Annual Report of Research and Monitoring in the Greater Kejimkujik Ecosystem 2009

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Mersey Tobeatic Research Institute

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Cover photos from top left:
- Snapping turtle at Perch Lake by A. Belliveau, MTRI
- Rose root at Delaps Cove by A. Belliveau, MTRI
- Old growth forest near Sporting Lake by A. Belliveau, MTRI
- Oakland Lake campsite by A. Belliveau, MTRI
- Eight adult loons on Cobrielle Lake by N. Burgess, Environment Canada

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Annual Report of Research and Monitoring in the Greater Kejimkujik Ecosystem 2009

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INTRODUCTION

This is the fifth Annual Report of Research and Monitoring in the Greater Kejimkujik Ecosystem. As with previous editions, this one was inspired by a very similar series piloted by the Parks Canada Western Arctic Field Unit. This report serves as a compilation of the research and monitoring projects that were conducted in the Kejimkujik area. The summaries are all written by the researchers who are listed as contacts for each project but the report as a whole is a collaborative effort between Kejimkujik National Park and National Historic Site of Canada (Kejimkujik) and the Mersey Tobeatic Research Institute (MTRI). A committee comprised of Amanda Lavers and Crystal Doggett (MTRI), Sally O'Grady, Darien Ure, and Chris McCarthy (Parks Canada) collected, edited, and prepared the publication. Many thanks to all the researchers who took the time to submit the research and monitoring project summaries this year.

This report was produced in spring 2010 and is a compilation of the research and monitoring projects that were conducted in the Kejimkujik area in 2009 by Parks Canada, MTRI, and their partners. The purpose of the report is to make information about these projects available to the public, government agencies, researchers and other stakeholders.

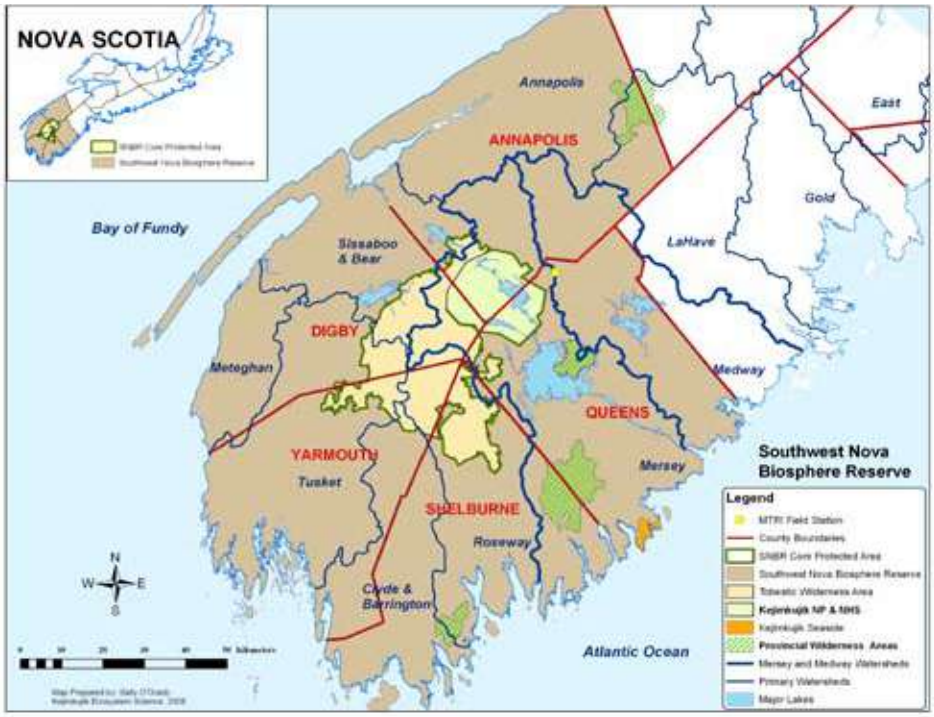
Research and monitoring projects provide the information necessary to make wise management and conservation decisions. The projects in this report are organized in four chapters corresponding to Kejimkujik's Ecological Integrity (EI) Indicator Ecosystems: Coastal, Forest, Wetland, and Freshwater, with an additional chapter highlighting research about the Human Dimensions of sustainable resource use. Projects are categorized as either monitoring or research projects.

The research and monitoring projects detailed in this report are important tools for attaining sustainable management of our natural resources and maintaining ecological integrity of our protected areas. The monitoring projects are conducted to keep track of how the ecological systems around us are changing over time and examine the effectiveness of management actions. The research projects provide a better understanding of the ecology of the area and how it is affected by natural and human-related influences. Overall, they indicate an impressive amount of work that is being undertaken in Kejimkujik and the surrounding area.

Kejimkujik represents the Atlantic Upland Natural Region in Parks Canada's network of protected areas. Kejimkujik consists of 381 km^2 inland and 22 km^2 on the coast and, in combination with the Tobeatic, is the core area of the Southwest Nova Biosphere Reserve. Since its establishment, Kejimkujik has been an important centre of science for southwest Nova Scotia. In collaboration with partners, research and monitoring in the park and surrounding landscape has informed decision-makers on a number of management issues at local, regional and national scales. Kejimkujik was declared the first Ecological Monitoring and Assessment Network site in Canada (1993) and was the first in Canada to install a Smithsonian Institution Monitoring and Assessment of Biodiversity plot (1994). Kejimkujik also serves as one of five core Canadian Acid Precipitation Monitoring Network sites that monitor the long-range transport of air pollutants and is a long-term climate monitoring station for Environment Canada. In 1995, Kejimkujik was designated a national historic site (the only national park in Canada with this dual designation) highlighting the cultural significance of the area and the importance of aboriginal peoples to understanding and presenting commemorative integrity. Kejimkujik is identified by the Parks Canada Agency as a species at risk priority site where stewardship and recovery are paramount. More information about Kejimkujik can be found at www.pc.gc.ca/pn-np/ns/kejimkujik or at the Friends of Keji Cooperative Association website (www.friendsofkeji.ns.ca).

The Mersey Tobeatic Research Institute (MTRI) is a non-profit co-operative with a mission to advance collaborative research, monitoring, and management that promotes sustainable use of resources and biodiversity conservation in the Southwest Nova Biosphere Reserve. MTRI maintains a field station that provides office workspace, accommodation for researchers, space for public presentations and a site for learning. MTRI provides expertise in the community and coordinates research and monitoring projects to address the goal of sustainable resource management. MTRI also provides an important link from research to the public through an active outreach and education program. More information about the co-operative is available at www.merseytobeatic.ca.

The Southwest Nova Biosphere Reserve (SNBR) comprises a large portion of terrestrial and coastal southwestern Nova Scotia (see map below). The United Nations Educational, Scientific and Cultural Organization (UNESCO) internationally recognizes a biosphere reserve as an area in the world that is deemed to demonstrate a "balanced relationship between humans and the biosphere." Biosphere reserves around the world fulfill the following three functions: conservation, sustainable development, and capacity building. Collaborative efforts among people in the designated area promote the sustainability of local economies and communities, as well as the conservation of the ecosystems. A biosphere reserve is also a mechanism used for regional planning and multi-sector collaboration. It offers an opportunity for the community to envision sustainability for the region and to work towards achieving it. In 1999, a group of volunteers from Queens and Annapolis counties in Nova Scotia developed a proposal for the establishment of a UNESCO Biosphere Reserve incorporating Kejimkujik and the Tobeatic as the core protected area. This group of volunteers later became incorporated as the Southwest Nova Biosphere Reserve Association (SNBRA). In September 2001, the nomination document received approval and the region of southwest Nova Scotia was designated a biosphere reserve by UNESCO.



S. O'Grady, Parks Canada

Kejimkujik and Tobeatic comprise the core area of the Southwest Nova Biosphere Reserve

Photos on page 9 by A. Belliveau, MTRI
Clockwise from top left:
- Old posts on Crescent Beach
- Herring gull in Clare
- Beach at Saint Mary's Bay
- Willet at Crescent Beach
- Footsteps in the sand at Meteghan River

COASTAL

Rationale

The Piping plover is a small shorebird that has been listed as an Endangered species by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) since 1985. Presently, the Piping plover nests on the white sandy beaches of southwest Nova Scotia, including St. Catherine's River Beach at the Kejimkujik Seaside. In recent years, the number of nesting pairs of Piping plover in the province has decreased significantly due to habitat disturbance, loss and fragmentation, predation and development of over-wintering grounds. The Piping plover is often referred to as a *management dependent species*, as sustained management actions are needed to maintain and increase population levels. Park staff have monitored plover adults and chicks within the park since 1985 to assess Piping plover population levels at the Kejimkujik Seaside (and southwest Nova) and to implement a suite of management strategies focused on protecting and sustaining plover numbers.

J.W. Chardine

Piping plover chick

Monitoring

PIPING PLOVER MONITORING PROGRAM

OBJECTIVES

- To monitor the number of breeding pairs of Piping plover and their productivity (number of chicks fledged per pair).
- To monitor the extent of suitable nesting habitat for Piping plover in Kejimkujik and restore a portion of nesting habitat on St Catherine's River Beach.
- To examine predation and abandonment of nests through deployment of a digital video recorder.
- To note predators or signs of predators on St Catherine's River Beach.

D. Smith, Parks Canada

Habitat restoration efforts at Kejimkujik Seaside

METHODS

- Park staff monitored St. Catherine's River Beach frequently during Piping plover nesting season. This was done at a distance with binoculars and spotting scopes. Other birds and animals, particularly predators, were also noted.
- Nest, chick, and habitat observations were recorded. Nests were located by observing territorial birds and individuals exhibiting nesting behaviours.
- After a minimum of three eggs were laid (of four in a full clutch) nests were numbered and georeferenced.
- A digital video recorder was deployed on nests with 4 eggs to monitor potential predation and study abandonment rationale.
- Habitat restoration was completed on one section of St Catherine's River Beach, through removal of dense marram grass, using a tractor and by hand.

RESULTS

- Three pairs of Piping plovers were observed at St. Catherine's River Beach and four nest attempts were documented.
- The first two nests had video recorders placed on them; unfortunately, technical difficulties caused no footage to be documented. Both of these nests hatched completely and a total of 6 of 8 chicks were fledged.
- The third pair had two unsuccessful nest attempts.
- The habitat management efforts this year focused on modifying the original management zone to follow natural contours on the beach in an effort to mimic natural blow-outs.

YEARS OF DATA

- Ongoing project since 1985

PARTNERS

- Parks Canada
- Piping Plover Recovery Team (Eastern Canada)
- Bird Studies Canada
- Environment Canada
- Province of Nova Scotia

Parks Canada

Volunteers receiving instruction before working on the habitat restoration project

Parks Canada

Park staff setting up cameras to record Piping plovers

Parks Canada

Volunteers

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Rationale

The Annapolis Basin has historically been a productive area for clam harvesting, however reductions in the soft shell clam population as well as closures to harvest areas have had negative impacts on the industry and the clam harvesters in the area. With support from the Nova Scotia Department of Fisheries Innovation Fund, the Bay of Fundy Marine Resources Centre contracted Clean Annapolis River Project (CARP) to evaluate options for enhancing soft shell clam populations in the Annapolis Basin.

Labelled soft shell clam prior to relocation

Research

SOFT SHELL CLAM ENHANCEMENT TRIAL

OBJECTIVES

- To evaluate the effectiveness of techniques for enhancing wild clam spat settlement in the Annapolis Basin.
- To evaluate if the growth rate of soft shell clams could be increased by relocation of the clams on a beach.

METHODS

- Between July and October 2009 two enhancement approaches were evaluated.
- The first enhancement project assessed techniques to enhance the settlement of soft shell clam spat. This was carried out at two sites in the Annapolis Basin: Twin Cove Road and Pony Road. The two sites differed in bottom substrate, with Twin Cove being a gravel-sand beach and Pony Road being a muddy-silty area.

  • The project investigated the effect that four techniques had on encouraging wild spat to settle. These techniques included: sediment roughing, netting, balsam fir bough brushing and using snow fencing.

  • On July 13th and 14th, 25m x 25m enhancement plots were established at each site with five 1m x 1m subplots of each treatment randomly assigned within, as well as five control subplots. The plots were kept in place until October 13th at Pony Road and October 16th at Twin Cove Road. Post treatment sediment samples were then taken from each subplot and examined for the presence of soft shell clam spat and results were compared based on treatment type as well as site location.
- The second enhancement project examined the difference in growth rate when clams are relocated from a high tide intertidal zone to a low intertidal zone. Clams were planted at Twin Cove Road along a 10m transect in densities of 20, 10, or 5 clams per 25cm x 25cm quadrat. The two zones differed in their bottom substrate with the high tide composed of grain-sand and the low tide area composed of muddy-silt.

Pony Road clam enhancement site, Annapolis Basin

RESULTS

- No significant difference was found in spat settlement between treatments at either site. Neither was a significant difference found in the abundance of spat recovered between the two sites.
- Clams planted at the low tide level experienced significantly more growth than those at the high tide level. No difference was found comparing the effect of density on growth. Recovery of relocated clams, particularly at the low tidal area was extremely low (60% recovery at the high tide level compared to 23% at the low tide level).

YEARS OF DATA

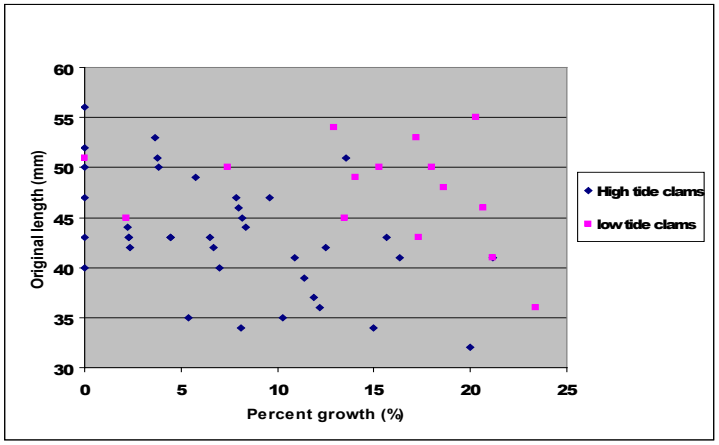
- Single year project

PARTNERS

- Bay of Fundy Marine Resource Centre
- Nova Scotia Department of Fisheries and Aquaculture Innovation Fund

CARP

Marla Bojarski prepares a site for clam growth enhancement trial



CARP

Percent growth of clams at the high & low tide level as a function of original length

CARP

The use of netting, one of the four spat settlement treatments evaluated

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Rationale

The Kejimkujik Seaside Coastal Change Project investigated the natural history that Kejimkujik Seaside has experienced in the past 80 years. The project used seven sets of aerial photos (1927, 1945, 1965, 1976, 1992, 2000 and 2007) to investigate how two sensitive lagoon and barrier beach complexes have moved and changed since 1927. By processing each aerial photo, a digital database of ecosystem communities for each study year was created. Analysis focused on the rate of movement of each barrier beach and how sensitive coastal habitats, such as salt marsh, have adapted to the shifting landmass. Special care was placed on the observed relationship between ecosystems as they adapt, shift, expand or recede during these periods of change. The results of this project have given insight into the dynamic nature of this coastal environment, and will be used to make future monitoring decisions.

Little Port Joli lagoon with barrier beach seen in the background

Research

KEJIMKUJIK SEASIDE COASTAL CHANGE

OBJECTIVES

- To create a digital database of coastal ecosystem communities for each study year.
- To map ecosystem communities for each study year.
- To analyze landform change.
- To analyze coastal ecosystem change

METHODS

This study involved three steps:

- Orthorectification: Assigning each aerial photo geographic reference.
- Delineation: Identifying ecosystems on each aerial photo and drawing polygons around each.
- Classification: Classifying each polygon delineated with the appropriate ecosystem class. A total of 24 classes were used to create a digital database of coastal ecosystem communities for each study year.

RESULTS

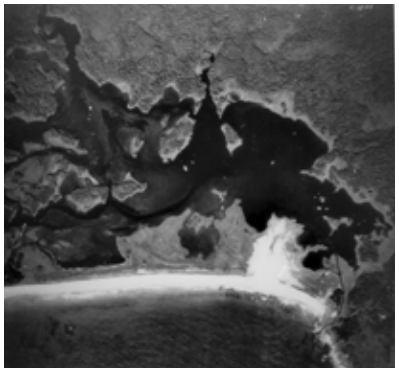
- A series of ecosystem maps was created for each study year, showcasing the coastal change for both St. Catherine's River and Little Port Joli Basin areas.
- Significant events occurred between 1945 and 1965 at the St.Catherine's River lagoon which saw a large opening in the barrier beach, exposing the lagoon system to the Atlantic Ocean.
- The extent of St. Catherine's River lagoon has changed significantly in the last 80 years while the Little Port Joli lagoon has remained relatively stable with little visible change.
- The St. Catherine's River barrier beach has moved approximately 160 m inland at a rate of 1.2 m/year since 1927. The Little Port Joli barrier beach has only moved approximately 16 m or 0.2 m/year.
- Even though the separation between each basin is only 500 m, the two have had significantly different natural histories. Little Port Joli remains relatively stable while St. Catherine's River is quite dynamic.

YEARS OF DATA

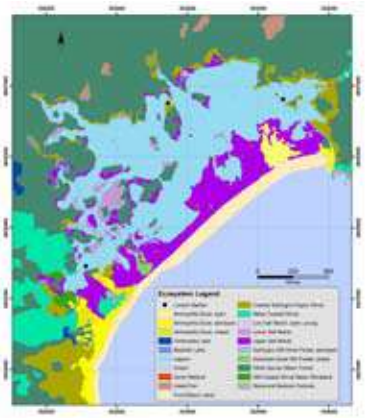
- Single year project

PARTNERS

- Applied Geomatics Research Group (AGRG)
- Acadia University
- Parks Canada

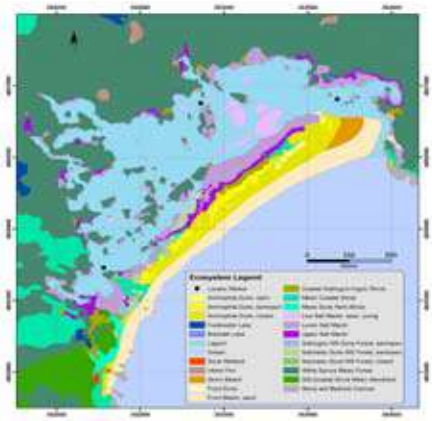


1927 aerial photo of St. Catherine's River Basin



1927 ecosystem map of St. Catherine's River Basin area

2007 aerial photo of St. Catherine's River Basin



2007 ecosystem map of St. Catherine's River Basin area

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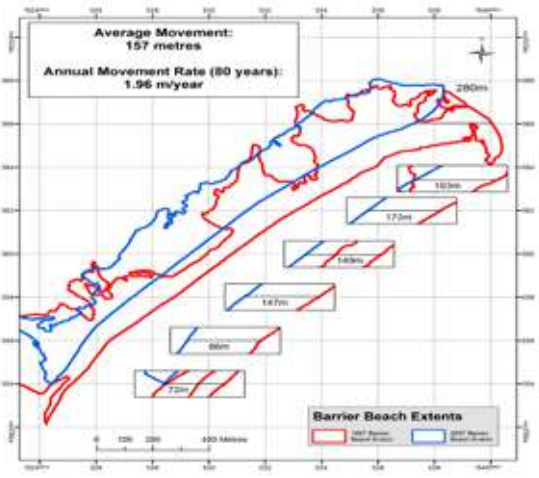


AGRG

St. Catherine's River barrier beach movement map, showing the difference between the 1927 extent and the 2007 beach extent

Photos on page 17 by A. Belliveau, MTRI
Clockwise from top left:

- Pink Red maple at Pretty Mary Lake
- Prescribed burn at Big Dam Lake
- Lady slipper near the Medway River
- Old growth conifers at McVickers Lake
- Hemlock varnish shelf fungus at Medway Lake

FOREST

Rationale

Forest birds are useful indicators of ecological integrity. They are relatively easy to detect and monitor, can highlight changes in forest conditions, are linked to forest stand type, and are sensitive to a broad range of ecosystem changes. Forest birds are monitored as part of Kejimkujik's Ecological Monitoring and Reporting Program which assesses changes in ecological integrity over time by monitoring and reporting on forest, freshwater, wetland and coastal indicators.

M. Crowley

Red-eyed vireo

Monitoring

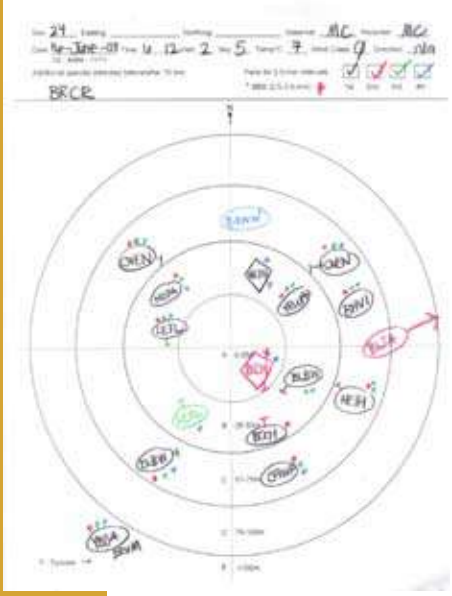
FOREST BIRD MONITORING IN KEJIMKUJIK

OBJECTIVES

- To monitor forest birds as an indicator of ecological integrity using point counts in hardwood-dominated mixedwood and hemlock sites in Kejimkujik.
- To report on forest bird health for Kejimkujik's State of the Park Report by analyzing community similarity and trends in bird abundance for 22 bird focal species in the two forest types.

METHODS

- Point count surveys were conducted in hardwood-dominated mixedwood and hemlock sites in 2003, 2004, and 2009.
- These sites were surveyed twice in June by recording all birds detected during a ten-minute point count period. Abundance was measured by a count index indicating the maximum number of potential pairs of each species detected at each point during those two visits.
- The data from 2003 and 2004 were averaged to create a reference year to compare with the data collected in 2009.
- Percent similarity was calculated for each focal group at the level of the forest stand to analyze trends in community similarity. A Poisson generalized linear mixed-effects model was fit to each bird focal group using the maximum number of potential pairs as the response variable to analyze trends in bird abundance. All analyses were done using R (version 2.10).



M. Crowley

Example of a completed point count data sheet with distance bands and showing the time-to-detection method.

RESULTS

- The community similarity analysis produced mean results for all bird focal species groups above the chosen threshold value, suggesting that community similarity for bird species in mesic hemlock and hardwood-dominated mixedwood forests has remained stable over the past five years.
- There was no significant increasing or decreasing trends observed in bird abundance for the bird focal groups.

RESULTS
Continued

- Bird monitoring programs typically require 10-20 years of data before trends become meaningful. The results in this report are based on an analysis of two points in time (2003/4 baseline and 2009), making it difficult to draw firm conclusions. Further years of monitoring will increase the ability to detect trends.
- Many additional factors were discussed. To view the full report, request a copy of Kejimkujik's State of the Park Report 2010 Technical Compendium.

YEARS OF DATA

- 2003, 2004 and 2009

PARTNERS

- Parks Canada
- Dalhousie University

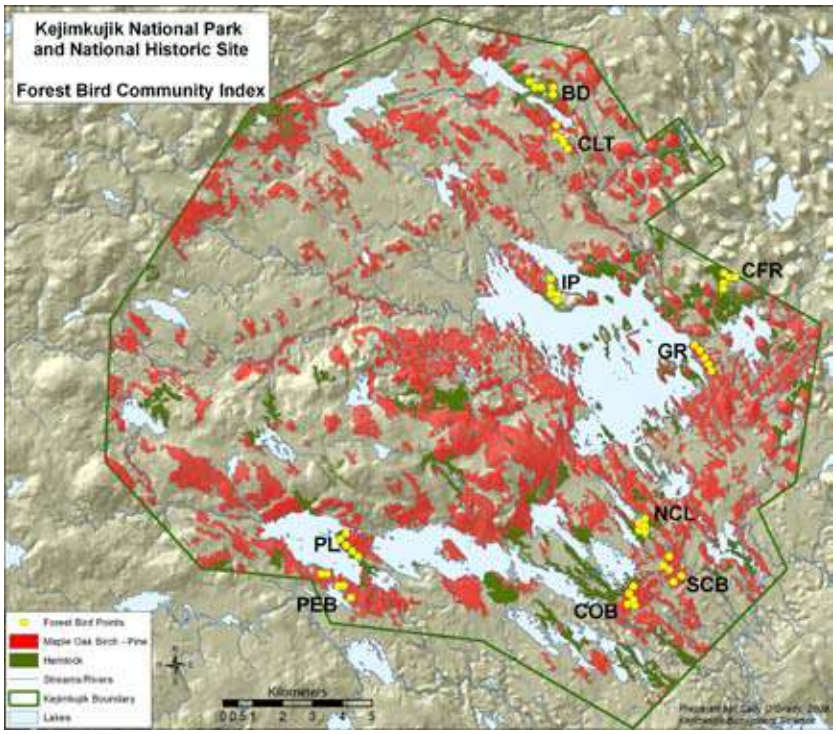
Mature Mesic Hardwood Dominated Mixedwood Forest Species	Mature Mesic Hemlock Dominated Forest Species	Mature Mesic Forest Species (found in both Mixedwood and Hemlock)
Ovenbird Red-eyed vireo Yellow-bellied sapsucker Least flycatcher Black-throated blue warbler Veery Downy woodpecker Eastern wood pewee	Blue-headed vireo Blackburnian warbler Black-throated green warbler Swainson's thrush Golden-crowned kinglet Brown creeper Bay-breasted warbler	Hermit thrust Northern parula Yellow-rumped warbler Hairy woodpecker Black-capped chickadee Red-breasted nuthatch Pileated woodpecker

Forest bird focal groups

M. Crowley

J. Barteaux

Megan Crowley performing a point count in Big Dam forest stand



S. O'Grady, Parks Canada

Location of bird monitoring forest stands at Kejimkujik (BD: Big Dam, CLT: Channel Lake Trail, IP: Indian Point, CFR: Canning Field Road, GR: Grafton Road, NCL: North Cranberry Lake, SCB: Square Camp Brook, COB: Cobrielle, PEB: Pebbleloggitch, PL: Peskawa Lake)

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Rationale

Christmas Bird Counts have been carried out annually for over a century. They have been conducted at several locations in Nova Scotia over the last 50 years. Currently, within Nova Scotia, approximately 35 Christmas Bird Counts are conducted every year. The counts occur on one day between mid-December and early January (hence the name Christmas Bird Count) within the same set area. The bird counts document early winter birds and can be compared from year-to-year and area-to-area. The Nova Scotia Bird Society maintains a master record of all counts within the province and annually reports the counts with notes on the unique results of that year.

Mourning dove in winter

Monitoring

CALEDONIA CHRISTMAS BIRD COUNT

OBJECTIVES

- To document early winter birds during an ongoing annual survey.
- To record sufficient data so that the results may be compared from year-to-year and count-to-count.
- To utilize interested volunteer members of the public to complete the annual count.
- To publicize the results to inform and interest the local public in the bird communities of the Caledonia area.

METHODS

- Annually, a one day Christmas Bird Count has been held between specific dates determined by the Audubon Society between mid-December and early January.
- The count was held on one specific day from midnight to midnight.
- The count has always been held in the same area - a circle of 24 kilometers diameter centered where a brook flows northward out of Donnellan Lake in West Caledonia.
- The coordinator organized volunteers to cover different areas so the maximum number of habitats were searched and the most species located while preventing repeated counting of the same birds in the same areas.
- The bird species and their numbers were recorded.
- The time spent in the woods and at bird feeders, distances traveled, methods of travel and numbers of people involved were recorded to compare the effort by observers.

Amanda Lavers taking part in the 2009 Caledonia Christmas Bird Count

RESULTS

- This is Nova Scotia's only entirely inland Christmas Bird Count.
- The December 20, 2009 count noted 29 bird species and 1316 total birds.
- Twenty-three observers participated despite impending stormy weather.

RESULTS
Continued

- The most common birds observed were Black-capped chickadee, Evening grosbeak, and American goldfinch.
- Unusual observations included a Hermit thrush and Song sparrow which are not usually seen this far north in winter and one Herring gull.
- Compared to counts at other locations, Caledonia's count for White-breasted nuthatch and Evening grosbeak was very high.
- Across Nova Scotia, the count for Pine siskin was low this year.

YEARS OF DATA

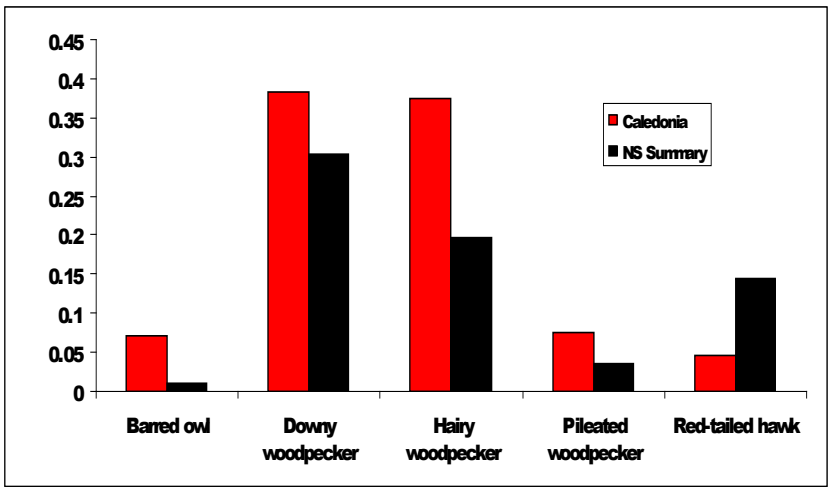
- Ongoing project since 1991

PARTNERS

- Nova Scotia Bird Society (NS summary data provided by David Currie)
- Mersey Tobeatic Research Institute

A. Belliveau, MTRI

Downy woodpecker



MTRI

Comparison of the 10-year average number of birds per party hour recorded in the Caledonia Chrismas Bird Count to the summary of all Nova Scotia Christmas Bird Counts

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Rationale

Nocturnal owls are surveyed across Canada as indicators of forest ecosystem health. As top predators in the food chain, they are vulnerable to habitat disturbance. Barred owls have specialized habitat requirements that link them to large hardwood trees for cavity nesting. Additionally, they are sensitive to forest cover and composition changes associated with forest management activities. Owls are not easy to monitor due to their secretive, nocturnal activities. They roost for much of the day and attempts to conduct visual surveys are challenging. Bird Studies Canada coordinates surveys in all three Maritime provinces. Locally, two official routes have been conducted annually since 2002 while a third, unofficial route, was established in 2005. These surveys document relative owl counts and note changes over time within landscapes being changed by forest harvesting and human developments.

A. Lovers MTRI

Barred owl

Monitoring

NOCTURNAL OWL SURVEY

OBJECTIVES

- To carry out an annual survey of nocturnal owl populations on established routes.
- To compare local populations within Nova Scotia, within the Maritimes and within Canada.

METHODS

- At night, volunteer surveyors drove their designated route and stopped every 1.6 kilometers. At each stop they broadcast recordings of owl calls prepared by Bird Studies Canada and recorded the number and species of owls heard or seen.
- Route 40 was surveyed by Peter Hope. This route began on highway Route 8, eight km north of Mersey River Bridge in Maitland Bridge and continued north to South Milford.
- Route 41 was surveyed by Donna Crossland. with the aid of 18 volunteers. This route began at the Kejimkujik entrance and ended near the Gold Mines trailhead.
- One unofficial route, using the same protocol, began at the entrance of the Devonshire/ Rossignol Road and continued towards the Mersey River. This route was surveyed by Peter Hope.

M. Elderkin

Saw-whet owl

RESULTS

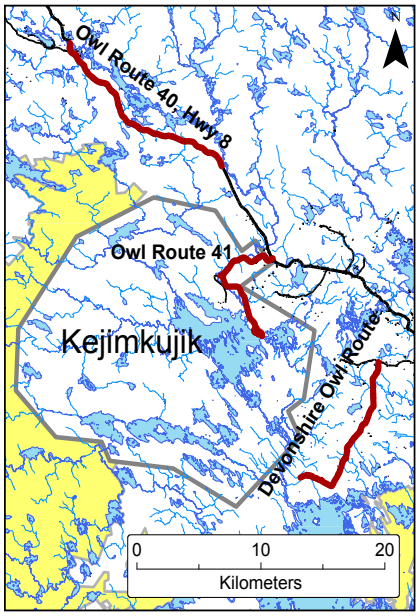
- In spring 2010, 18 Barred, five Saw-whet and two Long-eared owls were reported. In other years Great horned owls have also been detected.
- The Route 40 survey (along Route 8) detected two Barred and two Saw-whet owls on April 24, 2010.
- The Route 41 survey (within the park) detected 16 Barred owls and one Saw-whet owl on April 23, 2010.
- The Devonshire / Rossignol survey detected two Long-eared owls and two Saw-whet owls on April 25, 2010.

YEARS OF DATA

- Ongoing project since 2002

PARTNERS

- Parks Canada
- Bird Studies Canada
- Mersey Tobeatic Research Institute

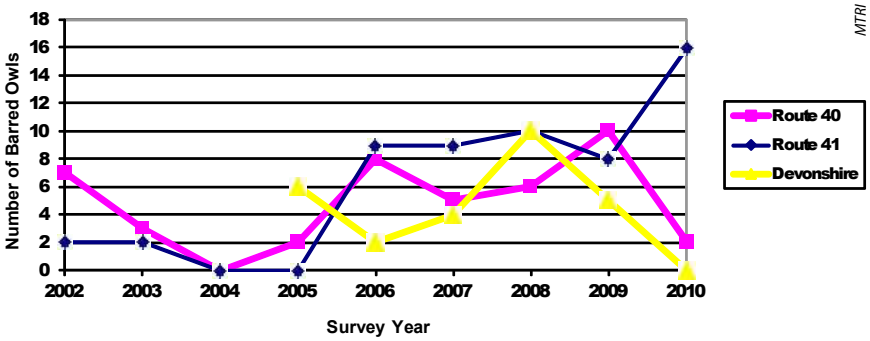


A. Belliveau, MTRI

Owl survey routes are indicated in red

J. Mundle, NBDNR

Barred owl observed during nocturnal monitoring



MTRI

Number of barred owls detected on three survey routes. The Highway 8 (Route 40) and Kejimkujik (Route 41) routes have been surveyed since 2002 and the Devonshire/Rossignol route has been surveyed since 2005

D. Crossland, Parks Canada

Volunteers helping Donna Crossland with nocturnal owl survey

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Rationale

Once common throughout Nova Scotia, the American marten is now limited to two known populations in the province: Cape Breton Island and the western portion of mainland Nova Scotia. The mainland marten population, with a hotspot centred near Weymouth, is classified as 'data deficient' by the Nova Scotia Department of Natural Resources. This population is believed to be at least partially the result of a reintroduction program that released 116 marten from New Brunswick into 11 sites at Kejimkujik between 1987 and 1994. In 1979, the last reported marten trapped on mainland Nova Scotia was from this area, which suggests a remnant population may have existed prior to the Kejimkujik releases. To determine the presence or absence of rare or endangered mammals in remote areas, hair snag stations can be used to collect DNA samples, which can be used to determine the health and size of a population.

H.Maillhot-Couturel

Release of marten after incidental catch during live trapping session for flying squirrels

Monitoring

SWNS MARTEN DISTRIBUTION

OBJECTIVES

- To determine the distribution, size and health of the southwestern Nova Scotia (SWNS) marten population.
- To develop an understanding of the multi-scale habitat associations of the SWNS marten population.
- To determine the efficacy of various hair snag techniques using captive animals being held at the provincial wildlife park at Shubenacadie as well as in the field.
- To collect hair samples for future analysis to determine health and size of the SWNS marten population.

METHODS

- Marten habitat models were developed for the five SWNS counties using current forest inventory data and geographic information systems (GIS).
- The Trappers Association of Nova Scotia and other volunteers placed four to eight hair snags (a baited wooden trap equipped with glue patches for hair sampling) within 5 km^2 grids predicted to contain marten habitat (based on the GIS habitat model), in areas that form natural funnels or crossings.
- Hair snags were checked every four days for 12 days or until tracks, scat or hair was found in or around the snag.
- Hair was collected to verify species identification.
- Habitat information was collected at each hair snag site to populate the GIS habitat model.

H.Clapp

Marten hair snag station

RESULTS

- From the 193 surveyed locations, 99 had evidence of marten, 26 locations found no marten present and 68 blocks are waiting for hair analysis to determine if marten hair was found.
- From 2007-2010 trappers placed hair snags in 193 locations throughout SWNS. Of the 193 locations, trappers recorded

H. Clapp

Track found near a marten hair snag station

RESULTS *Continued*

the quality of habitat at 25 sites. Most martens were in mature softwood forest stands, mixed wood forest stands, regenerating softwood thicket forest stands, old growth forest stands, and forest stands with lots of woody debris.

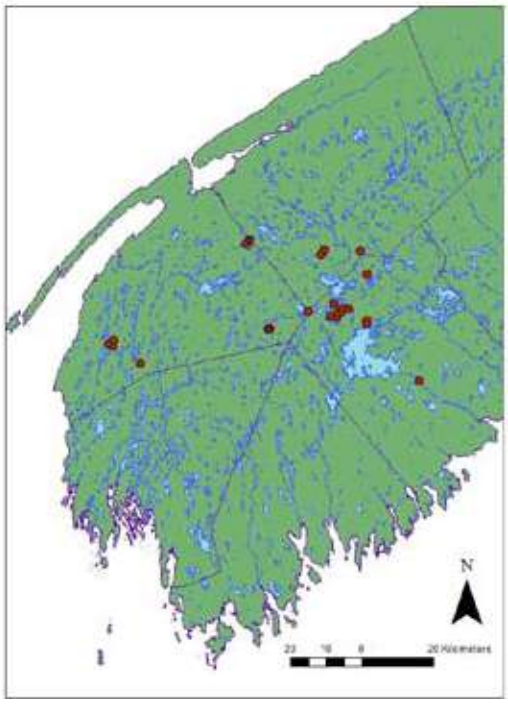
- Based upon the use of hair snags thus far it has been recommended that trappers and researchers record habitat and forest stand type for each location they set up hair snags to provide a better understanding of marten habitat.
- The NSDNR habitat model has proven valuable and should be reviewed and updated, perhaps to include coarse woody debris which has been present in many places where marten have been located.

YEARS OF DATA

- Year 3 of a 3 year project

PARTNERS

- Trappers Association of Nova Scotia
- Nova Scotia Department of Natural Resources
- Nova Scotia Habitat Conservation Fund



NSDNR

Evidence of marten was recorded within southwestern Nova Scotia in the locations marked by red dots

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Rationale

Flying squirrels may be sensitive to fragmentation and good indicators of landscape connectivity because they need mature trees to climb for gliding and to sleep in during the day. To understand the connectivity requirements of flying squirrels in Nova Scotia, local life history data are required to determine how long they live, how many young they have and how they disperse. With this project, live-trapping, passive integrated transponder (PIT) tags and nest boxes were used to collect life history data for flying squirrels. PIT tags are small glass microchips that are inserted under an animal's skin and that provide the time, date and unique code for the animal when they pass through a circular antenna.

T.Garde

Flying squirrel in a tree

Monitoring

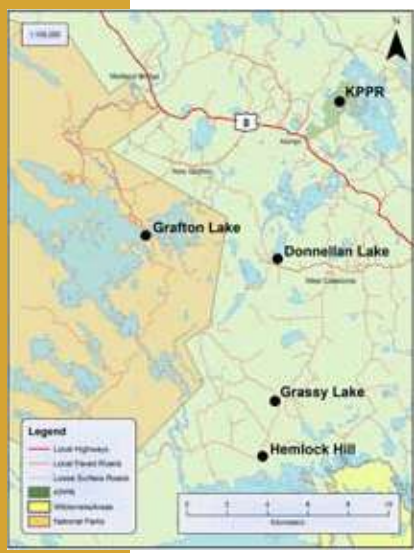
MONITORING FLYING SQUIRREL SURVIVORSHIP

OBJECTIVES

- To determine survivorship of flying squirrels.
- To determine fecundity (ability to produce young) of flying squirrels.

METHODS

- Study grids were installed at six sites in the Mersey and Medway watersheds with wooden brackets placed on the south side of trees at chest height.
- Live traps were placed on the brackets and baited with peanut butter and apples.
- Captured flying squirrels were measured, implanted with PIT tags and released where they were caught.
- PIT tag receiving stations were placed within the grid to monitor survivorship.



A. Belliveau, MTRI

Map of Upper Mersey Watershed showing each of the four study sites

RESULTS

- Between January and April of 2010, 50 flying squirrels (21 Southern and 29 Northern) were live-trapped near Donnellan Lake, Grafton Lake, Hemlock Hill and Kempt Provincial Park Reserve (KPPR).
- Seventeen flying squirrels were recaptured from previous years. Fourteen of these had been PIT tagged last year, two had been tagged two years ago, and one remained from three years ago.
- Fourteen Northern flying squirrels were captured at KPPR this year where none were found last year.
- Incidental captures included two rare American marten, one Weasel and one Red-backed vole.

YEARS OF DATA

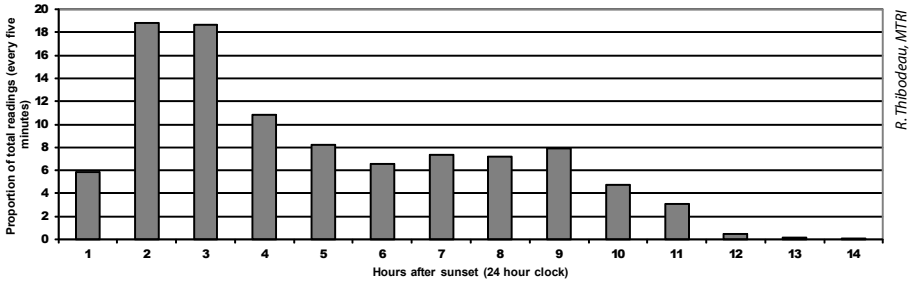
- Ongoing project since 2005

PARTNERS

- Mersey Tobeatic Research Institute
- Parks Canada
- Nova Scotia Habitat Conservation Fund
- YWCA
- Acadia University

R.Thibodeau, MTRI

Release of a flying squirrel



R. Thibodeau, MTRI

Proportion of Northern and Southern flying squirrel visits to PIT tag monitoring stations by hour after sunset for data collected between 2005-2010 using a total of 1061 data points

R. Thibodeau, MTRI

Flying squirrel being carefully measured and PIT tagged

A. Belliveau, MTRI

Rachel Thibodeau handles a Short-talied weasel that was caught in a squirrel trap

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Rationale

Plethodontid salamanders lack lungs and breath through their glandular skin and the roofs of their mouths, which must remain moist for respiration; they are vulnerable to desiccation and soil contaminants. Plethodontids can reach high densities in many forest habitats and play an important role in ecosystem food webs and detrital dynamics. They are completely terrestrial, occupy a small home range, and have stable population sizes under normal conditions, making them good indicator species. The only common plethodontid in Kejimkujik is the Eastern red-backed salamander. Salamanders are monitored as one component of the integrated forest plots designed to assess and monitor the state of forest ecosystems at Kejimkujik and detect changes over time. Other forest measures assessed at these plots include the following: forest birds, trees, shrubs, ground vegetation, soil decomposition rates and lichens.

S. Chisholm, Parks Canada

Yellow spotted salamander

Monitoring

PLETHODONTID SALAMANDER MONITORING

OBJECTIVES

- To monitor plethodontid salamander abundance in mixed and hemlock forest ecosystems of Kejimkujik.

METHODS

- Salamander abundance was assessed at twelve long-term integrated forest plots that were established in 2003 in mixed and hemlock forest ecosystems using a stratified random sampling design.
- Within these plots, salamander abundance was assessed once per week for four weeks in mid-September to mid-October each year.
- At each plot, the number of salamanders observed under forty artificial cover boards was counted and recorded.

S. Chisholm, Parks Canada

Artificial cover object

RESULTS

- A trend analysis suggests that salamander abundance appears to be increasing in hemlock and mixed forests at Kejimkujik over the last seven years.
- These results suggest that stressors such as climate change, acid rain, and land use change currently do not significantly influence salamander abundance in forest ecosystems at Kejimkujik.

YEARS OF DATA

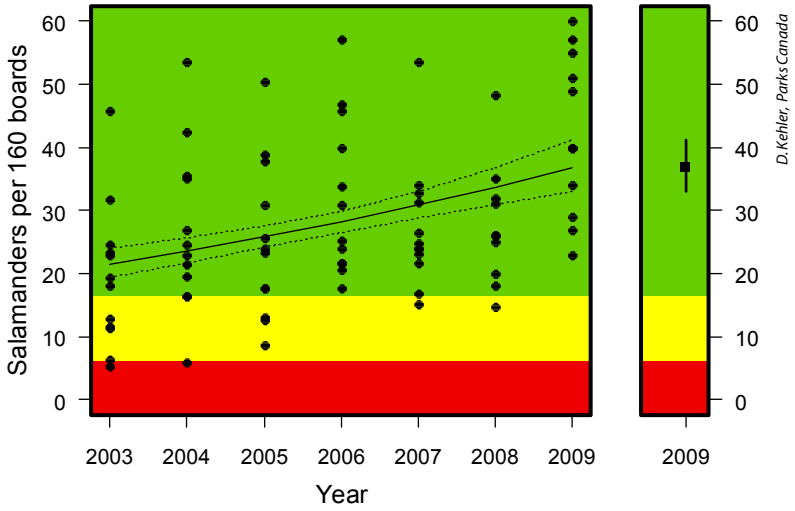
- Ongoing project since 2003

PARTNERS

- Parks Canada
- Ecological Monitoring and Assessment Network (EMAN)
- Dalhousie University

S. Chisholm, Parks Canada

Eastern red-backed salamander



D. Kehler, Parks Canada

Status and trend in salamander abundance in hemlock and mixed forests at Kejimkujik (Note: Green indicates good condition, yellow indicates fair condition, and red indicates poor condition, based on assessment of natural variation in salamander abundance data at Kejimkujik from between 2003-2008)

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Rationale

Since 2004, defoliation and mortaltity caused by the native Jack pine budworm, in mature stands of White pine throughout western Nova Scotia have generated concern among forest managers. In Nova Scotia, the Jack pine budworm is unique in that it is feeding specifically on mature White pine rather than its usual host, Jack pine, which is its preferred host in other regions of Canada and the United States. To effectively monitor this new forest pest, assess the risk posed by the insect, and measure the impact to the forest and give management recommendations certain relationships must be understood such as: i) the relationship between Jack pine budworm population dynamics and White pine pollen cone density, ii) the relationship between insect density and subsequent host plant damage, iii) developmental time and phenology of Jack pine budworm, iv) natural enemies of the Jack pine budworm, v) the value of a previously isolated sex pheromone for sampling and/or controlling Jack pine budworm and vi) the role of host plant quality in influencing the foraging preferences and associated performance of Jack pine budworm on White pine versus Jack pine.


NSDNR

Jack pine budworm larva exposed in feeding chamber

Monitoring

JACK PINE BUDWORM POPULATION ASSESSMENT

OBJECTIVES

- To delineate and map defoliated areas and determined area affected by severity classes.
- To determine overwintering larval population levels (survey is incomplete at this time).

METHODS

- Using a Hughes 500 helicopter, flight lines were flown 5 km apart at an altitude of 500-700 meters. Visual assessments of defoliation by severity levels (light, moderate, severe) occurring in White pine stands were made and delineated using a digitizing tablet personal computer.
- Three branch samples 60 cm long (one branch from three different trees) were collected from each sample point. These were washed in a 1% solution of sodium hydroxide for two hours then filtered to extract the overwintering larvae. These larvae were counted to assess if there were population levels damaging enough to cause defoliation the following year.


NSDNR

Mature White pine defoliated by Jack pine budworm larvae

RESULTS

- Aerial defoliation surveys for Jack pine budworm feeding damage were conducted during the month of August and two general locations were observed to contain feeding damage this year.
- The first location, Fourth Lake Flowage in Digby County, which had been hit particularly hard in 2007 and 2008, only sustained light damage this year. Staff collected four overwintering larvae survey points from that same area and the results show that next years' population will be substantially less.
- The second location, which is in the Cowie Bay-Barney Lake area of Lake Rossignol, Queens County, are new areas of defoliation for 2009. They are in the same general area of defoliation which has occurred there since 2007. Staff will be collecting more sample points from this and other areas in the near future.

YEARS OF DATA

- Ongoing project since 2004

PARTNERS

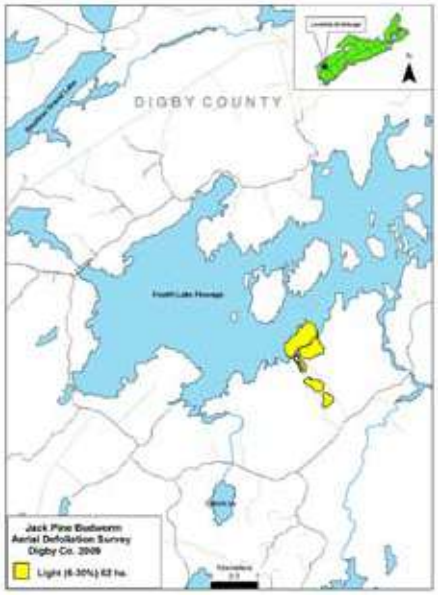
- Nova Scotia Department of Natural Resources

NSDNR

Overwintering L-2 larvae (16x magnification)

NSDNR

Overwintering larvae branch sample collection



Jack pine budworm defoliation near Fourth Lake flowage, Digby County 2009

NSDNR

Jack pine budworm defoliation near Lake Rossignol, Queens County 2009

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Rationale

Boreal felt lichen and other rare lichens of the coastal forest community are threatened by forestry practices and air pollution. The threat posed by forestry is largely due to lack of ability to detect the lichens presence and to predict where these lichens will occur. Little is known about which sources of air pollution pose the greatest threats and at what levels. Some progress from the forestry threat has been made in the last three years with the use of the GIS habitat algorithm to identify likely habitat. Since the GIS algorithm was developed in 2005, 29 new Boreal felt lichen locations were found and protected. This project focused on finding new rare lichen sites; getting a better understanding of health of the population, habitat and level of threat; increasing awareness of rare lichens in Nova Scotia and protecting existing Boreal felt lichen sites.

R. Cameron, NSDOE

Boreal felt lichen

Monitoring

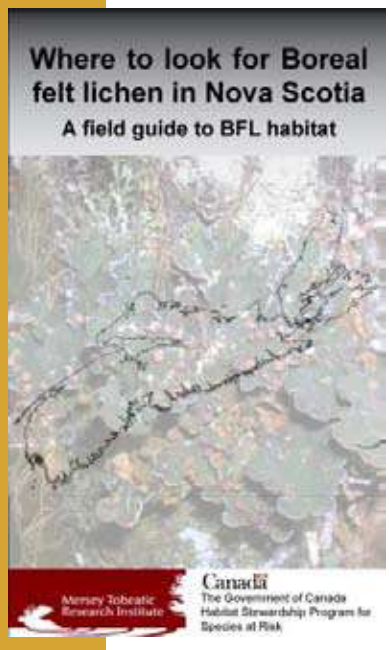
BOREAL FELT LICHEN MONITORING

OBJECTIVES

- To improve the predictive ability of a GIS habitat algorithm to increase likelihood of finding Boreal felt lichen.
- To increase knowledge of habitat characteristics and severity of threats at Boreal felt lichen sites over time.
- To raise the profile of Nova Scotia's rare lichens.
- To protect newly found Boreal felt lichen and rare lichen sites through verbal landowner stewardship agreements and cooperation with large forest companies.

METHODS

- Sites predicted as likely habitat and adjacent areas were searched for the presence of Boreal felt lichen and other rare lichens.
- NewPage Port Hawkesbury Corporation cross-referenced their harvest plans with the GIS habitat algorithm and when the two overlapped, MTRI surveyed those areas prior to harvest operations. When Boreal felt lichen was found a 100 m buffer was left surrounding the site.
- GIS data on each searched site were collected and included forest cover, surficial geology, bedrock geology, climate, topography, soil drainage, soil texture, distance from wetland, distance from coast, and wetland density.
- All currently known sites of Boreal felt lichen were permanently marked for long-term monitoring.
- Data were collected on habitat parameters including trees species, tree heights, tree diameters, tree ages, crown cover, slope, aspect, soil drainage, ground cover and other parameters.
- When Boreal felt lichen sites were found the landowners were provided with information about lichens.



C. Doggett, MTRI

A field guide to aid those trained to identify Boreal felt lichen habitat

RESULTS

- In 2009, Boreal felt lichen was identified at seven new sites with 62 thalli (individuals).
- Partnership with NewPage Corporation involved MTRI surveying areas where NewPage harvest plans overlap with the predictive habitat algorithm.
- Over the past six years 21 thalli have been lost at six sites.

RESULTS
Continued

- During this project year, six participants from the advanced lichen identification workshop joined MTRI's lichenologist in the field or volunteered independently on multiple days (totaling approximately 45 learning field days). At least three of these participants successfully helped to identify new boreal felt lichen sites!
- A 10-page habitat identification guide was developed and is available at www.merseytobeatic.ca.

YEARS OF DATA

- Ongoing project since 2006

PARTNERS

- Mersey Tobeatic Research Institute
- Nova Scotia Department of Environment
- Nova Scotia Department of Natural Resources
- Government of Canada Habitat Stewardship Program for Species at Risk
- World Wildlife Fund Endangered Species Recovery Fund
- NewPage Port Hawkesbury Corporation
- Nova Scotia Nature Trust

NSDOE

Map showing the areas where the computer generated algorithm predicts Boreal felt lichen habitat to occur

J. Todd , MTRI

Tom Neily surveying Boreal felt lichen habitat

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Rationale

Kejimkujik is situated in the Acadian Forest region, a transition zone between more southerly tree species (*e.g.*, maples, beech, oaks, pine and hemlock), and northern coniferous boreal tree species (*e.g.*, spruces and Balsam fir). The Acadian forest is generally thought to perpetuate itself through the process of gap dynamics – small openings in the forest created by insects, windthrow or general senescence of individual trees that are re-colonized by early successional species, or depending on the gap size, by species from the climax community. The assessment of trees and shrubs in permanently marked forest plots provides important information about the structure and composition of a forest and how it is changing over time.

S. Chisholm, Parks Canada

Forest in Kejimkujik

Monitoring

TREE GROWTH, REGENERATION AND SUCCESSION

OBJECTIVES

- To monitor tree growth, sapling regeneration and forest succession in hemlock and maple-oak-birch-pine stands at Kejimkujik.
- To determine if the Forest Tree Index (calculated from measurements of tree growth, sapling regeneration and forest succession) is within the range of natural variation historically observed in forest plots across western Nova Scotia.

METHODS

- Tree growth, regeneration and succession were assessed at 12 long-term integrated forest plots that were established in 2004 in mixed and hemlock forests using a stratified random sampling design.
- Every five years, marked trees within these plots are recensused and measured for diameter at breast height (DBH). New trees, over 4 cm, are identified, enumerated and measured.
- Three submeasures were examined: productivity- growth rate of mature trees, forest succession- the change in dominance (basal area) of large trees and, tree regeneration- basal area of small trees.
- Each submeasure was scored as poor, fair or good by comparing data to thresholds developed using historic data from forest plots across western Nova Scotia. The overall Forest Tree Index was calculated by combining the scores for each of these submeasures.

D. Ure, Parks Canada

Sarah Chisholm measuring diameter at breast height (DBH) of a tree

RESULTS

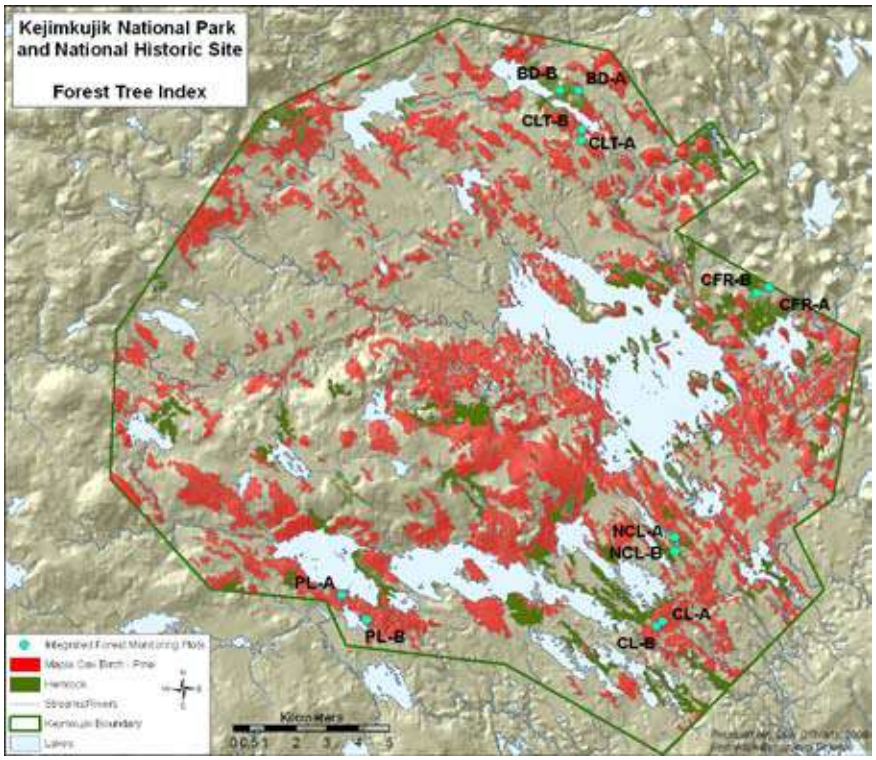
- Overall the current status of the Forest Tree Index at Kejimkujik is good since productivity, forest succession and tree regeneration are all in the expected range. Evaluation of trends over time will require collection of additional years of data.
- Red spruce dominance has declined since 2004, possible reasons for this decrease in dominance are unknown.
- Eastern hemlock demonstrated growth rates that are lower than expected based on natural variation in the reference data for Nova Scotia. This low growth rate between 2004 and 2009 may be related to residual effects of the Pale-winged gray moth outbreak.

YEARS OF DATA

- Ongoing project since 2004

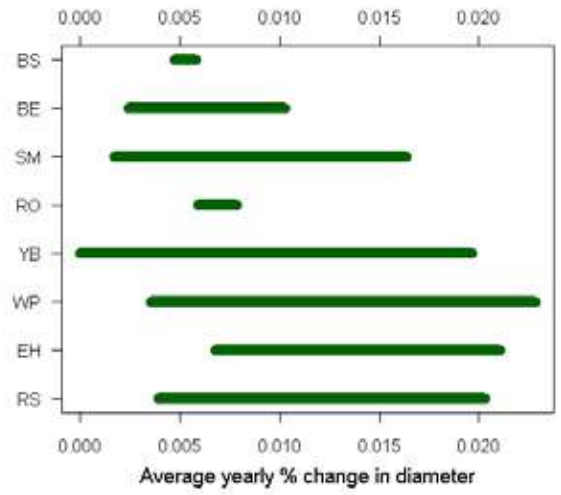
PARTNERS

- Nova Scotia Department of Natural Resources
- Ecological Monitoring and Assessment Network
- Parks Canada



S. O'Grady, Parks Canada

Location of tree monitoring plots in Kejimkujik (BD: Big Dam, CLT: Channel Lake Trail, IP: Indian Point, CFR: Canning Field Road, GR: Grafton Road, NCL: North Cranberry Lake, SCB: Square Camp Brook, COB: Cobrielle, PEB: Pebbleloggitch, PL: Peskawa Lake)



D. Kehler, Parks Canada

Growth rates for key tree species: American beech (BE), Sugar maple (SM), Black spruce (BS), Red oak (RO), Yellow birch (YB), Eastern hemlock (EH), White pine (WP) and Red spruce (RS) between 2004 and 2009

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Rationale

The rate at which forest litter decomposes and is recycled in the soil is an important driver of forest ecosystem productivity. The decomposition of organic litter is a complicated forest process involving the interaction of decomposer bacteria, fungi, soil fauna, the quality and quantity of litter inputs, soil aeration, moisture, pH and temperature. Several variables may influence and alter this process including climate change, the deposition of acids and other pollutants and local effects such as soil trampling, ungulate hyper-abundance and epidemic insect outbreaks. Monitoring of forest decomposition at Kejimkujik began in 2004. Decomposition is monitored as one component of the integrated forest plots designed to assess and monitor the state of hemlock and mixed forest ecosystems at Kejimkujik and detect changes over time.

Soil horizon in spruce-moss forest

Monitoring

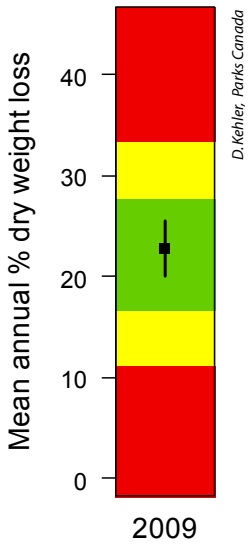
MONITORING FOREST DECOMPOSITION RATES

OBJECTIVES

- To monitor the status and trends in annual decay rates in hemlock and mixed forests at Kejimkujik and determine if current levels are within the range of natural variation.
- To compare decomposition rates among different forest types to determine expected levels of decomposition for forests at Kejimkujik.

METHODS

- Soil decomposition was assessed annually at twelve long-term integrated forest plots that were established in hemlock and mixed forests in 2004 using a stratified random sampling design.
- Eight additional plots were established in four different forest ecosystem types along a perceived gradient of soil productivity to inform threshold development (*i.e.*, treed bogs with peat soils were expected to exhibit lowest decomposition activity while rich soils with deep Mull humus such as those in beech-maple forests were expected to exhibit highest decomposition activity).
- At each plot, annual decay rate in soil humus was monitored using year-to-year dry weight losses of standardized wood pieces (*i.e.*, White birch tongue depressors of standard species and dimensions) as a proxy for soil decomposition.
- Wood standards were dried to constant weight at 70°C for 24 hours. One annual decay rate station was located in each corner of a 20 x 20 m tree plot. Wood standards were buried at 5 cm depth in the humus layer of the soil or at the soil horizon, whichever was less, and left to decompose for one year. After retrieval they were dried at 70°C for 24 hours and weighed to determine annual dry weight loss as a measure of annual decay rate of the forest soil.



Annual dry weight loss of wood standards in hemlock and mixed forest plots at Kejimkujik in 2009. (Note: Green indicates good condition (<25% change from baseline condition); yellow indicates fair condition (25-50% change from baseline condition); red indicates poor condition (>50% change from baseline condition

RESULTS

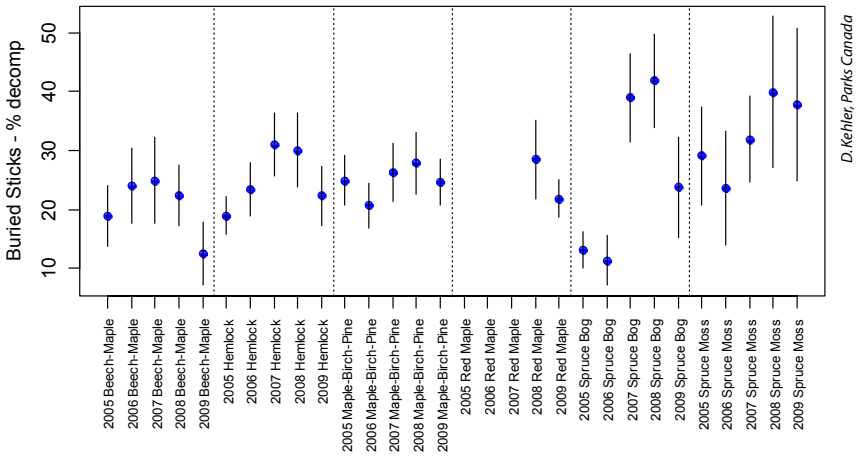
- The mean annual dry weight loss of wood standards in hemlock and mixed forests in 2009 was 23% ± 2.
- Annual decay rate data from hemlock and mixed forests at Kejimkujik were analyzed in comparison to thresholds established based on the maximum acceptable amount of change in mean annual dry weight loss of wood standards in these forest types. Dry weight loss of buried standards in hemlock and mixed forests retrieved in 2009 was compared to the mean dry weight loss in these forests during the previous baseline years (*i.e.*, 2005 to 2008). Dry weight loss for 2009 was within 25% of the baseline condition for both forest types, and as a result the decomposition rates at Kejimkujik in 2009 seem to be reflective of natural conditions.
- An examination of decomposition rates in buried wood standards retrieved from six different forest types between 2005 and 2009 does not show the expected gradient in forest productivity; forest bogs were expected to demonstrate the lowest decay rates and beech-maple forests were expected to have the highest decay rates. Research will continue to explore the potential explanations for and implications of this finding.

YEARS OF DATA

- Ongoing project since 2004

PARTNERS

- Parks Canada
- Ecological Monitoring and Assessment Network (EMAN)



Mean (and 80% confidence interval) annual dry weight loss in wood standards in six forest types at Kejimkujik between 2005 and 2009

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Rationale

The provincial Forest Ecosystem Classification (FEC) can be thought of as a catalogue of forest and woodland ecosystems in Nova Scotia. The FEC provides information about the site, soil moisture, soil nutrients and tree and understory plant species. Classifying forest ecosystems based on vegetation, soil and site characteristics allows forestry professionals, woodlot owners and researchers to recognize similar forest ecosystem units on the ground and to develop a common understanding of these units. This allows for the development and use of best management practices which address hazards and operational limitations associated with different ecosystems, leading to more predictable and sustainable forest management. Forest ecosystem classifications also provide a means through which ecosystem-based management principles can be applied operationally at the stand level, and a framework from which to communicate the success or failure of different management treatments. Most forest resource values can be evaluated within the classification.

A. Belliveau, MTRI

Lake Mulgrave

A. Belliveau, MTRI

A forest plant called Pyrola observed at Lamb's Lake

Research

FOREST ECOSYSTEM CLASSIFICATION

OBJECTIVES

- To develop a comprehensive forest ecosystem classification system for Nova Scotia.
- To identify and describe recurring vegetation communities and soil types associated with Nova Scotia forests.
- To provide an ecological framework from which to communicate and promote ecosystem-based management at the stand level.
- To provide an ecological framework from which best management practices can be developed and applied to promote sustainable forest management in the province.

METHODS

- A stratified sampling approach was taken to divide the province's forest landscapes into 47 different sampling units (based on earlier biophysical and ecological land classification).
- Cover type maps, soil series map and surficial geology maps were also used to narrow down potential sampling areas.
- Arc View 9 and Google Earth were used to create navigational tools to get to each site as well as to display each FEC plot that was completed.
- At each sample location, detailed vegetation, soil and site data were collected from representative plots. Data included an inventory of above ground plants (bryophytes, lichens, herbs, shrubs and trees) and a full soil profile description. Where applicable, sequential plots were also established along major slopes.
- Similar plant communities and soils were grouped into recurring vegetation types and soil types based on statistical analysis and expert opinion.
- Ecotypes were also delineated which represent general productivity units as reflected by changes in soil moisture and nutrient regimes.

RESULTS

A. Belliveau, MTRI

Alain Belliveau, Kirsten Campbell, Eugene Quigley and Peter Neily near the Upper Mersey River

A. Belliveau, MTRI

Sugar maple and Ground cedar at Pretty Mary Lake

- This project was initiated as a pilot from 2000-2003, and as a full scale provincial project from 2004 onward. Approximately 1500 plots have been measured across the province, with about 367 located in western Nova Scotia. Of the latter, 63 plots were established in 2009, 25 completed by NSDNR and 48 plots completed by MTRI.
- The Forest Ecosystem Classification for Nova Scotia's Western Ecoregion - Interim Report was published in 2006 and contains fact sheets for 39 vegetation types, descriptions for 16 soil types (plus 3 phases), keys for identifying vegetation types and soil types and information on provincial ecotypes found in western Nova Scotia (available from NSDNR).
- The number of vegetation types and soil types will increase as more data are collected and analyzed. An interim Eastern FEC was produced in 2007. A review draft of the Provincial FEC is scheduled for completion in mid-2010.
- Forest soil types of identification and Interpretation manual is available online at www.gov.ns.ca/natr/publications/forpubs.htm. This document contains keys to determine soil type and soil texture as well as photographs of the soil types and distinguishing features.
- A Field Manual for Forest Ecosystem Classification, NSDNR Manual FOR 2007-1 is available online at www.gov.ns.ca/natr/publications/forpubs.htm. This report provides the methodology used to establish sample plots for forest ecosystem sampling.

YEARS OF DATA

- Ongoing project since 2000

PARTNERS

- Nova Scotia Department of Natural Resources
- Parks Canada
- Dalhousie University
- Nova Scotia Department of Environment
- Mersey Tobeatic Research Institute

P. Neily, NSDNR

Kirsten Campbell and Alain Belliveau working in a hemlock forest at Eleven Mile Lake

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Rationale

In the summer of 2009, the BIObus collected specimens at six National Parks in Newfoundland, Nova Scotia and New Brunswick, including Kejimkujik. This work was conducted as part of an on going study aimed at gathering a synoptic collection of voucher specimens and tissue material of animals occurring in Canadian National Parks for subsequent molecular analyses at the Canadian Centre for DNA Barcoding and for authoritative identification by taxonomists. It complemented collections made in 2008 at 7 National Parks in Ontario, Manitoba, Saskatchewan and Alberta. Each year, the goal was to collect specimens from as broad range of arthropod taxa as possible within these parks and subsequently to recover high-quality sequences of 655 base pairs of cytochrome c oxidase subunit I gene (CO1, the standard animal DNA barcode). These specimens and their sequences then become part of the growing collection of the growing collection of reference library DNA barcodes of Canadian animals (www.barcodinglife.org).

A wasp in Kejimkujik

Research

DNA BARCODE BIODIVERSITY ASSESSMENT

OBJECTIVES

- To gather a synoptic collection of voucher specimens and tissue material of animals occurring in Canadian National Parks for subsequent molecular analyses.
- To collect specimens from as broad range of arthropod taxa as possible and to recover high-quality sequences.
- To make broad collections of invertebrates in a range of habitats within Kejimkujik.

METHODS

- Field survey efforts were targeted at obtaining tissue material and specimens for specific taxonomic groups.
- Target groups included moths, butterflies, dragonflies, flies, mosquitoes, wasps, bees, ants, beetles, caddisflies, mayflies, stoneflies, springtails, spiders and ticks, earthworms, snails and slugs.
- Collections were sorted to morpho-species, DNA was extracted and the DNA barcode was sequenced.
- These sequences and specimen images were added to the Barcode of Life Datasystem (BOLD) www.barcodinglive.org.
- These sequences were compared for similarity to 13 other sampled National Parks.

RESULTS

- To date more than 1300 specimens have been sequences from Kejimkujik that represent 300 species from 119 families.
- 20% of these species are shared with Cape Breton Highlands National Park, Nova Scotia.
- 22% of these species are shared with Kouchibouguac National Park, New Brunswick.

RESULTS
Continued

- 29% of these species are shared with Riding Mountain National Park, Manitoba.

YEARS OF DATA

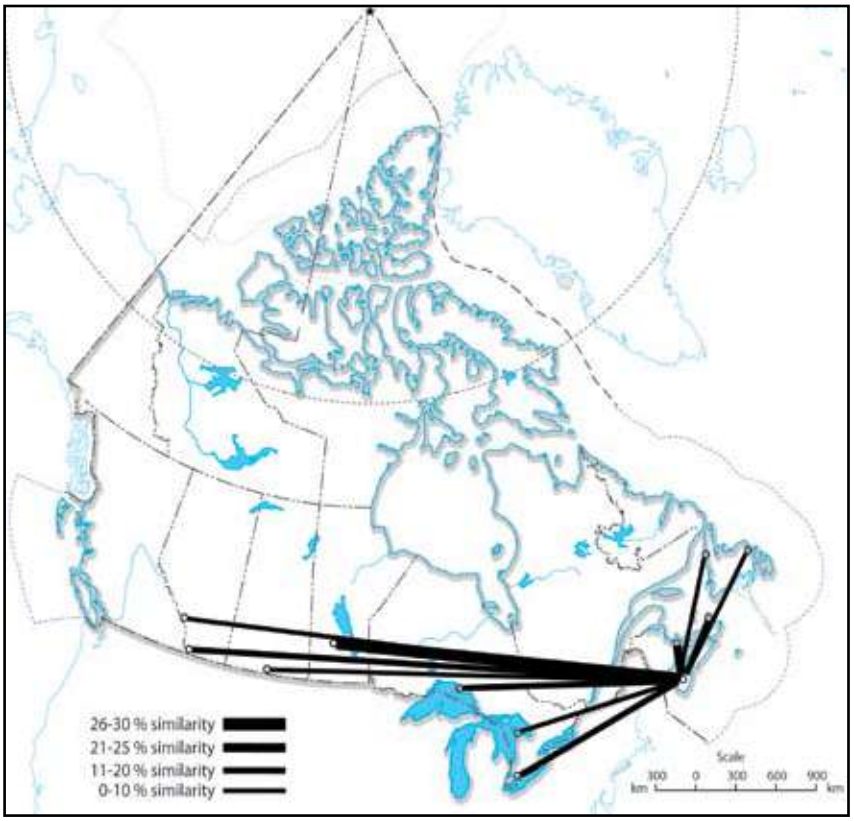
- Year 2 of a 2 year project

PARTNERS

- Parks Canada
- Genome Canada, Ontario Genomics Institute
- Ontario Ministry of Research and Innovation

J.Smith

Habitat variables were captured in panoramas like this one taken at Jake's landing canoe rental facing the water, Kejimkujik



Biodiversity Institute of Ontario

A graphic representation of the similarities discovered between Kejimkujik and other National Parks

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Photos on page 18 by A. Belliveau, MTRI unless otherwise credited
Clockwise from top left:

- Kejimkujik Lake
- Banded killifish at Herring Cove Lake
- Fieldwork at Sporting Lake Stream by B. Caverhill, MTRI
- Slapfoot Beach, Kejimkujik Lake
- A misty morning on Oakland Lake

FRESHWATER

Climate change has been identified as an important potential influence on ecological integrity in the Greater Kejimkujik Ecosystem. A great deal of research has been conducted to support the use of changes in spring ice out date as an indicator of climate change because there is a strong correlation between ice out date and winter air temperature. Monitoring ice phenology and lake ice freeze-thaw cycles can aid in the understanding and prediction of how climate change is affecting aquatic ecosystems. Volunteers are important resources to this program because as citizen scientists they can keep careful track of ice-in and ice-out dates and have provided many long-term datasets.

A. Lavers, MTRI

Ice cover on Donnellan Lake

Monitoring

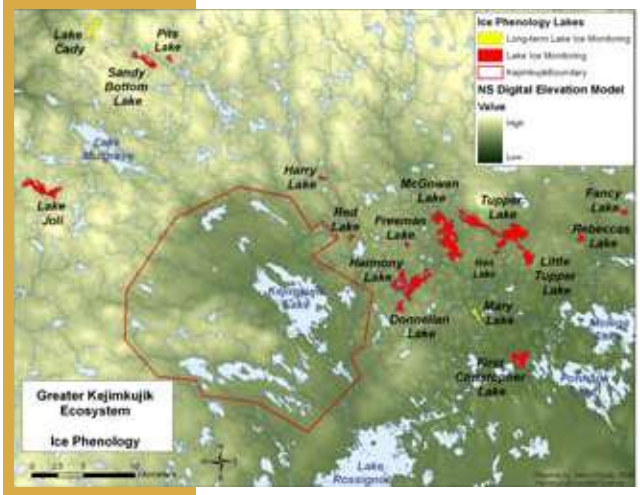
ICEWATCH

OBJECTIVES

- To monitor and assess changes in the duration of ice coverage on lakes within the Greater Kejimkujik Ecosystem.
- To determine if the mean duration of ice coverage (*i.e.*, Julian date of ice-off) is within the range of natural variation (*i.e.*, between 82 and 107 days, as determined through analysis of data between 1963 and 2007 for Mary and Cady Lakes) and if it has increased or decreased over time

METHODS

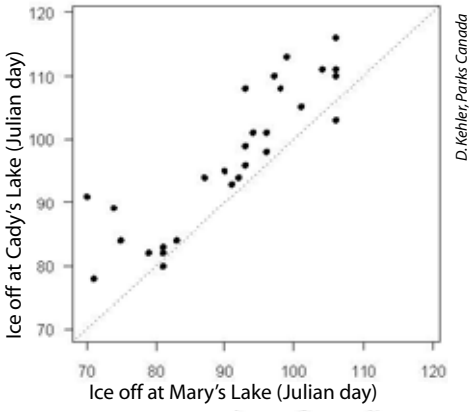
- Two dedicated community volunteers, Reg Baird and Irene Holdright, independantly recorded ice observations for years resulting in a valuable long-term data set for ice phenology in southwest Nova Scotia (starting in 1963 for Mary Lake, Queens County and 1976 for Cady Lake, Annapolis County). These long-term data were used to identify the natural range of variability for lake ice in this region.
- Simple linear regression was used to examine the relationship between ice off dates on Mary and Cady Lakes (1976-2007) and results showed a strong relationship despite differences in location and lake size. As a result, thresholds developed from historical variation in the time-series of ice off data from these two lakes were applied to the suite of lakes surveyed in this program.
- Ice phenology has been assessed on 17 lakes in the Southwest Nova Biosphere Reserve since 2006 through a dedicated group of lakeshore residents and volunteers, coordinated through the Mersey Tobeatic Research Institute's IceWatch program.
- On each lake, community volunteers that live on watershores or that drive by the lake every day keep track of "ice-on" and "ice-off" events and the duration of complete ice cover until complete ice thaw is recorded.



S. O'Grady, Parks Canada

Locations of IceWatch lakes in Southwest Nova Scotia

RESULTS



Relationship between ice off dates at Cady and Mary Lake (1976-2007) using data from volunteers Reg Baird and Irene Holdright

- IceWatch data were examined for trends between 1963 and 2009 using simple linear regression models and no significant trend was detected. As a result, the ice off date appears to be stable on lakes in the Greater Kejimkujik Ecosystem (GKE) over the last 46 years.
- To obtain a status assessment, the trend model was used to estimate the condition of the measure for the most recent year of data (2009) and this was compared to the established thresholds. Using this approach, the current status of ice phenology within the Greater Kejimkujik Ecosystem was found to be good.
- Scientific research shows that ice phenology is changing on lakes in the Northern Hemisphere in association with increasing air temperatures over the last 150 years. Much of the research presenting declining trends in lake ice-out dates has been conducted using long-term datasets (i.e., greater than 100 years). The current time-series for the GKE includes 46 years of data. As a result, it is important to continue monitoring ice phenology in this region to determine if there are detectable long-term trends.

YEARS OF DATA

- Ongoing project since 2004

PARTNERS

- Parks Canada
- Mersey Tobeatic Research Institute
- Ecological Monitoring Assessment Network
- IceWatch program volunteers

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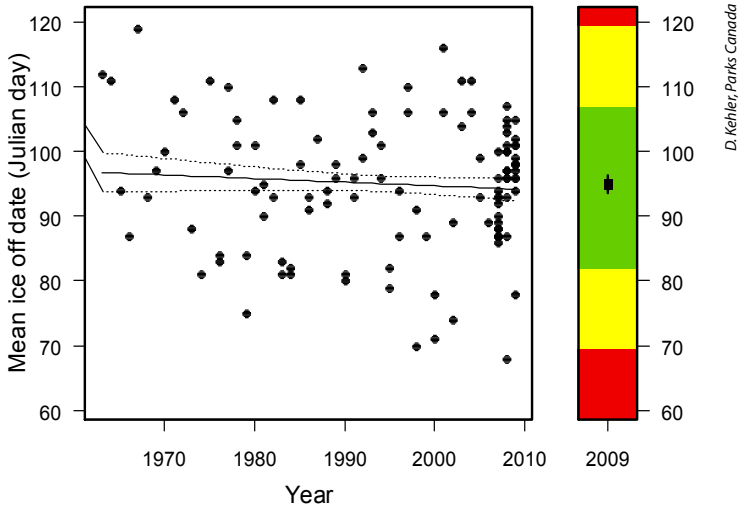

Status and trend for ice off date for lakes in the Greater Kejimkujik Ecosystem (1963-2007) (Note: Green indicates good condition, yellow indicates fair condition, and red indicates poor condition as determined through analysis of natural variability in Mary and Cady lakes between 1962 and 2007)

Rationale

Acid rain has impacted freshwater ecosystems in eastern Canadian provinces for many decades. Legislation in Canada and the U.S.A. has reduced emissions that contribute to acid deposition, expected to result in some degree of chemical and biological recovery of these acidified lakes and wetlands. In order to verify these expectations, Environment Canada is monitoring aquatic macroinvertebrate, amphibian and minnow species composition in small acid sensitive lakes across Ontario, Quebec and Kejimkujik in Nova Scotia. Although assessing water quality in acid-sensitive lakes is vital, sampling fish and invertebrates is also important because these organisms represent the food base for breeding loons and waterfowl. Results of fish and invertebrate sampling indicates the recovery, or lack of recovery, in the ability of these acid sensitive habitats to support waterbirds. Identification of certain acid-sensitive fish and invertebrate species, as well as shifts in communities to more acid-sensitive compositions, indicates the chemical and biological recovery of degraded ecosystems. This monitoring also allows Environment Canada to assess the effectiveness of current air pollution regulations in Canada and the U.S.A., and to determine if changes to regulations are required to further protect acid sensitive habitats from the impacts of acid deposition.

Shoreline on Big Dam West Lake, Kejimkujik

Monitoring

ACID RAIN BIOMONITORING

OBJECTIVES

- To establish the current composition and abundance of aquatic invertebrate, amphibian and minnow species (waterbird prey) within acid sensitive lakes of Kejimkujik.
- To determine whether species assemblages are changing in response to changing lake chemistries.
- To provide data on fish and invertebrate communities present in Kejimkujik, which can then be related to results obtained across south eastern Canada.

METHODS

- Food web sampling was conducted on nine lakes within Kejimkujik in June 2009.
- Sampling was completed in the same manner that Canadian Wildlife Service (CWS) food chain monitoring is conducted in Ontario and Quebec Regions, to ensure comparability of current and historic data.
- Minnows and amphibian tadpoles were captured in baited minnow traps and aquatic invertebrates were collected using sweeps and benthic drags.
- Benthic samples were preserved in the field and the invertebrates were later sorted from the detritus in a laboratory using dissecting scopes.
- All specimens were sent to a taxonomist for identification to species level.

Christina Nussbaumer performing a sweep sample for aquatic invertebrates

RESULTS

- This is the first year of a two year project. Data collected from sampling in June 2009 will be incorporated with data collected during the coming summer.
- Results will feed into on-going assessment of the impacts of acidification on aquatic wildlife in eastern Canada by Environment Canada.

YEARS OF DATA

- Year 1 of a 2 year project

PARTNERS

- Environment Canada
- Parks Canada
- Mersey Tobeatic Research Institute

Environment Canada

Adam Martens performing a kick and sweep sample on Puzzle Lake

Environment Canada

Kick and sweep sampling for benthic invertebrates

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Rationale

Brook trout are the most popular sportfish in Nova Scotia and the main fish species caught in Kejimkujik. As a result of past and present programs and research, a great deal is known about this species which makes it very useful as a monitoring measure for the freshwater ecosystem. Brook trout are regarded as being highly sensitive to various environmental factors including habitat alteration, increased water temperatures, inter-species competition and over harvesting. Two measures were selected to report on the status and trends in brook trout at Kejimkujik: relative abundance and condition. A Creel Census has been used to monitor Brook trout abundance and condition. This program and data collection is accomplished by experienced fish management volunteers that are coordinated by park Resource Conservation staff. The Mersey River from the southern end of Kejimkujik Lake to the park boundary (just above Lake Rossignol) and Peskowesk Brook (including Peskawa Lake) to the southern park boundary are the two focus areas for the Creel Census Program. The Creel Census Program is carried out for three year periods every five years. A similar program was carried out from 2002 to 2004 and the current sample program runs from 2009 to 2011.

Parks Canada

Brook trout being carefully handled and measured for weight and length prior to live release

Monitoring

BROOK TROUT MONITORING PROGRAM

OBJECTIVES

- To determine if the mean relative abundance (catch per unit effort) for mature Brook trout (*i.e.*, greater than 25 cm in length) is in good condition (*i.e.*, greater than 0.078) in the Mersey and Peskowesk watersheds and to determine if it has decreased since the last creel census in 2002 - 2004.
- To determine if the mean condition index (relative weight) for Brook trout (greater than 19 cm in length) in the Mersey and Peskowesk watersheds is in good condition (greater than 101.4) and to determine whether it has decreased since the last census.

METHODS

- Selected fish management volunteers and park staff angled in both drainage basins: the Mersey River Watershed (MRW) and the Peskowesk Lake Watershed (PLW). Angling was by fly fishing with barb-less hooks only. Sufficient angling effort was required to accomplish 75 to 100 individual fishing trips of equal to or more than one hour in each of the two delineated watershed zones. In addition, 50 Brook trout from each of the two watersheds were accurately measured for fork length and weight. All of the data were carefully recorded and subsequently digitized.
- Trout fork length from the tip of the nose to the fork in the tail were measured. The tail was fanned-out and the reading was taken to the nearest 0.1 cm. Trout were placed in a measuring device designed to ensure an accurate measure with minimal harmful effects to the fish.
- The fish's whole weight was taken by suspending the trout in a plastic bag using a spring-type scale with a range of between 0 - 2,500 grams. The plastic bag weight was deducted from the total weight measurement and recorded to the nearest tenth of a gram.
- In order to apply a consistent approach among volunteers and staff involved with the creel census, a pre-season workshop was held to review project requirements and protocols.

Parks Canada

A group of Creel Census volunteer anglers participating in the 2009 field work

RESULTS

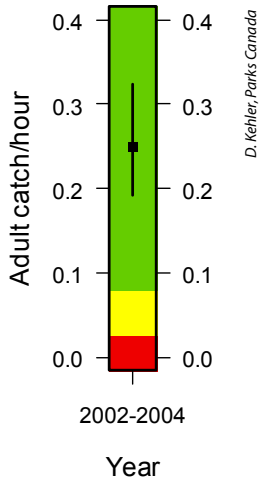
- Thresholds for the relative abundance measure were developed using the monthly catch and effort data from the Eel Weir at Kejimkujik in 1994-1996, as the population was judged to be in good condition at that time. Thresholds for condition in the same optimal period were set using the 2.5% and 16% quantiles of the distribution of data.
- Data from 2002-2004 were analyzed in comparison to these baseline thresholds.
- Initial analysis of the first year of the current census showed the mean relative abundance for the Mersey River watershed was 3.8 Brook trout caught per hour of fishing. For the Peskowesk Brook watershed it was 4.4 trout per hour. Moreover, the average trout length was 20.5 cm and 23.8 cm respectively for these two areas.

YEARS OF DATA

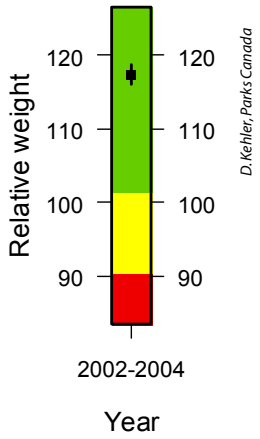
- Ongoing program since 1970s
- Current project: year 1 of a 3 year project (2009-2011)

PARTNERS

- Parks Canada
- Volunteer fly fishermen



Status of adult Brook trout catch per unit effort at Eel Weir in 2002-2004 in comparison to established thresholds. The mean + 80% confidence interval for adult catch per hour is displayed



Status of Brook trout condition (relative weight) from 2002-2004 in Peskowesk and Upper Mersey watersheds combined in relation to established thresholds. The mean and 80% confidence interval for relative condition is displayed

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Rationale

The Annapolis River Guardians volunteer monitoring program began collecting water quality data in the Annapolis River watershed in 1992. The Clean Annapolis River Project (CARP) initiated the program as a public awareness project and has had numerous volunteer sample collectors over the years. It is one of the longest running and most extensive volunteer based water quality programs in Eastern Canada. More than 90 volunteers from the communities of the Annapolis Valley have participated in the program over the years, with over 3500 water samples being collected and analyzed.

Clean Annapolis River Project

The Annapolis River near Bridgetown

Monitoring

ANNAPOLIS RIVER GUARDIANS

OBJECTIVES

- To establish and support a regular observation system that provides an early warning of environmental problems.
- To provide a long-term record of the Annapolis River's health.
- To develop interest in the Annapolis River and community stewardship to ensure a viable resource for future generations.
- To develop a knowledgeable group of local individuals who can promote the preservation, rehabilitation, and use of these aquatic resources in the future.

METHODS

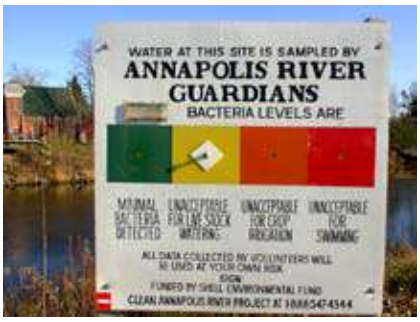
- In 2009, the Annapolis River Guardians completed their 18th year of continuous water quality monitoring on the Annapolis River.
- Ten volunteers monitored eight sites over the course of the season, which ran from April to November.
- Total suspended solids and turbidity were added to the suite of parameters monitored in 2008 and this monitoring was continued in 2009.
- The other parameters monitored included dissolved oxygen, *E. coli* bacteria, air and water temperature, pH and conductivity, as well as local weather conditions.

Clean Annapolis River Project

Chelsea Fougère collects a water sample from the bridge in Wilmot

RESULTS

- *E. coli* bacteria levels along the Annapolis River during 2009 were slightly higher than those observed in 2008. The 2009 *E. coli* data exhibited higher medians for many locations, most likely due to the wet weather of 2009. Sampling events from May through September often coincided with significant rainfall events, causing the overall bacteria counts to be elevated.
- The mean summer water temperature for the Annapolis River during 2009 was 17.8°C, 2.2°C cooler than for the same period in 2008. This value represents the lowest average summer temperature for the Annapolis River since 1997 and the first time the annual reading has been below the 18-year average since 2003.



Clean Annapolis River Project

Riverside site for reporting water quality results

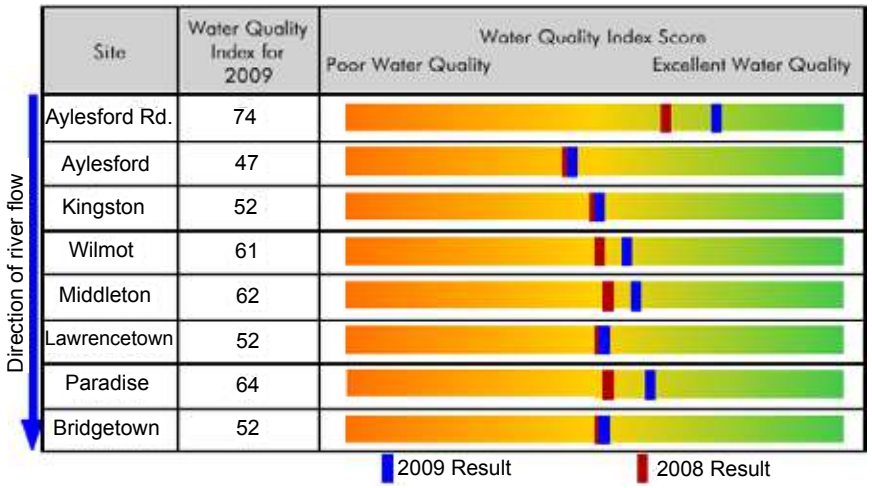
- The pH levels at each of the River Guardians sites were consistently within the recommended range for the protection of aquatic life (6.5-9.0). Mean pH values for the eight monitoring locations along the Annapolis River ranged between 6.8 and 7.4.
- During the 2006 to 2009 period, 62% of total phosphorus results exceeded the suggested guideline level of 0.030 mg/L. These elevated phosphorus concentrations are believed to have a role in excessive periphyton growth along the main stem of the river and depression of dissolved oxygen levels in the tidal portion of the river.
- Working in conjunction with Environment Canada, turbidity and total suspended solids (TSS) samples were collected in 2008 as part of the regular bi-weekly sample collection as well as during high flow precipitation events. This sampling was continued in 2009, as these activities were part of a two-year effort to establish a baseline for turbidity and TSS in the Annapolis watershed and develop a numerical relationship between these parameters.

YEARS OF DATA

- Ongoing project since 1992

PARTNERS

- Clean Annapolis River Project
- Environment Canada – Atlantic Coastal Action Program
- Nova Scotia Department of Environment
- Human Resources and Service Development Canada
- Acadia University – Acadia Centre for Estuarine Research



Clean Annapolis River Project

The 2008 and 2009 Water Quality Index results for water quality monitoring locations along the Annapolis River

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Rationale

Primary productivity is the rate at which light is converted to biomass through photosynthesis in an ecosystem. The amount of primary productivity by algae in freshwater ecosystems provides important information about food availability and lake trophic status (nutrient level). In naturally oligotrophic (nutrient poor) lakes, such as those in and around Kejimkujik, levels of primary productivity are most strongly influenced by the availability of nutrients, primarily nitrogen and phosphorous. Freshwater systems can receive inputs of nutrients from the surrounding watershed through erosion and runoff containing fertilizers, sewage or animal waste. This nutrient-loading causes heightened growth of algae and plants, which then die and decompose, depleting water of dissolved oxygen and affecting aquatic ecosystem structure and function. The most commonly used and accepted measure to monitor primary productivity and the effects of nutrient loading in lakes is the concentration of the photosynthesizing pigment, chlorophyll *a*.

A. Bellfiveau, MTRI

Kejimkujik Lake

Monitoring

LAKE PRIMARY PRODUCTIVITY

OBJECTIVES

- To monitor the status and trends in primary productivity in lakes in and around Kejimkujik.
- To determine if lake primary productivity (*i.e.*, the concentration of chlorophyll *a*) is within acceptable trophic level limits for oligotrophic lakes (*i.e.*, between 1.0-2.5 µg/L) and if it is increasing or decreasing over time.
- To compare primary productivity levels on lakes throughout the Greater Kejimkujik Ecosystem to detect excessive nutrient inputs and potential impacts to freshwater ecosystem health.

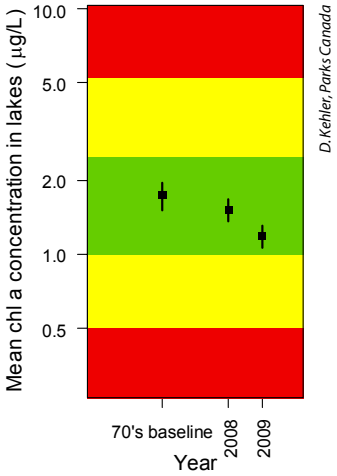
METHODS

- Eighteen brown and clear lakes were selected for long-term monitoring of primary productivity at Kejimkujik. Twelve lakes that are part of MTRI's lake monitoring program in the Mersey and Medway watersheds outside of Kejimkujik were also sampled.
- Lakes within Kejimkujik were sampled in June and August each year. Lakes outside the park were sampled only once in August each year. Water samples were filtered immediately by vacuum filtration in dim light, preserved and stored in dark sub-zero temperatures prior to submission to a laboratory for extraction and fluorometric analysis of chlorophyll *a* content.
- Concentrations of chlorophyll *a* in the lakes were compared to thresholds based on established trophic level limits. Results from a subset of 14 lakes at Kejimkujik were also compared to historical data collected by Kerekes and Schwinghamer in the early 1970s for the same set of lakes to determine trends in primary productivity over time.

MTRI

Lindsey Beals sampling chlorophyll *a* on Kejimkujik Lake

RESULTS



Mean chlorophyll *a* concentration (*u*g/L) from 14 lakes in 1971 and 18 lakes in 2008 and 2009 at Kejimkujik (Note: Green indicates the range of acceptable values for oligotrophic lakes; Yellow indicates the range of values approaching nutrient loading or nutrient depletion; red indicates the range of values depicting a change in historic trophic status)

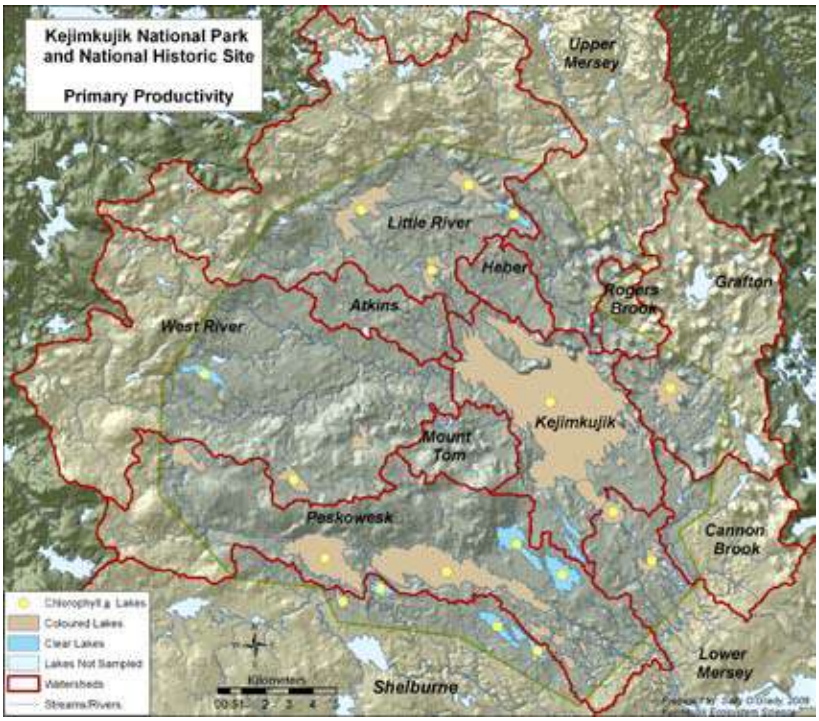
- The mean concentration of chlorophyll *a* in 18 lakes at Kejimkujik for 2008 and 2009 (1.36±0.13 µg/L) is within the acceptable range for oligotrophic lakes (*i.e.*, between 1.0 and 2.5 µg/L) but approaching ultra-oligotrophic (extremely nutrient poor) status.
- Although still within the acceptable range, the mean concentration of chlorophyll *a* in 14 lakes in 2008 and 2009 (1.28±0.13 µg/L) is significantly less than the mean concentration in 1971 (1.64±0.16 µg/L). These results suggest that lakes at Kejimkujik are not currently impacted by nutrient loading but that nutrient depletion may be a concern.
- The mean concentration of chlorophyll *a* in 9 lakes sampled in August of 2008 and 2009 in the Mersey and Medway watersheds outside the park (2.16±0.38 µg/L) is significantly different than the mean concentration of chlorophyll *a* in 18 lakes sampling in August in Kejimkujik (1.47±0.14 µg/L) indicating that these lakes in the greater ecosystem have slightly higher nutrient and primary productivity levels than inside the park.
- The concentration of chlorophyll *a* in lakes sampled in the Mersey and Medway watersheds outside the park is approaching the upper acceptable limit for oligotrophic ecosystems (2.5 µg/L), which suggests that some nutrient-loading may be occurring in these lakes.

YEARS OF DATA

- Ongoing project since 2008

PARTNERS

- Parks Canada
- Mersey Tobeatic Research Institute
- Dalhousie University



Locations of clear and brown lakes for primary productivity monitoring in Kejimkujik

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Rationale

Acidification of freshwater lakes in Nova Scotia is causing concern in many aspects of its ecosystems, including Common loon productivity levels and fish composition. Kejimkujik and surrounding areas contain poor acid buffering geology and soils. The area is topographically low in comparison to the surrounding areas. Lakes are also small and shallow and receive deposition of acid rain from major emission producers in central Canada and northeastern United States. This causes relatively low pH levels in freshwater lakes of the area. Evidence shows acidity to be recovering in precipitation after a reduction in emissions, but at a slower rate than originally expected. Monitoring has been undertaken to collect information on water quality that will help maintain aquatic health in the Mersey and Medway watersheds.


L. Beals, MTRI

Sand Lake

Monitoring

LAKE AND COLD WATER HABITAT

OBJECTIVES

- To measure pH, dissolved oxygen, temperature and conductivity of selected lakes in and around Kejimkujik.
- To determine how emission reductions and climate variations affect acidity.
- To determine how water quality affects ecosystems in the long term.

METHODS

- Water quality data were collected in August at 1 m intervals at the lake's deepest point using a YSI Sonde and Secchi disk to determine pH, dissolved oxygen, temperature, conductivity and lake coloration.


B. Keoghoe, MTRI

Lindsey Beals taking Secchi disk measurements on Murphy Lake

RESULTS

- In 2009, 50% of 16 lakes monitored had a pH below 5, 25% had a pH between 5-6, and 25% had a pH of 6 and above.
- A significant increase in pH was recorded in two lakes, Donnellan and Harmony, between 2008 and 2009. Nine out of the 16 lakes showed an increase in pH between 2008 and 2009, while the remaining seven showed a slight decrease.
- Since emission reductions have been implemented, pollutant deposition has decreased, but acidity has not decreased at the rate originally hypothesized. This could be due to the area's low buffering capability and requires further monitoring and assessment.

YEARS OF DATA

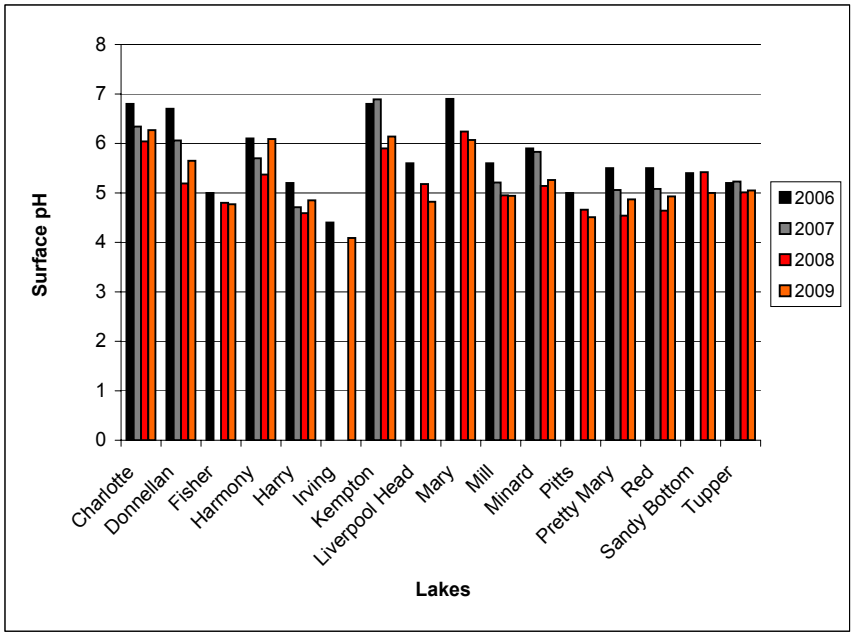
- Ongoing project since 2005

PARTNERS

- Mersey Tobeatic Research Institute
- Parks Canada
- Acadia University
- Environment Canada

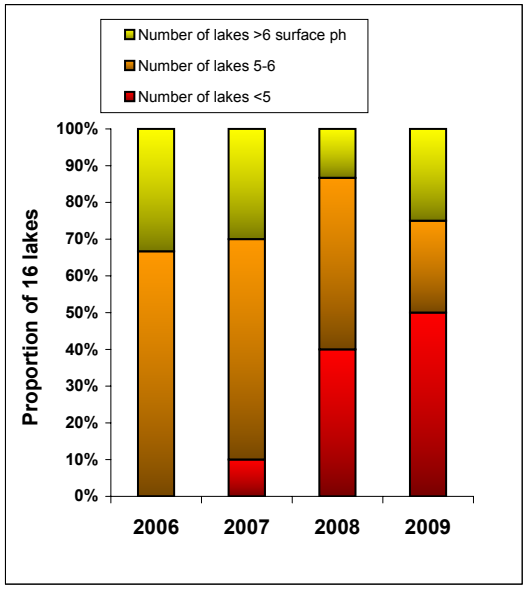
L. Beals, MTRI

Benna Keoghoe monitoring water quality on Murphy Lake



B. Keoghoe, MTRI

Surface pH values for 15 lakes surveyed from 2006 to 2009



B. Keoghoe, MTRI

Proportion of lakes with pH values of greater than 6, between 5 and 6 and less than 5 for the years 2006, 2007, 2008 and 2009

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Rationale

Freshwater ecosystems at Kejimkujik are influenced by the regional history of forestry. Although forestry practices no longer take place within Kejimkujik, several dams persist within the park. The presence of small dams in watersheds is known to affect the biological diversity and various ecological processes. As a result of these potential impacts, Parks Canada supports the removal of old dams that may compromise ecological integrity. Three small logging dams were constructed in the Mountain-Cobrielle watershed in the early 1940s. Environmental assessments were conducted to evaluate the impact of these dams and findings suggested significant environmental effects. An ecosystem restoration plan was developed to remove the three dams, restore historic water levels and quality and to restore historic migration routes for fish. This plan was implemented and removal of the dams occurred between 2004 and 2005. Several measures were monitored in 2008 and 2009 to assess the effectiveness of this restoration initiative.

D. Pouliot, Parks Canada

Exposed littoral zones demonstating regrowth of vegetation following removal of the small dams

Monitoring

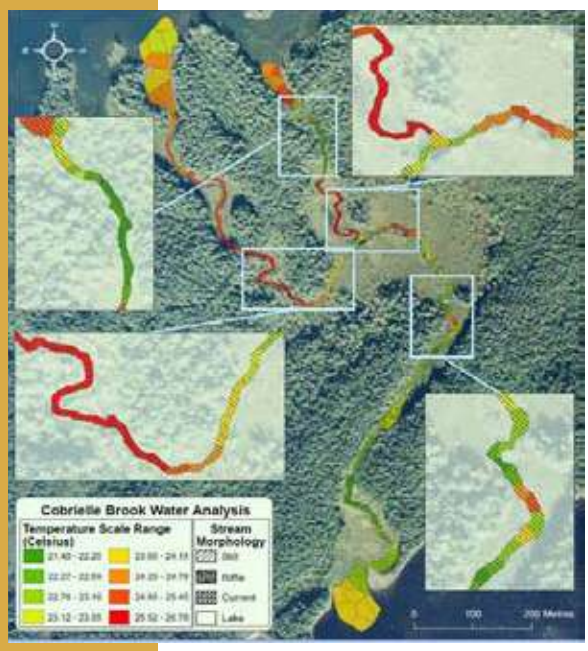
MOUNTAIN-COBRIELLE WATERSHED RESTORATION

OBJECTIVES

- To assess whether the water level in the Mountain-Cobrielle watershed has returned to historic levels.
- To assess whether the water quality in the Mountain-Cobrielle watershed is reflective of natural conditions.
- To assess whether fish passage been restored in the Mountain-Cobrielle watershed.

METHODS

- Water level assessment: A permanent water level monitoring station was not established prior to dam removal and as a result, it is not possible to directly compare current and historic water level in a quantitative manner. Visual signs of water level change were examined around Cobrielle Lake in 2008 and 2009. Bleached dead trees, eroded shoreline and unvegetated littoral zones were recorded as signs of recent water level lowering.
- Water quality assessment: Cobrielle and Mountain Lakes were both included as sample lakes in the condition monitoring program for the Water Quality Index at Kejimkujik. Water samples were collected annually in May and October. The methodology for water sampling and lab analysis followed Environment Canada's best practice guidelines.
- Fish passage assessment: Fish passage was evaluated through visual inspections of connectivity throughout the Cobrielle watershed. Site visits occurred during the summer 2008 and spring and fall 2009. Inspections took place at the dam sites and along the entire length of Cobrielle Brook. Any potential obstructions to fish passage at a range of water levels and site conditions were assessed and recorded.



D. Bourdeau, Parks Canada

Spatial variation of the water temperature along Cobrielle Brook on July 2nd, 2008 (data collected by Oliver Woods and Daniel Pouliot)

RESULTS

D. Pouliot, Parks Canada

Researcher Marla Bojarski inspecting the beaver dam (in 2008) on the north branch of Cobrielle Brook following the removal of the small logging dam in 2004 and 2005

- Water level: Water level in Cobrielle Lake has decreased but remains higher than historic levels due to the presence of a beaver dam. However, since beaver dams are considered to be natural elements of the ecosystems, the management action is considered to be effective. Water level in Cobrielle Brook was also restored.
- Water quality: The Water Quality Index for Mountain and Cobrielle Lakes has shown to be fair from 1998-2007. This result is similar to the average Water Quality Index calculated for 18 lakes at Kejimkujik. The brook water quality has been considered eutrophic and mostly unsuitable for Brook trout. Further investigations will be conducted to develop and implement strategies to enhance the brook water quality.
- Fish passage: Fish passage restoration has been successful for most of the brook but an old logging road is still crossing the brook on the north branch. Restoration of the brook from the road debris is planned for 2010.

YEARS OF DATA

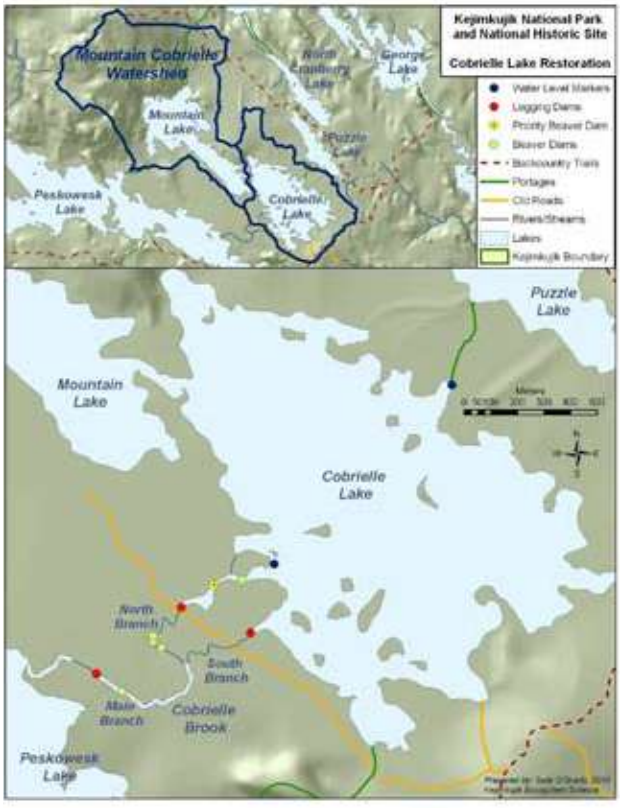
- Environmental assessment: 1999-2003
- Dam removal: 2004-2005
- Management effectiveness monitoring: 2008-2009

PARTNERS

- Parks Canada
- Fisheries and Oceans Canada
- Parc national de La Mauricie

D. Pouliot, Parks Canada

Danik Bourdeau taking notes on a small island in Cobrielle Lake



S. O'Grady, Parks Canada

Mountain-Cobrielle watershed with locations of old logging dams removed in 2004-5, current beaver dams and water level monitoring sites

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Rationale

Aquatic connectivity within aquatic ecosystems has been identified as very important for the success of Brook trout and other fish species. Barriers to fish passage, including dams, culverts, and other modifications to the natural stream bed reduce the ability of fish to migrate up and down stream in search of habitat suitable for spawning, feeding, overwintering and summer refugia. As access to the stream network decreases, so does the stream's ability to support healthy, abundant fish populations, making fragmentation a significant threat to the integrity of freshwater ecosystems throughout Southwest Nova Scotia. Aquatic habitat fragmentation can be attributed to the extirpation of species, such as the Atlantic salmon, from watersheds such as the Mersey. To help restore connectivity for Brook trout in the Mersey River watershed, crossings on fish bearing streams are being identified in and around Kejimkujik and prioritized for remediation.

J. Barteaux, MTRI

Rogers Brook culvert, which is impassable to fish due to outfow drop

Monitoring

AQUATIC CONNECTIVITY

OBJECTIVES

- To inventory and survey stream crossings within Kejimkujik and within at least four catchments extending beyond the park's boundaries.
- To prioritize crossings in need of remediation based on fish habitat suitability and impact on stream network connectivity.
- To determine how stream connectivity within Kejimkujik and the surrounding area resembles that of natural conditions and to establish whether this is improving or declining over time.
- To collaborate with and engage partner organizations through workshops and resource sharing.

METHODS

- An inventory of stream crossings (bridges, culverts and dams) was completed for Kejimkujik and four transboundary catchments. Streams were identified as fish-bearing by assessing them for typical Brook trout habitat conditions.
- Crossings were surveyed to calculate passability scores for barriers on stream networks. Scores for partially passable barriers were refined using FishXing software developed by the US Geological Survey.
- Resulting scores were used to calculate a Dendritic Connectivity Index (DCI) for the area of interest. This tool measures the impact of barriers on stream connectivity and fish passage. These scores, along with records of invasive fish sightings, were used to help prioritize crossings for remediation.
- Meetings with partner organizations were held to collaborate on aquatic connectivity initiatives in Southwestern Nova Scotia.

A. Lovers, MTRI

Aquatic connectivity training and partnership building workshop at Kejimkujik

RESULTS

B. Toms, MTRI

Wood box culvert on Hwy 8 obstructing fish passage due to high water velocity and outflow drop

- Culverts and road crossings on backcountry trails and decommissioned roads were catalogued and surveyed in 2008 and 2009. This concluded the effort to locate stream crossings and conduct preliminary culvert assessments within park boundaries.
- In total, 12 culverts were located on streams containing fish habitat within Kejimkujik's boundaries. In addition, investigation of dam remnants within the park identified three locations where fish passage was either fully or partially blocked.
- Aquatic connectivity within Kejimkujik was generally fair, however, there were four catchments negatively impacted by improperly functioning culverts or dam remnants.
- In the fall of 2009, 28 crossings over fish habitat streams in transboundary catchments were surveyed. Of these, 14 were fully passable, 6 were impassable and 8 were partially passable.
- Two collaborative meetings were held with partner organizations: the first in August and the second in November. The first meeting gave potential partners of the Aquatic Connectivity project the opportunity to meet one another and share ideas and experiences, as well as learn how to follow accepted methods of culvert passability assessment. Various media have reported on project activities and helped spread the idea of culverts and fish passability to a large public audience. The second meeting served as a venue for continued collaboration between groups and a place to continue learning standard passability surveying techniques.

YEARS OF DATA

- Ongoing project since 2008

PARTNERS

- Parks Canada
- Mersey Tobeatic Research Institute
- Clean Annapolis River Project
- Nova Scotia Salmon Association: Adopt-A-Stream
- Bluenose Coastal Action Foundation

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J. Barteaux, MTRI

Example of a rotten wood culvert obstructing fish passage on an abandoned road

Rationale

In 2012 the Government of Canada will introduce new regulations to minimize mercury emissions from industries in Canada. The regulatory agenda describes the government's intentions to regulate emissions of smog precursors, greenhouse gases and hazardous air pollutants including mercury (Regulatory Framework for Air Emissions). The Clean Air Regulatory Agenda (CARA) Mercury Science Program is part of the Science in Support of Regulatory Activities and Accountability Program of CARA. Within this program there are various components (research, monitoring, modelling and assessment) which will determine current concentrations of mercury in the air, ecosystems and human health. The Water Quality Monitoring and Surveillance, Atlantic office, is lead for the aquatic monitoring component in the Atlantic and has selected two sites for analyses. Kejimkujik Lake was selected as a national background site and is sampled for mercury concentrations in selected fish species, water and sediment. Sampling occurs each fall and results will contribute to Ecological Risk Mapping for Canada.

Jakes Landing

Monitoring

MERCURY SCIENCE: ECOLOGICAL RISK MAPPING

OBJECTIVES

- To establish a monitoring program for temporal mercury trends in forage and predatory fish at specific sites across Canada.
- To collect information at the national sites that will be used to produce a map identifying the regions of Canada which are likely to support high levels of mercury methylation and, thus, represent areas where biota could be at risk from exposure to high levels of toxic methylmercury. Kejimkujik was selected as a background site and, also because of its status as a 'supersite' or a site in which other CARA related work is currently ongoing.

METHODS

- Each fall staff collected 15 specimens of trout, yellow perch and forage fish. These fish were captured using rod and reel to allow for size selection and minimize the killing of fish.
- Samples were analyzed for total mercury, major metals, carbon and nitrogen stable isotopes and lipid content. In addition sediment samples and water samples were collected at three locations within the lake. Mercury samples were collected in triplicate for quality control assurance.
- Fish samples were bagged in clean plastic bags, tagged and frozen the same day. Water and sediment samples were collected on the final field sampling day and placed in cooler with ice packs.
- All samples were shipped to Environment Canada's National Laboratory for Environmental Testing in Burlington, Ontario the following day.

RESULTS

- In the 2008 sample season 208 predatory fish were collected from 13 lakes. Of these 47 % were above the 0.5 µg/g Health Canada guideline. There was large variation of mercury concentrations in fish within each lake.

RESULTS
Continued

- In Kejimkujik Lake, 15 trout were collected within the range of 19 to 30 cm, 12 yellow perch that range from 14 to 20 cm and a selection of forage fish. Analyses showed the majority of fish had concentrations below the guideline, although a few did exceed.
- Mercury in the water samples based on one year of data was near 0.3 ng/L and in fish tissue normalized for weight mercury was 4 ng/g. These concentrations were higher than most other sites sampled.
- More complete analyses will be provided once additional years of data become available.

YEARS OF DATA

- Year 3 of a 3 year project

PARTNERS

- Environment Canada
- Parks Canada

Environment Canada

CARA program vehicles and equipment

Environment Canada

CARA team members fishing

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Rationale

Common loons face multiple stressors in their environment that affect their health, reproduction and survival. These stressors include loss of nesting habitat to human development, loss of eggs to flooding and predation, human disturbance and pollution sources like acid rain, lead fishing sinkers and mercury. Our past research at Kejimkujik found a link between poor loon reproduction and high mercury levels. Acidic lakes with high mercury levels in fish and loons produce fewer loon chicks on average. As part of a national study of mercury levels in Common loons, adult loons and their chicks were captured on lakes in Kejimkujik and nearby. This project aims to monitor mercury levels in Common loons at selected sites across Canada, and track any trends in those mercury levels over time. Mercury levels in the loons will be linked with mercury levels measured in yellow perch (which loons eat) in the same lakes by research partners from the University of New Brunswick, and with loon productivity as measured by MTRI. The findings of this study will feed into a Canadian assessment of the risks of mercury pollution to fish and wildlife being carried out by Environment Canada.


Environment Canada

Four adult Common loons

Monitoring

MONITORING MERCURY IN COMMON LOONS

OBJECTIVES

- To monitor the mercury levels in Common loon adults and their chicks in Kejimkujik.
- To monitor any changes in those mercury levels over time.
- To track mercury levels in loons along with any changes in loon reproductive success, fish mercury levels and deposition of mercury air pollution.

METHODS


Environment Canada

Neil Burgess holding an adult loon

- Common loon adults and chicks were captured during the day or at night in late July and early August 2009.
- Captured loons were banded with a unique combination of coloured leg bands, measured, blood and feather samples were taken for mercury analysis and then the birds were released unharmed.
- Blood and feather samples were sent to the National Wildlife Research Centre in Ottawa, along with other loon samples from across Canada, for mercury analysis.

RESULTS

- Due to poor chick production in 2009, only one Common loon adult was captured within Kejimkujik on North Cranberry Lake.
- Five adult loons and 3 chicks were also captured on Tupper and Donellan lakes outside the park.

YEARS OF DATA

- Year 1 of a 2 year project

PARTNERS

- Environment Canada
- BioDiversity Research Institute (Maine, USA)
- Mersey Tobeatic Research Institute
- Parks Canada

Environment Canada

Taking a blood sample from the leg of an adult loon

Environment Canada

Field crew setting up for loon capture

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Rationale

The Common loon is a highly visible water bird inhabiting many of the lakes within the Southwest Nova Biosphere Reserve. It is an icon of wilderness and people are captivated by its beauty and haunting call. Concerns have been raised about the health of loons after a study by the Canadian Wildlife Service (CWS) found very high blood mercury concentrations in Kejimkujik loons. These levels have been associated with impaired reproduction and altered breeding behavior in some areas. LoonWatch began on 16 lakes within Kejimkujik in 1996. In 2006, the program was expanded to the greater landscape through MTRI where volunteers are trained to observe and record loon activity and breeding success on their assigned lake throughout the summer using a national protocol developed by Bird Studies Canada. These two program components will provide a picture of how well loon populations are doing in the region.

J. Bryk, MTRI

Adult loon sitting on nest at Grafton Lake

Monitoring

THE KEJIMKUJIK-MERSEY LOONWATCH PROGRAM

OBJECTIVES

- To observe Common loon abundance and breeding success on lakes within Kejimkujik and in the Southwest Nova Biosphere Reserve with a focus on the Mersey and Medway watersheds.
- To determine status and trends in loon abundance, lake use and reproductive potential of resident birds.
- To monitor water quality on lakes being observed by Loon Watchers outside Kejimkujik.

METHODS

Outside Kejimkujik:

- Lakeside dwellers and cottagers with an interest in loons were recruited and provided with information about loons and the monitoring protocol.
- Trained volunteers were used to survey lakes in June for loon pairs, in July for newly hatched chicks and in August for surviving young.
- MTRI staff visited many of these lakes, canoed to the deepest part and measured water quality at one meter intervals, recording temperature, conductivity, dissolved oxygen and pH.
- Volunteer data were collected and compiled, then shared with Bird Studies Canada.

Inside Kejimkujik:

- LoonWatch uses trained volunteers in a coordinated effort to simultaneously survey study lakes within a three hour observation period, in early June and during the third week of August.
- Loon monitoring combined data gathered from intensive LoonWatch days involving many volunteers, plus public observations and repeated surveys by Kejimkujik staff.
- The Canadian Wildlife Service is also doing more intensive work to better understand population dynamics and relative mercury levels in loons in the region (See page 62-63).

L. Beals, MTRI

Volunteer Jim Moores monitoring loons on Tupper Lake

RESULTS

A. Lavers, MTRI

Donnellan Lake nest with one egg

- In 2009, the two LoonWatch programs had over 55 volunteers monitoring loons on at least 54 lakes in the Southwest Nova Biosphere Reserve and about the same number monitoring loons on 16 lakes inside Kejimkujik.
- Six loon chicks were recorded by LoonWatchers outside Kejimkujik, on Tupper, Fancy, Sandy Bottom, Charlotte and Donnellan lakes. Four of these chicks were observed as large chicks that had a good chance of survival.
- The surface pH of volunteer lakes ranged from 4.51-6.27.
- The June Kejimkujik LoonWatch recorded 11 territorial pairs and a total of 27 adult loons, but no nests or chicks. Unfortunately the August LoonWatch was rescheduled and then cancelled due to inclement weather.

YEARS OF DATA

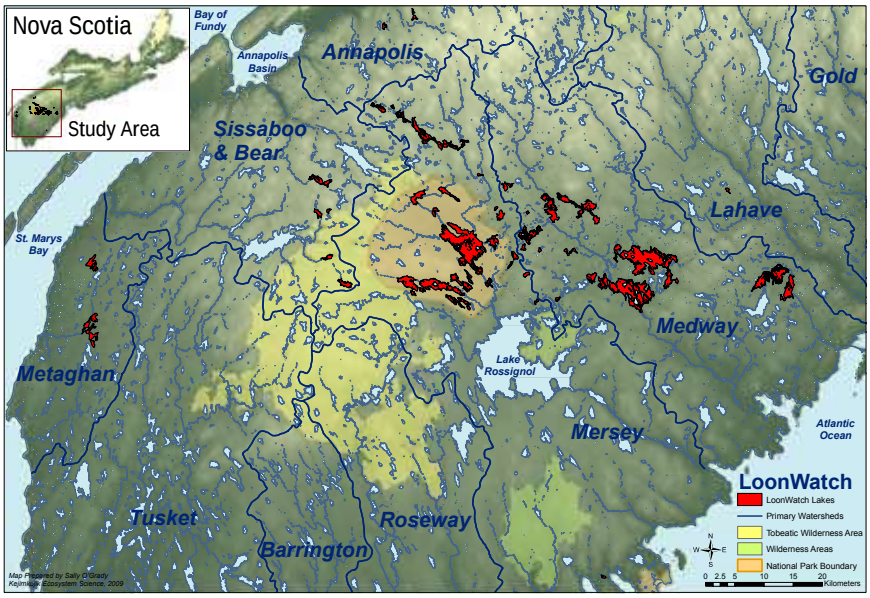
- 2006 was the first year for the Mersey LoonWatch Program.
- 1996 was the first year for the Kejimkujik program.
- Monitoring will continue on an annual basis.

PARTNERS

- Parks Canada
- Mersey Tobeatic Research Institute
- Bird Studies Canada
- LoonWatch volunteers

L. Beals, MTRI

From left LoonWatchers Nick, Tyler and Andrew Cosman surveying Murphy Lake



S. O'Grady, Parks Canada

Map showing locations of LoonWatch Lakes in the Southwest Nova Biosphere Reserve with Kejimkujik shaded in brown and Tobeatic in yellow

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Rationale

The Common loon is widely used as an indicator of the health of lake ecosystems. The number of chicks that each territorial loon pair is able to raise is monitored on 35 study lakes within Kejimkujik and the surrounding region; this is a measure of the loon's reproductive success or productivity. Loon productivity is adversely affected by such factors as acid rain, structural and recreational development of lake shorelines, disturbance by boaters, water-level fluctuations, predators and mercury pollution. Loons compete for food with common mergansers, another waterbird observed on these study lakes. The Canadian Wildlife Service monitored loon productivity in Kejimkujik from 1988 until 1997. Loon productivity was found to be limited by mercury levels in the loons and the fish that they eat. Some lakes in Kejimkujik had high mercury levels in fish and loons and low loon productivity, and vice versa. Environment Canada resumed monitoring of fish mercury levels in 2006 and Common loon productivity in 2007.

A. Lavers, MTRI

Common loon family including parents and one chick on Charlotte Lake

Monitoring

MONITORING COMMON LOON PRODUCTIVITY

OBJECTIVES

- To monitor the number of territorial Common loon pairs on the study lakes.
- To monitor the number of loon chicks produced by these territorial pairs.
- To provide data on loon productivity for each study lake, which can then be related to environmental factors, human disturbance and mercury pollution.

METHODS

B. Keoghoe, MTRI

Jessica Bryk surveying for loons

- Common loons and Common mergansers were surveyed at least three times from early June until September 2009 by trained researchers on 24 lakes within Kejimkujik and 11 lakes in the surrounding area.
- Surveys included adult loons, nests, eggs and chicks and Common mergansers and chicks.
- Surveys were conducted by canoe (except Ben Lake which was only surveyed from shore).
- When loons were located, the time, date, weather, a GPS location of where the loon was first seen and behaviour were recorded.
- Survey results were summarized in a database and productivity was calculated for each territorial loon pair.
- Maps were made of the GPS sightings and territories.

RESULTS

- Three Common loon chicks were counted on three of the 24 lakes surveyed within Kejimkujik.
- Five loon chicks were counted on four of the 11 lakes surveyed outside the park.
- On the 35 lakes surveyed, 57 territorial pairs were counted over the summer, with 28 of these territories showing evidence of breeding.

RESULTS
Continued

- A total of three large loon chicks were counted at the end of the summer on the 35 lakes.
- According to these observations, Common loon productivity for 2009 was very low at 0.05 chicks produced per territorial pair. Abnormally low loon productivity was likely due to predation or weather. Fifteen out of 34 eggs were suspected to have been predated at the egg or downy chick stage. Two out of 34 eggs were suspected to have been flooded and three out of 34 eggs were suspected to have been abandoned because of low water levels.

YEARS OF DATA

- Year 3 of a 4 year project

PARTNERS

- Parks Canada
- Mersey Tobeatic Research Institute
- Canadian Wildlife Service, Environment Canada
- TD Friends of the Environment Foundation
- Mountain Equipment Co-op
- Canada Summer Jobs, Service Canada
- Nova Scotia Community Trust

L. Beals, MTRI

Common loon nest on Frozen Ocean Lake that was later flooded.

C. Gray, MTRI

Loon nest with eggs on North Cranberry Lake

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Rationale

The Common loon is at a high risk of nesting failure because its leg position makes overland movement clumsy, forcing loons to nest at the interface between a terrestrial and an aquatic ecosystem. Loons must nest close enough to water to easily access their nest, but still ensure that flooding, stranding or washout of the nest does not occur with water level changes throughout the incubation period. Loon nest predators include scavenging mammals and birds. Loons require a wide angle of view to see approaching predators from the water and abundant nest cover to conceal the nest from terrestrial and overhead predators. Predators may be attracted to the nest site of the loon if they notice movement and therefore loons typically leave and approach the nest underwater. The selective pressure put on loons to ensure nesting success should create similarities between nest characteristics of loons.

L. Beals, MTRI

Loon egg hatching on Turtle Lake nest

Research

LOON NEST STRUCTURE AND MICROHABITAT

OBJECTIVES

- To locate Common loon nests on 35 lakes in the Kejimkujik area.
- To measure the structure of nests.
- To study the microhabitat of nests.

METHODS

- Shorelines were surveyed by canoe to locate nests.
- The physical structure of each nest was measured including the following parameters: width, depth, materials used in the nest, and distance to water line.
- Nest microhabitat was measured including the following parameters: underwater substrate, surrounding vegetation, orientation, location on island or mainland, angle of view from nest and lake bed slope.

L. Beals, MTRI

Measuring dimensions of a nest on Charlotte Lake

RESULTS

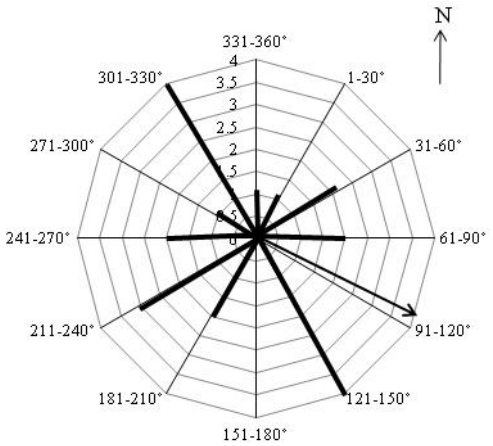
- 18 of 22 (81%) nests were found on islands.
- Nests averaged 52 ± 26 cm from the water line at the time they were measured.
- The average angle of view was found to be 147˚.
- Many nests (8 of 22) were facing NW or SE.
- Nest cover was higher on the land side than on the water side of the nest.
- Water depth 0.5 m from the edge of the nest was 20 ± 11 cm.

YEARS OF DATA

- Single year project

PARTNERS

- Mersey Tobeatic Research Institute
- Parks Canada
- Canada Summer Jobs, Service Canada
- Saint Francis Xavier University

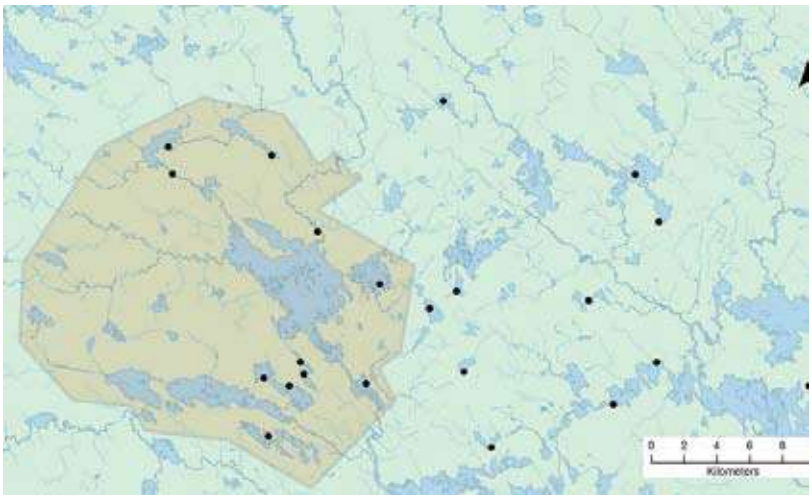


L. Beals, MTRI

Graph showing the cardinal direction that 22 loon nests were facing with the mean direction indicated with an arrow (the predominant orientation was NNW or SSE)

A. Lavers, MTRI

Lindsey Beals measuring water depth at a Donnellan Lake loon nest



L. Beals, MTRI

Locations of measured loon nests indicated by black dots

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Rationale

A major acidifying agent to the fresh waters of the Kejimkujik area is sulphate. Sulphate in stream water has three sources: geological material, burning of fossil fuels and marine aerosols. Quantifying sources of sulphate is important for realistic mitigation and management practices. In watershed scale sulphate budgets, chloride concentrations in stream water are used to estimate marine derived sulphate by assuming the chloride in stream water is recently derived from the ocean and transported inland by weather events. Long term monitoring of precipitation and stream water in Moose Pit Brook and Pine Marten Stream by Environment Canada has revealed an imbalance in the chloride budget: chloride output from streams is up to three times greater than chloride input of precipitation alone. Excess chloride could be coming from unmeasured atmospheric deposition such as fog and/or from the soils and rocks within the watersheds.

Fog water dripping from grass

Research

IDENTIFYING SOURCES OF CHLORIDE IN STREAMS

OBJECTIVES

- To characterize the chloride content in fog, soils and bedrock in the watersheds.
- To identify and quantify sources of chloride to the streams.

METHODS

- Ionic trends in Environment Canada's historic data set were identified.
- Fog, soils and bedrock were sampled at Moose Pit Brook and Pine Marten Stream.
- Chloride concentrations in the samples were determined.
- The chlorine stable isotope composition of the samples was characterized.

RESULTS

- An analysis of historical data showed chloride concentrations in stream water were less variable than in precipitation. This implies storage of water and chloride in the soils and groundwater reservoir which is larger than previously thought.
- Fog water (1.15 mg/L to 39.9 mg/L in 10 samples) has higher and more variable concentrations than precipitation (0.11 mg/L to 2.89 mg/L in 12 samples).
- The mineral bound chloride in soils and bedrock has significant but low concentrations (<10 ppm to 320 ppm). The biotite monzogranite in Moose Pit Brook had a higher chloride content.
- Water soluble chloride in soils is generally highest near the surface and lowest at 1 to 2 m depths.
- Much of the extra chloride may be coming from fog, while a small portion is likely coming from weathering of soils and bedrock.

T.Bachiu

Suspended screen used to collect fog water

YEARS OF DATA

- Single year project

PARTNERS

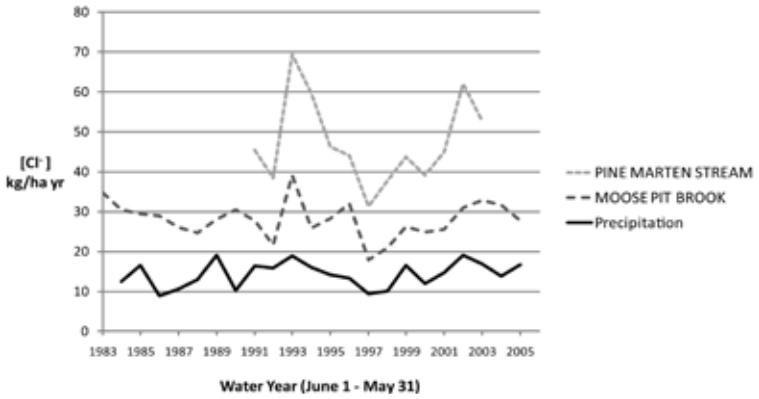
- Dalhousie University Earth Sciences Department
- Environment Canada; Acid Rain Program
- Cosmogenic Nuclide Extraction Facility – Dalhousie University
- Atlantic Laboratory for Environmental Testing
- National Hydrology Research Centre
- Mersey Tobeatic Research Institute
- Parks Canada

L. Newton

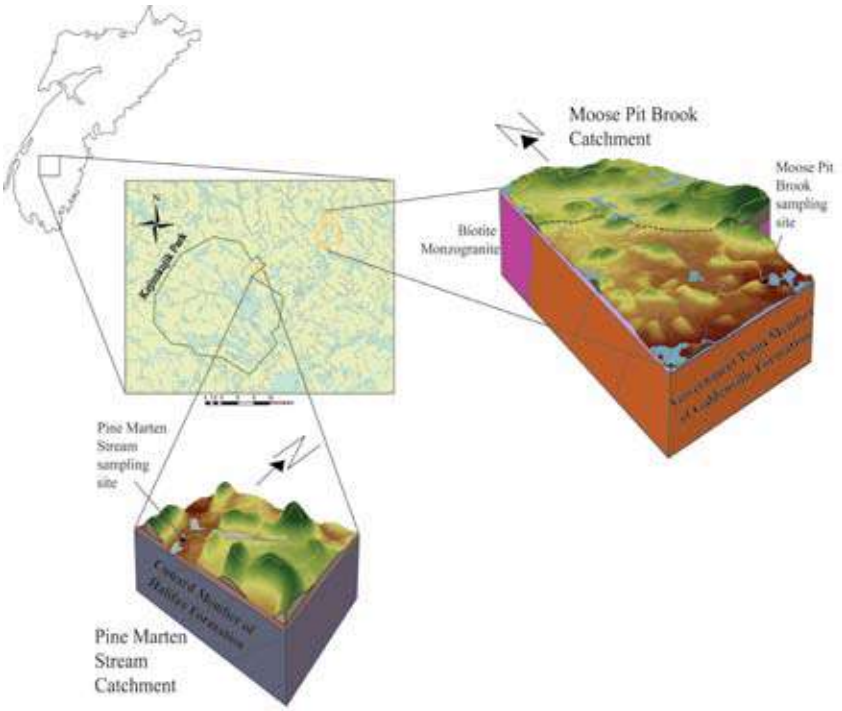
Tim Bachiu digging a soil sampling pit in a stoney drumlin

T. Bachiu

Example of granite clast till in Moose Pit catchment showing soil horizons and the water table



Yearly inputs of chloride to the catchments from precipitation are less than the yearly chloride outputs of the streams



T. Bachiu

Schematic side views of the study catchments representing the boundaries, glacial deposits and underlying geology (Catchments boundaries delineated using ArcHydro. Input to ArcHydro and digital elevation model from lidar data courtesy Dr.Chris Hopkinson of the Applied Geomatics Research Group, Middleton, NS. Relief in Pine Marten catchment is 52 m, and 102 m in Moose Pit Brook catchment)

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Rationale

Mercury is known to affect the nervous system and reproduction of humans and wildlife if exposure from fish consumption is high. Kejimkujik has no direct anthropogenic mercury sources, yet fish and loon tissues contain concentrations that are among the highest in North America. In an earlier study in 2006 and 2007, mercury levels in Yellow perch were found to have increased in 10 of 16 lakes in Kejimkujik and likely posed a greater risk to loons, and perhaps to the fish themselves, than a decade before. Although mercury can affect wildlife, little is known about how the health of wild fish with high levels of mercury can be affected. The reasons why fish from some lakes in Kejimkujik have increased mercury levels even though emissions of this pollutant to the atmosphere from human activities have decreased in North America is also currently unkonwn.

Y. Fuchs

Big Dam East Lake, where some of the aquatic insects were collected for this study

Research

EFFECTS OF MERCURY IN FRESHWATER FOOD WEBS

OBJECTIVES

- To understand whether high mercury concentrations in Kejimkujik are affecting the ability of Yellow perch to grow and reproduce.
- To understand how mercury gets transferred up the food web into perch in these low-pH lakes.

METHODS

Yellow perch health:

- In September, adult Yellow perch were collected from six lakes within the park. These lakes are known to have perch with a wide range in mercury concentrations.
- For each fish, its length and weight was measured and scales were taken to determine age and assess growth. Muscle tissue was collected to measure mercury. Ovaries or testes were sampled to understand whether egg or sperm cell development was delayed and if there was any damage to livers, kidneys or spleens from exposure to mercury.

Food web study:

- The same fish from four of the lakes in the perch health study were also used in the food web study.
- Insects and other fish that the perch may be eating were also collected to understand how much mercury is in the diet of the perch and how it compares from one lake to another.
- Insects were collected in June, July and August, whereas fish were collected in September.

K. Kidd

Katharina Fischer dissects a Yellow perch and collects various tissues near Hilchemakaar Lake in Kejimkujik

RESULTS

- Field work for the first year of this two year study was completed in September 2009. All of the Yellow perch have been analyzed for mercury and the levels in their muscles were similar to the results from earlier studies.
- Differences have been observed between lakes in how well the fish grow and in how large their ovaries or testes are but these do not seem to be related to mercury levels. However, there is some evidence that mercury is damaging the liver and kidney tissues in fish with the highest levels.

RESULTS
Continued

- Mercury was measured in several different types of insects from these lakes and levels were found to vary from one type of insect to another and from one lake to another.
- Results will be used to understand whether perch mercury is highest in lakes where insect mercury is highest. The lab analyses for both projects are ongoing and other field work is being planned for 2010 to expand the number of lakes in these two projects.

YEARS OF DATA

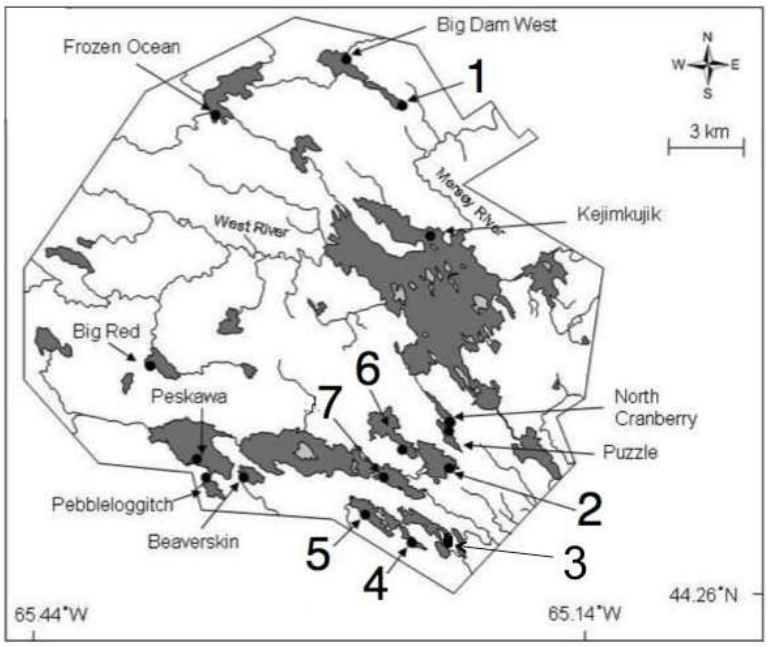
- Year 1 of a 2 year project

PARTNERS

- Parks Canada
- Environment Canada
- Natural Sciences and Engineering Research Council of Canada

K. Fischer

Meredith Clayden sorting samples using sieves to separate insects by size for identification



K. Kidd

Lakes in Kejimkujik that are part of the study on mercury in food webs: 1) Big Dam East; 2) Cobrielle; 3) Hilchemakaar; 4) Upper Silver; 5) Back; 6) Mountain; 7) Peskowesk

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M. Gautreau

A Yellow perch from Kejimkujik on a length board to determine fork length of the fish

Rationale

Mercury is a globally distributed, toxic environmental contaminant. Quantifying the release of volatile mercury from aquatic ecosystems is integral to predicting mercury-sensitive freshwaters. Inorganic mercury (Hg^{+2}) in freshwater lakes can be reduced to volatile elemental mercury (Hg^{0}) through reactions with dissolved organic matter (DOC) and energy from solar radiation. Current predictive models lack the gross oxidation and reduction rate kinetics of these reactions and how they change with water characteristics. A comprehensive knowledge of the way mercury behaves in a freshwater lake system, such as the lakes of Kejimkujik, will enable the examination of specific factors affecting mercury photoreactions such as DOC, dissolved ions, biotic activity and solar attenuation and to how to apply these factors in a predictive model.

A. Belliveau, MTRI

Kejimkujik Lake

Research

MERCURY PHOTOREACTIONS IN KEJIMKUJIK LAKES

OBJECTIVES

- To quantify gross and net photoreduction rates for mercury with variations in DOC concentration in a series of lakes in Kejimkujik.
- To develop of a mechanistic predictive model to describe the formation of volatile mercury.
- To identify lakes that are likely to retain deposited mercury as opposed to volatilize it to the atmosphere.

METHODS

- Freshwater samples were collected from 10 lakes in Kejimkujik spanning a range of DOC concentrations from 3.78 to 13.28 mg /L in May 2008 and May 2009 (DOC ranging from 2.6 to15.4 mg/L).
- Samples were frozen until analysis of DOC, total mercury, and mercury photo-reduction and oxidation rates.
- Both filter-sterilized and unfiltered waters were analyzed using a quartz photoreaction cell in combination with a Luzchem photo-reaction chamber (combined UVA UVB irradiation) and a TEKRAN 2537 gaseous elemental mercury analyser to quantify gross and net reduction rates.
- Rate constants were derived using a kinetic fitting model for a pseudo first-order reaction.

N.O.Driscoll

Emma Vost samples lake water for mercury at Big Dam East Lake in May 2009

RESULTS

- Results from batch experiments and gross reduction experiments on the 2008 lakes showed that unfiltered samples of lake water released more mercury (279 ± 48 pg) when exposed to UV radiation than 0.2 μm filtered samples (185 ± 37 pg).
- Net photoreduction rate constants were much more variable and had much higher associated error (range from 1.28 x 10^{-5} to 4.50 x 10^{2} for filtered and 3.20 x 10^{-1} to 2.97 x 10^{-3} for unfiltered).
- Calculated gross oxidation rates (1.42 x 10^{-3} to 3.42 x 10^{-3} for filtered, and 1.90 x 10^{-3} to 2.78 x 10^{-3} for unfiltered) were not significantly different than the gross reduction rates, suggesting that the system is in equilibrium.

RESULTS
Continued

- DOC was related to rate constants for gross reduction, net reduction and gross oxidation, and a significant exponential decay relationship was found to exist.

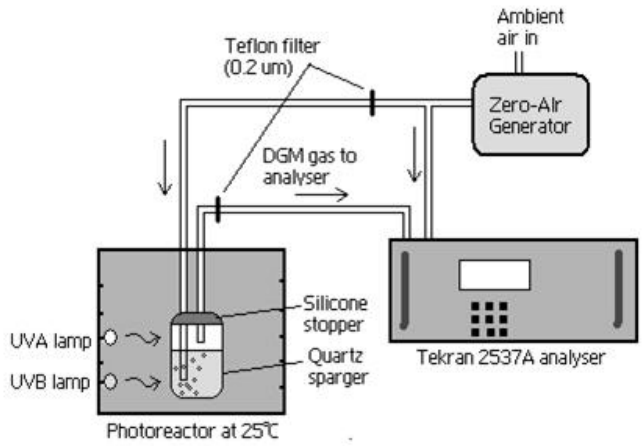
YEARS OF DATA

- Year 2 of a 2 year project

PARTNERS

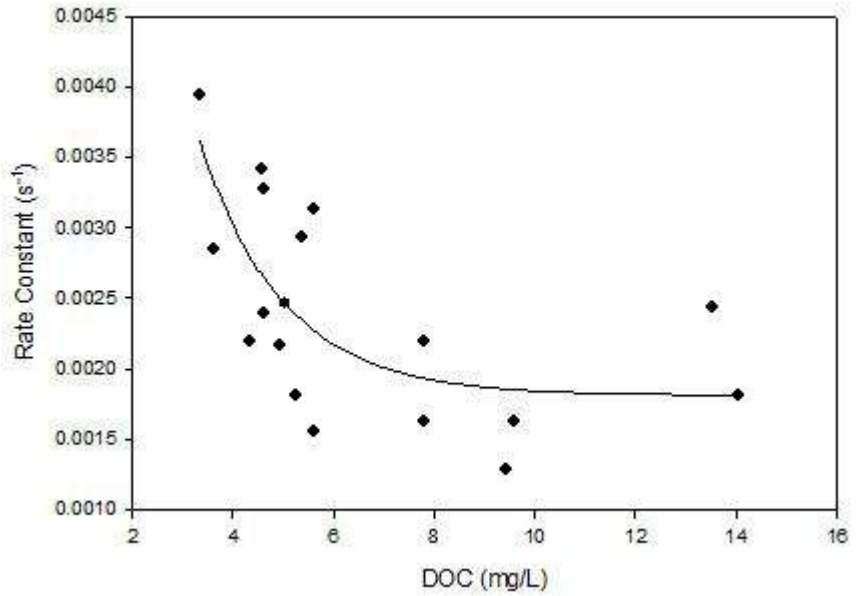
- Natural Sciences and Engineering Research Council of Canada
- RBC Blue Water Program
- Acadia University

E. Vost



Schematic of the continuous DGM analysis system that was modified for analysis of photo-kinetics with the addition of a quartz sparger and photo-incubator

E. Vost



An exponential decay line (Line y = 0.00181 + 0.0136*e-0.604x) fit to the data plotted for gross reduction rate constants and DOC indicates a fair relationship ($R^2 = 0.49$ and $p > 0.001$ ($p = 0.0065$))

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Rationale

The Moose River, a tributary of the Annapolis Basin, is approximately 11 km in length from its source at Lake Cady to where it empties into the Annapolis Basin at Clementsport. The watershed has a catchment of approximately 42 km^2. The Clementsport dam, built in the 1940s to provide water for the Cornwallis military base, is currently in a derelict condition and a barrier to fish passage on the Moose River. The Moose River has a confirmed history of supporting Atlantic salmon, good water quality, viable spawning habitat and interest among project partners to re-build fish stocks.

Looking downstream at the dam following the draining of the impoundment

Research

CLEMENTSPORT DAM FEASIBILITY STUDY

OBJECTIVES

- To evaluate options for restoring fish passage and ecosystem functions to the Moose River in the vicinity of the Clementsport dam.

METHODS

- Clean Annapolis River Project retained the services of an external consulting team composed of Parish Geomorphic, McCullough Environmental Engineering and AECOM Ltd. The consultants undertook a feasibility study to evaluate various scenarios and to make recommendations for the best options for restoring fish passage.
- The feasibility study examined four options: do nothing, partial removal of the dam, full removal of the dam, and rebuilding of the dam.
- In addition to the work undertaken by the consultants, CARP completed baseline ecological monitoring of the site during 2009. A committed group of local volunteers supported this work by conducting a fish utilization study of the river below the dam. Students from the Nova Scotia Community College, Centre of Geographic Sciences (Lawrencetown) also assisted the project through the preparation of a site survey.

Eric Hutchins, National Oceanic and Atmospheric Administration, inspects the non-functional fishway

RESULTS

- The feasibility study will be completed by July 31, 2010.

YEARS OF DATA

- Single year project

PARTNERS

- Gulf of Maine Council on the Marine Environment and the National Oceanic and Atmospheric Administration
- RBC Blue Water Program
- Nova Scotia Community College, Centre of Geographic Sciences

CARP

Note the deterioration of the spillway when looking upstream at the Clementsport dam in May 2009

CARP

Clementport dam, October 2009, with whirlpool above hole in toe of dam

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Rationale

Trout and salmon are threatened by numerous regional factors including acid precipitation, overfishing, climate change, habitat alteration and fragmentation and the introduction of invasive species. Salmon and trout are important components of local biodiversity and of cultural history as sources of food for natural predators, aboriginal people, early settlers and anglers. Although free from point-source pollution, the surface waters of the LaHave, Gold and Medway rivers have acidified due to acid precipitation compounded by long-range transport of air pollution and the inability to buffer acid deposition due to underlying geology and soil types. The reduction in acid precipitation since the 1980's has not reversed the acidic conditions of these watersheds alone and Atlantic salmon populations continue to decline. Terrestrial or catchment liming has not been tried in Nova Scotia but warrants serious consideration based on success in Europe and the extensive use of lime applications in agricultural systems to increase pH. MTRI has been developing a site selection tool that can be utilized in identifying prime sites to lime within these three watersheds.

A. Belliveau, MTRI

Paul Hebert fishing in the Upper Medway River

Research

TERRESTRIAL LIMING TO IMPROVE SALMONID HABITAT

OBJECTIVES

- To compile traditional and research knowledge about salmonid habitat and invasive species information from the Gold, LaHave and Medway watersheds.
- To create maps displaying salmonid habitat and invasive species records.
- To identify and refine site selection criteria for potential terrestrial catchment liming projects based on the following parameters: salmonid and invasive fish presence, soil types and property ownership data.

METHODS

- Mapping data were compiled from the following organizations: Geological Survey of Canada, the Nova Scotia Department of Natural Resources and Nova Scotia Geomatics.
- Published and unpublished electrofishing data were collected from the following organizations: Department of Fisheries and Oceans, Nova Scotia Power and the Bluenose Coastal Action Foundation.
- Representatives from the following associations were interviewed and attended meetings with mapping exercises to determine where salmonid populations persist: LaHave Salmon Association, Medway Salmon Association, Queens County Fish and Game Association, Nova Scotia Salmon Association and the Atlantic Salmon Federation.
- All of the data compiled were mapped using ArcGIS software.
- Utilizing the mapping technology, several optimal sites for liming were selected and ranked based on priority critera.
- Large landowners were contacted to gauge interest in the project in the event that a potential site could occur on their properties.

A. Belliveau, MTRI

The Medway River

RESULTS

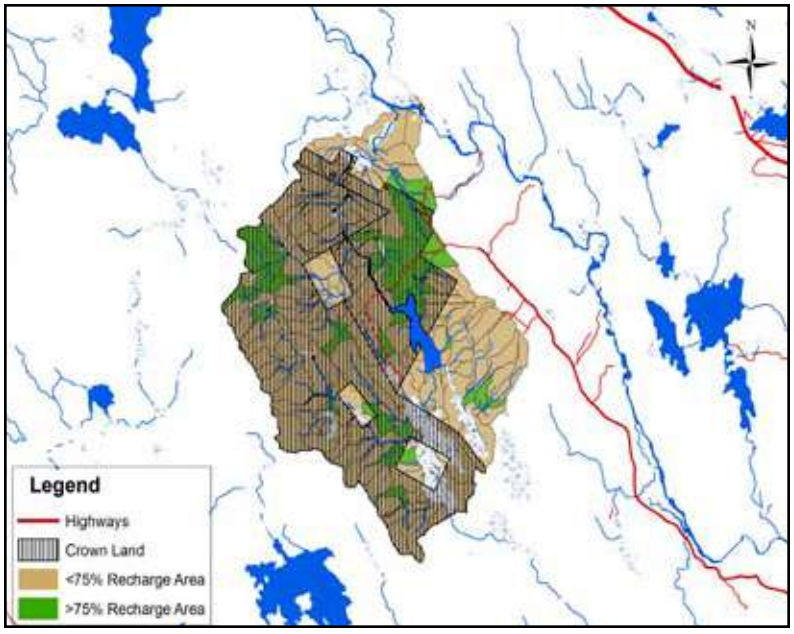
- Data relating to salmonid habitat in the Gold, LaHave and Medway watersheds were organized, mapped, continuously refined, updated and stored in a database.
- Eleven sites were ranked based on the site selection mapping tool.
- A full report is available at www.merseytobeatic.ca.

YEARS OF DATA

- Ongoing project since 2008

PARTNERS

- Environment Canada
- Nova Forest Alliance
- Atlantic Salmon Federation
- Nova Scotia Salmon Association
- Bluenose Coastal Action Foundation
- Department of Fisheries and Oceans
- Nova Scotia Power Incorporated
- Queens County Fish and Game Association
- LaHave River Salmon Association
- Nova Scotia Department of Fisheries and Aquaculture



B. Toms, MTRI

Catchments and property ownership within the Beech Hill Brook watershed where dark areas represent catchments with > 75% recharge area (slope < 5%)

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Rationale

Zooplankton are useful ecosystem indicators because they are sensitive to ecological conditions in lakes and have a short lifespan that allows them to respond quickly to environmental changes such as acidification, nutrient enrichment and climate change. Zooplankton are the primary grazers on algae and are also an important food source for fish. Changes that occur in the zooplankton community can affect the entire aquatic food web. Since environmental stressors related to human impacts have affected lakes in Kejimkujik, most notably acidification, it is important to understand the current distribution and ecology of zooplankton within the park and how zooplankton communities have changed since the onset of these stressors. Long-term monitoring data on zooplankton in Kejimkujik are unavailable, but fortunately zooplankton leave fossils in lake sediments that can be identified to the species level and used to track any changes in zooplankton that may have occurred from approximately1850 to present.

J. Korosi, Queens University

Big Dam West Lake

Research

ZOOPLANKTON FOSSILS AS ECOLOGICAL INDICATORS

OBJECTIVES

- To identify the species of zooplankton found in the surface sediments of 15 lakes in Kejimkujik and compare them to other regions of Nova Scotia with different acidification histories (*e.g.* Cape Breton).
- To determine the ecological tolerances and optima of individual species. These data can be applied to track changes in species assemblage since approximately 1850 in these lakes and relate them to environmental stressors such as acidification (this work is ongoing).

METHODS

B. Ginn, Queens University

Josh Thienpont after having collected a sediment core

- A sediment core was collected from the deepest basin of 15 lakes in Kejimkujik (Frozen Ocean, Big Dam East, Big Dam West, Channel, Kejimkujik, Back, Upper Silver, Peskawa, Peskowesk, Pebbleogittch, Beaverskin, Loon, Mountain, Cobrielle and Grafton lakes).
- The sediment cores were sectioned into 0.25 cm slices or intervals.
- Dates were established for each sediment interval (*e.g.* 1850) using radioisotopes
- Zooplankton fossils were isolated and analyzed in the uppermost 0.25 cm sediment interval to establish current species assemblages in the park. Since older sediment material is overlain by newer material, the uppermost sediments contain the most recently deposited zooplankton remains.
- Current species assemblages were related to water chemistry data to determine the ecological preferences of individual species.
- The next step will be to analyze zooplankton fossils in the entire sediment core for selected lakes to determine how zooplankton have changed over time.

RESULTS

- Abundant remains of a group of zooplankton known as Cladocera (water fleas), which have a hard exoskeleton, were identified in the sediments of lakes in Kejimkujik. Soft-bodied zooplankton groups, such as copepods and rotifers, were not preserved in lake sediments.

RESULTS
Continued

J. Thienpont, Queens University

Sectioning a sediment core into 0.25 cm intervals on shore

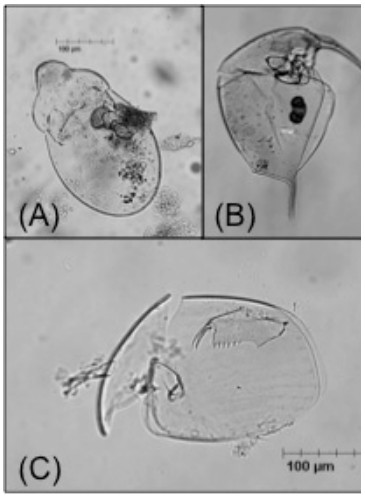
- Lakes displayed a high diversity of cladoceran species that live on plants. Overall, the Cladocera found in Kejimkujik are well adapted to live in low-pH, highly coloured lakes. Species assemblages were statistically most strongly related to lake size and depth (reflecting the abundance of plant habitat available), and lake colour.
- Large-bodied, acid sensitive Daphnia, a keystone cladoceran species in many lakes, were scarce in Kejimkujik lakes relative to other regions of Nova Scotia that have not been as heavily impacted by acid rain.
- Holopedium, a species that is often out-competed in lakes by Daphnia, were observed in high abundances in Kejimkujik lakes relative to the rest of the province. Holopedium is an acid-tolerant, softwater species that is considered a less nutritious food source for fish than Daphnia.
- Next step: determine if Daphnia were present in these lakes prior to the onset of acidification.

YEARS OF DATA

- Single year project

PARTNERS

- Natural Sciences and Engineering Research Council of Canada
- Queen's University

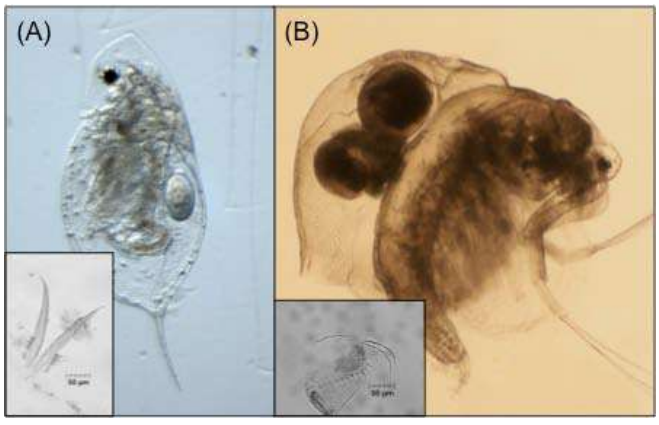


J. Korosi, Queens University

Cladoceran remains found in Kejimkujik lake sediments: A) *Paralona* sp. head capsule, B) *Bosmina* sp. whole animal, C) Alona sp. whole animal

J. Korosi, Queens University

Josh Thienpont and Adam Jeziorski paddling out to Upper Silver lake to take a sediment core



J. Korosi and S. Arnott, Queens University

Live individuals of A) *Daphnia* and B) *Holopedium*, with images of their post-abdominal claws recovered from lake sediments inset

CONTACTS

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Photos on page 83 by A. Belliveau
Clockwise from top left:

- Blue spotted salamander in Kempt
- Hare's tail cotton grass, Medway River
- Wetlands grasses, Jake's Landing
- Wetlands, Herring Cove Lake
- Water arum, Meteghan Station

WETLANDS

Rationale

The Nova Scotia Nature Trust's Rare Plant Monitoring program engages volunteers in collecting field data on the habitat for Atlantic coastal plain plants found along lakeshores and bogs in southwestern Nova Scotia. Volunteers are trained to identify and count these rare plants and monitor changes in populations at the same sites every year. Monitoring helps to determine how the plant populations behave over time. Are they migrating along the shoreline? Are they staying in one established location? Are the numbers of plants increasing or decreasing? This information improves the ability to protect these exceptional plants and their habitat. The Atlantic coastal plain flora is one of the most endangered plant groups in Canada; 11 of the 90 species are considered Endangered, Threatened, or Special Concern by the Committee on the Status of Endangered Wildlife in Canada. Five species are considered to be globally at risk of extinction and 25 are listed as 'at risk' or 'sensitive' by the Nova Scotia provincial government. Rare Plant Monitors play a key role in aiding their recovery both as "citizen scientists" and as communicators of how interesting species at risk recovery can be.


R. Sarrazin

Plymouth gentian, a nationally Endangered Atlantic coastal plain flora species

Monitoring

RARE PLANT MONITORING

OBJECTIVES

- To involve local landowners, recreational land users and other interested individuals in the conservation and recovery of Atlantic coastal plain flora in southwestern Nova Scotia.
- To collect information on the geographic distribution of Atlantic coastal plain flora on private lands in southwest Nova Scotia.
- To track changes in and assess threats to Atlantic coastal plain flora populations and habitat in southwest Nova Scotia.

METHODS

- Outreach and education initiatives were conducted with landowners in Lunenburg, Queens, Shelburne, Yarmouth, Digby and Annapolis counties about the importance of protecting coastal plain plants and habitat on their property.
- Volunteers were trained to identify Atlantic coastal plain flora species, measure population density, gauge habitat threats and record this information.
- Volunteers visited selected Atlantic coastal plain flora sites on private lands one or more times each year to count plant populations, photograph the sites and record observations of habitat.
- Monitoring data collected by the Nature Trust were submitted to the Atlantic Coastal Plain Flora Recovery Team, which uses the data to plan the conservation and recovery of Atlantic coastal plain flora.


NSNT

Redroot in flower, found by Rare Plan Monitor volunteers

RESULTS

- Nova Scotia Nature Trust volunteers monitored Atlantic coastal plain flora habitat on nine lakes, contributing significantly to long-term data records of habitat characteristics and species occurrences on these lakes.
- Incidental new findings included the flowering of Redroot recorded at a site not previously known to have flowering individuals and beaver herbivory of Buttonbush noted by one volunteer monitor.
- Eighteen new volunteer monitors were trained in 2009.

YEARS OF DATA

- Ongoing project since 1999

PARTNERS

- Nova Scotia Nature Trust
- Atlantic Coastal Plain Flora Recovery Team
- Nova Scotia Department of Environment
- Nova Scotia Department of Natural Resources
- Government of Canada Habitat Stewardship Program for Species at Risk
- Nova Scotia Habitat Conservation Fund
- Nova Scotia Species at Risk Conservation Fund
- Municipality of the District of Shelburne
- Canadian Wildlife Federation
- Aveda International

NSNT

Buttonbush, which one Rare Plant Monitor reported this year was preyed upon by beavers

NSNT

Rare Plant Monitors and Nature Trust staff member show off Redroot in flower at training session

CONTACTS

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Rationale

Blanding's turtles in Nova Scotia exist in three small populations on the Mersey and Medway watersheds and have been listed as Endangered under both the federal Species at Risk Act and the Nova Scotia Endangered Species Act. One of the concerns for this long lived (80+ years), slow maturing (20+ years) species is the lack of young adults in the population. This is of particular concern in the population at Kejimkujik where only 5 young females have been recorded during the last decade. Rates of predation of unprotected nests are variable but can reach 100%. Raccoons are the primary nest predators and their populations may be unusually high in human inhabited areas (*e.g.,* campgrounds and communities). An annual volunteer-based nest protection program was established in Kejimkujik and later expanded to populations outside the park to engage the public in helping to protect and care for turtle nests.

J. McNeil Parks Canada

A nesting Blanding's turtle burying her eggs at McGowan Lake

Monitoring

BLANDING'S TURTLE NEST MONITORING

OBJECTIVES

- To protect Blanding's turtle nests from predation to improve recruitment into the populations.
- To collect eggs for incubation and rearing (from Kejimkujik nests).
- To provide an opportunity for volunteers to engage in Species at Risk recovery.
- To collect long-term data on female survivorship, clutch size, hatching success and site fidelity.

METHODS

Nest Protection (June)

- Known nesting sites were monitored on a nightly basis during nesting season.
- Individual turtles were radio tracked to locate new nesting sites.
- At 7:30pm, volunteers and researchers walked each site watching for turtles. Observers watched females go through the nesting process and recorded data related to behaviour and movements, weather, timing of activities and clutch size.
- Once a nest was completed and the female had left the site, volunteers covered the nest with a wire mesh cage and secured it with large rocks to protect the nest from predation.
- Eggs from selected nests in Kejimkujik were collected and transported to Oaklawn Farm Zoo for incubation.

Nest Monitoring (September – October)

- Nests were monitored periodically until the first hatchlings emerged and then were monitored daily by volunteers and researchers who marked, measured, weighed and released hatchlings turtles at the nest site.

Parks Canada

Volunteers recording data as Blanding's turtles nest in June

RESULTS

Nest Protection (June)

- In 2009, volunteers in Kejimkujik located and protected a record 25 Blanding's turtle nests. Of these, eggs from 12 nests were collected for incubation, which produced 110 hatchling turtles.
- Twelve nests were protected at McGowan Lake and Pleasant River, with help from volunteers, researchers and community members.

Nest Monitoring (September – October)

- 129 hatchlings emerged in total in 2009.
- A total of 53 hatchlings emerged from the 13 nests in Kejimkujik. Volunteers also helped to excavate eggs from nests that were overdue.
- At McGowan Lake, 44 hatchlings emerged from the protected nests.
- In Pleasant River, 32 hatchlings emerged from volunteer-monitored protected nests.

YEARS OF DATA

- Ongoing project since 1989 in Kejimkujik
- Ongoing project since 2000 at McGowan Lake
- Ongoing project since 2002 at Plesant River

PARTNERS

- Parks Canada
- Blanding's Turtle Recovery Team
- Acadia University
- Friends of Keji Cooporating Association
- Mersey Tobeatic Research Institute
- Government of Canada Habitat Stewardship Program for Species at Risk
- Oaklawn Farm Zoo

Parks Canada

Volunteers releasing newly hatched Blanding's turtles from their protective nest enclosure

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Rationale

Blanding's turtles in Nova Scotia are listed as Endangered under both the provincial Endangered Species Act and the federal Species at Risk Act. The listing is in part due to their small population size and limited distribution in the province. Since 1969, only 300 individual adults have been captured, most within the three currently known populations. Unconfirmed sighting reports suggest that additional populations may exist elsewhere in the southwest region of the province (SWNS). Searching for new populations is a labour intensive undertaking, requiring the help of many volunteers.

Bob the Blanding`s turtle in McGowan Lake

Monitoring

BLANDING'S TURTLE DISTRIBUTION SURVEYS

OBJECTIVES

- To search for additional populations of Blanding's turtles in several areas around SWNS.

METHODS

- Live trapping was conducted using hoop traps baited with sardines. Traps were set for two to five days and were checked daily by trained staff and volunteers.
- Visual surveys were conducted by slowly searching the area by canoe or on foot.
- All new turtles captured were given a unique notch code so that they can be individually identified on subsequent captures. Turtles were handled by trained personnel in accordance with the standard procedures developed by the Blanding's Turtle Recovery Team.
- Search areas were selected based on proximity of sighting reports and presence of appropriate looking habitat identified from air photographs or ground surveys.

RESULTS

- Twenty-six individual trapping sessions were conducted on four watersheds for a total of 841 trap nights on provincial and private lands.
- Sixteen volunteers were involved in trapping, putting in over 400 hours of effort. Volunteers were involved in all 26 trap sessions and 15 of the 26 sessions were conducted entirely by trained volunteers.
- No new areas containing Blanding's turtles were found during the trapping sessions. However, two Blanding's turtles were found in new areas by incidental observations (one by a member of the public and one by MTRI staff); these will be priority areas for follow up surveys in 2010.

A Blanding's turtle surfacing in a turtle trap

YEARS OF DATA

- Ongoing project since 1989

PARTNERS

- Acadia University
- Mersey Tobeatic Research Institute
- Parks Canada
- Nova Scotia Power Incorporated
- Nova Scotia Department of Natural Resources
- Friends of Keji Cooporating Association
- Government of Canada Habitat Stewardship Program for Species at Risk

J. McNeil, Parks Canada

A new notch followed by a hatchling notch

J. McNeil, Parks Canada

Volunteers carrying out a visual survey for Blanding's turtles by canoe

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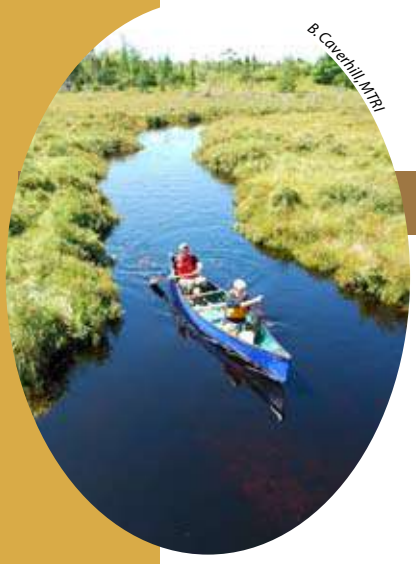
Rationale

Nova Scotia Power Incorporated (NSPI) contracted the Mersey Tobeatic Research Institute in August 2009 to conduct turtle and snake surveys on three watersheds in southwest Nova Scotia: Sissiboo, Tusket and Mersey. These watersheds were of particular interest to NSPI because they were in the process of re-licensing them for hydropower generation, and field teams had already collected data on various parameters of aquatic health such as water quality, fish, odonates and vascular plants. It was recommended that reptiles at risk also be considered in the re-licensing process and MTRI was chosen to do the work based on its expertise in research concerning both aquatic health and species at risk in Nova Scotia.



B. Caverhill, MTRI

Turtle researchers

Monitoring

TURTLE AND SNAKE SURVEYS

OBJECTIVES

- To collaborate with NSPI in the monitoring of the aquatic health of watersheds in which they generate power with hydro dams and reservoirs.
- To determine the presence of reptile species at risk, specifically Blanding's turtles, Snapping turtles and Eastern ribbonsnakes within certain areas on the Sissiboo, Tusket and Mersey watersheds.

METHODS

- Previously existing data on Blanding's turtle, Snapping turtle and Eastern ribbonsnake sightings from the study area were acquired and a mapping exercise was conducted.
- Survey sites were selected in each watershed based on existing sighting reports, habitat quality and accessibility and proximity to NSPI reservoirs and dams.
- Field surveys were conducted in late August and early September, including a total of 353 trap nights, 173 hours of trapping effort and six dedicated hours of visual survey effort for snakes.

RESULTS

- No Blanding's turtles were captured on any watershed during the study period although habitat conditions were not ideal.
- Several Snapping turtles and dozens of Painted turtles were captured on the Mersey and Sissiboo watersheds, while only a couple of Painted turtles were captured on the Tusket.
- Two Eastern ribbonsnakes were captured in the Mersey watershed where a population may occur.
- Considering the vast geography these three watersheds encompass, it is recommended that NSPI consider continued sampling for reptile species at risk in the region, learn about the effects of hydro power on these species and also to contribute to our understanding of their distribution in the province.

B. Caverhill, MTRI

Group of surveyors getting ready to check traps

YEARS OF DATA

- Single year study

PARTNERS

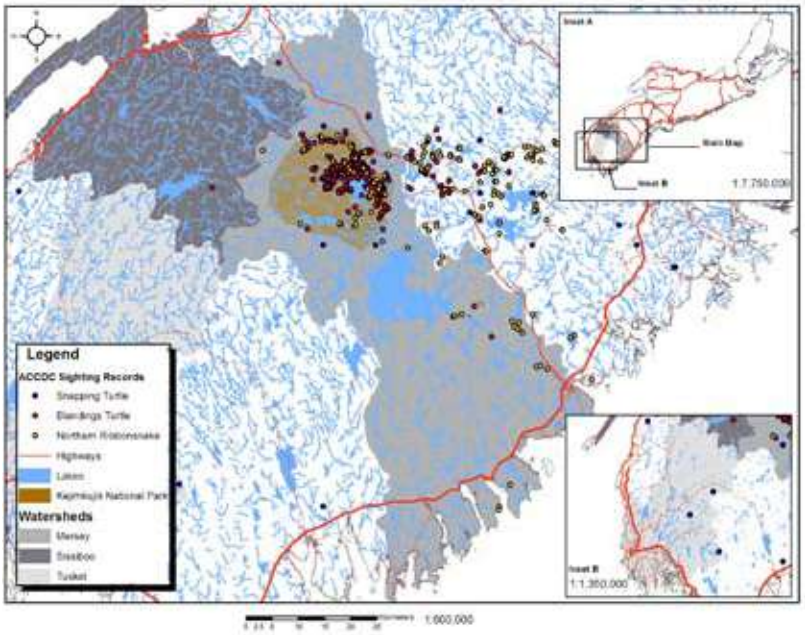
- Mersey Tobeatic Research Institute
- Nova Scotia Power Incorporated
- Acadia University
- Parks Canada
- Blanding's Turtle Recovery Team
- Atlantic Canada Conservation Data Centre

B. Caverhill, MTRI

Eastern ribbonsnake

MTRI

Brennan Caverhill checking turtle traps



B. Toms, MTRI

Sightings overview map prepared with information provided by the Atlantic Canada Conservation Data Centre

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Rationale

The Nova Scotia population of Blanding's turtles has been listed as Endangered through the federal Species at Risk Act and the Nova Scotia Endangered Species Act. This small population is geographically isolated from the species main range and low juvenile recruitment has been observed. Headstarting, along with other conservation strategies, has been used in an attempt to increase juvenile recruitment. Headstarting involves the captive rearing of hatchlings collected from the wild and their subsequent release to their natural habitat. This conservation tool allows turtles to avoid high mortality rates associated with early life stages and to grow under optimal conditions. Little is known about behaviors of released headstarts and their ability to adapt to their new environment. Studying the survival, growth, and movement of headstarts following their release will evaluate the headstarting program for Nova Scotia Blanding's turtles.

One year old wild juvenile Blanding's turtle in Kejimkujik

Research

BLANDING'S TURTLE HEADSTART TRACKING

OBJECTIVES

- To track headstarted hatchling turtles released in 2008 throughout summer and fall.
- To trap and conduct visual surveys for wild juvenile Blanding's turtles.
- To compare survival, growth, and movement of released headstarts to those of wild juveniles to assess the ability of headstarts to behave like wild juvenile turtles.
- To evaluate the effectiveness of a headstart program for Nova Scotia Blanding's turtles by examining the ability of headstarts to adapt to their new environment.

METHODS

- Radio tracking of headstarts released in summer 2008 was continued.
- Visual surveys and trapping sessions, using baited hoop traps, were conducted to continue searching for wild juveniles. Once found, wild juveniles were also fitted with radio transmitters.
- Headstarts and wild juveniles were tracked during the summer and fall to study their movements and survival.
- Headstarts and wild juveniles were measured monthly to assess growth rates.

RESULTS

- Only two headstarts and two wild juveniles were found in spring 2009 with working radio transmitters from the previous field season. Over the summer, three more headstarts, released in 2008, were found. Two headstarts, released in the early 90s, now around 15 years of age were also found.
- A total of 23 wild juveniles were found through visual surveys and trapping. Wild juveniles ranged from one to 18 years of age. A total of eight one year old and three two year old turtles were found through visual surveys.
- Mortality rates for a small sample size were similar between wild and headstarted hatchlings. Two headstarts (three years old) and two wild juveniles (one year old and two years old) were found dead over the course of the field season.

YEARS OF DATA

- Year 2 of a 2 year project

PARTNERS

- Acadia University
- Blanding's Turtle Recovery Team
- Parks Canada
- Endangered Species Recovery Fund
- Friends of Keji Cooperating Association
- Mersey Tobeatic Research Institute

P. Kydd

Lilianne Arsenault with Cleopatra, a three year old Blanding's turtle headstart released in 2008

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Rationale

Conservation canines have been used for decades to find endangered or threatened species in the wild. Dogs have been used to find Desert tortoises, Brown tree snakes, bats, Atlantic right whales (finding floating defecation), Siberian tigers, Black bears, Grizzly bears, fishers, bobcats, Black-footed ferrets, Kit foxes, Red foxes, Gray foxes, House sparrows, tinamous, and game birds just to name a few. The purpose of this study was to determine if dogs could be trained to detect, discriminate, search and track by scent Eastern ribbonsnakes in Kejimkujik.

J. McNeil Parks Canada

Sable, a Conservation Canine in training

Research

WILDLIFE CONSERVATION CANINES

OBJECTIVES

- To assess the usefulness of dogs in detecting, trailing and tracking Eastern ribbonsnakes in their natural environment though considering the following questions: (i) Is a trained dog more efficient than a trained human at finding Eastern ribbonsnakes? (ii) Does having a trained dog on a team help to find more Eastern ribbonsnakes than if the team was composed of humans only? and (iii) Are dogs helpful in finding the Eastern ribbonsnake's hibernacula?

METHODS

- In a previous 2009 study, Gadbois and Demontfaucon showed that dogs were able to discriminate Eastern ribbonsnake scent from distractor odours such as Red-Bellied Snake and Garter Snake scents.
- Training with the dogs began in February of 2009 and transitioned to the field with two of the four canines that were trained during the winter and spring.
- The graduated canines received maintenance training and modification of behaviours following performance in field trials during the summer. The maintenance training will be ongoing as the dogs continue to be used in the field.
- The dogs were trained based on a protocol inspired from Errorless Discrimination Training or EDT, following a simplified fading-in procedure.
- Once the dogs had learned the target scent, the main goals were to: (i) maintain the dogs' level of accuracy by using line-ups, matrices, and games, (ii) transfer the lab skills to the field and (iii) collect data from the field.

Troy Frech

Grafton Lake Eastern ribbonsnake survey using both dogs and people

RESULTS

J. McNeil, Parks Canada

An Eastern ribbonsnake basking at Grafton Lake

- Canines do better than humans at finding snakes, even when number of humans per team and number of field hours have been taken into consideration.
- Although capture rates attributed to dogs may not be as good in the fall, sightings are still helped by the canines. Canines and humans were a complement to each other, humans being very visual while canines are very "olfactory".
- There is no doubt that ribbonsnakes, mostly because of their semi-aquatic environment, were a challenge but there were some successes. A full report is available upon request.
- Other projects that are being pursued include using Wildlife Conservation Canines for other reptiles such as Blanding's Turtles and Wood Turtles, as well as carnivores.

YEARS OF DATA

- Single year study

PARTNERS

- Dalhousie University
- Acadia University
- Parks Canada
- Mersey Tobeatic Research Institute

Jeffie McNeil, Parks Canada

Conservation canine in traininig, Zyla sniffing for ribbonsnakes

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Rationale

The Eastern ribbonsnake is listed as a threatened species under the federal Species at Risk Act. The Nova Scotian population is at the northeastern edge of its range, occurring within Kejimkujik and the surrounding area. Limited research has left much unknown about the snake. This study intends to deliver a deeper understanding of ribbonsnake movements between ajoining patches of wetland within an active season. This understanding will improve conservation efforts for the Eastern ribbonsnake.

Young Eastern ribbonsnake at Molega Lake

Research

EASTERN RIBBONSNAKE MOVEMENTS

OBJECTIVES

- To gain evidence of Eastern ribbonsnake movements through capture-recapture techniques and the use of PIT tagging.
- To find and survey several new high-density sites of ribbonsnakes along the shore of Keddy's Cove in Molega Lake.
- To determine the level of PIT tag retention of individuals tagged the previous year.

METHODS

- High priority sites for surveying were chosen based on previous sighting reports as well as habitat similarities. Volunteer observations were examined and landowners were instructed on proper reporting methods.
- Several sites were surveyed for ribbonsnakes on a regular basis with an emphasis on the central site. Surveyors varied in number, from one to five, and survey effort was recorded. Observed snakes were captured in most cases and identified.
- PIT tags were inserted subcutaneously into ribbonsnakes of a certain minimum size in an effort to permanently mark them for future identification.
- Data were gathered for all observations about temperature, weather, snake behaviour and snake characteristics.

Rachel Thibodeau recording measurement data at Molega Lake

RESULTS

- Eastern ribbonsnakes were not observed in all the zones surveyed but seemed to be concentrated in the central region, which was concurrent with the previous year's findings. Sightings in the areas peripheral to the central zone were much lower than within the central zone itself. This was consistent throughout the season.
- Ribbonsnakes were typically found close to the water's edge and in one location at the end of the summer they were found to concentrate in specific areas.

RESULTS
Continued

- No snakes that had been PIT tagged that were under 27 grams of weight were recaptured, and consequently, the minimum eligible weight for a snake to be PIT tagged was raised.
- The tagged snakes that were recaptured were all large adults that did not seem to have suffered any adverse side-effects from the procedure. One individual was recaptured with a PIT tag and was presumed to be gravid, which indicated that the PIT tag was not impeding her survival or reproductive success.

YEARS OF DATA

- Ongoing project since 2004

PARTNERS

- Acadia University
- Eastern Ribbonsnake Recovery Team
- Dalhousie University
- Parks Canada
- Mersey Tobeatic Research Institute

J. Saroli

PIT tag reader shown with adult Garter snake

R. Thibodeau, MTRI

Measuring the length of a young Eastern ribbonsnake

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Rationale

The Eastern ribbonsnake, a subspecies of the Northern ribbonsnake, is considered Threatened in Canada. Its range in Nova Scotia is known as the Greater Kejimkujik Ecosystem in Queens, Annapolis and Lunenburg counties. The structure of the population is currently being investigated through the ongoing collection of sightings and captures. Within the current range extent there are large areas without any sightings or captures. Recently, there have been confirmed sightings far from what was formerly considered to be the range limit.

J. McNeil, Parks Canada

Coiled Eastern ribbonsnake

Research

EASTERN RIBBONSNAKE RANGE

OBJECTIVES

- To gain a better understanding of the range and population structure of the Eastern ribbonsnake by searching areas outlined in the recovery strategy as priority areas as well as other areas where snakes were likely to occur but had not yet been found.

METHODS

- Visual searches for ribbonsnakes were conducted with two or more trained people until it was felt that the area had been searched thoroughly.
- When captured, snakes were processed for standard body measurements. Location, habitat and climatic variables were also collected.
- Cover boards made of metal were also placed in areas where searches took place and checked each time that the sites was visited for the presence of ribbonsnakes. The air temperature and the temperature under and above the board were recorded.

M. Crowley

Brad Toms recording ribbonsnake data at Eel Lake

RESULTS

- Ribbonsnakes were found for the first time at 3 sites (Eel Lake, Second Christopher Lake and Cow Moose Brook). All of these areas were between sites where snakes were previously captured.
- Snakes were also found at new sites along the Mersey River above Lake Rossignol. These captures are beginning to show that the population is more contiguous than previously thought.

YEARS OF DATA

- Single year study

PARTNERS

- Acadia University
- Eastern Ribbonsnake Recovery Team
- Dalhousie University
- Mersey Tobeatic Research Institute
- Nova Scotia Power Incorporated
- Parks Canada

M. Crowley

Brad Toms checking a coverboard

J. McNeil, Parks Canada

A ribbonsnake basking near a coverboard

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Photos on page 101 by A. Belliveau, MTRI
Clockwise from top left:

- Porcupine Brook researchers
- Rachel Thibodeau taking a photograph at the Mersey River
- A Garter snake at Randolphs Stream
- Tolerant hardwoods research near the Medway River
- Practicing yoga beside the Mersey River

HUMAN DIMENSIONS

Rationale

The Nova Scotia Community College's Energy Sustainability Engineering Technology (ESET) class was contacted and asked to do an energy audit for the Mersey Tobeatic Research Institute (MTRI) in Kempt, NS. The institute was interested in becoming more energy efficient. MTRI does research and education about climate change and wants to be a leader in energy efficiency and the utilization of green technologies in residential-scale buildings.

MTRI field station

Research

ENERGY AUDIT OF MTRI FIELDSTATION

OBJECTIVES

- To measure energy efficiency of MTRI's field station and make recommendations about how to reduce MTRI's carbon footprint.

METHODS

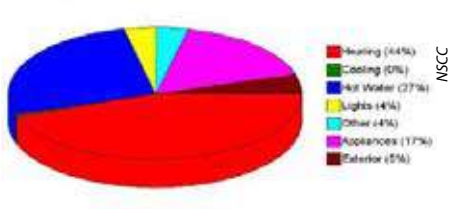
- The audit date was set for March 1st 2010. ESET students collected the necessary data to assess the performance of the building.
- Historical energy consumption data were collected by the audit team. The consumption data were plotted and reviewed for irregularities using linear regression analysis.
- The basic utility assessment was completed and detailed weather data were obtained for the region from Environment Canada.
- A complete walk-through audit to collect building specific data was performed. Pictures of the building were taken using thermal imaging cameras and digital cameras to assist in the analysis and recreating the building in a three dimensional model.
- The team collected information on the exterior walls using non-intrusive methods and historical material availability. The rooftop construction was inspected from the interior and confirmed against the architectural drawings, where available.
- Information regarding the type and size of all windows and doors was collected directly from the units.
- Measurements for all window types, doors and the exterior dimensions were taken and recorded.

A schematic showing what the MTRI field station might look like in the future with a well-insulated addition on the south side, solar panels, geothermal energy, and a small wind turbine

RESULTS

- The Building Energy Performance Index (BEPI) declined each year over the last three years.
- Based on the walkthrough audit the team identified the main source of electrical consumption as space and hot water heating. Above-grade and below-grade insulation of exterior walls in the basement would reduce the heating requirement for the building dramatically, which is currently 44% of electrical consumption. A solar thermal system could substantially reduce the hot water costs as well (27% of electrical consumption).

RESULTS
Continued



NSCC

Breakdown of MTRI field station's energy consumption by type of use in 2009 shows that heating, hot water, and appliances consume 88% of the total energy budget

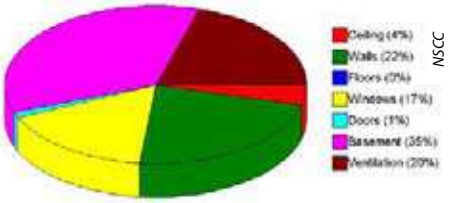
- The audit team recommends replacing all T12 lights with high efficiency T8 which is estimated to save MTRI hundreds of dollars per year. The measured and/or estimated thermal resistance values for the building components is as follows: R-Value of 6 for walls, 40 for ceiling, 4.12 for floor, and 1.92 for windows.
- Due to the variability of measurements some of the values may be slightly off; however, the variation should be less than 5%.
- Thirteen energy conservation measures were recommended including the following: insulate building, pipe insulation, domestic solar hot water system, lighting upgrade, resize heat pump after envelope upgrades, thermostat upgrade, low flow shower heads, energy policy implementation, power bar installs, weather stripping, alteration of expansion, future funding, attic hatch insulation / sealing.

YEARS OF DATA

- Single year project

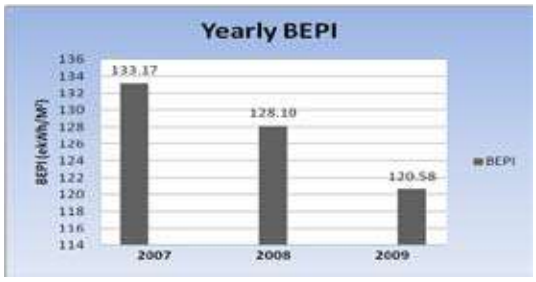
PARTNERS

- Mersey Tobeatic Research Institute
- ecoNova Scotia Fund
- Nova Scotia Community College



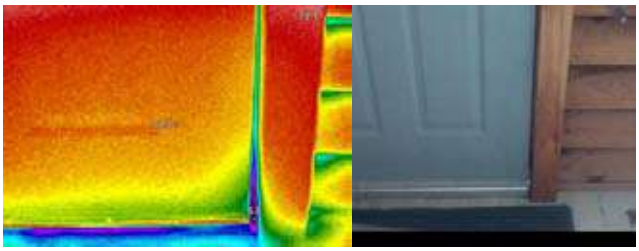
NSCC

Most of MTRI's heat loss is in its basement, walls, and windows



NSCC

MTRI field station annual BEPI (building energy performance index) adjusts for the total square meters of the building and indicates a decrease each year from 2007 to 2009


NSCC

Thermal images from around MTRI's exterior doors show in blue where cold air is entering the building and weather stripping could save energy


NSCC

Thermal images from the top of MTRI's hot water tank show in red where heat is escaping and insulation could save energy

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Rationale

The Southwest Nova Biosphere Reserve is one of Canada's "Biodiversity Hotspots". It is home to approximately 75% of the more than 40 Species at Risk (SAR) that live in Nova Scotia. SAR Stewardship Biologists from Kejimkujik have partnered with MTRI and other organizations, such as First Nations, academia, community groups and industry, to help recover the SAR that live in this unique region. Their work is to learn about SAR in the SNBR, share this knowledge with the public and engage interested individuals, families and communities in the conservation of these species and the habitat in which they live.

MTRI

This Monarch butterfly banner was carried by Cécile Vuillermet as part of the MTRI and Kejimkujik entry in the Queens County Exhibition parade

Research

SPECIES AT RISK STEWARDSHIP IN SNBR

OBJECTIVES

- To promote environmental stewardship and advocacy and create ambassadors for SAR.
- To increase awareness and understanding within the general public about SAR in the SNBR, and generate sighting reports.
- To help recover key SAR, including Blanding's turtle, Eastern ribbonsnake, Piping plover, Southern flying squirrel, Monarch butterfly, Water-pennywort and endangered Atlantic coastal plain flora.

METHODS

- Volunteer opportunities in the SNBR include: Blanding's turtle nest monitoring, trapping, radio tracking and visual surveys; Eastern ribbonsnake surveys; Piping plover habitat restoration; and Atlantic coastal plain flora monitoring.
- Partnerships continue to be established with individuals and organizations that work with SAR in Nova Scotia to enhance communication and collaboration and ultimately the recovery of SAR in the SNBR.
- Outreach strategies are developed to link science and stewardship to acheive awareness and appreciation for SAR in the SNBR.

L.Helmer

Jessica Bryk and Kyle Rawding at the Farmer's Market in Mahone Bay

RESULTS

- Volunteer stewards continue to monitor SAR on their properties throughout the SNBR and participate in volunteer programs. Over 300 individuals volunteered a total of more than 10,000 hours for the third year in a row in the Greater Kejimkujik Ecosystem in 2009.
- Over 100 volunteers and stewards attended a volunteer banquet in December to celebrate their achievements and plan for the future.
- Outreach events targeted community meetings, farm markets, door-to-door contacts and several media outlets to raise awareness of SAR with Nova Scotians, specifically in the SNBR.

YEARS OF DATA

- Year 3 of a 3 year project

PARTNERS

- Acadia University
- Bear River First Nations
- Mersey Tobeatic Research Institute
- Parks Canada
- Southwest Nova Biosphere Reserve Association
- Government of Canada Habitat Stewardship Program
- Friends of Kejimkujik Association

B. Caverhill, MTRI

Attendees at the Volunteer Banquet Celebration

B. Caverhill, MTRI

Everett Stone records events at the MTRI BBQ as part of a SAR video he prepared for Kejimkujik

A. Lavers, MTRI

A monarch butterfly visits the MTRI butterfly garden, the home garden of the Buttefly Club

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Rationale

The EMPOWER! Project was designed and delivered by a team of students, researchers and educators at MTRI in Kempt, Nova Scotia. MTRI has partnered with organizations like the Southwest Nova Biosphere Reserve Association (SNBRA) and the Clean Annapolis River Project (CARP) to engage and empower young environmental leaders in southwest Nova Scotia.

B. Caverhill, MTRI

Petroglyph workshop

Research

EMPOWER! YOUNG COMMUNITY LEADERS IN THE SNBR

OBJECTIVES

- To facilitate a network of active youth and engaging opportunities, mainly through internet portals like websites, Facebook pages and blogs.
- To research rural outmigration and profile inspiring youth and businesses within the biosphere.
- To spearhead a conference at Kejimkujik, where all involved can meet to learn and share their blossoming skill, knowledge and passion.

METHODS

- Junior high, high school and university students were employed at different times of the year.
- Environmental volunteer, education and job opportunities for youth in the Southwest Nova Biosphere Reserve were researched and summarized.
- Inspiring youth and businesses already operating in the Biosphere were discovered and interviewed.
- A gathering at Kejimkujik Park was planned and coordinated by MTRI staff and partners from CARP and SNBRA.

B. Caverhill, MTRI

EMPOWER! participants and organizers at Kejimkujik

RESULTS

- A web page was created on www.merseytobeatic.ca to summarize the volunteer, education and job opportunities available in the Biosphere.
- Profiles of inspiring youth and businesses were written and posted on the website. It was hoped that several will be published in local newspapers and magazines.
- A youth retreat was hosted in Kejimkujik in October 2009, which saw 40 high school students from 10 schools throughout Nova Scotia in attendance. New friendships were created, information was exchanged and all who participated learned a lot.

YEARS OF DATA

- Single year project

PARTNERS

- Mersey Tobeatic Research Institute
- Parks Canada
- Southwest Nova Biosphere Reserve Association
- Clean Annapolis River Project
- North Queens Schools

B. Caverhill, MTRI

A participant led group presentation during the EMPOWER! conference

B. Caverhill, MTRI

EMPOWER! youth at MTRI

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Rationale

MTRI was established in 2004 and within a couple of years was able to purchase its field station in the small rural community of Kempt, Queens County. To achieve its goal of promoting sustainable resource use, members of the MTRI co-operative have adopted ambitious education and outreach objectives and always strive to keep the lines of communication open between members and researchers and with the public. MTRI's plan for outreach includes a number of signature events such as monthly seminars about local research projects through the winter and a weekly series of seminars throughout the summer. Each year, MTRI hosts a Woodlot Demonstration in the fall and an Open House around the Christmas holiday. MTRI also works with North Queens schools to bring students to the field station in early summer to meet researchers. All of these education projects, and others, are advertised through local newspapers, by word of mouth, and other means. To evaluate the success of these efforts, phone surveys to local residents have been ongoing.

Megan Jones conducts phone surveys for MTRI

Research

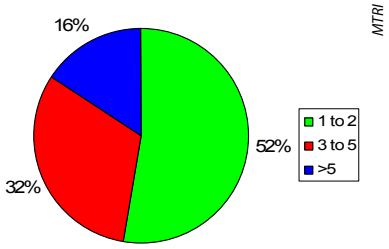
SOUTHWEST NOVA SCOTIA PHONE SURVEY

OBJECTIVES

- To determine how successful MTRI's education and outreach activities have been at reaching members of the local community.
- To create a database of baseline information related to the perceptions of the residents of southwest Nova Scotia to activities taking place in and around MTRI.
- To enable local citizens of southwest Nova Scotia to become involved in research and monitoring activites in their area.

METHODS

- A series of questions was developed to assess the participant's awareness of activities in and surrounding MTRI, including topics such as: whether people have heard about MTRI and what are their information sources; if people know what MTRI does; creating a profile of willing respondents which describes their outdoor activities, dependance on the forest industry, their visitation of Kejimkujik, their age, and their gender; determine what people know about invasive fish, old forests, and species at risk; determine the values and concerns of respondants about economic and environmental issues.
- Random phone numbers in the North Queens exchange were called and permission was requested of the household resident to answer the survey.
- Volunteers Nancy Bingham and Jamie Ryan collected answers and analysed the data gathered from phone conversations with local citizens.



The number of times people had read newspaper articles about MTRI

RESULTS

- The community of North Queens includes approximately 800 households. Of those who were phoned, 56 people agreed to answer a series of questions.
- Of those, 40 had heard of MTRI; 19 people who had heard about MTRI had read about it in newspaper articles, 23 had seen posters in the community, and 19 had heard about MTRI's public talks. Five interviewees had attended a public talk and one had visited MTRI's website.

RESULTS
Continued

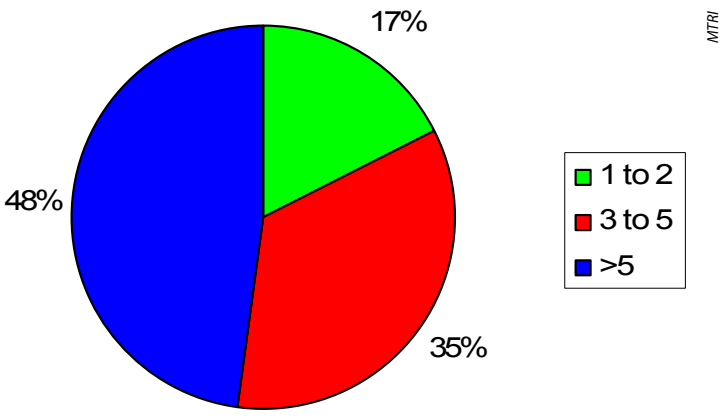
- When asked what MTRI works on, the most common responses were: Blandings turtles, loons, forestry and wildlife, species at risk and ribbon snakes, but there were also a variety of different answers.
- Of those interviewed, 41% said that someone in their household worked in the forest industry.
- Kejimkujik had been visited in the past year by 21 of the respondents.
- Of the 56 respondents who answered questions, 42 said they participated in outdoor activities. The most popular activities were (in order): hiking (28/42), bird watching (28/42), fishing (25/42), bicycling (21/42), camping (20/42), hunting (19/42), bicycling (21/42), driving an ATV (19/42), canoeing (17/42), and cross-country skiing (7/42).
- When asked what came to mind as major economic problems or issues in North Queens, the most common responses were: lack of jobs and problems in the forest and mill closures, although there were a variety of answers.
- When asked what comes to mind as major environmental problems or issues in North Queens, the most common responses were: clear cutting, acid rain and pollution, although there were a large variety of different answers.
- There were 40 respondents who had heard of the Smallmouth bass and Chain pickerel, and most of those knew about the environmental problems that they cause.
- There were 50 people who thought that old growth forests are important to the environment because of their role as animal's habitats, their beauty, their history and the new growth they bring.
- When asked if the interviewees could identify some endangered species, the most common answers were: Blandings turtles, ribbonsnakes and Mainland moose but people also suggested lady slippers, loons and a number of other species.
- 46% of respondents were male and 54% were female.

YEARS OF DATA

- Ongoing project since 2007

PARTNERS

- Mersey Tobeatic Research Institute
- Service Nova Scotia



Number of times people had read posters about MTRI

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Rationale

This project focused on the supply and demand for Mi'kmaw cultural tourism in Nova Scotia. Although the Mi'kmaq wish to share their culture and traditions with their youth as well as tourists, little has been done to develop and market a successful Mi'kmaw cultural tourism sector. A need for research that explores the development of a sustainable cultural tourism industry while addressing tourist demands, the economic development needs of Mi'kmaw communities, and the preservation of cultural integrity for future generations of Mi'kmaq and Nova Scotia tourists was found. This study sought to better understand the interests and motivations of general tourists visiting the province, cultural tourists at particular Mi'kmaw cultural tourism locations (in Kejimkujik, Bear River First Nation and Millbrook First Nation) as well as the perspectives of Mi'kmaw hosts.


M. Lynch

Matthew Labrador, a Mi'kmaw interpreter, teaching visitors about flint knapping

Research

PERSPECTIVES ON MI'KMAW CULTURAL TOURISM

OBJECTIVES

- To assess tourist interest, motivations, expectations, and satisfaction in participating in authentic Mi'kmaw tourism activities.
- To examine the ideas, perceptions, and components of cultural tourism development from the Mi'kmaw perspective.
- To provide recommendations about improving the chances for success of a Mi'kmaw cultural tourism industry that addresses the interests of tourists and the Mi'kmaw people.

METHODS

- Potential old forest sites in a ~50,000 hectare area were surveyed with GIS using Nova Scotia Department of Natural Resources (NSDNR) Forest Inventory database, and also using Land Registry information provided by Service Nova Scotia and Municipal Relations.
- Methods used in fieldwork included the administration of tourist surveys and interviews with particular Mi'kmaw people. Specifically, surveys were administered in person to tourists in the summer of 2008: i) At Nova Scotia Visitor Information Centres (n=394) in Amherst and Halifax to gauge their interest and attitudes towards participating in Mi'kmaw cultural tourism activities; and ii) At existing Mi'kmaw tourism destinations (n=111) in Nova Scotia (the Bear River Heritage and Cultural Centre, the Glooscap Heritage Centre, Kejimkujik National Park and the Millbrook Pow Wow) to gauge motivations, satisfaction, and reactions to their Mi'kmaw tourism experience.
- Interviews (n=11) were conducted in late summer and fall of 2008 with participants who presently work or have worked in, or have a particular connection to, Mi'kmaw cultural tourism at the selected study sites.


M. Lynch

A Mi'kmaq monument in Kejimkujik

RESULTS

The following are selected findings from tourist surveys at Mi'kmaw cultural tourism locations and information gathered from Mi'kmaw interviewees.

- 66.7% of tourists surveyed at Mi'kmaw cultural tourism locations stated that this was not their first Aboriginal tourism experience. The most commonly cited Aboriginal tourism activity that tourists had participated in was a visit to Kejimkujik where they took part in a Mi'kmaw event.
- Tourists placed the most importance on Mi'kmaw cultural tourism's ability to provide an educational and authentic experience and least importance on price and entertainment factors.
- In terms of tourist satisfaction, 55.5% 'strongly agreed' and 39.1% 'agreed' that they enjoyed their Mi'kmaw tourism experience.
- According to Mi'kmaw interviewees, the goals of Mi'kmaw cultural tourism are to promote culture, provide employment opportunities, create greater cultural respect and understanding and educate tourists and the Mi'kmaq.
- Mi'kmaw hosts emphasized the effectiveness of sensory, participatory, story-telling, and nature-based activities and stressed the importance of sharing authentic parts of their culture with tourists.
- Future vision for Mi'kmaw cultural tourism included more youth involvement, more resources (financial, human, natural), expanded programs and tourism offerings, greater networking among Mi'kmaw communities and improved marketing.

M.Lynch

Mary-Frances handing out surveys to tourists on a Mi'kmaw Petroglyph Tour

YEARS OF DATA

- Single year project

PARTNERS

- Social Sciences and Humanities Research Council
- Dalhousie University

M.Lynch

Cathy Leblanc, a Mi'kmaw interpreter, speaking about the encampment site

M.Lynch

Mi'kmaw wigwam - encampment site

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Rationale

Over the past four centuries, little of Nova Scotia's forested areas have escaped human influences. The outcome has been a proliferation of relatively young, even-aged, early successional forests types across an increasingly fragmented landscape. Less than 1% of Nova Scotia's forest cover remains as old forest, which makes it increasingly difficult to maintain ecological connectivity between them. Old forests are a vital component of the forest ecosystem and biodiversity; they are important habitat for wildlife including mosses, lichens, cavity nesting birds and mammals. Most of Nova Scotia's forest land (70%) is privately owned with almost half in small private holdings. Small private landowners must be included in collaborative work to maintain landscape connectivity, conserve biodiversity and restore old forests in western Nova Scotia.

A. Belliveau, MTRI

Old forest near the Upper Medway River

Research

RESTORATION OF OLD FORESTS

OBJECTIVES

- To find and characterize old forest features on small privately owned land in northern Queens County and southern Annapolis County.
- To foster stewardship of old forests on private land utilizing research findings to design communication products and community outreach opportunities.
- To assist woodland owners with the creation of management plans for their woodlands that promote restoration of old forest characteristics.
- To map and inventory old forests on public and private lands.

METHODS

- Potential old forest sites in a ~50,000 hectare area were surveyed with GIS using Nova Scotia Department of Natural Resources (NSDNR) Forest Inventory database, and also using Land Registry information provided by Service Nova Scotia and Municipal Relations.
- Queries were developed in ArcMap to identify, in order of priority: (i) tolerant hardwoods stands; (ii) coniferous stands; and (iii) lower quality coniferous and hardwood stands. These queries included height restrictions according to species and a minimum one hectare forest stand.
- At each site, sample points were randomly selected where parameter measurements were taken including tree species, age, height and coarse woody debris using NSDNR's Old Forest Scoresheet.
- Stewardship work with landowners was undertaken to assess interest in management plans and the prospects of restoration on their woodlands.
- Information was gathered and interviews with a subset of landowners took place to determine goals and objectives for their woodlands, which were compiled in restoration based forest management plans.
- Educational talks with landowners and other members of the community were also undertaken.
- A GIS map and information database for public and private old forests was initiated.

A. Belliveau, MTRI

Map of MTRI property with agroforestry products indicated

RESULTS

- Twenty-four study plots were set up at 12 sites, of which 13 were dominated by hardwood, three by softwood species and eight were mixed wood stands. Over half of the sites were dominated by American beech.
- The average number of trees per hectares was 1510, though the average number of live trees in diameter classes >40 cm, >50 cm and >60 cm were 55, 13 and 4 respectively; only four sites contained trees that were greater than 60 cm in diameter.
- The average percentage of climax species within the study plots was 79%, though the average Old Growth Score was only 43 out of a maximum of 100. The highest scoring site was 75, whereas the lowest was 7.
- The lowest score feature was dead woody debris averaging 4 out of15 and is a result of past anthropogenic disturbances such as fire and logging.
- The oldest tree on private land was 225+ years old and was 50 cm in diameter. The oldest tree on public land was 352+ years old and was also 50 cm in diameter.
- Restoration based forest management plans were completed for ten interested landowners including the following headings: Goals & Objectives, Maps & Photographs, Woodland Condition, Restoration Options, and Activities & Timeline.

YEARS OF DATA

- Ongoing project since September 2006

PARTNERS

- Mersey Tobeatic Research Institute
- Private Landowners
- Nova Scotia Department of Natural Resources
- Environment Canada Eco Action Program
- Nova Forest Alliance
- Nova Scotia Department of Environment and Labour
- Natural Resources Canada
- Mountain Equipment Co-op
- Sage Environmental Fund
- Environmental Systems Research Institute
- Nova Scotia Community College
- Bowater Mersey Paper Company
- Dalhousie University
- Nova Scotia Nature Trust
- Parks Canada

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A. Belliveau, MTRI

Geneviève Dubuc counts rings on a downed hemlock tree that ages 275 years old

Rationale

In May of 2006, the province of Nova Scotia announced it would purchase ecologically and recreationally important lands from the Bowater Mersey Paper Company. The acquisition, which included 29 parcels for a total of 10,050 hectares, was completed in March 2007. One of those parcels was the 72 hectare Mickey Hill Pocket Wilderness in Graywood, Annapolis County. After much discussion, The Nova Scotia Department of Natural Resources (NSDNR) and the Mersey Tobeatic Research Institute decided to collaborate on a resource analysis for the Mickey Hill Pocket Wilderness. First, an inventory was completed by biologists, forest researchers, and cartographers at the Mersey Tobeatic Research Institute. This inventory helped officials and stakeholders understand many of the issues at hand regarding the management of the Mickey Hill Pocket Wilderness.

Mickey Hill Pocket Wilderness

Research

MICKEY HILL POCKET WILDERNESS RESOURCE ANALYSIS

OBJECTIVES

- To gather information on park values including flora, fauna, geology, climate, cultural heritage, recreational prospects, research and monitoring opportunities, adjacent landowner issues, park user surveys and other pertinent information.
- To produce maps and write an analytic report on gathered resource information.
- To provide a meeting place for stakeholders to review report information.

METHODS

- Ecological inventories were conducted by botanists, lichenologists and biologists to describe the area's flora, fauna and various ecosystems.
- A visitor and cottage owner survey was conducted on-site and via mail regarding park values.
- Publications and information were reviewed on park values from various individuals, groups and organizations.
- Digital geographic data were collected from sources such as the Nova Scotia Department of Natural Resources and the Nova Scotia Geomatics Centre and mapped using ARcGIS.

RESULTS

- Key issues discussed in the report submitted to NSDNR included park access, the impact of the park on surrounding landowners and future promotion of the park.
- In the park visitor survey, 100% of participants reported having found out about the park from local friends and family, not a single participant was from outside Nova Scotia, and 68% of participants said the park was good the way it currently is.
- A full fauna inventory was assembled, with over 40 mammal species, 13 amphibian species, nine reptile species, over 70 bird species and nine fish species having been listed in the resource analysis report.
- Seven invasive and/or alien species were recorded on site, included multiflora rose, Smallmouth bass and European starling.

RESULTS
Continued

- Bathometric data were used to determine that Lambs Lake is a 80-hectare, very shallow, rocky lake (maximum depth of 4.5 meters). Its summer surface pH levels ranged from 5.06 to 6.2 and summer surface temperatures regularly reach 25 °C.
- Cultural and historical data were analysed, including indigenous evidence dating back 3500 to 7000 years ago, documents from Europeean settlers from the 17th century, and more recent lumbering and sport guiding stories from over a hundred years ago.

YEARS OF DATA

- Single year project

PARTNERS

- Mersey Tobeatic Research Institute
- Nova Scotia Department of Natural Resources
- Nova Scotia Department of Fisheries and Oceans
- Nova Scotia Power Incorporated

A. Belliveau, MTRI

Green snake in Mickey Hill

A. Belliveau, MTRI

Yellow birch in Mickey Hill

A. Belliveau, MTRI

Lily pads in Mickey Hill

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APPENDIX 1

PROJECTS IN KEJIMKUJIK AND THE GREATER KEJIMKUJIK ECOSYSTEM IN 2009

	Kejimkujik	Greater Kejimkujik Ecosystem	Monitoring	Research
Coastal				
Piping Plover Monitoring Program	X	X	X	
Soft Shell Clam Enhancement Trial		X		X
Kejimkujik Seaside Coastal Change	X			X
Projects not included in this report:				
Eelgrass Monitoring and Recovery	X		X	
European Green Crab Coastal Monitoring	X		X	
Lagoon Water Quality Monitoring	X		X	
Barrier Beach Dune Dynamics Monitoring	X		X	
Forest				
Forest Bird Monitoring in Kejimkujik	X		X	
Caledonia Christmas Bird Count	X	X	X	
Nocturnal Owl Survey	X	X	X	
SWNS Marten Distribution	X	X	X	
Monitoring Flying Squirrel Survivorship		X	X	
Plethodontid Salamander Monitoring	X		X	
Jack Pine Budworm Population Assessment		X	X	
Boreal Felt Lichen Monitoring		X	X	
Tree Growth, Regeneration and Succession	X		X	
Monitoring Forest Decomposition Rates	X		X	
Forest Ecosystem Classification		X		X
DNA Barcode Biodiversity Assessment	X			X
Projects not included in this report:				
White-tailed Deer Monitoring	X		X	
Invasive Plant Monitoring	X		X	
Lichen Monitoring	X		X	
Park Infrastructure Footprint Monitoring	X		X	
Land Cover Change Monitoring	X		X	
Freshwater				
IceWatch	X	X	X	
Acid Rain Biomonitoring	X		X	
Brook Trout Monitoring Program	X		X	

	Kejimkujik	Greater Kejimkujik Ecosystem	Monitoring	Research
Annapolis River Guardians		X	X	
Lake Primary Productivity	X	X	X	
Lake and Cold Water Habitat	X	X	X	
Mountain-Cobrielle Watershed Restoration	X		X	
Aquatic Connectivity	X	X	X	
Mercury Science: Ecological Risk Mapping	X		X	
Monitoring Mercury in Common Loons	X	X	X	
The Kejimkujik-Mersey LoonWatch Program	X	X	X	
Monitoring Common Loon Productivity	X	X	X	
Loon Nest Structure and Microhabitat	X	X		X
Identifying Sources of Chloride in Streams	X	X		X
Effects of Mercury in Freshwater Food Webs	X			X
Mercury Photoreactions in Kejimkujik Lakes	X			X
Clementsport Dam Feasibility Study		X		X
Terrestrial Liming to Improve Salmonid Habitat		X		X
Zooplankton Fossils as Ecological Indicators	X	X		X
Projects not included in this report:				
Kejimkujik Lake Water Quality Monitoring	X		X	
Stream Flow Monitoring	X		X	
Benthic Invertebrate Monitoring	X		X	
Wetland				
Rare Plant Monitoring	X	X	X	
Blanding's Turtle Nest Monitoring	X	X	X	
Blanding's Turtle Distribution Surveys	X	X	X	
Turtle and Snake Surveys		X	X	
Blanding's Turtle Headstart Tracking	X	X		X
Wildlife Conservation Canines	X	X		X
Eastern Ribbonsnake Movements	X	X		X
Eastern Ribbonsnake Range	X	X		X
Projects not included in this report:				
Wetland Water Quality and Quantity	X		X	
Snapping Turtle Distribution	X	X	X	
Wetland Vegetation Monitoring	X		X	
Barren Meadow Blanding's Turtle Population	X			X
Human Dimensions				
Energy Audit of MTRI Fieldstation		X		X
Species at Risk Stewardship in SNBR	X	X		X
Empower! Young Community Leaders in the SNBR	X	X		X
Southwest Nova Scotia Phone Survey		X		X
Perspectives on Mi'kmaw Cultural Tourism	X	X		X
Restoration of Old Forests		X		X
Mickey Hill Pocket Wilderness Resource Analysis		X		X
Projects not included in this report:				
Community-Based Mi'kmaq Education		X		X

APPENDIX 2

INDEX OF PROJECTS BY RESEARCHER NAME

Annual Report of Research and Monitoring in the Greater Kejimkujik Ecosystem 2009

Parks Canada Parcs Canada

Canada

Mersey Tobeatic Research Institute

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