples.



6. Kenauk Institute Internship Program

The Kenauk Institute has committed to providing undergraduate internships and a graduate senior internship for students studying biology at McGill and other Universities. Interns are expected to juggle a variety of responsibilities including 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, such as writing a good CV, creating posters and presentations, boat driving and wilderness first aid training.

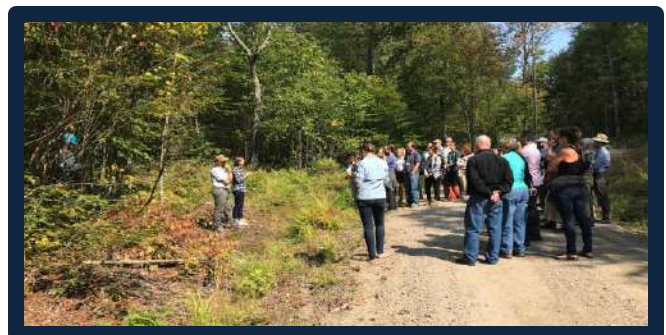


2018 Upcoming Educational Programs

Many of the educational programs will be repeated in 2018 including both Outward Bound / YMCA programs, the Saint-Michel elementary school field trips, and potentially the Tohoku, ISFORT and McGill programs. The Kenauk Institute will continue developing educational programs for high school and university students, including a millennial program in partnership with the Bishops College School and Westover School focused on research and outdoor adventure.

2017 Conference and Site Visit

In 2017 the Kenauk Institute held its first site visit and conference. This was an opportunity for researchers and students alike to become familiar with Kenauk and the opportunities we have to offer in terms of research and educational programs. The day consisted of presentations/talks as well as a site visit. We had 50 participants representing over 14 different universities and organizations.



Research and Educational Partnerships

