Annual Report of Research and Monitoring in the Greater Kejimkujik Ecosystem 2015

Parks Canada Parcs Canada

Canada

Mersey Tobeatic Research Institute

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Cover Photos, clockwise from top left:
- Kejimkujik Seaside, by W. Pitts
- River Reflection, by W. Pitts
- K. Dubois solo canoeing at Gillfillan lake, by MTRI
- Mount Merrit Road, by A. Belliveau, ACCDC
- Flagstaff Brook, by A. Belliveau, ACCDC

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Annual Report of Research and Monitoring in the Greater Kejimkujik Ecosystem 2015

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WETLAND

HUMAN DIMENSIONS

J. Reid

INTRODUCTION

This is the eleventh Annual Report of Research and Monitoring in the Greater Kejimkujik Ecosystem. 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). 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 winter 2016 and is a compilation of the research and monitoring projects that were conducted in the Kejimkujik area in 2015 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 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, how it is affected by natural and human-related influences and how to affect restoration. 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 Wilderness Area, 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 Smithsonian Institution Monitoring and Assessment of Biodiversity plots (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 an important species at risk site where stewardship and recovery are paramount. In 2010, Kejimkujik was designated "Dark Sky Preserve" by the Royal Astronomical Society of Canada. 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 promote sustainable use of natural resources and biodiversity conservation in the Southwest Nova Biosphere Reserve and beyond through research, education and the operation of a field station. MTRI's field station is located between Kejimkujik and Caledonia in Kempt, Queens County where it provides office work space, accommodation for researchers, space for public presentations and a site for learning. The field station has taken great efforts to reduce its carbon footprint by employing five green technologies for heating, cooling and power generation. It has been awarded Gold by LEED for Homes and reduced its power consumption by more than 50% through renovations and energy conservation. 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 charitable co-operative is available at www.merseytobeatic.ca.

S. O'Grady, Parks Canada

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

The Southwest Nova Biosphere Reserve (SNBR) comprises a large portion of terrestrial and coastal southwestern Nova Scotia (see map above). 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.

Photos on page 9, clockwise from top left:
- Piping plover, by W. Pitts
- European green crab by Parks Canada
- Management zone nest at Keji Seaside, by W. Pitts
- Kejimkujik Seaside, by J. Reid
- Eelgrass condition monitoring, by M. Smith, Parks Canada

Coastal sidebar photo: J. Reid

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. Piping plovers nest on white sandy beaches including St. Catherine's River Beach at Kejimkujik Seaside. In recent years, the number of nesting pairs of Piping plovers in the province has decreased significantly due to habitat disturbance, loss and fragmentation, predation and development of distant over-wintering grounds. The Piping plover is often referred to as a management dependent species, as sustained management actions are sometimes 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 Kejimkujik Seaside and to implement a suite of management strategies focused on protecting and sustaining plover numbers.

Parks Canada

Banded Piping plover

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 plovers in Kejimkujik Seaside and restore a portion of nesting habitat on St. Catherine's River Beach.
- To note predators or signs of predators on St. Catherine's River Beach.

METHODS

- Park staff and volunteers monitored St. Catherine's River Beach and Little Port Joli Beach during Piping plover nesting season. This was done at a distance with binoculars and other observations including predators, garbage and stewardship and threat indicators were 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.
- Plover habitat was enhancement and restoration efforts were maintained and continued.

G. Hamilton-Burge

Piping plover survey volunteers at St. Catherine's River Beach

RESULTS

- As in previous years, St. Catherine's River Beach and Little Port Joli Beach at the Kejimkujik Seaside were surveyed in 2015 from May-August.
- At St. Catherine's River Beach, four Piping plover pairs, seven nests (three re-nests), nine chicks and six fledglings were observed.
- At Little Port Joli, one pair, two nests (one re-nest) and three chicks which all fledged were observed. This represents the first time in 26 years that fledglings have been confirmed on this beach.
- This season, 20 volunteers assisted with Piping plover monitoring surveys totalling 75 hours. A Piping plover information day was held in July where staff educated over 60 park visitors about plovers and how to help in their recovery.
- Although no birds were banded at the Kejimkujik Seaside last

RESULTS
Continued

year during the first year of the Environment Canada banding project, staff recorded 61 observations of ten banded Piping plovers at St. Catherine's River Beach in 2015 (white: E2, EP, ET, C2, E9, EL, JE, NJ and black: 44, T5). Three of these birds nested, five were observed eight or more times, and five were observed once or twice as they moved through the area.

YEARS OF DATA

- Ongoing project since 1985

PARTNERS

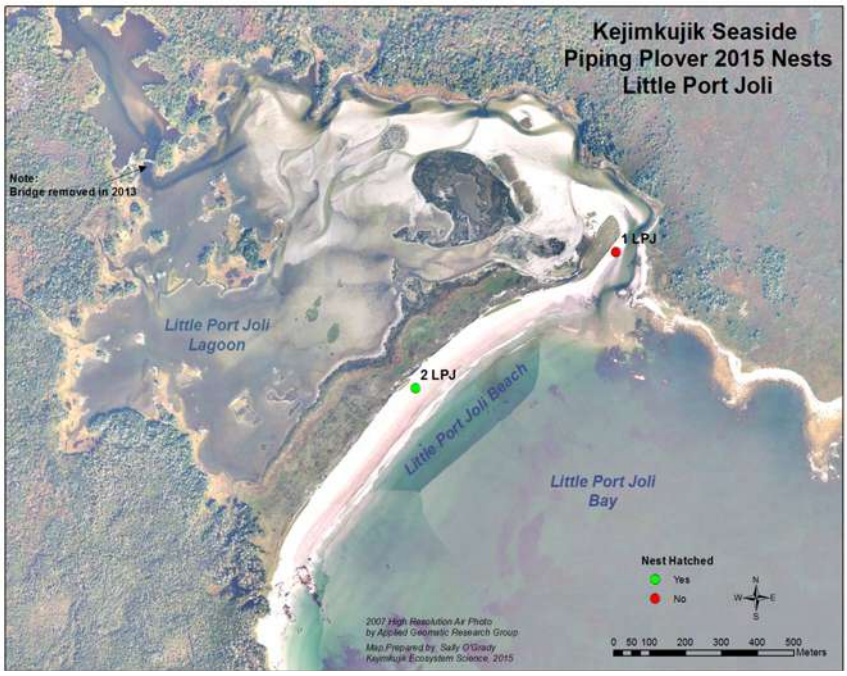
- Parks Canada
- Piping Plover Recovery Team (Eastern Canada)
- Bird Studies Canada
- Environment Canada
- Province of Nova Scotia

G. Hamilton-Burge

Banded Piping plovers mating in June

G. Beaulieu, Parks Canada

Piping plover public education and outreach



S. O'Grady, Parks Canada

Locations of Piping plover nest attempts on Little Port Joli Beach,

M. Crowley, Parks Canada

Piping plover survey

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Rationale

The European green crab, a marine invasive species that has sometimes been termed an "ecosystem engineer", was detected in Nova Scotian waters along the Fundy shore in the mid-1950's and had made its way around the province to the Gulf of St. Lawrence by the mid-1990's. Coastal marine systems world-wide are threatened by invasions of non-native species such as this and are challenged by the issues invasive species cause through predation and competition with native species. The European green crab has been described as one of the most devastating clam predators and has been observed ripping out delicate eelgrass shoots in search of their preferred benthic prey at Kejimkujik Seaside. Indeed by 2010, less than 2% of the eelgrass beds in Little Port Joli Estuary remained and the juvenile age-classes of Soft shell clams were nearly non-existent. This project focuses on green crab population control as a means of coastal ecosystem restoration.

O. Woods

European green crab

Monitoring

EUROPEAN GREEN CRAB COASTAL MONITORING

OBJECTIVES

- To control impacts on native species by conducting green crab removal operations according to prescribed rates of catch per unit effort.
- In combination with other research and monitoring projects, assess the ecological consequences of overabundant green crab populations in Kejimkujik Seaside ecosystems.
- To involve local interests, industry and other government departments in restoration activities and in the development of a positive use for harvested green crabs.
- To assess management effectiveness in green crab control and in restoring impaired coastal habitats such as Eelgrass beds.

METHODS

A. Levesque, Parks Canada

European green crab trapping in St. Catherine's River estuary

- In 2010, trapping was determined to be the most effective method of green crab control and to conduct ecological integrity monitoring. Two types of traps were used: modified eel traps to provide standardized monitoring, and modified shrimp (Russell) traps developed by local fishing expertise to facilitate larger scale green crab removal outside of monitoring efforts.
- Total count, morphological data and sex were recorded for all individuals captured through monitoring.
- Green crabs captured during removals were also counted and a daily sample of fifty randomly selected crabs per distinct area were examined to determine morphology and sex.
- All by-catch and other pertinent data were recorded throughout all sampling investigations to determine population structure, distribution and relative density characteristics of native species.

RESULTS

- Initial monitoring at St. Catherine's River and Little Port Joli indicated similar densities in both estuaries before removals began.
- Since 2010, nearly 2 million green crabs have been removed from Little Port Joli Estuary and sold or composted. Size, sex ratios, distribution and trap location efficiencies have been

RESULTS
Continued

determined. The proportion of larger males has declined in areas where the greatest number of removals occurred, followed by larger catches of females and smaller crabs.

- Numbers have been reduced to well below prescribed thresholds in the upper estuary and the numbers remain low there. Overall green crab numbers continue to fluctuate as the recovered state of the upper estuary facilitates a new ecosystem equilibrium.
- Knowledge about effective fishing techniques was improved including amounts of bait to use, fishing hotspots and how often to pull traps to gain maximum efficiencies.
- Options for positive use of culled invasive green crabs were investigated including use as lobster bait, fertilizer and composting.
- Native species by-catch is increasing and species that have never been seen such as the Grey triggerfish and Rudderfish are now being observed in Kejimkujik Seaside estuaries.
- Results from this project have enabled ecosystem recovery projects (Eelgrass transplanting) to enhance native species' populations and ecosystem processes.

G. Beaulieu, Parks Canada

'Gone crabbin' visitor experience program

YEARS OF DATA

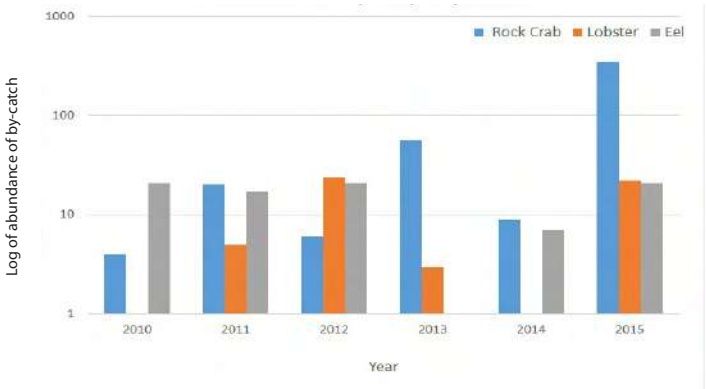
- Ongoing project since 2008

PARTNERS

- Parks Canada
- Dalhousie University
- Fisheries and Oceans Canada Gulf Region
- Fisheries and Oceans Canada Bedford Institute of Oceanography

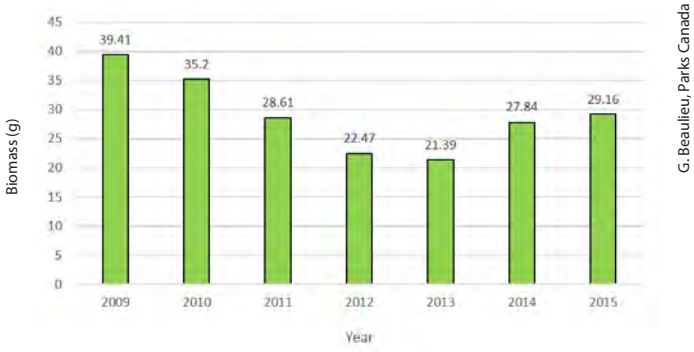
G. Beaulieu, Parks Canada

Green crab removal in St. Catherine's River 2015



G. Beaulieu, Parks Canada

Abundance of by-catch from European green crab monitoring efforts in Little Port Joli estuary at Kejimkujik Seaside



G. Beaulieu, Parks Canada

Mean European green crab biomass from standardized monitoring in Little Port Joli estuary

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Rationale

The European green crab is a highly invasive marine predator reported to have commercial (*e.g.* Soft shell clams) and ecosystem (*e.g.* Eelgrass beds) consequences. When considered from a conservation and resource management perspective, it would be beneficial to describe its population structure, which provides a basis for determining range expansion rates following initial introduction. Green crab genetic markers provide the basis for an examination of differences in two (southern vs. northern) European green crab lineages introduced to Atlantic Canada. This project includes 1) reconstructing the invasion path for each lineage; 2) describing the lineage-specific physical tolerances by comparing southern vs. northern range limits; and, 3) investigating the role that hybrid offspring between the two lineages played in expanding their range and population explosions. Protocols and genetic markers from current work will be employed to directly address resource management and conservation needs. Results from this project will also be available to influence regulation, policy and science advisory processes.

Research

GENETIC ASSESSMENT OF GREEN CRAB INVASIONS

Searching for young-of-the-year green crabs under rocks and seagrass

OBJECTIVES

- To assess the spatial scale of dispersal and connectivity in non-native green crab populations.
- To determine the relative distribution of green crab lineages (*i.e.* northern vs. southern), and possibly hybrids in Atlantic Canada.
- To compare current crab lineages with previous studies to estimate future expansion rates into vulnerable marine coastal ecosystems.
- To develop connectivity networks to support conservation planning.

METHODS

- Adult green crab were trapped in rocky intertidal areas of Nova Scotia, New Brunswick, Prince Edward Island and Newfoundland. In Nova Scotia, one sample site was located in the Kejimkujik Seaside.
- Young of the year were sampled at the same locations by overturning rocks, boulders and seaweeds to collect newly settled individuals (less than 6 months old).
- Approximately 50 adult and young of the year green crab were collected from each location, and carapace width and sex recorded.
- Adult green crab tissue samples were dissected from limbs and preserved in ethanol for genetic analysis. Young of the year were preserved whole.
- Genetic structure was characterized using high throughput genotyping.

RESULTS

- DNA extracted from adult and young of the year samples are currently being analyzed.

YEARS OF DATA

- Year 2 of a 3 year project

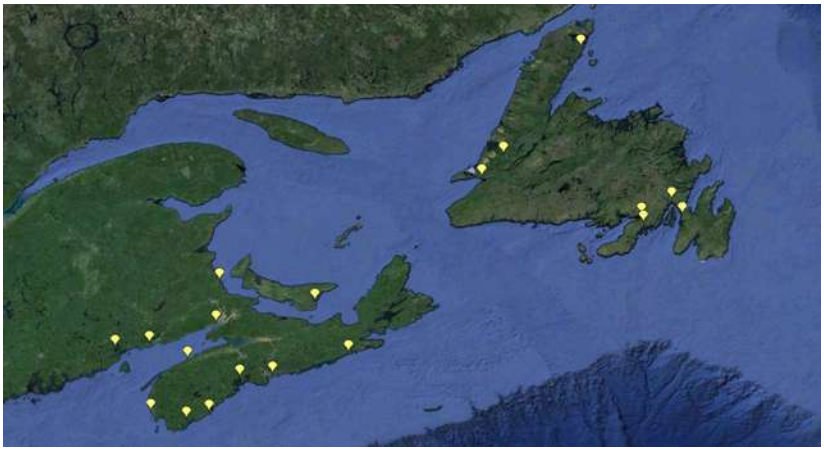
PARTNERS

- Fisheries and Oceans Canada, Bedford Institute of Oceanography
- Fisheries and Oceans Canada, Northwest Atlantic Fisheries Centre

C. DiBacco

Preserved green crab tissue sample for genetics analysis

Retrieving a green crab trap at Two Rivers Inlet, New Brunswick, 2015



Green crab collection sites, 2015

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Rationale

Eelgrass is the dominant seagrass species of marine ecosystems in Atlantic Canada. Eelgrass communities perform important ecological services in nearshore waters, it is often referred to as a 'keystone species' due to its ability to enhance biodiversity and productivity. Eelgrass beds provide nursery habitat for juvenile stages of fish and invertebrates and important feeding habitat for migrating waterfowl. The primary production of eelgrass beds and their associated epiphytic community exceeds that of many cultivated terrestrial systems, playing an important role as biological filters, sediment stabilizers, exporters of organic matter to subsidize productivity of other coastal ecosystems and as valuable carbon sinks. Declines in eelgrass can precipitate cascading ecosystem effects and a loss of valuable ecological services. By 2010, eelgrass at Kejimkujik Seaside had declined to less than 2 % of its 1987 distribution.

V. Bell, Parks Canada

Collection of Eelgrass transplant donors

Monitoring

EELGRASS COASTAL MONITORING AND RECOVERY

OBJECTIVES

- To detect long-term change in Eelgrass extent.
- To detect long-term change in Eelgrass condition measures that signal a decline or improvement in environmental quality.
- To assess whether management response is effective in reversing Eelgrass loss.

METHODS

- Suitable Eelgrass habitats at St. Catherine's River and Little Port Joli estuaries were examined by canoe to determine the presence of Eelgrass beds.
- The extents of each discrete bed were mapped by a swim survey using mask and snorkel. The surveyor carried a Global Positioning System (GPS) unit with a track function to record locations for later mapping and area determinations.
- The SeagrassNet monitoring protocol was used to measure conditions along transects established within Eelgrass beds including morphology, grazing, epiphyte load, wasting disease and water quality variables.
- Eelgrass transplant plots were monitored at Little Port Joli estuary for general condition and survival.

M. Smith, Parks Canada

Eelgrass bed viewed from the surface at Little Port Joli estuary

RESULTS

- After reaching less than 2% of its 1987 distribution by 2010, Eelgrass decline has been reversed coincident with effective control of European green crabs at Little Port Joli estuary. Since 2011, an annual restoration rate of 10% has consistently been observed at Little Port Joli estuary.
- No Eelgrass beds were detected at St. Catherine's River estuary in 2015, however green crab removal efforts began only in the summer of 2015.
- Using donor plugs from within the estuary, and with the assistance of volunteers, the first Eelgrass transplant trials on this coast have done well and have contributed to the spread of Eelgrass outside of the upper estuary in 2015. Keeping green crabs under control continues to facilitate Eelgrass recovery, as initial transplant trials located near high densities of green crab resulted in a 60% loss of eelgrass transplants within 2 months.

RESULTS
Continued

- Future monitoring will continue to assess the success of green crab mitigations on Eelgrass recovery at Kejimkujik Seaside. Opportunities for additional Eelgrass transplant work in Little Port Joli will also be explored in 2016.

YEARS OF DATA

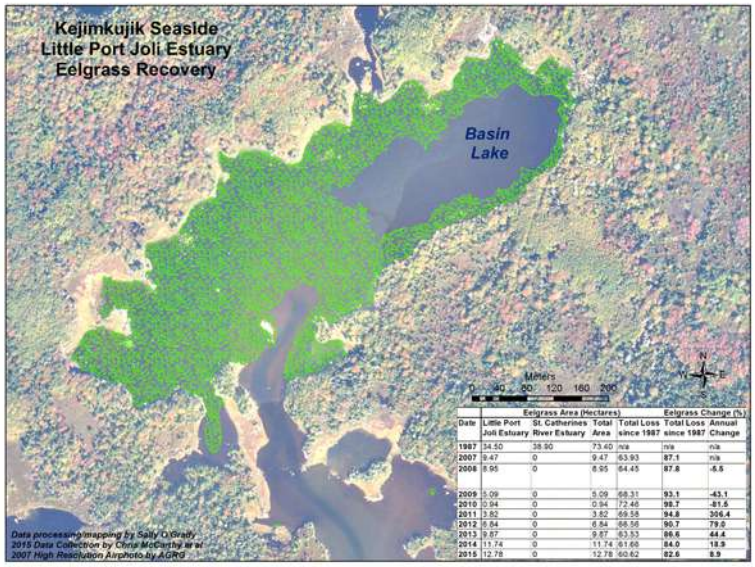
- Ongoing project since 1987

PARTNERS

- Parks Canada
- School for Resource and Environmental Studies, Dalhousie University
- Fisheries and Oceans Canada Gulf Region
- Fisheries and Oceans Canada Bedford Institute of Oceanography
- Harrison Lewis Marine Centre

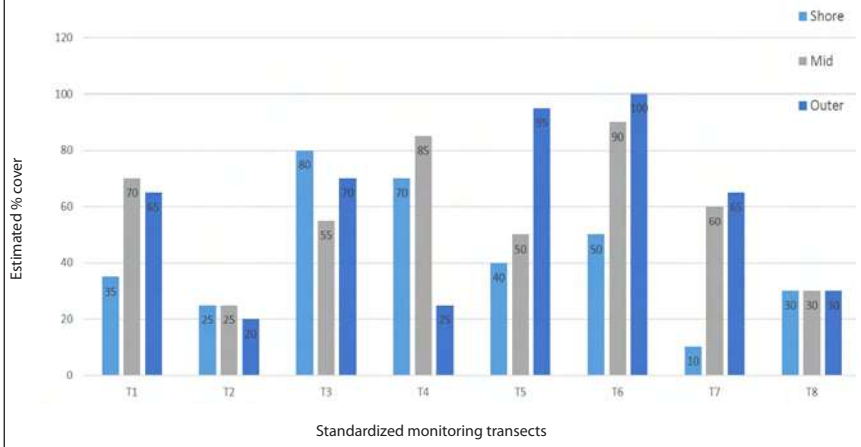
O. Woods

Eelgrass



S. O'Grady, Parks Canada

Extent of Eelgrass at Kejimkujik Seaside Little Port Joli estuary in 2015



G. Beaulieu, Parks Canada

Standardized monitoring transects

Percent cover of Eelgrass estimated in 2015 from permanent monitoring transects in Little Port Joli estuary

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Rationale

The Clean Annapolis River Project (CARP) has completed extensive monitoring of the freshwater portion of the Annapolis River for the past 25 years through its River Guardians water quality monitoring program. In recent years however, additional projects have focused on gathering more information about the environmental health of the lower estuarine portion of the river. In 2015, CARP partnered with Eastern Charlotte Waterways and four other watershed groups across the Atlantic provinces to identify local stressors affecting estuarine health in the Annapolis River estuary, and in five other maritime estuaries. The aim of this project was to generate baseline information about estuary health that can be used to guide the management of estuaries to enhance the ecological health of these ecosystems.

L. Freeman, CARP

L. Cliche collecting a secchi disk reading in the lower portion of the Annapolis River estuary, as part of water quality sampling

Monitoring

MONITORING THE HEALTH OF THE ANNAPOLIS RIVER ESTUARY

OBJECTIVES

- To create a methodology for assessment and the means to report findings on estuary health.
- To collect baseline data for eutrophication indicators, sediment contaminants, and fecal coliforms that can be used to measure environmental health in the Annapolis River estuary and in other participating regions.
- To gather baseline data to assess biodiversity in the Annapolis River estuary.
- To partner with project partners to create a reporting methodology for estuary health in Atlantic Canada that could be applied across the Maritimes.

METHODS

- Project partners collaborated to develop a sampling methodology that could be used to sample twenty randomized sites within each of their estuaries.
- Multiparameter water quality sondes, secchi disks, and grab samples were used to collect water quality data and depth profiles in the Annapolis River estuary throughout the spring, summer and fall.
- Grab samples were used to collect water and sediment samples for analysis of fecal bacteria, eutrophication indicators and contaminants including trace metals, mercury, PAHs, PCBs, OC pesticides, and TOC.
- Fish, shrimp, crustaceans and submerged aquatic vegetation were sampled as part of biodiversity assessments, using the Community Aquatic Monitoring Network Program (CAMP) protocols from Fisheries and Oceans Canada.

J. Medicraft, CARP

CARP and Bear River First Nations staff sorting through fish sampled for CAMP biodiversity assessments

RESULTS

- 15 sites were sampled for fecal coliform analysis, five times throughout the sampling year, two following rain events of 12.5 and 25 mm.
- Depth profiles of salinity and dissolved oxygen were measured once per season, throughout the spring, summer and fall.
- 20 sites were sampled for eutrophication indicators such as nitrates and chlorophyll a, and sediments were collected from five nearshore sites.

RESULTS
Continued

- Biodiversity was measured at six sites in the estuary, once in the summer, and in the fall.
- Results were analyzed and were used to generate a report card on estuary health that will guide future monitoring and management actions in the Annapolis River estuary and other participating regions.

YEARS OF DATA

- Single year project

PARTNERS

- Eastern Charlotte Waterways
- Miramichi River Environmental Assessment Committee
- Bluenose Coastal Action Foundation
- Southern Gulf of St. Lawrence Coalition on Sustainability
- ACAP Humber Arm
- Community Based Environmental Monitoring Network
- Acadia Centre for Estuarine Research
- Fisheries and Oceans Canada
- Environment Canada
- Gulf of Maine Council's EcoSystem Indicator Partnership

L. Freeman, CARP

The lower portion of the Annapolis River estuary

K. McLean, CARP

The upper portion of the Annapolis River estuary

J. Medicraft, CARP

L. Bell using a beach seining net to collect a fish sample in the lower portion of the Annapolis River estuary

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Rationale

The Roseate tern nests colonially on small islands and typically feeds on small schooling fish. The Roseate tern is listed as endangered in Canada, where it nests locally with Common and Arctic terns. The largest Roseate tern colony in Canada is on North Brother Island in southwest Nova Scotia (up to 50 pairs).

Despite the importance of the colony on North Brother Island, very little is known of the feeding habits of these terns, particularly their diet and foraging habitat. This information would be useful in guiding management practices for preferred Roseate tern foraging habitat during breeding.

Adult Roseate tern with an American sandlance on North Brother Island

Research

FORAGING ECOLOGY OF ROSEATE TERNS IN SWNS

OBJECTIVES

- To evaluate the efficacy of three methods for identifying fish fed by adults to young Roseate terns on North Brother Island:
  a)Photography of food provisions
  b)Video of food provisions
  c)Traditional observations of food provisions with binoculars
- To identify a non-invasive method for tracking adult Roseate terns moving between North Brother Island and foraging sites during the chick-rearing period.

METHODS

DIET:

Photography of prey provisioning

- Prey deliveries to chicks were photographed from a blind with a digital camera equipped with a 300 mm telephoto lens. Photos are currently being analyzed to quantify prey taxon delivered to chicks.

Video recordings of provisions

- A small, digital color camera was placed near two Roseate tern nest boxes just prior to egg hatching. We are currently studying the video with the hope of identifying prey delivered to chicks.

FORAGING HABITAT USE:

- Using a small boat, we followed and tracked several adult Roseate terns moving from the North Brother colony to foraging habitat. Their tracks were recorded with a hand-held Global Positioning System (GPS).

RESULTS

- Fisheries and Oceans Canada biologists were consulted to assist with fish species identification.
- Preliminary analyses of photos indicate that young Roseate terns were fed a variety of small, nearshore fish species, including American sandlance, Mummichog, and hake.

RESULTS
Continued

- Five adult Roseate terns were tracked by boat as they moved from the North Brother colony to foraging habitat during the rearing period. All five birds moved south from the colony; distances between foraging sites and North Brother varied between 1 km to 9 km.
- Using a geographic information system, we will overlay GPS tracks of tern movements and coordinates of foraging sites onto bathymetry charts to examine water depth and substrate at feeding sites.

YEARS OF DATA

- Year 1 of a 3 year project

PARTNERS

- Canadian Wildlife Service
- West Pubnico

T. D'Eon

Roseate terns and nest boxes on North Brother Island

T. D'Eon

Shawn Craik, Manon Holmes, and Katy Beaulieu observing terns on North Brother Island

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Photos on page 23, clockwise from top left:
- Autumn leaves at Big Rocky Lake, by A. Belliveau, ACCDC
- Saw-whet owl, J. Reid
- Canopy cover near Big Dam in Kejimkujik by J. Barker, MTRI
- Snow Shoe Lakes old growth forest, by A. Belliveau, ACCDC
- Medway old growth forest, by A. Belliveau, ACCDC

Forest sidebar photo: J. Reid

FOREST

Rationale

Forest birds 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. As such, forest birds can provide a relatively rapid assessment of forest ecological integrity through conducting a series of 10 minute point counts. Using both auditory and visual detections, point counts provide a tally of bird species and abundances present. Changes in bird population composition and abundances can indicate corresponding changes in forest condition (*e.g.* stand structure and composition). Forest bird population declines have been reported for many species across North America.

Ovenbird

Monitoring

FOREST BIRD MONITORING IN KEJIMKUJIK

OBJECTIVES

- To monitor trends in forest bird populations as an indicator of ecological integrity using point counts in mature stands of hardwood-dominated mixedwood and hemlock in Kejimkujik over the long term.
- To determine whether the abundances of some ecological groupings of bird species have increased or decreased over time.

METHODS

- Point count surveys were conducted in mature hardwood-dominated mixedwood and hemlock-dominated sites from 2003, 2004, and from 2009-2015 (with reduced sampling in 2013).
- The data from 2003 and 2004 were averaged to create a reference year to compare against subsequent years of data.
- Sites consisted of five stands each of hardwood-dominated mixedwood and hemlock, and each stand consisted of five permanent point count sites that were separated by sufficient distance to avoid double detection of bird species.
- Sites were surveyed twice throughout the bird breeding season (last week of May to the first week of July) by recording all birds detected during a ten-minute point count period.
- All birds detected were recorded on circle sheets, as well as digitally recorded since 2010 to provide backup verification where needed for accurate bird identifications.
- The maximum number of potential pairs per species was obtained by comparing data for the two visits. This index of abundance was used in trend analysis.
- During some years, not all permanent point count sites were visited, thereby lowering the sample size and the total abundance of birds detected. Therefore the average number (rather than total counts) of potential pairs in each stand type was used to compare yearly trends.

RESULTS

- A number of forest birds associated with hemlock dominated stands appeared to exhibit strong declines when comparing populations in 2003 to the year 2014. Among the species that have declined the most were Bay-breasted warbler (73 %), Yellow-rumped warbler (42 %), Swainson's thrush (42 %), Black-throated green warbler (29 %), and Blackburnian warbler (28 %).
- Forest birds of hardwood-dominated stands have not experienced the strong declines observed in hemlock-dominated stands. Most breeding populations have remained stable and in some cases have increased slightly.
- While most declines were observed among neotropical migrant species, two resident bird species have experienced strong declines in hardwood-dominated stands between 2003 and 2014: Black-capped chickadee (79 %) and Red-breasted nuthatch (67 %).

YEARS OF DATA

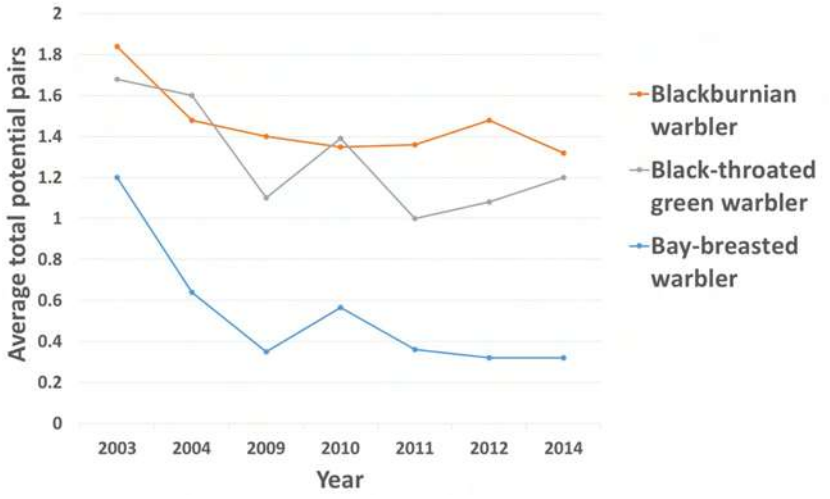
- Ongoing project since 2003

PARTNERS

- Dalhousie University, Dr Cindy Staicer

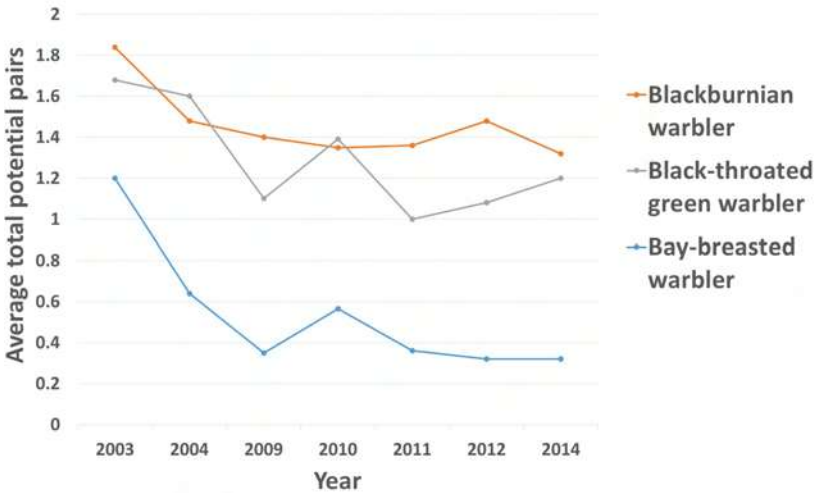
Parks Canada

Black-throated blue warbler



D. Crossland, Parks Canada

Bird trends in Eastern hemlock stands from 2003-2014



D. Crossland, Parks Canada

Bird trends in hardwood stands from 2003-2014

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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 and in Caledonia since 1991. 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 and Audubon Society maintain a master record of all counts within the province and annually report the counts with notes on the unique results of that year.

American goldfinch

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 engage 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.
- This count has consistently been held in the same area: a circle of 24 km 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 could be 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.

White-breasted nuthatch at bird feeder

RESULTS

- The 2015 Caledonia Bird Count occurred on December 20th when 35 species and 1276 individual birds were observed. There were 22 hours spent observing feeders and a total of 82 hours volunteered.
- There were 49 observers who participated this year, up from 31 last year.
- The total number of kilometres walked was 122 and driven was 152.

RESULTS
Continued

- Rare birds sighted included the following: Sharp-shinned hawk, Great horned owl, Northern flicker, Common redpoll and White-throated sparrow.
- Species not observed that are usually included in the Caledonia Bird Count include Canada goose and Pileated woodpecker.

YEARS OF DATA

- Ongoing project since 1991

PARTNERS

- Nova Scotia Bird Society
- Mersey Tobeatic Research Institute

B. Toms, MTRI

American robin eating Staghorn sumac

B. Toms, MTRI

Black-capped chickadee at bird feeder

J. Reid

D. Reid looking for birds at the 2015 Caledonia Christmas Bird Count

MTRI

Morning dove

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Rationale

Aerial insectivorous bird populations have been in sharp decline for several decades in North America. The Chimney swift was listed as Threatened in 2007 by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and under the federal Species at Risk Act (SARA) in 2008. In Nova Scotia, several well known roost sites have been informally monitored for many years by a number of dedicated volunteers. In 2010, multiple stakeholders came together, along with experts from Quebec, Ontario and Manitoba, to identify gaps and needs for Chimney swift recovery in the maritime provinces and to bring current monitoring in line with other Canadian programs. The result was the Maritime Swiftwatch program initiated by Bird Studies Canada. This project aims to systematically monitor population levels at known roost sites, to learn more about nesting ecology of Chimney swifts and increase awareness of Chimney swifts.

K. Dubois participating in Chimney swift survey

Monitoring

MCGOWAN LAKE CHIMNEY SWIFT MONITORING

OBJECTIVES

- To conduct counts at the McGowan Lake roost site on standardized dates and other dates during migration and nesting seasons.
- To introduce new volunteers to Chimney swift monitoring to expand the base of available volunteers.
- To analyze automated counter data to get a better understanding of arrival and departure rates as well as seasonal fluctuations.

METHODS

- Chimney swifts were counted as they entered the roost site at dusk using visual and video counts. Weather conditions were also noted along with any other aerial insectivores. Counts took place on standardized dates as well as casually on other dates.
- An Eco-Visio data logger was deployed in July 2013 and collected in November 2013.

RESULTS

- Six counts took place from 05 May to 01 June 2015 including four counts on standardized dates. The highest count was 231 and the lowest was nine. One night the birds entered early likely because of bad weather.
- 2015 had the highest average counts of the last five years.
- Two counts (one bird and two birds) took place in August likely after the roost was no longer in use.
- One count was excluded because birds entered early in bad weather and could be heard inside the chimney.

YEARS OF DATA

- Ongoing project since 2011

PARTNERS

- Bird Studies Canada
- Blomidon Naturalist Society
- Ecology Action Center
- Mersey Tobeatic Research Institute
- Nova Scotia Power

Year	Minimum Count	Maximum Count	Average (n)
2011	14	162	80 (12)
2012	9	98	56 (10)
2013	4	241	132 (14)
2014	2	137	70 (8)*
2015	9	231	137

B. Toms, MTRI

Count data from McGowan Chimney swift roost 2011-2015 (*Two counts, with only 1 bird and 2 birds, took place in August likely after the roost was no longer in use)

B. Toms, MTRI

Shinglemill Brook, Chimney swift habitat

B. Toms, MTRI

McGowan Roost with counter on chimney

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Rationale

The Forest Health Group within the Forest Protection Division of the Department of Natural Resources monitors and assesses insect and disease populations and damage, and provides technical advice and management options to forest stakeholders. In 2004, an aerial damage survey detected defoliation and mortality caused by the Jack pine budworm, a native insect of Jack pine stands, in mature and old growth stands of White pine throughout the Southwest Nova Biosphere Reserve. Because this was the first record of this defoliating pest causing damage to the forests of Nova Scotia, it generated concern among forest managers. The reason for the concern is that in Nova Scotia the Jack pine budworm is feeding specifically on White pine rather than its usual host, Jack pine, which is its preferred host in other regions of Canada and the United States.

Monitoring

JACK PINE BUDWORM POPULATION AND DAMAGE ASSESSMENTS

Forest Health, NSDNR

Pine Lake mortality and damage

OBJECTIVES

Aerial Surveys:

- To observe and record locations of defoliation, determine the size (ha) of the outbreak and the severity of the damage.

Ground Surveys:

- To place pheromone traps baited with lures in mature and old growth stands of White pine to collect male moths to detect building populations.
- To collect branch samples to determine overwintering larval (L2 second instar larval stage) population levels.

METHODS

Aerial Surveys:

- Using one helicopter, two observers flew the entire province at an altitude of 600 m (approximate) along flight lines spaced 10 km apart.
- Locations of defoliation or mortality were delineated using a digitizing tablet and/or a personal computer using ArcPad software.
- Damage severity was also recorded for each polygon using a severity rating of light, moderate or severe defoliation or mortality.

Ground Surveys:

- Using ArcGIS software, forest stands containing a major component of mature to old growth White pine were selected that provided the habitat required to support an outbreak population of Jack pine budworm.
- At each of these sites one Multi-Pher® pheromone trap containing a lure to attract the male moths were placed during late June or early July, just before the peak period of moth emergence and flight activity.
- One 60 cm mid-upper crown branch section was collected from each of three trees at the sample location and brought to the Nova Scotia Department of Natural Resources lab for further processing. Each branch section was processed through a 1% sodium hydroxide wash to remove the second instar larvae from their hibernaculum and then identified and counted.

Forest Health, NSDNR

L-2 extraction wash procedure

RESULTS

Aerial Survey:

- No aerial survey was flown in 2015.

Ground Survey Trapping:

- Forty Nine Multi-Pher® pheromone traps baited with lures to attract male moths were placed (see map) in mature and old growth white pine stands during June 2015 and were picked up in late fall and winter. Twenty-one traps contained 0 moths; seventeen traps contained 1-10 moths; and one trap contained 18 moths. Three traps were missing and seven were on the ground (see map).

Overwintering L2 larvae:

- Eleven locations were assessed in 2015. No larvae were detected from any of those sites (see map).

YEARS OF DATA

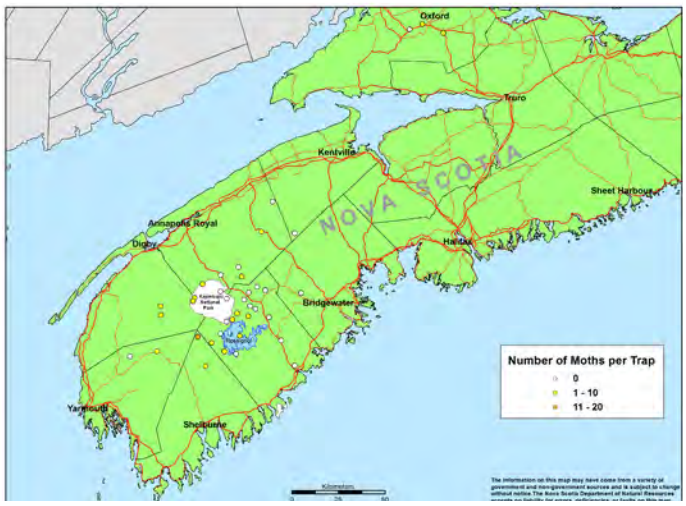
- Ongoing project since 2004

PARTNERS

- Nova Scotia Department of Natural Resources

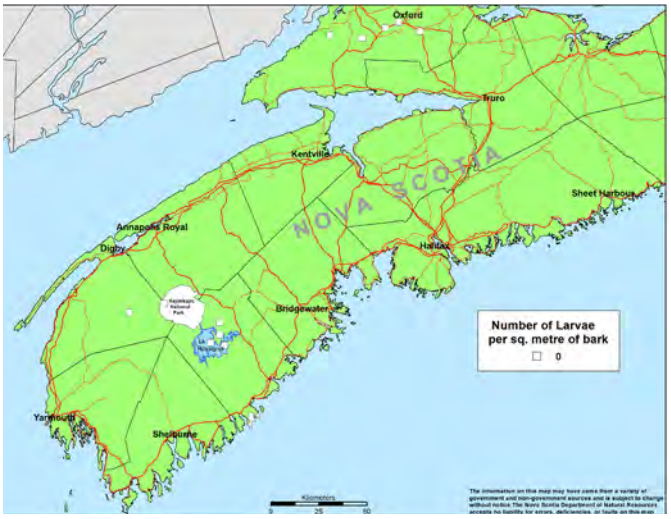
Forest Health, NSDNR

Adult moth 21-30 mm; L-2 larvae 2-3 mm



Forest Protection, Forest Health Group, NSDNR

Jack pine budworm trap results 2015



Forest Protection, Forest Health Group, NSDNR

Jack pine budworm L2 larvae results 2015

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Rationale

Boreal felt lichen (BFL) and other rare lichens that inhabit coastal forests in Nova Scotia are at risk because of air pollution and forestry. Boreal felt lichen and other rare cyanolichens are difficult to detect and as a result the knowledge of their ranges and distributions is incomplete. Little is known about which sources of air pollution pose the greatest threats and at what levels. A Geographic Information System (GIS) habitat algorithm was developed by the Nova Scotia government and has allowed the forest industry to use precaution when harvesting in potentially sensitive areas. This project has fostered partnership with industry to search for rare lichen. Since the algorithm was developed, knowledge of Boreal felt lichen populations has increased greatly. The continuation of this long term data set will be crucial to conserving Nova Scotian populations of Boreal felt lichen.

Boreal felt lichen found at Johnston's Pond

Monitoring

BOREAL FELT LICHEN MONITORING IN NOVA SCOTIA

OBJECTIVES

- To improve predictive ability of a GIS habitat algorithm to increase the 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 rare lichens in Nova Scotia.
- To find and protect Boreal felt lichen and other at risk lichen sites in Nova Scotia.

METHODS

- In forested areas, sites predicted by GIS as likely habitat were searched for Boreal felt lichen.
- Known sites were permanently marked for long term monitoring.
- When new Boreal felt lichen sites were found the provincial government and relevant stakeholders were notified. Any losses or habitat destruction were also reported.
- Temperature and humidity loggers (ibuttons) were deployed and collected at Boreal felt lichen sites on Cape Breton Island.

Boreal felt lichen found while doing a survey on a Nature Conservancy of Canada's property

RESULTS

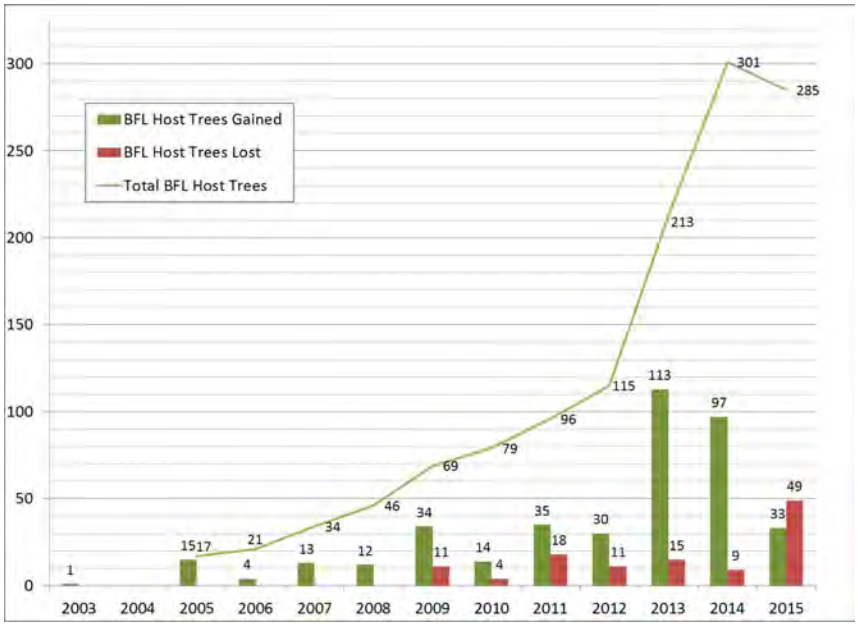
- 400 trees with Boreal felt lichen were discovered from 2005 to 2015 through this project and during the same time 117 of those trees no longer contained Boreal felt lichen.
- In 2015, 33 new trees containing Boreal felt lichen were found.
- Monitoring occurred at 162 trees known to contain Boreal felt lichen (54 %); 49 no longer hosted Boreal felt lichen.
- In 2015, MTRI researchers found five trees containing Vole ears lichen (Endangered).
- A temperature and humidity study of habitat was continued using automated data loggers at Boreal felt lichen sites on Cape Breton Island and results are being analyzed.

YEARS OF DATA

- Ongoing project since 2007

PARTNERS

- Government of Canada through the federal Department of the Environment: Habitat Stewardship Program for Species at Risk
- New Page Corporation
- Northern Pulp
- Nova Scotia Environment
- Nova Scotia Department of Natural Resources
- Mersey Tobeatic Research Institute
- Mountain Equipment Co-op
- Nature Conservancy of Canada



B. Toms , MTRI

Number of BFL - host trees gained (green bar), BFL - host trees lost (red bar) and total number of BFL - host trees (green line)

B. Toms, MTRI

Boreal felt lichen found at Johnston's Pond

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Rationale

Since the decline of the Mainland moose in the province, the White-tailed deer, a naturalized species, became one of the major herbivores affecting Kejimkujik forest ecosystems. Selective browsing of deer on certain species of herbaceous plants, shrubs and trees can exert extensive influences on forest community composition and structure. Significant increases in deer populations may result in a reduction of some forest plant components (*e.g.* Sugar maple and Yellow birch) through over-browsing of regenerating seedlings and saplings. Alternatively, a decrease in local White-tailed deer abundance could result in changes in the predator trophic structure since deer are important prey for top predators, such as Eastern coyote and Bobcat.

E. Le Bel

White-tailed deer observed during the October roadside census

Monitoring

RELATIVE ABUNDANCE OF WHITE-TAILED DEER

OBJECTIVES

- To monitor and assess changes in the population of White-tailed deer at Kejimkujik.
- To determine if the mean number of White-tailed deer observed per day at Kejimkujik (as assessed through observation of roadside populations) is within the range of natural variation (*i.e.* between 1.39 - 5.89, as determined through analysis of data between 1987 - 2007) and if it has increased or decreased over time.

METHODS

- White-tailed deer have been monitored at Kejimkujik since 1976 through an annual roadside count, which was conducted each day in October along the Main Parkway and locations within Jeremy's Bay Campground. The number, age class and sex of observed deer were recorded.
- The sampling framework for this project represents only the roadside population of White-tailed deer at Kejimkujik.
- White-tailed deer roadside count data between 1987 and 2012 were analyzed to detect trends over time. A linear model was used to assess whether the slope of the temporal variable was significantly different from zero. The period from 1987 to present is presumed to reflect a stable population level for this region in the current conditions and was used for the assessment period for trend analysis.
- The status of White-tailed deer at Kejimkujik was also examined by comparing recent data to established thresholds. Thresholds for White-tailed deer abundance at Kejimkujik were developed based on statistical variability in the yearly mean of deer counted per day in the roadside survey at Kejimkujik between 1987 and 2007. To assess status, the linear model from the trend assessment was used to generate a point estimate (with associated error) of the measure for the most recent year, which was then compared to the established thresholds.

R. Neubauer

White-tailed deer grazing at roadside in Kejimkujik

RESULTS

- The average number of White-tailed deer observed each day in 2015 at Kejimkujik was 2.5, which is less than observations over the past two years. Last year's severe winter is believed to have been a factor in the decline, as prolonged periods

RESULTS
Continued

R. Neubauer

White-tailed deer are a common sight along the road in Kejimkujik

of deep snow are known to negatively impact deer winter survival. The average depth of snow on the ground in Kejimkujik during the winter of 2015 was three times greater than the past three years.

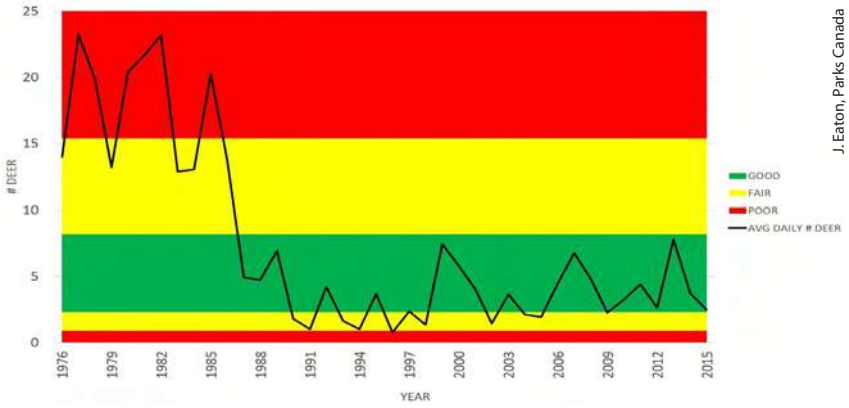
- These observation numbers for 2015 were similar to those from 2012 (2.65 obs/day) and 2009 (2.27obs/day), indicating that there may be a cyclical nature to relative deer abundance in Kejimkujik.
- The 2015 average daily observation (2.5 obs/day) is well within the range of acceptable abundance according to established Kejimkujik thresholds. High deer numbers are known to cause detrimental effects to hardwood recruitment as they browse on the young trees and hinder their growth and establishment. There is however the possibility that as the forests within Kejimkujik mature, deer will not find suitable browse material and migrate toward the roadsides where new growth is more abundant, potentially elevating the roadside deer count.
- Detailed research into understanding the carrying capacity of White-tailed deer at Kejimkujik would allow for improved monitoring thresholds, determining the affect deer population numbers have on forest growth and regeneration, and to help improve future management decisions.

YEARS OF DATA

- Ongoing project since 1976

PARTNERS

- Parks Canada
- Nova Scotia Department of Natural Resources
- Volunteers



J. Eaton, Parks Canada

Average number of White-tailed deer observations in October at Kejimkujik with thresholds

E. Le Bel

Large buck crossing the road in Kejimkujik

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Rationale

Plethodontid salamanders lack lungs and breathe through their glandular skin and the roof of their mouth, 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 useful indicator species of forest ecosystems due to their life history traits. They are completely terrestrial and occupy a small home range. They generally have long life spans (ten plus years), high annual rates of survivorship and low birth rates, resulting in stable population sizes under normal conditions. Thus a change in population is more likely to be an indication of some stress to a forest ecosystem rather than simply due to shifts in home range. In Nova Scotia there are only two native plethodontid salamanders: the Four-toed salamander (rare) and the Eastern red-backed salamander (common). 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.

K. Rowter, Parks Canada

The less common Yellow-spotted salamander

Monitoring

PLETHODONTID SALAMANDER MONITORING

OBJECTIVES

- To monitor plethodontid salamander abundance in the mixed Red maple/Red oak/White pine forest ecosystems and Eastern hemlock forest ecosystems of Kejimkujik.

METHODS

- Salamander abundance was assessed in 12 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 40 thick wooden boards (artificial cover boards) was counted and recorded. Though the monitoring focus was placed on Eastern red-backed salamanders, all other salamander species were recorded when present.
- Colour phase of the salamanders are also recorded. Red-backed salamanders have three phases; the "red-back" which is black with a red stripe running down the back, the "lead-back" which is all black and "erythristic" which is all red but very uncommon.

K. Rowter, Parks Canada

Eastern Red-backed salamander with juveniles

RESULTS

- Since monitoring of Eastern red-backed salamanders began in 2003, the salamander population has remained in good condition in both the hemlock and mixed hardwood forest ecotypes.
- No apparent declines in salamander abundance (2008-2015) indicates that possible stressors such as climate change, acid rain and land use change have had no significant effect on salamander populations in Kejimkujik forests.
- In fact this year marked the highest recorded number of Eastern red-backed salamanders per board since the beginning of the monitoring program. There were also a high number of juveniles recorded in this year's salamander monitoring, possibly due to the late spring.

RESULTS
Continued

- We are currently investigating what environmental variables may be influencing salamander abundance. There seems to be a correlation between temperature (both air and soil) and the number of salamanders found beneath boards.

YEARS OF DATA

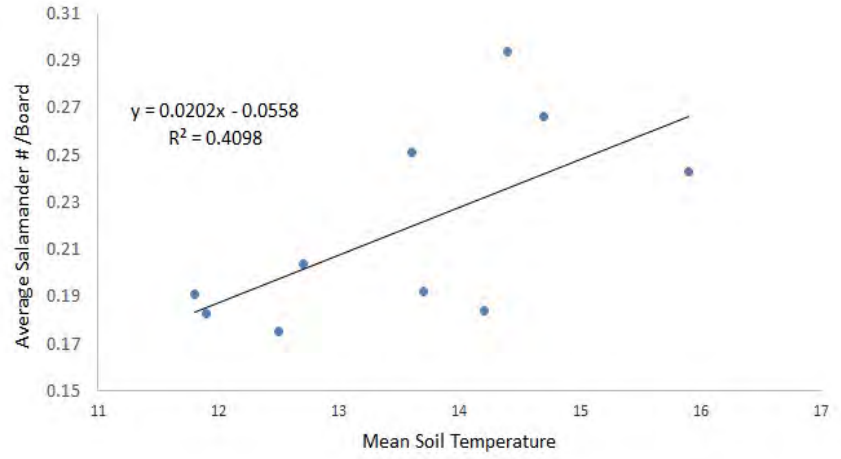
- Ongoing project since 2003

PARTNERS

- Parks Canada
- Volunteers

J. Eaton, Parks Canada

Volunteers checking cover boards



K. Rowter, Parks Canada

Average number salamanders (2008-2015) as a function of soil temperature

Parks Canada

Salamander monitoring is a measure of forest health

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Rationale

Red oak trees play a significant role in the Acadian Forest, providing both food and shelter for a diversity of wildlife. Monitoring Red oak plots in Kejimkujik over the past few years has shown poor levels of regeneration. Some of the contributing factors to the decline of Red oak in the Acadian Forest likely include past forestry practices, natural stand succession and suppression of forest fires. Other contributing factors that may have altered Red oak regeneration and distribution also include browsing by White-tailed deer, acorn predation and stress from defoliators. The purpose of this work is to assess the health of mixed-wood stands containing Red oak and to determine appropriate sites for Red oak regeneration experiments both inside and outside Kejimkujik. These proposed experiments will help build a better understanding of management techniques to be used in Kejimkujik and other parts of the Acadian Forest region.

J. Barker, MTRI

Red oak sapling

Research

RED OAK REGENERATION IN MIXEDWOOD STANDS

OBJECTIVES

- To monitor hardwood, especially Red oak, regeneration over a 10-year period within permanently marked transects and determine the impact White-tailed deer have on Red oak regeneration.
- To monitor Red oak and other hardwood tree species that are within White-tailed deer exclosures which protect hardwood seedlings and saplings from browsing by large herbivores.
- To assess defoliation damage inflicted on mature Red oaks by the Oak leaf shredder and Oak leaf roller.
- To assess changes in Cancer root (parasitic on Red oak) populations within control and prescribed burn sites.

METHODS

J. Barker, MTRI

MTRI staff member, J. Reid, maintaining transect markers

- Tree species regeneration was estimated along belt transects of 150 x 2 m by counting tree species in various height classes both in control sites and treatment (prescribed burn) sites in five locations within Kejimkujik.
- Data were collected at the beginning and at each 50 m interval along the transect by estimating standing living volume with a prism sweep, estimating canopy cover, noting ground vegetation and taking photos of north, east, south and west aspects.
- Red oak defoliation was estimated visually in the canopy of mature oaks within the belt transects.
- Trees species, their height classes and any browsing were noted within 42 deer exclosures in seven locations, with both control and treatment sites, within and outside of Kejimkujik.
- Cancer root clumps were noted and counted where present along transects and within exclosures.

RESULTS

- Preliminary analysis of pre- and post-burn data suggests the prescribed burn area is succeeding toward a Red maple and Witch hazel uplands forest and that White pine seedlings and saplings were reduced by almost 50% on prescribed burn sites.

RESULTS
Continued

- Data from transects showed that, on average, Red oaks experienced about 39% defoliation in years prior to 2012, but less than 9% between 2012 – 2015, suggesting a reduction in recent Oak leaf roller and Oak leaf skeletonizer outbreaks. Consequently, canopy cover has increased on most sites. Successful girdling has decreased canopy cover on some treatment sites.
- Transect data showed an increase of 18% in the number of browsed Red oak saplings in the last year. This may be explained by the late spring snow cover in 2015.
- Exclosure data dating back to 2011 showed only slight differences in Red oak seedlings between control and prescribed burn sites.
- The number of Cancer root clumps showed a decrease in all previously recorded sites. Numbers have fluctuated considerably since monitoring of this rare parasitic plant species started, and more work is needed to track variables that may affect its growth.

YEARS OF DATA

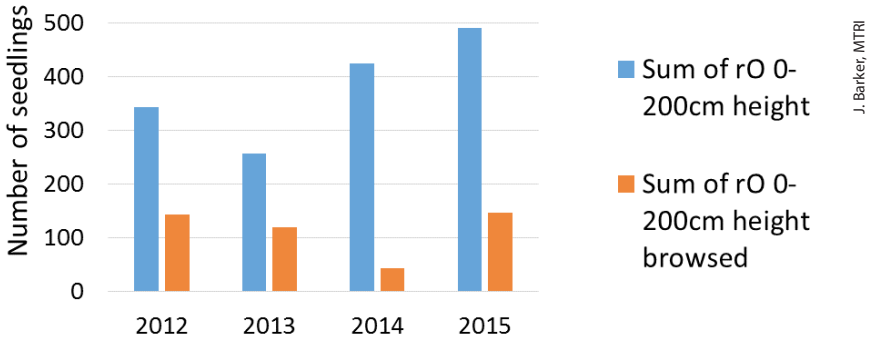
- Year 9 of an ongoing project

PARTNERS

- Mersey Tobeatic Research Institute
- Parks Canada
- Service Canada

J. Barker, MTRI

Red oak transect canopy



J. Barker, MTRI

Transect browse trends: Red oak sapling (0-200 cm) count

J. Barker, MTRI

MTRI researcher, A. Berry, measuring tree diameter

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Rationale

Old forests are rare, but they still exist in the Maritimes. At the Mersey Tobeatic Research Institute, we have been working within southwestern Nova Scotia to identify old forests on private and public land and to encourage landowners to steward these special places and to restore old forest characteristics to their woodland since 2006. The current focus of MTRI's old forest project is to build a network of partners who manage or have a vested interest in old forests to raise the profile of these special places and protect their rich and unique biodiversity. Through knowledge generation and outreach that facilitates positive impacts on woodlands of every ownership type this ecosystem-based project will reach across the Acadian Forest region to engage the public. The project's comprehensive approach blends science, policy, and stewardship by focusing on key activity areas including field-truthing old forests, mapping their distribution on the landscape, co-ordinating a network and a science conference, reviewing regional policies and legislation, and educating the public about the importance of old forests and how they can be conserved and restored.

Research

OLD FOREST PROGRAM

Old growth softwood stand at Lake Munro, Nova Scotia

OBJECTIVES

- To establish partnerships and build capacity with multiple organizations and stakeholders throughout the Maritimes.
- To develop a field truthing methodology based on old growth forest indicators.
- To collect field-truthed old forest data in geographic information system (GIS).
- To conduct a comparative analysis between Maritime, British Columbia, Ontario and New England legislation and policy.

METHODS

- Develop a common field protocol for truthing old forests in Nova Scotia, New Brunswick and Prince Edward Island.
- Determine priority areas based on capacity of non-governmental organizations and paucity of field-truthed data.
- Measure old forests in priority areas and deposit data (using new app) in new database.
- Create a comparative analysis framework through partner consultations and conduct a rigorous legislative and policy analysis.
- Develop a network through one-on-one interviews, working group meetings and fall conference.

RESULTS

- Literature review and expert interviews were used to catalogue research tools, techniques, and approaches that have been used to field truth old forests. This was presented to an old forest working group consisting of many of our partners. A specific protocol working group has been struck to finalize a protocol for use in summer 2016. An app was developed as a research tool to collect data in the field using the most widely used protocol, Nova Scotia Department of Natural Resource's Old Forest Scoresheet. The app will be field tested summer 2016.
- The project coordinator was trained in multiple techniques for field truthing old forests and a small number of field sites were measured. Equipment was purchased to assemble four field kits for loan to partner organizations in summer 2016. During one-on-one interviews, a list of priority sites in each

RESULTS
Continued

of the three Maritime provinces was compiled.

- In partnership with the Atlantic Canada Conservation Data Centre, a geodatabase including over 400 records of field-truthed old forests has been compiled and was presented to the working group. We continue to request additional data from partners and to explore methods for mapping potential old forests that require field truthing.
- Forty-three individuals considered experts in old forest research and management were contacted from over thirty organizations. One-on-one meetings were held with over twenty-five individuals. A working group was struck with 18 participants from 15 organizations. A local organizing committee and program committee were struck to begin planning a multiday conference for fall 2016.
- East Coast Environmental Law Association was contracted to undertake a comparative legislative analysis. Seven law students from Dalhousie University and University of New Brunswick contributed to the research. The report will be presented to partners at a participatory session in June 2016.

YEARS OF DATA

- Ongoing project since 2006

PARTNERS

- Government of Canada's Atlantic Ecosystems Initiative
- Nova Scotia Department of Natural Resources
- Atlantic Conservation Data Centre
- East Coast Environmental Law Association
- Meduxnekeag River Association
- Conservation Council of New Brunswick
- New Brunswick Nature Trust
- Island Nature Trust
- Nova Scotia Nature Trust
- Nature Conservancy of Canada
- Dalhousie University
- University of New Brunswick
- Bear River First Nations

A. Berry, MTRI

T. Lutz, MTRI's Forest Technician enjoying an old growth forest in New Brunswick

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A. Belliveau, ACCDC

Stream flowing through old forest in Snowshoe Lakes Protected Area

Rationale

There have been hundreds of unconfirmed sightings of cougars in Nova Scotia but there has never been any substantiated physical evidence of their presence. This study was designed to determine the presence of cougar from physical evidence using a method of collecting hair samples from scratch post stations. Scratch post stations for detecting cougar presence have been used in other national parks in New Brunswick, Quebec and in Cape Breton. Cougar presence was substantiated through DNA analysis from Fundy National Park, New Brunswick and also from areas of Quebec and Ontario. Since 1998, COSEWIC has ranked the Eastern cougar as having insufficient data to evaluate its taxonomy or assign a status, despite many sightings from eastern Canada. Some sightings are suspected to be escaped captives or individual members from western populations who have wandered long distances from their established breeding ranges. A more recent hypothesis is that there may never have been a distinct "eastern" subspecies. In 2015, the United States removed the Eastern cougar from its endangered species list, declaring that it is now extinct. This top carnivore, regardless of whether it originates from eastern or western populations, could be roaming through southwest Nova Scotia and remains of high ecological interest.

Research

TO DETECT PRESENCE OF COUGAR IN SOUTHWEST NOVA SCOTIA

H. Clapp

H. Clapp collecting samples

OBJECTIVES

- To provide physical evidence to substantiate presence or absence of the Eastern cougar in southwest Nova Scotia.
- To passively collect photo evidence and hair samples for DNA analysis to substantiate cougar presence.

METHODS

- In 2008 and 2009 a total of eight cougar stations were established. These stations in Kejimkujik and the Tobeatic were placed in habitat that could be attractive to this species and and were monitored during years 2008-2015.
- Each station consisted of a 2 m high PVC pipe containing a lure made from Cougar urine. A liquid summer lure was dispensed using a wick and bottle, while winter lure, a solid attractant was hung in the PVC pipe and slowly released scent.
- The cougar scratch posts were designed to collect hair samples. Velcro or carpet was wrapped around the post to catch any hairs released by visiting wildlife. A 3 m^2 fence made with two strands of barbed wire surrounded the post to catch hair as the animal passed through the fence.
- All stations have been equipped with motion sensor cameras.
- Cougar stations were visited several times a year to replenish the lure and collect hair samples. Hair samples were collected using tweezers while wearing disposable nitrile gloves. Samples were sealed in small plastic bags which were placed in paper packets and labeled with the date, location, collector, name and any pertinent notes.
- Promising hair samples were sent for DNA testing at université de Montréal and Genome Québec. Identification techniques used mitochondrial DNA.

H. Clapp

Image of Barred owl captured by a motion sensor camera

RESULTS

- Hair samples were successfully collected and analyzed from scratch posts. The scratch posts and lure attracted a variety of mammal species that were identified either visually or through DNA testing, including American black bear, White-tailed deer, Eastern coyote and flying squirrel species. The game cameras when used, provided photographic evidence which confirmed presence of some of these mammals as well as a few bird species.
- To date there has been no conclusive evidence that there are Cougars within the study area. There are still a number of samples being tested at this time and some previous samples are being re-tested.

YEARS OF DATA

- Ongoing project since 2008

PARTNERS

- Kejimkujik National Park and National Historic Site
- Parks Canada
- Nova Scotia Environment

H. Clapp

Image of American black bear attracted to lure captured by motion sensor camera

H. Clapp

Image of White-tailed deer captured by motion sensor camera

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Rationale

Banding data suggest that large numbers of Northern saw-whet owls migrate through southwest Nova Scotia during fall; at least some of these owls may winter in the region. Despite this, we know next to nothing about staging and wintering habitat use by this owl in the Maritimes. In addition, it is generally unknown how saw-whets deal with the marine barrier, the Gulf of Maine separating the Maritimes from potential wintering habitat in the eastern United States.

Research

S. Craik, Université Sainte-Anne

Radio-marked female Northern saw-whet owl wintering on the campus of Université Sainte-Anne, Church Point, NS, January 2016

MIGRATION AND HABITAT USE BY NORTHERN SAW-WHET OWLS

OBJECTIVES

- To examine habitat use of staging and wintering Northern saw-whet owls radio-marked during fall migration in Nova Scotia.
- To examine fall migration chronology and routes of radio-marked birds.

METHODS

- Northern saw-whet owls were captured during fall migration during October-November at two study sites: Université Sainte-Anne (Church Point) and Bon Portage Island. Attempts to mark birds at Antigonish were not successful.
- Owls were captured with mist nests and an audiolure. Captured owls were aged, sexed, and issued a standard leg band.
- Twenty-six females were each fitted with a 1.6 g nanotag from Lotek Wireless Inc. Transmitters have a life expectancy of 305 days and were attached using a modified Rappole leg loop harness that will degrade and fall off with time.
- Owl movements were tracked using the Motus Wildlife Tracking System, a network of very high frequency (VHF) receivers on towers along the Fundy and Atlantic coasts of the Canadian Maritimes to Chesapeake Bay, Maryland. The receivers automatically detect and record signals from radiotransmitters at distances of up to about 15 km.

RESULTS

- Preliminary results suggest that trajectories of marked birds from Université Sainte-Anne were considerably different than those for birds marked on Bon Portage Island.
- Of 21 saw-whets marked at Université Sainte-Anne, at least two females crossed the Bay of Fundy as they were detected by towers along either the New Brunswick (Grand Manan) or Maine (near Calais) shores of the Bay of Fundy within one day of being previously detected at towers in Church Point.

RESULTS
Continued

This represents the first direct evidence of a Bay of Fundy crossing for this species.

- The majority of birds marked at Université Sainte-Anne moved away from the site within one day of being marked, suggesting that the campus woods are not an important stop-over site for many saw-whets. However, four birds remained in the area and are currently being tracked as part of a winter habitat use project.
- Bon Portage Island apparently serves as a stopover site for some owls; five birds remained on the island for at least 2 - 3 days following marking.
- Two birds left Bon Portage Island and were subsequently detected by towers along Nova Scotia's south shore, as far east as Eagle Head (about 10 km east of Liverpool), and one bird moved north toward Church Point via Cape Forchu (Yarmouth).

YEARS OF DATA

- Single year project

PARTNERS

- Acadia University
- Nova Scotia Habitat Conservation Fund
- Motus Wildlife Tracking Network

L. Hanks

Radiomarking a female Northern saw-whet owl at Université Sainte-Anne, Church Point, Nova Scotia

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L. Hanks

S. Craik with student A. Hanks radiomarking a female Northern saw-whet owl at Université Sainte-Anne, Church Point, Nova Scotia

Photos on page 47, clockwise from top left:

- Loon's nest with egg, J. Reid
- Brook just below Pine Lake, by A. Belliveau, ACCDC
- G. Theroux-Loiselle looking through the scope for loons, by MTRI
- Stoney Ditch Lake, by A. Belliveau, ACCDC
- A. Lavers and G. Theroux-Loiselle canoeing to water quality monitoring site, by MTRI

Freshwater sidebar photo: J. Reid

FRESHWATER

Rationale

Atlantic coastal plain flora (ACPF) is a group of plants found along the low lying land of the Atlantic coastal plain. These plants are typically poor competitors against other plants and therefore they often thrive in the areas where other plants are not able to grow quickly. These are typically along lake shorelines with a high degree of winter ice scour, where flooding is common, and in areas with low water nutrient levels (oligotrophic). Although ACPF can be found near water with moderate (mesotrophic) or even high (eutrophic) nutrient levels, increased lake nutrient levels have been identified as a significant threat to ACPF species. The shores of many high priority ACPF lakes are under threat from shoreline development. Directly involving landowners in volunteer activities will create ACPF stewards and reduce threats to ACPF.

ACPF habitat, Ponhook Lake

Monitoring

INCREASING SHORELINE STEWARDSHIP FOR ACPF HABITAT

OBJECTIVES

- To complete habitat mapping on 36 high priority ACPF lakes.
- To involve and recruit volunteers to help collect habitat data on ACPF lakes.
- To present results to community members and partners to raise awareness about ACPF habitat and threats to ACPF.

METHODS

- Shoreline habitat was documented through geo-referenced photos and habitat parameter data collected by researchers and volunteers.
- Habitat data will be processed into line form in geographic information systems (GIS) and displayed on an interactive public website.

RESULTS

- Habitat mapping was completed on Shingle Lake, Molega Lake, Ponhook Lake, Hog Lake, Fancy Lake, Kegeshook Lake, Gillfillan Lake, Salmon Lake, and Pleasant Lake.
- From 2010-2015 the entire shoreline of 35 high priority lakes was classified using a standard protocol covering more than 500 km of shoreline.
- Volunteers were directly involved in a variety of recovery activities.

YEARS OF DATA

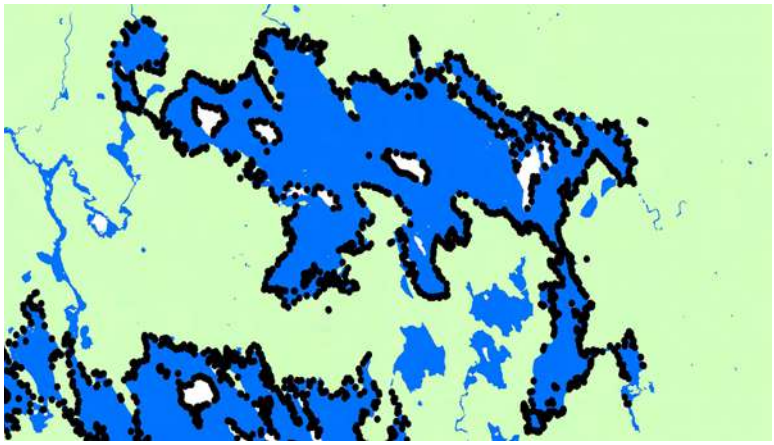
- Year 5 of a 5 year project

PARTNERS

- Government of Canada through the federal Department of the Environment: Habitat Stewardship Program for Species at Risk
- Atlantic Coastal Plain Flora Recovery Team
- Dalhousie University
- Nova Scotia Environment
- Nova Scotia Nature Trust
- Tusket River Environmental Protections Association
- Mersey Tobeatic Research Institute

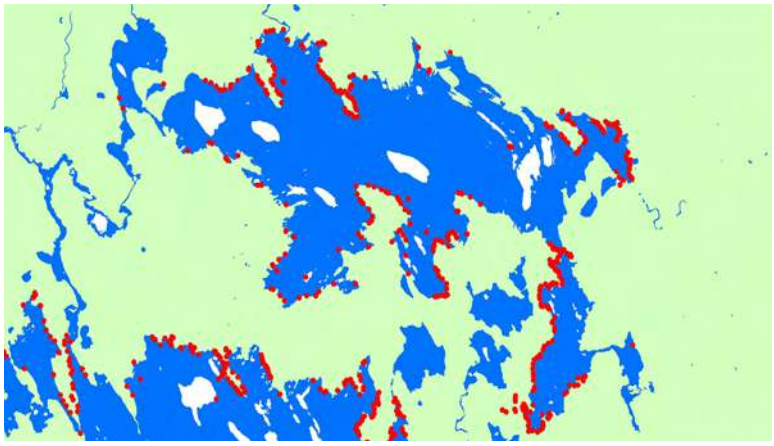
B. Toms, MTRI

ACPF 2015 surveys



B. Toms, MTRI

ACPF habitat coverage on Molega Lake



B. Toms, MTRI

ACPF habitat quality on Molega Lake

B. Toms, MTRI

E. Brooks conducting ACPF surveys on Ponhook Lake

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Rationale

Atlantic Coastal Plain Flora (ACPF) is a group of plants found along the low lying land of the Atlantic coastal plain. These plants are typically poor competitors against other plants and therefore they often thrive in the areas where other plants are not able to grow quickly. These are typically found along lake shorelines with a high degree of winter ice scour, where flooding is common, and in areas with low water nutrient levels (oligotrophic). Although ACPF can be found near water with moderate (mesotrophic) or even high (eutrophic) nutrient levels, increased lake nutrient levels have been identified as a significant threat to ACPF species.

MTRI's Wildlife Biologist, B. Toms collecting water quality data

Monitoring

WATER QUALITY IN ACPF HABITAT

OBJECTIVES

- To sample water quality from a representative subset of 15 of the high priority lakes identified in the ACPF recovery strategy.
- To involve and recruit volunteers to monitor lake water quality in future years of the project.
- To contribute to existing water quality data sets from high priority ACPF lakes.
- To present results to community members to raise awareness about the importance of lake water quality and ACPF.

METHODS

MTRI volunteer assisting with water quality monitoring

- Water samples and on-site measurements of water quality data were collected at the deepest point of the lake four times annually (May, July, August and October).
- The Carlsons trophic status index (TSI) was calculated for each sampling site.
- Field parameters (temperature, dissolved oxygen, turbidity, pH and salinity) were collected using a YSI Sonde.
- Phosphorus, nitrogen and chlorophyll measurements were obtained by independent laboratory measurements. True colour and alkalinity obtained in the fall through laboratory measurements.
- Community members aided in water quality sample collection.
- Sites were selected because baseline data does not exist for most of the chosen lakes and sampling in 2015 will provide a benchmark value for any future change in lake nutrients or water chemistry.

RESULTS

- Lakes sampled included Salmon Lake, Annis Lake, Pleasant Lake, Somes Lake, Fanning Lake, Kegeshook Lake, Gold Lake, Harpers Lake, Fanning Lake, Belliveau Lake, Moosehorn Lake, Molega Lake, Pretty Mary Lake, Mudflat Lake and Mill Lake.
- 15 high priority lakes were sampled (Tusket: 3, Medway: 5, Annis: 3, Roseway: 2, Meteghan 1, Petit: 1) in August.
- Five sites were found to be eutrophic, 9 mesotrophic and one oligotrophic based on the Carlsons TSI value.

YEARS OF DATA

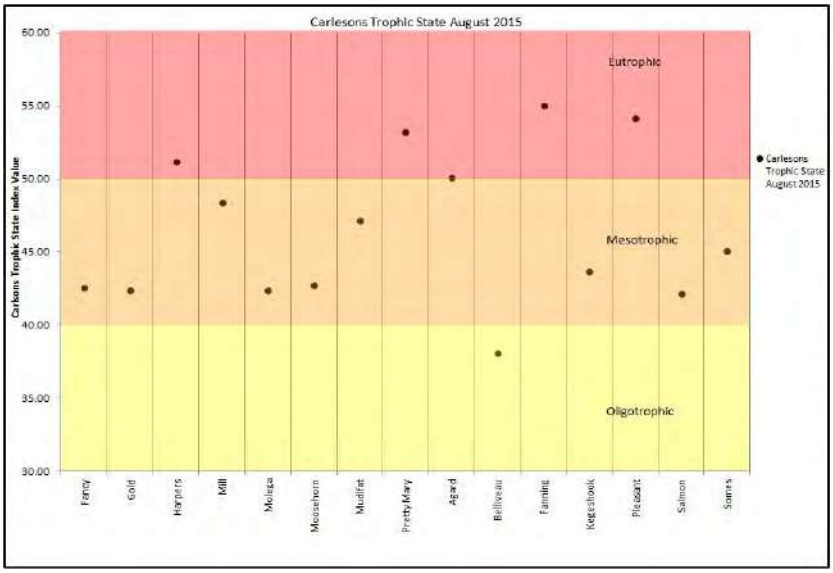
- Year 5 of a 5 year project

PARTNERS

- Sage Environmental Program
- Government of Canada through the federal Department of the Environment: Habitat Stewardship Program for Species at Risk
- Parks Canada
- Mersey Tobeatic Research Institute
- Atlantic Coastal Plain Flora Recovery Team
- Tusket River Environmental Protection Agency (TREPA)
- Acadia University
- St. Mary's University
- Dalhousie University
- Nova Scotia Department of Natural Resources

J. Sollows

MTRI volunteer collecting water quality data



B. Toms, MTRI

Carlsons TSI values for sample sites where colour bars denote oligotrophic status ranging from 0-39 (yellow), mesotrophic status from 40-49 (orange) and eutrophic status from 50-69 (pink)

TREPA

J. Sollows, Tusket River Environmental Protection Agency Water Quality Coordinator

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Rationale

Atlantic Coastal Plain Flora (ACPF) is a group of taxonomically unrelated plants that mainly inhabit lakeshores and wetlands along the Atlantic coastal plain region of North America. Disjunct from their main range, southwestern Nova Scotia has one of the last large populations and offers some of the most suitable remaining habitat for ACPF species. However, knowledge gaps, such as the identification of key habitat characteristics and potential habitats, restrict the establishment of strategic conservation plans. ACPF are found in riparian zones, which support complex habitat patches created and destroyed by hydrological disturbances. Habitat patches are mostly delimited by vegetation structure, which is defined by the height, coverage and types of vegetation. Thus, spatial patterns of vegetation structure would provide information on the size and spatial arrangement of habitat patches and biotic habitat characteristics. Representing the edge of their distribution, Nova Scotian populations are important for ACPF species survival.

N. Dazé Querry

A blooming Virginia meadow-beauty on Cameron Lake's shoreline

Research

HABITAT CHARACTERISTICS OF ACPF

OBJECTIVES

- To assess spatial patterns of ACPF richness/species and structural diversity indices along the lakeshore to forest gradient.
- To assess spatial relationships of ACPF richness/species and structural diversity indices at different scales and positions.
- To identify fine scale habitat characteristics associated with ACPF richness/species.
- To characterize soil properties along the lakeshore to forest gradient.

METHODS

- Seven lakes, 19 ACPF species and 16 sites, mostly in Queens county were selected.
- Two soil transects (approximately 22 m) perpendicular to the waterline at each site were established. Inclination, soil pH, organic and mineral layer thickness, mineral Munsell color and texture, depth to water and soil saturation were measured every 2 m along each transect.
- A 20 m transect was established perpendicular to the waterline with 20 x 20 cm contiguous quadrats at each site and a 5 x 5 m grid at each of five sites. Both transects and grids started at the edge of emergent vegetation (approximately 1-2 m in the water). Transects extended at least 5 meters in the forest and the grids ended near the forest edge.
- In each quadrat, the cover of different structural elements (*e.g.* shrubs, graminoids, sundews, moss, litter) at different heights (*e.g.* 20 cm, 40 cm, 60 cm) and ACPF species was visually estimated. The elevation (cm) and main substrate (*e.g.* gravel, cobble, stone) for each quadrat was also noted.
- Different structural elements (*e.g.* overall, substrate, plant, shrubs) were combined into indices using the Shannon Diversity Index. The data were analyzed using spatial pattern analysis and multiple regression.

N. Dazé Querry

Quadrat of 20 x 20 cm with numerous ACPF species

RESULTS

- ACPF richness was higher close to the waterline, where the level of structural diversity was low and then it increased until it reached the forest edge.

RESULTS
Continued

N. Dazé Querry

Atlantic Coastal Plain Flora habitat on Hog Lake

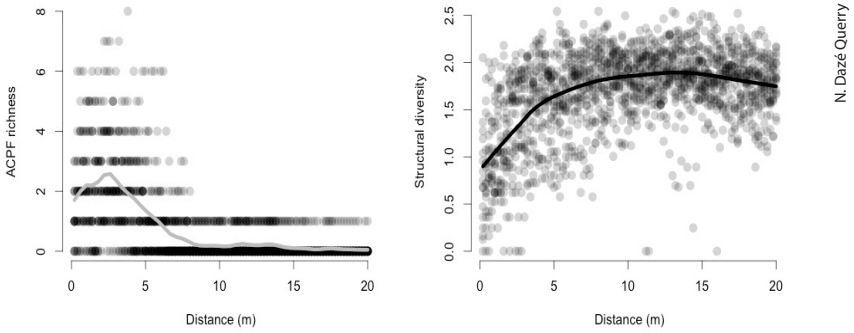
- ACPF appeared to be distributed with multiple patches or one patch of different levels of ACPF richness (*e.g.* skewed distribution) along shorelines. The average last change in ACPF richness (5.5 m) was located before the first change in structural diversity (6.8 m).
- Spatial patterns of diversity indices showed similar characteristics. The average first change in structural, plant and shrub diversity could represent the beginning of the forest edge. Changes in substrate diversity mainly occurred on lakeshores and close to the forest edge.
- ACPF herbs species (*e.g.* Golden pert, Redroot, Lance-leaved violet) were mainly found within the first 5 m of the transect, whereas shrubs species (*e.g.* Inkberry, Northern bayberry) started around 5 m and had a wider range.
- Along the transect, structural diversity was positively associated with ACPF richness at finer scales (< 2 m). Structural diversity became negatively associated with ACPF richness at larger scales (> 2 m). Shrub diversity mostly had a negative impact on ACPF richness across all scales.
- Positive relationships between structural diversity and ACPF richness occurred on lakeshore and became negative closer to the forest edge.

YEARS OF DATA

- Single year project

PARTNERS

- Saint Mary's University
- Natural Sciences and Engineering Research Council of Canada
- Sarah Lawson Scholarship
- Strategic Cooperative Education Incentive
- Atlantic Canada Conservation Data Centre



N. Dazé Querry

ACPF richness (number of ACPF species) and structural diversity for each quadrat of the 16 transects along the lakeshore to forest gradient

N. Dazé Querry

Quadrat of 20 x 20 cm with numerous ACPF species

CONTACTS

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Rationale

The Community-Based Environmental Monitoring Network (CBEMN) is a non-profit organization housed in the Geography Department at Saint Mary's University. Operating for over a decade, its primary objective is to increase community capacity for water quality monitoring by providing equipment, information and training to stewardship organizations across the Atlantic Provinces. The CBEMN is currently wrapping up its major project called CURA H2O that helped build capacity for non-governmental water quality monitoring through a standardized training program and an accompanying set of monitoring equipment. CURA H2O has project components in all of the Atlantic Provinces, Alberta, British Columbia and internationally, and has built a central database to house and integrate regional water quality data. As CURA H2O wraps up in the fall of 2016, several major project components (training course, database etc.) will be posted to the CBEMN website where they will be developed and maintained in the future.

O. Woods, CURA H2O

Humber Arm Atlantic Coastal Action Program staff collecting baseline water quality data

Monitoring

COMMUNITY BASED MONITORING AND MANAGEMENT

OBJECTIVES

- To increase community capacity for water monitoring and management in the Atlantic provinces and abroad.
- To standardize the way in which stewardship organizations conduct water quality monitoring.
- To leverage thousands of volunteer hours that are already dedicated to water quality monitoring.
- To establish a stewardship driven water quality database to promote networking/data sharing between organizations.

METHODS

- CURA H2O established an online training course and accompanying toolkit (Wet-Pro).
- Equipment and training was delivered to stewardship organizations across the Atlantic provinces.
- A central database was developed to house community data.
- A mobile application was developed to facilitate data uploads from the field.

L.Cliche

Wet-Pro training with Northeast Avalon Atlantic Coastal Action Program

RESULTS

- CURA H2O has provided standardized training and equipment (Wet-Pro) to 42 stewardship organizations (six in Southwest Nova) all of which are actively uploading water quality information to the data management infrastructure.
- 838 monitoring locations have been established (135 in Southwest Nova) totaling over 14,000 water quality observations (4000 from Southwest Nova).
- In-kind contributions from stewardship organizations is estimated to be more than $4,500,000 over the duration of the project.

YEARS OF DATA

- Year 5 of a 5 year project

PARTNERS

- Social Sciences and Humanities Research Council
- Environment Canada
- Nova Scotia Environment
- World Wildlife Fund
- Community Based Environmental Monitoring Network
- Clean Annapolis River Project
- Mersey Tobeatic Research Institute
- Clean Annapolis River Project
- Medway River Salmon Association
- Clean Nova Scotia
- Bluenose Coastal Action Foundation
- Discovery Centre
- Parks Canada
- Cobequid Salmon Association
- Oathill Lake Conservation Society
- Sackville Rivers Association
- Unama'ki Institute of Natural Resources
- Tusket River Environmental Protection Association
- Salmon River Salmon Association
- Cape Breton ACAP
- Nature Conservancy Canada
- Ecology Action Centre

Screenshot of the Stewardship Database from http://curah2o.com/water-quality/

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O. Woods, CURA H2O

Volunteers with Pictou Landing First Nation walking to a permanent monitoring site

Rationale

Water quality is a globally accepted and widely used measure for assessing and monitoring the condition of freshwater ecosystems. The physical and chemical characteristics of water have a strong influence on aquatic biota and freshwater ecosystem processes. Additionally, many of the primary stressors to freshwater processes are reflected in changes to water quality (e.g. acidification, eutrophication and deforestation). As a result, changes in water quality may provide an early warning of environmental stress to aquatic ecosystems. Atlantic Canada is particularly sensitive to acidification because its soils and bedrock generally have poor acid-buffering capabilities. Primary productivity (the rate at which light is converted to biomass through photosynthesis) is another key measure used to determine information about food availability and lake trophic status (nutrient level), and is commonly determined by measuring the photosynthesizing pigment, chlorophyll a. In Kejimkujik, 18 lakes have been monitored twice per year since 2008 to provide insights to the freshwater ecosystem health of the region.

M. Crowley, Parks Canada

L. Lawrence preparing to take a secchi disk measurement on Big Dam Lake

Monitoring

LAKE WATER QUALITY MONITORING IN KEJIMKUJIK

OBJECTIVES

- To monitor the status and trends in water quality in freshwater lakes in Kejimkujik by assessing a core suite of water quality parameters that are critical to aquatic ecosystem health and that may be impaired by primary stressors in the bioregion.
- To monitor the status and trends in primary productivity (chlorophyll a) in freshwater lakes in Kejimkujik.
- To determine if the results correlate with the range of natural variation for lakes in Kejimkujik or if there are observed changes over time and to compare with levels on lakes throughout the Greater Kejimkujik Ecosystem.

METHODS

- Water quality and primary productivity were selected as a monitoring measure for Kejimkujik's Freshwater Ecological Integrity Indicator, as part of Parks Canada's State of the Park reporting.
- Eighteen brown and clear water lakes are sampled annually in June and August. These sites represent all brown and clear lakes greater than 20 ha that are accessible and part of Environment Canada's Acid Rain Lake Monitoring Network.
- To obtain data for the nine parameters selected, water quality was assessed in-situ using an YSI Sonde and through water samples sent to Environment Canada's analytical lab in Moncton for processing and analysis. Chlorophyll a samples were filtered, frozen and sent to the Water Lab at Dalhousie University.
- Following the guidelines and formulas develop by the Canadian Council of Ministers of the Environment (CCME), a Water Quality Index (WQI) value was produced for all sites combined for the water quality measure.
- The WQI is a tool used to summarize complex water chemistry data into a single index to simplify and standardize water quality assessment and reporting across the country. The WQI is broadly used by Environment Canada and other organizations to communicate the status and trends in water quality.

M. Crowley, Parks Canada

A view of Back Lake

METHODS
Continued

- For primary productivity measure, concentrations of chlorophyll a were compared to thresholds based on established trophic level limits and trend over time.
- Full protocol documents are available upon request.

RESULTS

- Of the 18 lakes sampled, Big Red Lake was the most acidic with the lowest recorded pH of 4.4 and Grafton Lake was the least acidic with the highest recorded pH of 6.5. The average pH for all lakes was 5.4.
- The WQI was last analyzed in 2010 and considered to be in fair condition and stable.
- Now that seven years of data are available, a more in-depth analysis is planned.
- Commencing in 2013, a portion of water quality samples were obtained by volunteers assisting park staff.

YEARS OF DATA

- Ongoing project since 2008

PARTNERS

- Parks Canada
- Environment Canada
- Dalhousie University

K. Rowter, Parks Canada

M. Crowley collecting a water sample on Back Lake

Stressor	Parameter	Oligotrophic threshold (low nutrient lakes)	Mesotrophic threshold (moderate nutrient lakes)	Eutrophic threshold (high nutrient lakes)
Eutrophication	Total phosphorous	<10 ug/L	10-30 ug/L	30-100 ug/L
	Total nitrogen	<350 ug/L	350-650 ug/L	>650 ug/L
	Dissolved oxygen	>5 mg/L (summer)	5 mg/L (summer)	5 mg/L (summer)
Acidification	pH	>5.0 (brown)	>5.0 (brown)	>5.0 (brown)
		>5.9 (clear)	>5.9 (clear)	>5.9 (clear)
	Calcium	>0.64mg/L (brown)	>0.64mg/L (brown)	>0.64mg/L (brown)
		>0.74mg/L (clear)	>0.74mg/L (clear)	>0.74mg/L (clear)
	Aluminum	<0.16mg/L (brown)	<0.16mg/L (brown)	<0.16mg/L (brown)
		<0.046mg/L (clear)	<0.046mg/L (clear)	<0.046mg/L (clear)
Land use change	Turbidity	<1.3FTU	<1.3FTU	<1.3FTU
	Nitrate	<2.9 mg/L	<2.9 mg/L	<2.9 mg/L
	Dissolved organic carbon	<10.8mg/L (brown)	<10.8mg/L (brown)	<10.8mg/L (brown)
		<4.68mg/L (clear)	<4.68mg/L (clear)	<4.68mg/L (clear)

K. Rowter, Parks Canada

Thresholds of the nine parameters used to calculate the Water Quality Index

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Rationale

Fish passage in aquatic ecosystems is an essential consideration for the survival of many species, as it impacts access to favourable habitats for spawning, feeding, overwintering, and for thermal refuge. The construction of watercourse crossing structures, such as culverts, if they are poorly designed, installed incorrectly or are not maintained, can create barriers to fish migration and restrict fish access to upstream habitats. Clean Annapolis River Project (CARP) has been assessing the barrier status of watercourse crossings such as culverts in the Annapolis River watershed since 2007 with the aim of restoring aquatic connectivity throughout the watershed. This work has led to the fish habitat restoration work completed in 2015 in partnership with Nova Scotia Liquor Comission (NSLC) Adopt A Stream, and the development of an online database tool, to be hosted by NSLC Adopt A Stream, that will store provincial watercourse crossing data.

Monitoring

AQUATIC CONNECTIVITY IN THE ANNAPOLIS RIVER WATERSHED

Volunteers L. Heubach and N. Brown helping to build a tailwater control structure as part of culvert restoration activities

OBJECTIVES

- To identify road watercourse crossings within the Annapolis River watershed and assess their barrier status.
- To analyze and prioritize barrier watercourse crossings for remedial activities.
- To prescribe and design remedial actions for prioritized barrier watercourse crossings to restore fish access to upstream habitats.
- To create tools to support and facilitate the assessment of watercourse crossings.

METHODS

- Barrier watercourse crossings that were assessed by CARP staff between 2010 and 2014 were shortlisted and prioritized for remediation.
- Shortlisted sites were revisited in 2015 to select candidates for remedial activities.
- Selected sites were analyzed and remedial activities were prescribed to address migration barriers. Prescribed activities ranged from tailwater control weirs to baffle installations, and were designed according to the Guidelines for the Design of Fish Passage for Culverts in Nova Scotia, developed by Fisheries and Oceans Canada.
- Prescribed restoration actions were carried out according to the recommended prescribed remediations.

RESULTS

- Forty-five watercourse crossings were shortlisted for remedial activities in 2015, and of these, 15 received restoration work. Restoration activities included debris removals, tailwater control weir installations, construction of fish chutes, and installation of baffles and low flow barriers.
- Restoration work occurred primarily in priority sub-watersheds where higher quality habitats were previously identified via sub-watershed planning activities (2012 to 2014). Access was restored to over 33 km of upstream habitats from restoration activities, and access was improved to an additional 13.7 km.
- CARP partnered with NSLC Adopt A Stream to create a

RESULTS
Continued

watercourse crossing assessment database, to compile data collected across the province, and facilitate the assessment of watercourse crossings.

YEARS OF DATA

- Ongoing project since 2007

PARTNERS

- NSLC Adopt A Stream
- Fisheries and Oceans Canada

J. Medicraft, CARP

J. McCamon taking culvert measurements as part of aquatic connectivity assessments

J. Gray, CARP

CARP and NSLC Adopt A Stream staff installing a fish chute at the outflow of a barrier culvert

J. McCamon, CARP

A fish chute, installed as part of restoration initiatives to restore fish passage

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Rationale

Mercury (Hg) is emitted to and transported via the atmosphere; however, current atmospheric mercury levels cannot be assumed to be representative of fish mercury concentrations or subsequent mercury exposure of fish-consuming humans and wildlife. The Freshwater Inventory and Surveillance of Mercury (FISHg) program is part of Canada's Clean Air Regulatory Agenda Mercury Science Program, which defines the state of the Canadian environment with respect to mercury in order to inform the development and track the effectiveness of policy measures. The FISHg network monitoring program identifies the spatial and temporal trends in fish mercury concentrations at six lakes across Canada.

T. Smith, Environment Canada

B. Lalonde and T. Smith using the core sediment sampler

Research

FRESHWATER INVENTORY AND SURVEILLANCE OF MERCURY

OBJECTIVES

- To establish a monitoring program for spatial and temporal mercury trends in fish, at six lakes across Canada, including Kejimkujik Lake.
- To provide data on mercury levels in fish across Canada in a single database.
- To identify the effectiveness of Canada's Clean Air Regulatory Agenda on reducing fish mercury levels across Canada by establishing baseline fish mercury concentrations.

METHODS

- Water, sediment and fish (ten trout and ten perch) were collected in Kekimkujik Lake in the fall of 2012-2015 at three locations.
- Numerous ancillary information was collected annually from each lake in the FISHg project as well (fish trophic position, water concentrations of mercury and other metals, DOC, major nutrients, pH and other water quality parameters of site specific concern).
- For the first time in 2015, a 30 cm core of sediment was obtained at the deepest location.
- For the first time in 2015, passive samplers were deployed at three locations at the surface and 1 m from the bottom and were left for 24 hours to sample mercury in the water.

RESULTS

- Fish concentrations of mercury are still pending.
- Passive samplers concentrations and sediment cores results are still pending.
- Water mercury and methylmercury concentrations ranged from 3.08-3.12 ng/L and 0.11-0.12 ng/l respectively.
- Water quality results for 2015 are available and were similar to those of 2014.

RESULTS
Continued

- The concentrations of metals in water and sediment were similar between the three sites.
- Sediment mercury and methylmercury concentrations ranged from 126-202 ng/g and 0.59-0.97 ng/g respectively.

YEARS OF DATA

- Ongoing project since 2012

PARTNERS

- Environment Canada

B. Lalonde, Environment Canada

Sediment sampling in Kejimkujik Lake

T. Smith, Environment Canada

B. Lalonde and T. Smith travelling from Jake's Landing

B. Lalonde, Environment Canada,, Google Earth

Project sampling sites at Kejimkujik

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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 research conducted by the Canadian Wildlife Service found that our Nova Scotia loons have the highest blood mercury concentrations of any loon population in North America. These levels have been associated with impaired reproduction and altered breeding behavior. Besides the bio-accumulation of mercury, loons are sensitive to lake water acidification, water level fluctuations and human disturbance. LoonWatch surveys began on park 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 an 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.

A Common loon observed by a LoonWatch volunteer

Monitoring

THE KEJIMKUJIK-MERSEY LOONWATCH PROGRAM

OBJECTIVES

- To observe loon abundance and breeding success on lakes within Kejimkujik and in the Southwest Nova Biosphere Reserve.
- To determine status and trends in loon abundance, lake use and reproductive potential of resident birds.
- To contribute to the monitoring of water quality on lakes being observed by LoonWatchers outside Kejimkujik.

METHODS

Inside Kejimkujik:

- LoonWatch used trained volunteers to simultaneously survey study lakes within a three hour observation period in late May and again in late August.
- LoonWatch observations in May focused primarily on observing the number of adult loons (territorial pairs and individuals) residing on each lake. The August LoonWatch focused on the importance of assessing the number of surviving juvenile loons. Nests were not specifically sought after during LoonWatch in an effort to minimize disturbance.

Outside Kejimkujik:

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

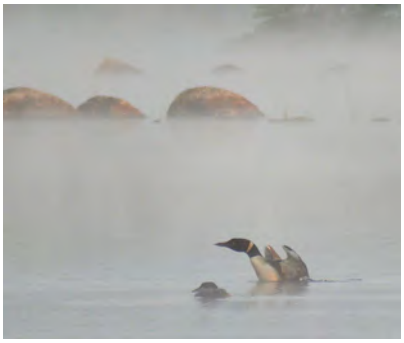
Kejimkujik 2015 LoonWatchers

RESULTS

Inside Kejimkujik

- The year 2015 marked a full 20 years of monitoring loons on 19 Kejimkujik lakes. Some volunteers have faithfully participated in the program since 1996, while some excellent new volunteers have been recently recruited to the program. This year, over 50 people contributed to LoonWatch.

RESULTS
Continued


J. Reid

Juvenile loon and adult loon observed by LoonWatcher

- The Kejimkujik spring LoonWatch reported 16 loon pairs, with no chicks yet hatched during the very cold, late spring.
- Seven juvenile loons survived the summer season, with two chicks produced on Loon and Peskawa lakes, and single, large chicks observed on Beaverskin, Lower Silver and Peskowesk lakes.
- A large juvenile loon was found on Highway 8 near Kejimkujik. Necropsy results were inconclusive, but the Bald eagle ranks high on the suspect list of predators. Three Bald eagles were recorded during the August LoonWatch, while such sightings were rare in previous decades.

Outside Kejimkujik

- In 2015, the Mersey LoonWatch program had 17 volunteers monitoring loons on 17 lakes in the Southwest Nova Biosphere Reserve. Six loon chicks were recorded on five lakes outside Kejimkujik. Water level fluctuations were relatively stable this year, but there were several reports of loon chick predation.
- Of the total six chicks observed, only two large chicks were observed late in the season, likely to have a good chance of survival.
- Seventy-six percent of the 2015 LoonWatchers reported Bald eagle sightings often or occasionally on their respective lakes. Loon monitoring programs, both inside and outside Kejimkujik, have received many reports of Bald eagles near inland lakes during the past two years. Growing populations of food-supplemented Bald eagles (*e.g.* from agricultural operations) may exert increased predation on loon chicks. Monitoring of Bald eagle numbers is important to determine the impact of eagle predation on loon chick survival.

YEARS OF DATA

- Ongoing project since 1996 (Kejimkujik) and 2006 (Mersey)

PARTNERS

- Parks Canada
- Mersey Tobeatic Research Institute
- Bird Studies Canada
- Environment Canada - Canadian Wildlife Service

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D. Crossland, Parks Canada

Founders of the LoonWatch program at Kejimkujik: Peter Hope (Retired Chief Park Interpreter at Kejimkujik) and Dr Joe Kerekes (Scientist Emeritus, Environment Canada).


D. Crossland, Parks Canada

Paul MacDonald, a 20 year LoonWatch program participant

Rationale

As an indicator of aquatic health, the Common loon has been a focus of research and monitoring at Kejimkujik and MTRI. Studies have shown that loons in the Kejimkujik area have high concentrations of mercury as a result of bioaccumulation, and that this may negatively affect the survival and reproduction in the long term. A total of 58 Common loons have been banded by Environment Canada. Seventeen loons were banded in the first banding period between the years 1995-1997, three juveniles and 14 adults. In the 2009-2012 banding period, 12 juveniles and 29 adults were banded. Loons were captured at night and banded with a unique combination of color leg bands in addition to a numbered Canadian Wildlife Service metal band. Loons were measured, sampled and then released. Loon research for the field season 2015 included productivity, survivorship surveys and water quality testing. As in 2013 and 2014, the focus again was on adult survivorship through re-sighting of loons that were banded by the Canadian Wildlife Service and the Biodiversity Research Institute.

C. Gray, MTRI

Common loon

Research

ADULT SURVIVORSHIP OF COMMON LOONS

OBJECTIVES

- To observe banded Common loons to enable researchers to identify information about individuals such as territory, mate fidelity, site fidelity and productivity.
- To develop and improve methodology for future study of adult survivorship through band re-sighting.

METHODS

- Loons were observed from lake shorelines and by canoe, using spotting scopes and binoculars.
- Researchers entered loon observations using a Global Positioning System (GPS) and recorded lake name, territorial divide if observed, date, presence or absence of bands, colours and position of bands, and year banded. On a separate data sheet, researchers recorded lake site information, weather conditions, UTM location and time of observation, behavioral information, age of chicks and nest site information.

C. Gray, MTRI

MTRI researcher, G. Theroux-Loiselle looking for loons through the spotting scope

RESULTS

- Researchers from MTRI surveyed 34 lakes in and around Kejimkujik. Eight lakes of which were added to the 2014 list in an attempt to locate banded juveniles that should be returning to the area, but none were found. Twenty three of those 34 lakes were the locations where loons were previously banded.
- Researchers observed banded loons on 12 of the 34 lakes surveyed. Seventeen adults were observed and identified by their unique leg band color combination. Eleven were resighted within Kejimkujik National Park and six were resighted outside the park. Bands were only partially observed on two individuals.
- All of the 17 banded loons that were resighted in 2015 were located on the lakes where they had been originally banded.

RESULTS
Continued

- There was some evidence of pair changes at Jeremy's Bay as well as Donnellan, Puzzle, North Cranberry, Big Dam and Grafton Lakes.
- Out of the 17 banded adults identified in 2015, three (out of six) banded adults were from 2009, ten (out of 16) banded adults were from 2010 and four (out of seven) from 2012. Forty six individuals were confirmed without bands during the 2015 field season, some possibly counted more than once.
- Ten loon nests were located; six nests successfully hatched chicks. Three nests appeared to have been predated, and two nest sites had been abandoned. A nesting pair on Turtle Lake successfully hatched one egg but not the second.

YEARS OF DATA

- Ongoing project since 2007

PARTNERS

- Environment Canada
- Parks Canada
- Mersey Tobeatic Research Institute
- Nova Scotia Economic Development
- TD Friends of the Environment Foundation
- CEGEP Sherbrooke

J. Reid

C. Gray, MTRI researcher, recording loon data on Kejimkujik Lake

C. Gray, MTRI

Common loon with leg band observed in 2015

C. Gray, MTRI

MTRI researcher, G. Theroux-Loiselle, looking for loons through binoculars

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Rationale

Kejimkujik's freshwater ecosystem is under immediate threat from two highly invasive predatory fish species; Smallmouth bass and Chain pickerel. Smallmouth bass are located in Cannon Lake, only 2 km upstream from the park boundary, flowing into Loon Lake. Chain pickerel are below Lake Rossignol, approximately 30 km downstream of Kejimkujik. Preventing the entry of these invasive species into Kejimkujik is paramount. Should either species become established in Kejimkujik, there would be significant negative impacts to the freshwater ecosystem, including direct and indirect effects on Brook trout and Blanding's turtle populations as well as overall changes to aquatic species abundance and composition. In 2015 we continued our monitoring of high risk watersheds in the park and in collaboration with MTRI and the Nova Scotia Department of Fisheries and Aquaculture's Inland Fisheries Division, Parks Canada assisted with a Smallmouth bass removal program in Cannon Lake, just outside Kejimkujik's boundary. Efforts began this year to assess options for long term protection of Kejimkujik's largest watershed, the Peskowesk system.

R. Baird

A volunteer angler prepares to release a freshly tagged trout

Monitoring

PROTECTING KEJIMKUJIK'S TROUT FISHING LEGACY

OBJECTIVES

- To monitor Kejimkujik watersheds that were deemed high risk for invasive fish introduction for evidence of invasive fish.
- To partner with MTRI, assisting Nova Scotia Department of Fisheries and Aquaculture's Inland Fisheries Division with a Smallmouth bass removal program in Cannon Lake.
- To systematically identify critical habitat for Brook trout within the park, including cold water refugia and spawning grounds.
- To establish an emergency response protocol for several watersheds in Kejimkujik should invasive fish be detected, with efforts focused in high risk watersheds.
- To evaluate long term methods of protecting the Peskowesk watershed from the threat of invasive fish.
- To collect data from park anglers through a newly developed information package and Angler Diary.

METHODS

- Invasive fish monitoring within Kejimkujik included minnow trapping, angling, fyke nets and Angler Diary results.
- Smallmouth bass informative posters were placed throughout the park to inform visitors of the threat and to help in species identification.
- Cannon Lake Smallmouth bass removals were carried out using a modified fyke net, angling, minnow trapping and electro-fishing boat. Each bass caught was measured for length, weight, sex and gut contents.
- Investigation into fish species composition in Peskowesk Brook began using angling, fyke-net and minnow trapping and engagement with volunteer anglers.
- Each park fishing license came with a newly developed information package and an Angler Diary to record effort and species caught. When the completed diary was returned anglers were given a commemorative crest.

M. Boddy, MTRI

Dissection of a large gravid female removed from Cannon Lake. The egg sac is indicated and a gut content inspection found a small White sucker

RESULTS

- No invasive fish were caught within Kejimkujik in 2015.
- The data from the 186 returned Angler Diaries provided an additional 1187 hours of recorded angling in the park with no reports of Smallmouth bass.

RESULTS
Continued

- A total of 210 bass were removed from Cannon Lake this year, which consisted of 30 young of the year, 98 male and 82 female (57 of which were gravid females that had yet to spawn) which should reduce overall population recruitment.
- Smallmouth bass from Cannon Lake had a mean length of 23 cm and mean weight of 237 g, with no significant differences in length or weight between male and female.
- Design options are being considered for an invasive fish barrier on Peskowesk Brook. This barrier would effectively protect the entire Peskowesk watershed (85 km^2), which accounts for almost a third of Kejimkujik's freshwater habitat.

YEARS OF DATA

- Year 2 of a 4 year project

PARTNERS

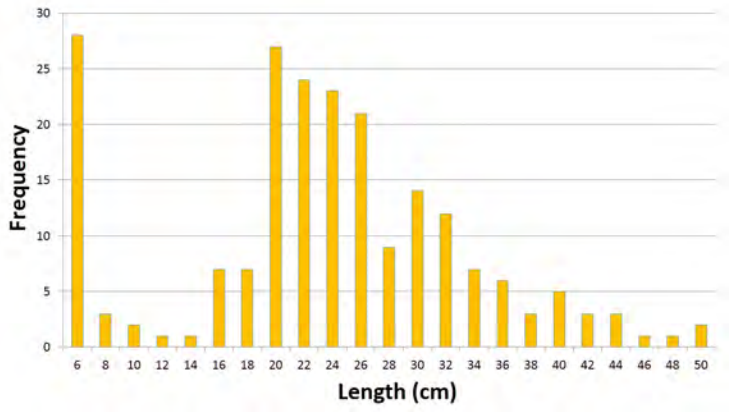
- Parks Canada
- Nova Scotia Department of Fisheries and Aquaculture's Inland Fisheries Division
- Kejimkujik's trout fishing volunteers
- Mersey Tobeatic Research Institute
- Department of Fisheries and Oceans Canada
- Acadia University
- Public Works and Government Services Canada

D. Reid, Parks Canada

Peskowesk Brook upstream from the bridge, where design options are being considered to protect the entire Peskowesk watershed

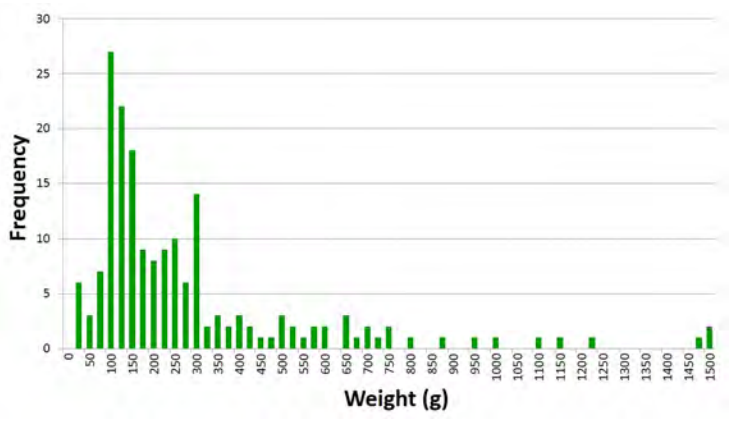
S. O'Grady, Parks Canada

Watershed map of the entire 85 km^2 Peskowesk system, including four of the largest lakes in Kejimkujik, including the only large clear lakes, Mountain and Cobrielle



D. Reid, Parks Canada

Length distribution of Smallmouth bass removed from Cannon Lake in 2015 (the spike at 6 cm comprises the 28 young of the year removed from the lake)



D. Reid, Parks Canada

Weight distribution of Smallmouth bass removed from Cannon Lake in 2015 (note that the young of the year were not weighed and are not included here)

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Rationale

The hydrological regime of a stream plays a critical role in determining the biodiversity and ecological processes of aquatic, wetland and riparian ecosystems. Stressors such as roads, dams, water diversions, deforestation, municipal development and climate change affect and alter hydrological processes. As a result, hydrological characteristics provide important information on the integrity of freshwater systems and how they may be changing over time. Critical parameters of hydrologic condition are assessed in five watersheds and used to monitor and report on the status and trends in stream flow at Kejimkujik.

Stream flow monitoring site on West River

Monitoring

STREAM FLOW MONITORING

OBJECTIVES

- To monitor the status and trends in stream flow in major transboundary watersheds at Kejimkujik.
- To determine if the Stream Flow Index is within the range of natural variation for major transboundary watersheds at Kejimkujik and if it is changing over time.

METHODS

- Stream flow was monitored at one site in each of the following five major transboundary watersheds at Kejimkujik: Mersey River, Little River, West River, Grafton Brook and Peskowesk Brook. The Mersey River site has been monitored by the Water Survey of Canada since 1968 and Parks Canada has been monitoring the other sites since 2008.
- A permanent stream gauging station was installed at each site, using an automated data logger to record a continuous record of water level.
- Measurements of water depth and stream flow were taken of a cross section of each stream periodically throughout the year to determine total discharge. Discharge measurements were done at a range of different water levels to define a rating curve for the relationship between water level and discharge for a given site.
- A time series of discharge data was generated from the measured water level data using the defined rating curve for each site.
- Historic discharge data from the Mersey River site were used to calculate five parameters selected to represent the critical characteristics of hydrologic processes.
- Thresholds for each parameter were established based on statistical variability in historical data from each site between 1968 and 1988 (*i.e.* the condition is good if it is within one standard deviation from the historic mean; the condition is poor if it is more than two standard deviations from the historic mean). Using the thresholds, each parameter was given a score for each year and the scores were averaged to obtain a Stream Flow Index value for the Mersey River for each year between 1989 and 2013.
- Thresholds for Mersey River (Mill Falls) were calculated

M. Smith measuring water velocity at Grafton Brook

Parks Canada

J. Eaton checks the placement of water level logger using survey equipment at Grafton Brook

METHODS
Continued

based on 1968-1988 while thresholds for Peskawesk and West River were calculated based on data collected 2009-2013. The data for Little River and Grafton Book were not analyzed at this time.

RESULTS

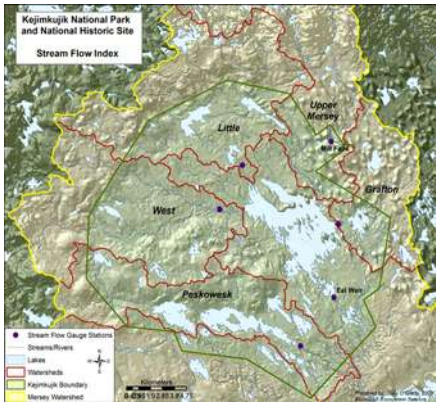
- Currently, a long-term dataset only exists for the Mersey River watershed (Mill Falls Station) which is in good condition (analysed up to 2012). Overall there is a declining trend in the Stream Flow Index between 1989 and 2012. More recent data will be acquired from Environment Canada to see if this trend has continued to the present.
- The Mersey River (Mill Falls Station) has experienced an increased frequency of high flow pulses since 1995. High flow pulses are defined as stream flow more than three times the median daily flow.
- Monitoring of the remaining four sites was initiated in 2008 and is ongoing. Site specific thresholds for Peskowesk and West River were assessed as good for the last year of sampling.

YEARS OF DATA

- Ongoing project since 1968 (Mill Falls and Eel Weir) with additional stations added in 2008

PARTNERS

- Parks Canada
- Water Survey of Canada, Environment Canada

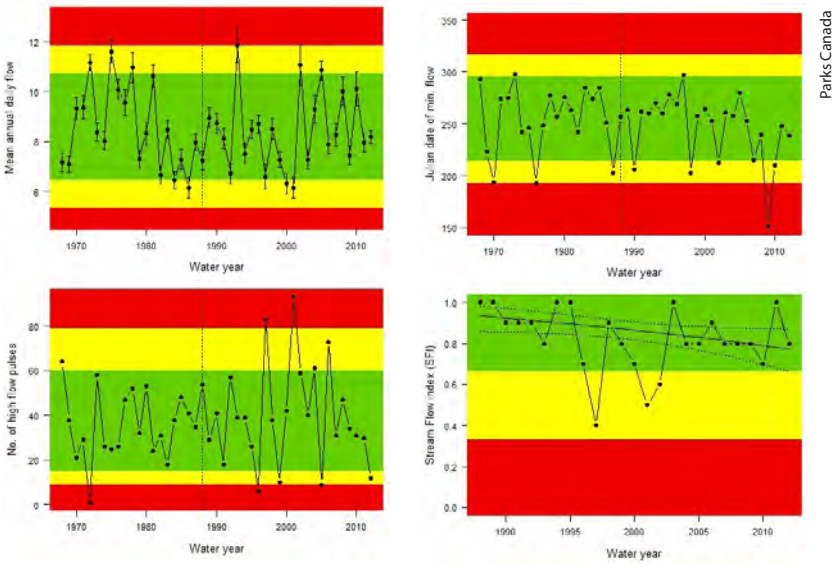


Parks Canada

Location of streammonitoring sites (blue dots) in five major trans-boundary watersheds (in red) at Kejimkujik

Parks Canada

Flood in 2010 at Grafton footbridge



Parks Canada

Stream Flow Index for Mersey River at Mill Falls 1965-2012

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Rationale

Monitoring benthic invertebrate communities has proven to be an accurate means of assessing aquatic health. These "bottom- living" organisms reflect the state of an aquatic ecosystem in a more comprehensive fashion than more traditional, one dimensional monitoring techniques. Benthic invertebrates are excellent biological indicators because they are abundant, relatively sedentary, long-lived (1-3 years) and sensitive to a variety of stressors. These characteristics allow them to mirror the conditions of their specific habitat and exhibit any environmental impacts that have occurred in the preceding weeks, months and even years. This type of long term monitoring plays a crucial role in honoring Kejimkujik's mandate to protect ecological integrity within the park. Although Kejimkujik can control events within its own boundaries, aquatic ecosystems are still vulnerable to transboundary impacts from adjacent land use, long range transportation of air pollutants and climate change. To this effect, benthic invertebrate monitoring serves as an early warning system to detect ecological distress and alert park management.

K. Rowter, Parks Canada

J. Eaton removes benthic invertebrates from the kick-net after sampling at West River

Monitoring

BENTHIC INVERTEBRATE MONITORING

OBJECTIVES

- To assess aquatic health in 22 representative streams at Kejimkujik.
- To determine how aquatic health of stream ecosystems is changing over time, as represented by the benthic macroinvertebrate communities.
- To contribute to Environment Canada's Canadian Aquatic Biomonitoring Network (CABIN) database.

METHODS

- Standard CABIN protocols were used which encompasses: site characterization, water chemistry analysis, reach characteristics, channel measurements, substrate characteristics and benthic invertebrate collection based on a standardized 3-minute kick-net sample.
- Benthic invertebrate identification to the lowest level possible by a qualified taxonomist.
- Data was entered into the national CABIN database.
- Data was analyzed and compared to results observed in 2005 and 2010 from identical sample locations to determine the current status and trends in stream ecosystems at Kejimkujik.

K. Rowter, Parks Canada

Benthic monitoring site at Duck Pond Brook

RESULTS

- Benthic invertebrates were sampled in 22 streams at Kejimkujijk in 2015, with sampling locations matching those from the 2005 and 2010 effort.
- Analysis was conducted on the 2010 data for species richness and result is that there has been no change in species richness from the benchmark 2005.
- Analysis is currently ongoing for the 2015 dataset.

YEARS OF DATA

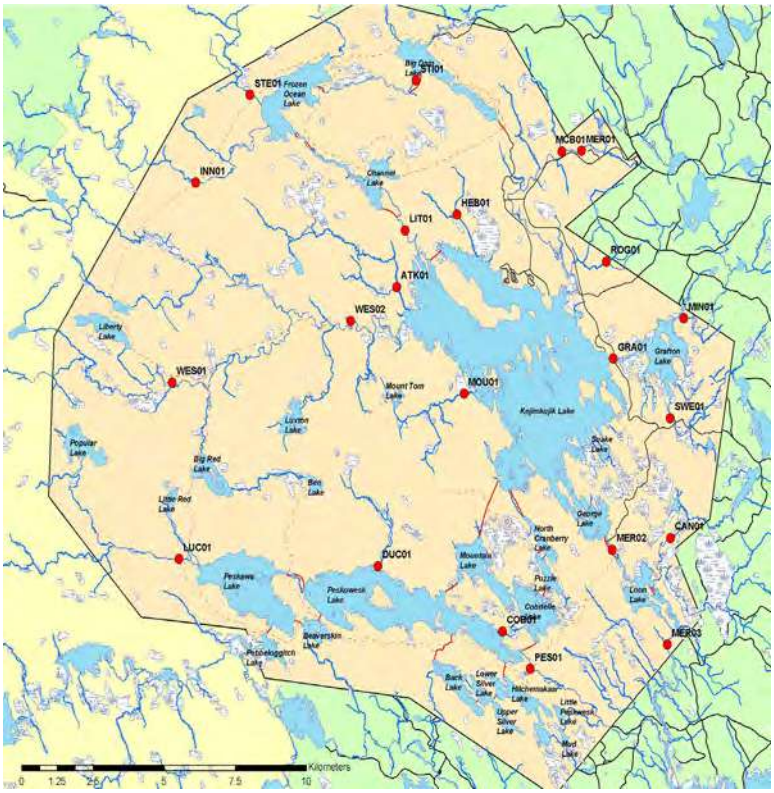
- Ongoing project since 2005
- The sampling frequency for this project is every 5 years

PARTNERS

- Parks Canada
- Environment Canada

K. Rowter, Parks Canada

J. Eaton measures stream velocity at the Stewart Brook monitoring site



S. O'Grady, Parks Canada

Benthic invertebrate monitoring sites (red dots) at Kejimkujik

Measure	Thresholds		
	Poor	Fair	Good
Species Richness	>2SD below mean	1-2SD below mean	<1SD below mean
EPT Index	>2SD below mean	1-2SD below mean	<1SD below mean
Community Structure	>30% of sites outside reference	10-30% of sites outside reference	<10% of sites outside reference

Parks Canada

Thresholds for measures of benthic invertebrate communities in Kejimkujik

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Rationale

Wood turtles, a species listed as Threatened both federally and provincially, are the most terrestrial freshwater turtle species in Canada. Studies throughout the Wood turtle's range have identified numerous threats to populations, including habitat destruction through development in riparian zones, agricultural activities, mortality of adults due to road traffic and the loss of nesting habitat. Research and monitoring of Wood turtle populations in Nova Scotia has focused largely on the Saint Mary's and Musquodoboit watersheds, providing a useful baseline of information for Wood turtle populations and ecology in watersheds with intensive agricultural land use. The Annapolis River watershed contains features consistent with high quality habitat, but observed distribution of wood turtles is patchy. Clean Annapolis River Project (CARP) collects data on wood turtle habitat and populations in the watershed, identities and mitigates threats through public education and engages the community in stewardship and conservation initiatives.

Red Rocket, August 9, 2015

Monitoring

WOOD TURTLE MONITORING AND STEWARDSHIP

OBJECTIVES

- To understand the ecological requirements, including habitat use, range, seasonal movements and breeding grounds of Wood turtles in the Annapolis River watershed.
- To recognize and address threats leading to population decline in the watershed.
- To educate communities in the watershed on Wood turtles and their importance.
- To involve community members in conservation efforts through volunteer field activities and creation of voluntary stewardship plans.

METHODS

- Locations along the Annapolis River and tributaries were identified as critical Wood turtle habitat, and visual surveys were conducted to locate Wood turtles. Observations were collected using the Blanding's Turtle Recovery Protocol.
- Radio transmitters were attached to selected Wood turtles, which were tracked weekly during the nesting season and bi-weekly thereafter through telemetry surveys. The final overwintering locations of radio tracked turtles were determined in November and December.
- Preferred nesting grounds were identified and monitored nightly by volunteers during Wood turtle nesting season (late May, June) to document the nesting process. Successfully laid nests were protected using a nest cover.
- Volunteers watched for hatchlings to emerge, starting three months post nesting, and data was collected on each hatchling according to the Blanding's Turtle Recovery Protocol.
- Volunteers were educated on Wood turtle habitat, river ecology and conservation initiatives.

RESULTS

- Eighteen turtles were observed through visual surveys, including four previously unrecorded turtles.

RESULTS
Continued

- Four nests were protected and monitored by volunteers with the following success:
- Nest 1 had 13 live hatchlings (of 13 eggs total), Nest 2 had 0 hatchlings (9 eggs containing dead embryos), Nest 3 had 1 hatchling (11 undeveloped eggs), Nest 4 had 7 hatchlings (3 undeveloped eggs).
- Four turtles were radio-tracked during the season.
- Five new stewardship plans were developed in collaboration with landowners/or managers.

YEARS OF DATA

- Ongoing since 2012

PARTNERS

- Clean Annapolis River Project
- Nova Scotia Habitat Conservation Fund
- Mersey Tobeatic Research Institute
- Acadia University

K. McLean, CARP

Field assistant S. Hannam and volunteer K. McClafferty measuring and weighing recently emerged hatchlings

J. McCamon, CARP

C. Spencer assisting on a field day with the Middleton High School O2 Class

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Photos on page 75, clockwise from top left:

- Eastern ribbonsnake, by J. McNeil, MTRI
- Blanding's turtle, by B. Toms, MTRI
- Turtle trap used for monitoring at Silver River, B. Toms, MTRI
- M. Heim and K. Dubois monitoring ACPF, MTRI
- Big Dam Lake, by A. Belliveau, ACCDC

Wetland sidebar photo: W. Pitts

WETLAND

Rationale

Atlantic Coastal Plain Flora (ACPF) is a unique group of unrelated plants that are mainly found along lake and rivershores, wetlands and saltmarshes in southwest Nova Scotia. Almost half of these species are listed as 'At Risk' or 'Sensitive' by the Nova Scotia General Status Ranks and some are globally rare. There are over 90 species of ACPF in Nova Scotia, including the Water-pennywort. Water-pennywort is a small plant with rounded, lobed green leaves. The leaves float like a lily pad in deep water and stand erect in shallow water or above the water line. This special plant is only found on three lakes in all of Canada. It is listed as 'Threatened' by the Species at Risk Act, 'Endangered' by the Nova Scotia Endangered Species Act and was recently re-assessed as 'Special Concern' by the COSEWIC. It is monitored annually by Kejimkujik staff and volunteers to assess its distribution and abundance on Kejimkujik and George lakes.

M. Crowley, Parks Canada

Water-pennywort

Monitoring

WATER-PENNYWORT MONITORING

OBJECTIVES

- To monitor Water-pennywort population abundance and density on Kejimkujik Lake.
- To assess water levels, stem height and percent damage within Water-pennywort stands.
- To survey Kejimkujik Lake to look for the establishment of new stands and for other rare ACPF.

METHODS

- Water-pennywort surveys were conducted annually on Kejimkujik and George lakes in early August.
- Surveys were conducted in both shoreline and aquatic habitats using transects to assess population abundance, density, stem height, water depth and percent damage of individual Water-pennywort ramets.
- Stand surface area was measured using a Global Positioning System (GPS).
- Extensive surveys were conducted every few years to search for new stands.

M. Crowley, Parks Canada

Water-pennywort monitoring

RESULTS

- Park staff and volunteers monitored Water-pennywort at eight sites in Kejimkujik in August 2015. This includes Ell Island and Mill Bay, which have not been monitored regularly in past years. A second survey was conducted on George Lake near the Eel Weir based on historical records, but no Water pennywort was located.
- The Mill Bay site perimeter was similar to previous years, while only four ramets were observed in one clump at Ell Island.
- There appears to be a correlation between water depth and the number of ramets observed at these sites, with higher numbers observed when water levels are low.
- Water-pennywort stand area and ramet density per stand fluctuate between years; however the Kejimkujik population appears to be stable.

YEARS OF DATA

- Ongoing project since 1999; initial population estimates for Water-pennywort were conducted in 1983

PARTNERS

- Parks Canada
- Atlantic Coastal Plain Flora Recovery Team
- Volunteers

M. Crowley, Parks Canada

Measuring water depth

M. Crowley, Parks Canada

Volunteers helping with monitoring effort

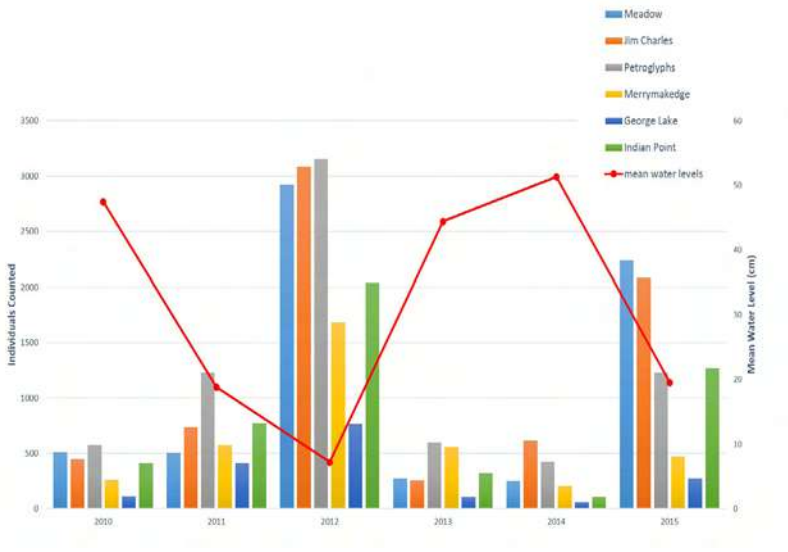
M. Crowley, Parks Canada

Quadrat at Water-pennywort monitoring site

Stand Name	2009	2010	2011	2012	2013	2014	2015
Merrymakedge Beach	1275	2711	2475	1964	1712	1123	1162
Georges	32	247	52	135	48	63	21
Indian Point	3286	3574	3788	3431	4745	2685	2725
Jim Charles	314	414	358	276	346	123	273
Meadow Beach	435	556	1452	925	1078	872	805
Petroglyphs	797	1701	1357	1488	1406	1098	746

Parks Canad

Estimated aerial extent (m^2) of Water pennywort stands at Kejimkujik



Parks Canada

Counts of Individual Water-pennywort ramets in relation to mean water levels observed for each year

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Rationale

Blanding's turtles in Nova Scotia exist in three small populations (Kejimkujik, McGowan Lake and Pleasant River) and a few smaller concentrations in southwest Nova Scotia. They 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. Raccoons are the primary nest predators and their populations may be unusually high in human inhabited areas (*i.e.* campgrounds and communities). Rates of predation of unprotected nests are variable but can reach 100%. An annual volunteer-based nest protection program was established in Kejimkujik and later expanded to populations outside Kejimkujik to engage the public in helping to protect and care for Blanding's turtle nests.

A newly emerged Blanding's turtle hatchling in Pleasant River

Research

BLANDING'S TURTLE NEST PROTECTION

OBJECTIVES

- To protect Blanding's turtle nests from predation in order to improve recruitment into the populations.
- To provide an opportunity for volunteers to engage in species at risk recovery.
- To collect long-term data on female survivorship and recruitment, clutch size, hatching success, site fidelity and nesting frequency.
- To locate previously unknown nesting areas.

METHODS

Nest protection (June):

- Known nesting sites were monitored on a nightly basis during nesting season. Surveys began in early evening and continued until approximately 10 pm if no turtles were seen or until the last turtle had left the site.
- One female at Pleasant River was radio tracked to locate her nesting site.
- Volunteers watched females go through the nesting process and recorded data on turtle identity, behaviour, 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.

Hatchling emergence (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.
- A subset of hatchlings in Kejimkujik was radio tracked upon emergence from the nest to locate habitats used throughout fall and winter.

The Blanding's turtle, Marjorie and her nest which is being protected from predators with a cage placed by dedicated volunteers after nesting

RESULTS

W. Pitts

A female Blanding's turtle, Emmalaine, laying her eggs

Nest Protection

- Nests were laid from June 13-July 3.
- Forty-five Blanding's turtle nests were located and protected.
- More than 80 volunteers contributed close to 2400 volunteer hours.
- Five young females were observed for the first time nesting or attempting to nest.
- A GPS logger attached to one young female showed that she traveled over 10 km to reach her nest site.

Hatchling emergence

- Hatchling emergence began on September 6.
- Over 330 hatchlings emerged from the protected nests.
- Emergence success varied by population with one population having only 47% success and the other two showing 81-86% success.
- In Kejimkujik, volunteers tracked nine hatchlings following emergence from the nest and were able to follow seven of those to their wintering sites. These seven have been enclosed in pens for the winter so that tracking can resume in spring.
- One hatchling from 2014 was tracked following spring emergence until July when it was eaten by a bullfrog, radio transmitter and all.

YEARS OF DATA

- Ongoing project since 1989 (Kejimkujik), 2000 (McGowan Lake) and 2002 (Pleasant River)

PARTNERS

- Parks Canada
- Mersey Tobeatic Research Institute
- Friends of Keji Cooporating Association
- Acadia University
- Blanding's Turtle Recovery Team
- Government of Canada through the federal Department of the Environment: Habitat Stewardship Program for Species at Risk
- Canadian Wildlife Federation
- Private donors

W. Pitts

Sandy, the Blanding's turtle's seven newly emerged hatchlings

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Rationale

Blanding's turtles in Nova Scotia are listed as Endangered under both the federal Species at Risk Act and the Nova Scotia Endangered Species Act. They occur in the southwest region of the province, but the extent of their range is not well understood. Until the mid 1990's, the only known population occured in Kejimkujik. Two new populations outside the park were discovered in 1996-7 and have been monitored regularly since their discovery. In 2006, volunteers Harold and Diane Clapp discovered a small concentration of Blanding's turtles in the Tobeatic Wilderness Area and in 2012 they discovered another concentration on the Medway River. This ongoing project employs researchers and volunteers to monitor known populations, learn more about newly discovered areas and follow up on public sighting reports to find new locations of Blanding's turtles.

J. McNeil, MTRI

Wilma's hatchling at McGowan Lake gravel pit

Research

BLANDING'S TURTLE DISTRIBUTION AND MONITORING

OBJECTIVES

- To conduct live-trapping and visual surveys in new areas to determine if Blanding's turtles are present.
- To radio track turtles found in new areas to determine seasonal habitat use.
- To conduct live-trapping and visual surveys in known populations to collect long-term data on survivorship, abundance and movement patterns of all age classes, including previously released head-started turtles.
- To provide an opportunity for volunteers to engage in species at risk recovery.
- To engage landowners in new occurence areas.
- To encourage new sighting reports from the public.

METHODS

M. Crowley, Parks Canada

Blanding's turtle monitoring in Kejimkujik

- Live-hoop traps were set by trained staff and volunteers and baited with canned sardines in soy oil. Traps were set in groups of 1 - 11 traps per site, depending on habitat size and configuration. Traps remained set for 2 - 4 nights and were checked daily.
- Visual surveys were conducted on foot or by canoe, occasionally with the aid of trained conservation canines.
- All new turtles captured were measured, weighed and photographed. They were given a unique code by notching the outer scutes of their shell and were released at the capture site.
- On selected turtles, radio transmitters were attached to the back of the shell using epoxy. Care was taken to ensure that the selected transmitter weight did not exceed 5% of the turtle's body weight.

RESULTS

Distribution surveys

- Four new areas were trapped for 122 trap nights, but no Blanding's turtles were captured through trapping.
- Two new Blanding's turtles were found on roads by local residents and MTRI volunteers. Both were near known populations, though not in established areas. One of these turtles, Lily, was outfitted with a radio transmitter and tracked throughout fall.

RESULTS
Continued

Monitoring known populations

- Monitoring was conducted at varying levels in each of the three known populations.
- 346 trap nights resulted in the capture of 39 individual Blanding's turtles including four new turtles.
- Forty additional turtles were captured during over 100 hours of visual and sniffer dog surveys.
- A total of 12 new turtles were found in the McGowan Lake population, all juveniles or young adults. This included the first young juveniles under age 5 found in the population.
- Five of the turtles caught in the Kejimkujik population were previously released headstarts; four were from the 2009-2010 cohorts and, now a mature young male, was was from the initial pilot program in 1994.

YEARS OF DATA

- Ongoing project since 1996

PARTNERS

- Mersey Tobeatic Research Institute
- Parks Canada
- Friends of Keji Cooporating Association
- Government of Canada through the federal Department of the Environment: Habitat Stewardship Program for Species at Risk
- Canadian Wildlife Federation
- Acadia University
- Blanding's Turtle Recovery Team
- Private donors

M. Crowley, Parks Canada

Volunteer at Kejimkujik helping with Blanding's turtle monitoring

M. Crowley, Parks Canada

Scooby Doo, the Blanding's turtle, found while monitoring in Kejimkujik

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Rationale

Eastern ribbonsnakes must find suitable underground sites to avoid freezing winter temperatures. However, it is not known if these sites typically occur within wetlands, at their edges or in adjacent terrestrial habitats. Knowing the characteristics of overwintering sites and their distance from the snake's summer wetlands is crucial for critical habitat identification, identifying threats and developing management plans for this species, which is listed as Threatened both federally and provincially. In winter 2009, the first known ribbonsnake overwintering area in a terrestrial habitat was identified in Nova Scotia and this site has been monitored annually since its discovery to document long-term use, number of snakes and site fidelity. Efforts continue to locate additional overwintering sites through systematic surveys of upland areas adjacent to known concentrations of ribbonsnakes.


W. Pitts

Eastern ribbonsnake

Research

EASTERN RIBBONSNAKE OVERWINTERING HABITATS

OBJECTIVES

- To monitor the one known overwintering site to document site use, snake abundance and site fidelity.
- To conduct surveys around known concentration sites in spring and fall to potential additional overwintering sites.

METHODS

- Surveys occurred primarily in the habitats around Grafton Lake, Kejimkujik. Surveys took place regularly from early April to early May and occasionally in October and November.
- Sites where snakes are found were revisited regularly to estimate the number of snakes using the site and the period of occupancy. Surrounding wetlands were visited occasionally during the active season to mark snakes and determine when they were moving.
- Surveys were conducted by experienced biologists and trained volunteers and were aided by conservation canines (dogs trained to identify ribbonsnakes by scent).
- Detailed data were recorded on search effort, weather conditions, geographic coordinates, habitat characteristics, snake behaviour and morphology.
- Attempts were made to capture all detected ribbonsnakes. Snakes were individually marked by ventral scale clipping. Snakes were measured, weighed, photographed and released at the capture site.


J. McNeil, MTRI

Eastern ribbonsnake fleeing across snow at McGowan Lake

RESULTS

- Spring emergence was delayed this year due to the heavy snow cover. The first snakes were found on April 20, three weeks later than the average over the previous five years.
- The first day of sightings included a snake that was travelling across the ice in a wetland.
- Snake presence was confirmed at both known overwintering sites near Grafton Lake in spring and fall, though the number of sightings was low (six snakes at Site 1 and four snakes at Site 2).
- At McGowan Lake, 13 sightings between April 20 and May 3 suggest another overwintering site near the edge of the wetland.

RESULTS
Continued

- In September, three sightings were reported on a road in West Caledonia, likely indicating a travel route between winter and summer locations.

YEARS OF DATA

- Ongoing project since 2009

PARTNERS

- Canadian Wildlife Federation
- Mersey Tobeatic Research Institute
- Parks Canada
- Acadia University
- Dalhousie University
- Eastern Ribbonsnake Recovery Team
- Government of Canada through the federal Department of the Environmment: Canada's Habitat Stewardship Program for Species at Risk

D. Clapp, MTRI

Conservation canine, Rosie, hard at work

W. Pitts

Eastern ribbonsnake in petroglyph area

J. McNeil, MTRI

Eastern ribbonsnake visual survey at Grafton Lake in Kejimkujik

J. McNeil, MTRI

Eastern ribbonsnake curled on sphagnum at McGowan Lake

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Rationale

The alien invasive fish species Smallmouth bass (recently documented within the Mersey River watershed less than 10 km from Peskowesk Brook), and Chain pickerel (known in an adjacent watershed) threaten Peskowesk Brook trout populations. Kejimkujik is thus exploring fish barrier options for Peskowesk Brook near the Peskowesk Brook bridge, in an attempt to preserve Brook trout above the bridge. Because this option may raise water levels up to 2 m and alter river shorelines that host rare Atlantic Coastal Plain Flora (ACPF), Atlantic Canada Conservation Data Centre (ACCDC) experts conducted a survey of the upper reaches of Peskowesk Brook to identify ACPF and other species that may be affected by the proposed barrier. The resulting data, maps, photographs, and report have been included in a detailed impact assessment being conducted by Parks Canada staff in collaboration with Public Works.

A. Belliveau, ACCDC

Species-rich brook shore wetland habitat

Research

ACPF ASSESSMENT ALONG UPPER PESKOWESK BROOK

OBJECTIVES

- To record information on ACPF species and communities, as well as all major ecosystems and other species that may also be affected by the fish barrier.
- To provide data, mapping, photos, and a report summarizing survey efforts and results.

METHODS

- Conducted fieldwork in and recorded data for all major habitat types present, with a focus on the brook shoreline.
- Recorded GPS track for approximately 6 hours of fieldwork and 4 km of on-foot travel.
- Compiled a full vascular plant species list for the surveyed area, with locations documented for first sightings of non-rare species, and all locations documented for rare species.

RESULTS

- Recorded 120 vascular plant species (118 native, 2 exotic), including two occurrences of the highly invasive Glossy buckthorn in wetland habitat.
- Documented 24 records of three provincially rare vascular plant species, all brook shoreline occurrences of ACPF species including Virginia meadow beauty, Redtop panic grass, and Round-leaved greenbrier.
- Mapped wetlands and described them according to hydrology, ecology and ACPF species richness.
- Identified two small patches of mature to old Eastern hemlock forest.
- Identified several bird species including the federally-listed Eastern wood-pewee.
- Noted a group of at least four North American river otter and a probable den located under the root mass of a half-fallen Red maple along the brook.

A. Belliveau, ACCDC

Glossy buckthorn in an ACPF wetland

YEARS OF DATA

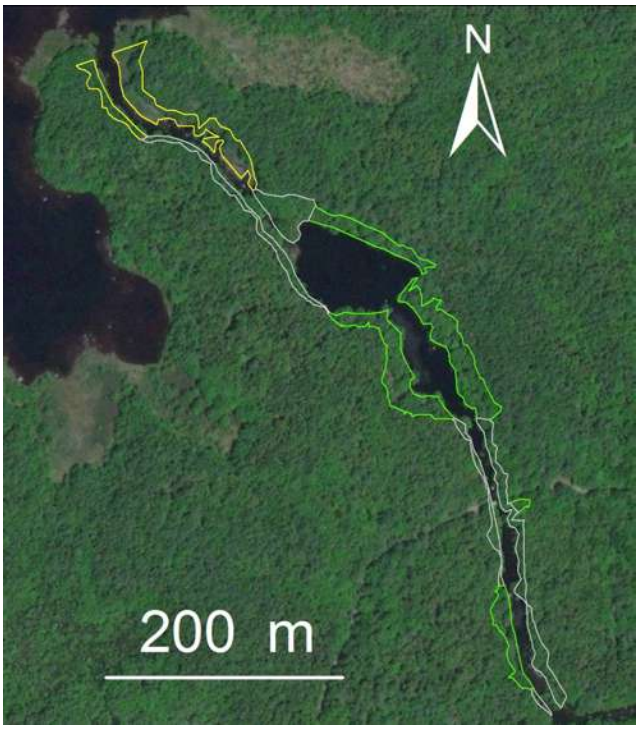
- Single year project

PARTNERS

- Atlantic Canada Conservation Data Centre
- Parks Canada

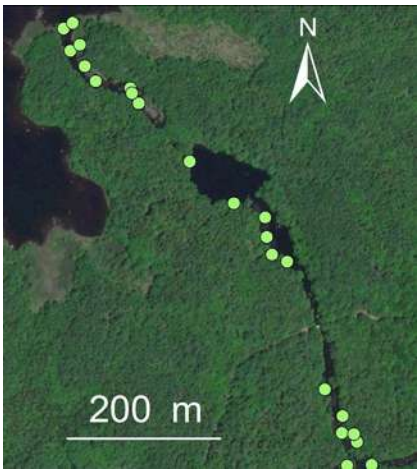
A. Belliveau, ACCDC

Virginia meadow beauty



A. Belliveau, ACCDC

Wetlands along Peskowesk Brook, including open graminoid wetland (yellow), forested peat wetland (green), and abruptly narrow shores (gray)



A. Belliveau, ACCDC

Provincially rare species locations along Peskowesk Brook

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Rationale

Forested wetlands are frequently impacted by forestry activities, watershed changes that alter their hydrology and urban and commercial projects that drain or fill these important habitats. Forested wetlands include shrub and treed swamps, bogs and fens and are among the most common wetlands in Nova Scotia. Despite their prevalence in the landscape, their significance in controlling and purifying water flowing through watersheds and the biodiversity they support, very little is known about their ecology here or what reflects a healthy condition. Developing an Index of Forested Wetland Integrity will help us to better understand key forested wetland bird species-habitat associations and refine priorities for conservation and management of these unique ecosystems.


M. Elderkin

Palm warblers were most commonly observed in shrubby peatlands

Research

INDEX OF FORESTED WETLAND INTEGRITY

OBJECTIVES

- To develop an Index of Forested Wetland Integrity using breeding bird communities.
- To determine which bird species are most responsive to landscape disturbance.
- To improve knowledge of forested wetland bird species habitat associations.
- To refine priorities for conservation and forest management based on results.

METHODS

- Wetland and forest inventory was used to identify potential field sites.
- Seventy-two forested wetlands (shrub swamps, treed swamps, shrub peatlands) were surveyed in 2015 using two 10 minute point counts per site between June 1 and July 3; six volunteer birders surveyed an additional 14 sites.
- Approximately even distribution of sites among wetland types and among the Western, Valley and Central Lowlands, and Fundy Shore Ecoregions.
- Characterized habitat at local (*e.g.* % canopy cover, stem density) and landscape (*e.g.* % land cover, fragmentation) scales for more than 50 variables.


J. Brazner, NSDNR

Red maple swamp along the North River Road near Aylesford Lake

RESULTS

- Only limited analysis has been completed to date, but results from the pilot study indicated that there are important differences in the bird communities among wetland types (*e.g.* shrub swamps had the highest species richness and abundance and treed swamps the lowest) and provided a sense of which species might be the best indicators for different wetland types (*e.g.* northern waterthrushes had a strong affinity for treed swamps, palm warblers for bogs).
- Eighty-four species of breeding birds were detected at the 86 sites surveyed in 2015.
- Several relatively rare species were not uncommon at our study sites (*e.g.* Canada warbler, Olive-sided flycatcher, Eastern

RESULTS
Continued

wood peewee) suggesting forested wetlands may be important refugia for certain at-risk species.

- We anticipate needing approximately 250 sites to have sufficient data to complete the full suite of analyses that are planned.

YEARS OF DATA

- Year 2 of a 5 year project

PARTNERS

- Nova Scotia Department of Natural Resources Wildlife Division and Regional Services
- Acadia University
- Parks Canada
- Atlantic Canada Conservation Data Center
- Volunteers

A. Westwood

Volunteers completed bird surveys at 14 forested wetlands in 2015

J. Brazner, NSDNR

Tall shrub bog along the Aylesford Road in Kings County

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Rationale

Big Meadow fen, Brier Island, was ditched half a century ago and has drained slowly ever since. As the fen dried, already rare plants including the Eastern mountain avens have become rarer while highly tolerant species such as those of the rose family have moved in. During the same period, Herring gulls and Great black-backed gulls began nesting in the dry, open spaces. The gull colony on Brier Island is now one of the largest in Atlantic Canada. With plans underway to re-wet Big Meadow fen, we aimed to collect baseline data on the movement and feeding patterns of the gulls currently nesting there. Understanding what drives local gull abundance is necessary for wildlife managers to mitigate the harmful effect of gulls on humans and other species, and also to protect gulls themselves as their species decline across the whole of eastern North America.

R. Owings

A Herring gull flies away from the intertidal zone

Research

BIG MEADOW GULLS

OBJECTIVES

- To describe spatial patterns in gull nesting in Big Meadow prior to fen restoration.
- To understand local gull movement and feeding behaviour so as to predict where they may relocate if displaced by fen restoration in the future.
- To monitor nest success and chick growth to quantify the baseline health of the Big Meadow sub-colony.

METHODS

- Three researchers standing arms' lengths apart, walked transect lines spaced every 30 m across Big Meadow fen. The clutch size of all gull nests within the transect line were recorded. A map was generated of total nests per transect line in order to delineate changes in nest density.
- Using basic drop traps, incubating Herring gulls were captured at their nests. Each adult with a field-readable colour band (red, blue, yellow or pink) and a federally issued metal band were marked. A backpack-style Global Positioning System (GPS) tracking device was attached. Blood and feather samples were taken for dietary isotope analysis.
- During the breeding season (May-Jul.), feeding sites as identified using the GPS data from tracking devices were visited. The number of gulls present at each site were counted and their feeding behaviour was described and recorded. Samples of all potential food items were collected for dietary isotope analysis.
- Hatch success and chick growth rates were recorded at a sample of nests. Sample feathers from 30-day-old chicks were taken for dietary isotope analysis.

A. Eno, Field Station archives

This gull chick wears a field-readable colour band and a federally issued metal band

RESULTS

- Gulls nested most densely in the drier interior of the bog where raspberry and spruce were also present.
- Gulls appear to rely predominately on anthropogenic sources of food, including fishery processing plants and agricultural lands. Gulls rarely flew offshore to open water during the nesting season. We hypothesize that this behaviour is due to the predictability and abundance of high quality food options at local anthropogenic sites.

RESULTS
Continued

- Gulls nesting in Big Meadow fen were in slightly better physical condition (high weight-to-size ratio) during incubation compared to gulls nesting at a nearby colony, Kent Island. Chicks in Big Meadow were also heavier than their Kent Island neighbours. These differences may partly explain why gulls have moved into Big Meadow while the size of other colonies has declined.

YEARS OF DATA

- Year 2 of a 2 year project

PARTNERS

- Environment Canada
- Nova Scotia Habitat Conservation Fund
- New Brunswick Wildlife Trust Fund
- University of New Brunswick
- Mersey Tobeatic Research Institute

S. Kramar

Researchers weigh gull chicks in Big Meadow fen

K. Shlepr, Google Earth

A sample of gull tracks captured by GPS devices

Z. Crysler

Hundreds of gulls congregate to feed at a fishery processing plant

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Rationale

The chemistry of the water in a peatland system is determined by two principal factors: the quality and quantity of the water coming into the system and the chemical transformation within the system itself. As a result, the quality and quantity of water in a wetland can be strongly influenced by many stressors, including land use change and forestry practices, infrastructure and road development, hydrological modification, acid deposition, the long-range transport of air pollutants and climate change. This project monitors water quality and quantity in peatlands (bogs) at Kejimkujik. The specific measures that are reported are a water quality index, based on the status of key wetland water quality parameters (i.e. pH, conductivity, salinity, phosphorous, nitrogen, potassium and calcium), and mean monthly water level. These water quality and quantity parameters affect the growth of plants and peatland communities, so changes in these parameters are indicative of significant changes in peatland communities.

M. Crowley, Parks Canada

K. Rowter collecting a water sample at Channel Lake wetland

Monitoring

WETLAND WATER QUALITY MONITORING IN KEJIMKUJIK

OBJECTIVES

- To determine if mean monthly water levels are within the range of natural variation for bogs at Kejimkujik and whether they have increased or decreased over the past five years.
- To determine if key water quality parameters (i.e. pH, conductivity, salinity, phosphorous, nitrogen, potassium and calcium) are within the range of natural variation for bogs at Kejimkujik and whether they have increased or decreased over the past five years.

METHODS

- Ten medium-large bogs, greater than or equal to 15 ha in surface area, were sampled for water quality and level at Kejimkujik.
- Wetland water quality and level were sampled in piezometers or small diameter observation wells, that were installed at each site.
- Water quality measurements were done in May and October using in-situ probes and through laboratory analysis of collected water samples.
- Water levels were measured manually in May and October as well as automatically through the use of Onset HOBO data loggers that record water level every 12 hours.
- The sampling frequency for this project is once annually for water quality and continuously for water level. Each site is visited twice annually to replace the data logger.

G. Turner

M. Crowley measuring water quality in-situ at Heber Meadows

RESULTS

- A preliminary examination of the data indicates that sub-measures have remained relatively stable over the past eight years, however there has been a steady decline in dissolved oxygen (DO). This may be the result of a natural cycle of senescence with increased Biological Oxygen Demand (BOD) as the wetlands age. BOD is a measure of the oxygen required for decomposition of organic matter and the oxidation of inorganics such as sulfide. BOD is introduced through natural biotic processes and surface runoff. If BOD is high, then DO

RESULTS
Continued

is low and BOD in wetlands can approach 100%. More research may be required to identify specific BOD trends within Kejimkujik wetlands.

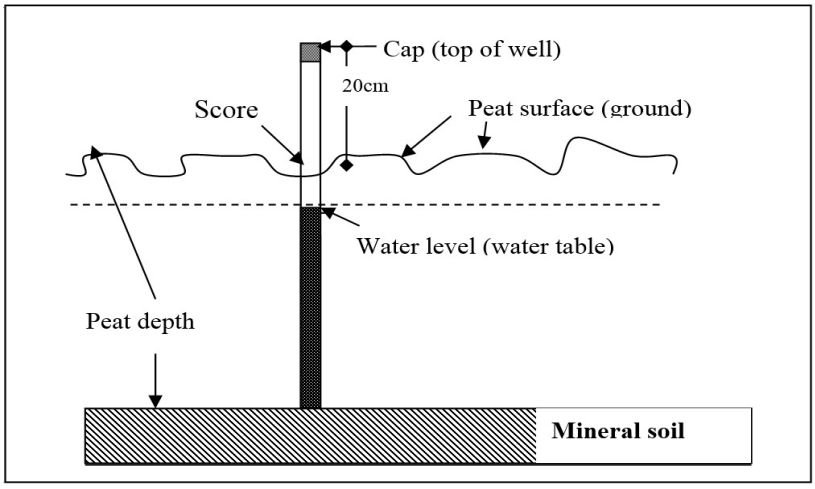
- Analysis is currently ongoing for 2015 water leveland water qualoty data.

YEARS OF DATA

- Ongoing project since 2008

PARTNERS

- Parks Canada
- Mersey Tobeatic Research Institute
- Environment Canada



Parks Canada

Piezometers installed in the peatlands are made of perforated PVC pipe and are used to collect water samples and record water quantity

Parks Canada

An aerial view of Atkins Meadow wetland

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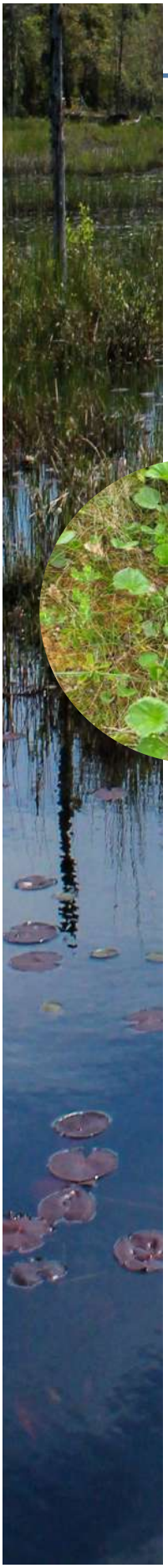


Rationale

The Eastern mountain avens, is a globally rare and endangered plant found mainly in coastal bogs in Digby County, Nova Scotia and high elevation alpine sites in New Hampshire. Habitat conditions of the Nova Scotian population range from pristine to degraded. Site impacts include former use as pasture, bog drainage, incursion of woody vegetation, presence of a large gull colony, roadside disturbance and all-terrain vehicle trails which are now mostly unused. Fungal endophytes are fungi or bacteria that live within living plant tissue without causing visible disease symptoms. Some are beneficial for plant growth and can offer protection against herbivory or pathogens through the chemical compounds they produce. They are known to colonize living plant tissue without presenting any symptoms of disease, and some species can provide benefits to their host plants. This project is investigating the biodiversity and potential ecological roles of foliar endophytes associated with this endangered plant, to aid in its recovery.

Eastern mountain avens

Research

ENDOPHYTE DIVERSITY OF EASTERN MOUNTAIN AVENS

OBJECTIVES

- To compare Eastern mountain avens foliar fungal endophyte diversity along a habitat disturbance gradient in Digby County, Nova Scotia.

METHODS

- Field collections of Eastern mountain avens leaves from five sites ranging from pristine to highly degraded (on Digby Neck and Brier Island.
- Leaf tissue subsamples were surface sterilized and plated onto two nutrient media types.
- Plates were incubated at 25 degrees Celcius until endophyte emergence.
- Pure cultures were obtained and preserved for each endophyte species.
- DNA was extracted and PCR amplification and fungal DNA barcoding were completed using Internal transcribed spacer (ITS) region of rDNA.
- Barcode sequences were identified by comparison to reference sequences in the National Center for Biotechnology Information GenBank database.

RESULTS

- There were 166 ITS barcodes generated, identifying 32 species within 21 genera, with a predominance of the fungal family *Gnomoniaceae (Sordariomycetes, Ascomycota)*. Site comparisons indicate differences in diversity of foliar fungal communities along the habitat disturbance gradient sampled; recovering sites had lower endophytic diversity (five to six species) than the reference pristine site (22 species).
- Eastern mountain avens foliar endophyte communities are diverse, and the condition of the habitat appears to impact the number and type of foliar endophytic species collected.

YEARS OF DATA

Single year project

PARTNERS

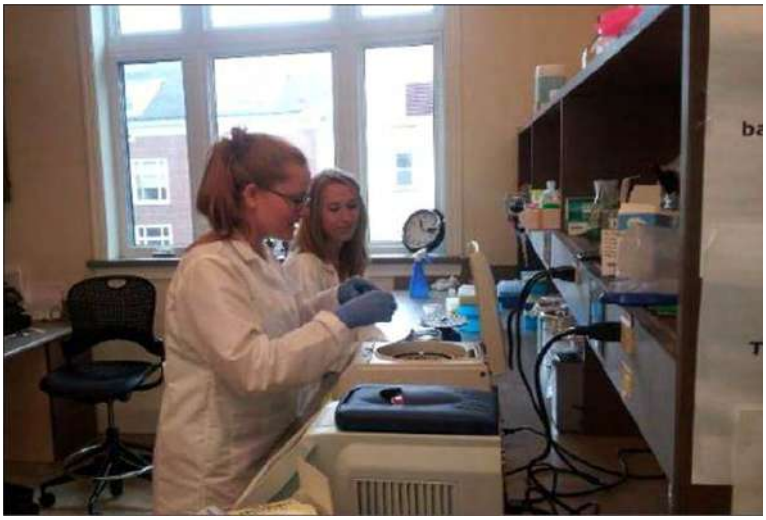
Nova Scotia Department of Natural Resources
Mersey Tobeatic Research Institute
Sage Environmental Fund
Nova Scotia Habitat Conservation Fund
Nova Scotia Museum Research Grant
Acadia University Honours Student Research Award
Arthur Irving Academy Scholarship

A. Walker, Acadia University

Petri dishes containing fungal endophyte cultures obtained from leaves of Eastern mountain avens

A. Walker, Acadia University

S. Adams and D. LaRue recording data during field collection



A. Walker, Acadia University

S. Adams and L. O'Halloran extracting endophyte DNA

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Rationale

Wetland vegetation composition is an important measure in monitoring the health of wetland ecosystems. The diversity of species and the proportions of species within the wetland are directly affected by the quantity and quality of water in the ecosystem, two other wetland ecosystem monitoring measures. These measures are subject to multiple stressors such as land use and atmospheric conditions. Therefore, changes to vegetative communities can indicate a negative impact from these stressors on the ecosystem. This project assesses changes in wetland vegetation through a similarity index that is applied to the data at each plot at regular five year sampling intervals. A greater than 75% similarity in vegetation communities compared over five year intervals indicates a stable ecosystem (high condition).

M. Smith, Parks Canada

Bog huckle berry with distinct pointy-tipped leaves

Monitoring

WETLAND VEGETATION MONITORING IN KEJIMKUJIK

OBJECTIVES

- To detect whether there has been a significant change (25% decrease in the similarity index) in peatland vegetation in bogs and fens over five years.

METHODS

- Ten large bogs, greater than or equal to 15 ha in surface area, were assessed for wetland vegetation at Kejimkujik in mid-summer.
- Wetland vegetation was assessed in two plots at each of the ten sites. Each plot comprises a 10x10 m tree plot containing two 5x5 m shrub plot and four 1x1 m vegetation plots.
- Percent vegetation cover and land cover were estimated in two plots at each site. Non-vascular plant identification was simplified in 2016 given the high level of expertise involved for proper species identification (*i.e.* sphagnum moss species were reduced to *Sphagnum* sp.).
- The sampling frequency for this project is slated to be once every five years - although the gap was six years for the first cycle.
- Ben Lake wetland plots were relocated following the first sampling periods and so therefore could not be compared between the two periods.

Parks Canada

K. Rowter at Channel Lake Trail wetland plot

RESULTS

- Wetland vegetation conditions are determined to be fair to good within Kejimkujik based on the similarity index applied to nine sites for 2009 and 2015. Overall the average similarity index was 78% indicating an overall condition of good.
- More analysis will be conducted to see what species have changed over time and to what degree.

YEARS OF DATA

- Ongoing project since 2009

PARTNERS

- Parks Canada

Parks Canada

Site marker at Still Brook vegetation monitoring plot

M. Smith, Parks Canada

D. Pouliot at Atkins wetland plot

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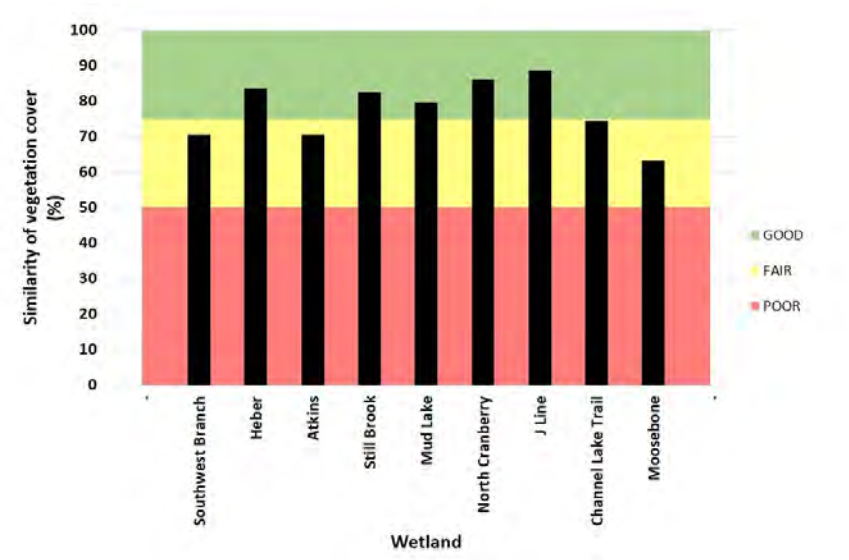


J. Eaton, Parks Canada

Wetland vegetation community health based on a comparison of vegetation cover in 2009 and 2015

J. Eaton, Parks Canada

D. Crossland and D. Pouliot at Mud Lake wetland plot

Rationale

The Canadian Wildlife Service annually flies aerial surveys of breeding waterfowl at predetermined locations across eastern Canada each spring. Surveys on selected 25 km^2 plots are flown using a single pass over all wetland habitats within plot boundaries. Survey results are used to ensure sustainable harvest of migratory gamebird resources (*i.e.* to set annual hunting regulations).

Bruce Pollard in helicopter conducting waterfowl survey

Monitoring

2015 EASTERN WATERFOWL SURVEYS

OBJECTIVES

- To complete aerial surveys in eastern Canada to provide an index of abundance for American black ducks and other migratory game and non-game species.
- To inform and ensure the sustainable harvest of migratory gamebird resources (*i.e.* to set annual hunting regulations).

METHODS

- In the Maritimes, a crew consisting of a pilot, a navigator/ observer and a second observer seated in the rear (opposite side as the front observer) recorded all waterfowl (and other wildlife) observed while on the plot.
- Surveys on selected 25 km^2 plots were typically flown at an altitude of between 15 m and 50 m above ground level, at a speed of between 15 to 50 knots (depending on habitat complexity) and are optimally surveyed between 09h00 and 16h00 daily.
- Survey protocols indicate a single pass over all wetland habitats within plot boundaries. Data from rotary-wing surveys are combined with data from fixed-wing surveys to generate composite estimates of abundance for commonly observed species.

RESULTS

- Surveys were completed in Kejimkujik on 30 April, 2015; the plot was flown between 12h35 and 13h20 (Atlantic Standard Time) for a total of 45 minutes spent on the plot.
- Surveys were flown with a Bell 206B helicopter owned by Vision Air Services (C-GGSX) equipped with bubble windows. At the time of the survey, wind speed was 15 knots, overcast cloud with light rain occurring for roughly 5% of the duration of the survey and temperatures of 3 degrees Celcius.
- A total of three species of birds were observed on the plot in 2015 including 2 unique pairs of American black ducks,

RESULTS
Continued

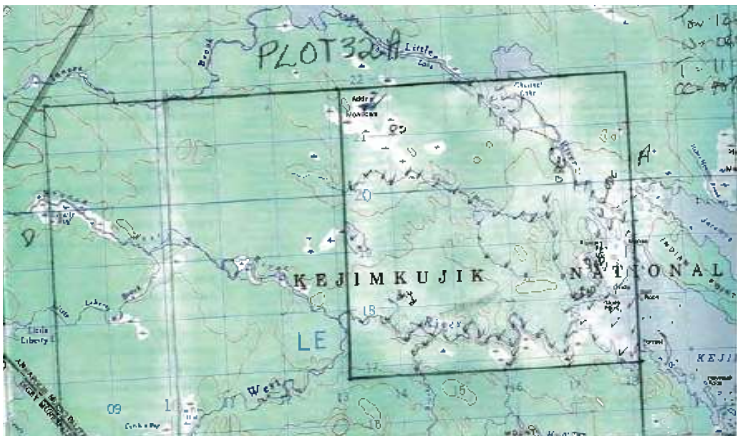
one pair of Hooded merganser, and one individual (sex not determined) Common loon. No mammalian species were observed during the survey.

YEARS OF DATA

- Ongoing project since 1990

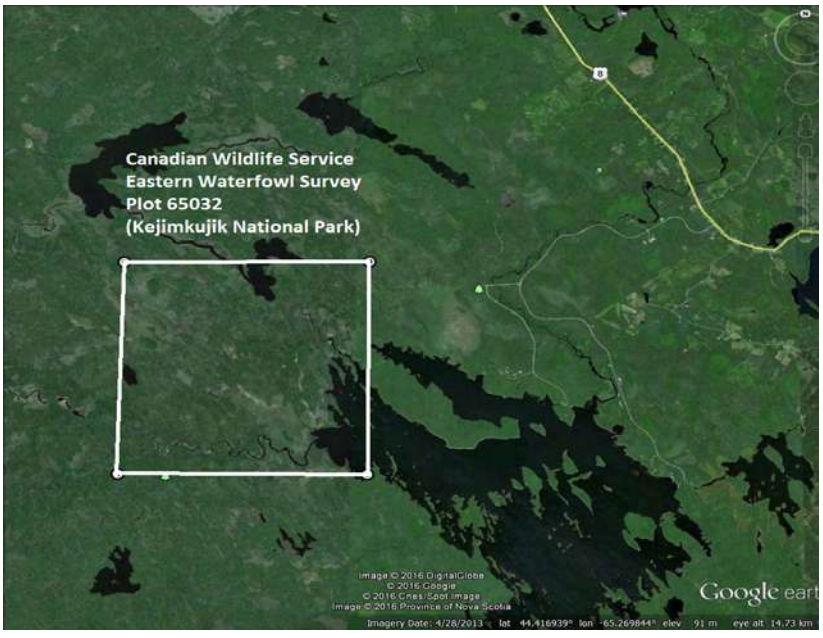
PARTNERS

- Environment and Climate Change Canada - Canadian Wildlife Service
- United States Department of the Interior - Fish & Wildlife Service



B. Pollard, Canadian Wildlife Servce

Field map from Canadian Wildlife aerial survey of Kejimkujik



B. Pollard, Canadian Wildlife Service

Google Earth image of the Kejimkujik aerial survey plot

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Photos on page 99, clockwise from top left:

- Bird hike 2015, by A. Lavers, MTRI
- Naturalist group at Kejimkujik, by Megan Crowley, Parks Canada
- Tree marking workshop, by J. Barker, MTRI
- Planting butterfly garden for senior, by C. Feltham, MTRI
- Monarch caterpiller on milkweed, by A. Lavers, MTRI

Human Dimensions sidebar photo: J. Reid

HUMAN DIMENSIONS

Rationale

The Monarch butterfly is a species that captivates a wide audience due to its life history and long distance migration. It is designated as a species of Special Concern under the federal Species at Risk Act, which means it is at risk of becoming Endangered if the threats to its population are not reversed. The Monarch butterfly is impacted by habitat loss, chemical and pesticide use and storms throughout its range. The milkweed plant is key habitat for the Monarch butterfly because the females only lay their eggs on milkweed and caterpillars only eat their leaves (no milkweed = no Monarch butterflies). In Nova Scotia, our native Monarch butterfly host is Swamp milkweed which grows along rivers and wet areas. The education, motivation and empowerment of individuals and communities to help this species are key to the recovery process.

Monarch caterpillar

Research

MONARCH BUTTERFLY STEWARDSHIP IN SNBR

OBJECTIVES

- To bring awareness about the Monarch butterfly to residents of the Southwest Nova Biosphere Reserve (SNBR) and vistitors of Kejimkujik and to promote the Butterfly Club, which encourages its members to create butterfly habitat by planting chemical-free butterfly gardens.
- To encourage Nova Scotians to create chemical-free butterfly gardens using Swamp milkweed to create breeding habitat for monarchs (directly engaging at least 200 gardeners as well as indirectly by partnering with commercial nurseries).
- To provide educational opportunities and first-hand experiences to witness the transformations of this species through an interactive display at the Kejimkujik Visitor Center.
- To contribute to monarch tagging and monitoring programs to assess population sizes, migration pathways, and staging areas.
- To conserve and enhance monarch breeding and nectaring habitat along roadsides where Common milkweed is growing in Annapolis Valley and elsewhere.

C. Jefferson

Monarch butterfly

METHODS

- Over 1000 native Swamp milkweed seeds were propagated in 2015 by MTRI, Nova Scotia Community College (NSCC), and other partners. Butterfly Club kits including two Swamp milkweed plants and educational information were sold at farmers' markets, public events, the Mersey Gift Shop in Kejimkijik and at MTRI's field station.
- Mass and social media were employed to advertise the Butterfly Club and recruit new members.
- Seniors in the North Queens area were contacted by direct mail with an offer to provide with free Swamp milkweed plants as well as planting services by MTRI staff and volunteers.
- Informative displays about monarchs, milkweed, native nectar plants, and chemical-free gardening were produced with input from three commercial nurseries in Nova Scotia.
- A working group was struck to continue discussions about the monarch program at MTRI and beyond.

METHODS
Continued

- MTRI partnered with agricultural and M'ikmaq communities to increase awareness of monarchs and to help increase habitat.

RESULTS

C. Feltham, MTRI

O. Thiebaut-Rizzoni a volunteer at MTRI from France and a local senior planting milkweed plants

MTRI

Swamp milkweed plants growing at MTRI

- In 2015 a record high 210 Butterfly Club members were recruited and more than 20 partnerships were created with organizations interested in recovering monarchs.
- Since it started, more than 1000 people have joined the Butterfly Club and planted Swamp milkweed at their homes, schools, community centres and businesses.
- Volunteers planted more than 1000 Swamp milkweed seeds this year at NSCC's horticulture program and at MTRI.
- In spring 2016, local commercial nurseries will promote habitat for monarchs by displaying signage developed by MTRI which demonstrates ways to create a chemical-free butterfly garden for monarchs.
- Eighty members of the Butterfly Club responded to an online survey and reported that on average, they now have double the number of milkweed stems that they started with. The majority (58%) reported that their milkweed was healthy, flowering, and growing well. Another 35% sought advice about some concerns they want to discuss.
- The numbers are up this year: there were at least 40 reports of adult monarchs and 49 caterpillars in the gardens of survey respondents.
- Many respondents identified other nectar plants available for butterflies in or near their gardens. Using a new online butterfly guide produced by Clean Annapolis River Project, many respondents also reported other butterfly species observed in their gardens.
- Efforts to increase monarch habitat in Nova Scotia may help migratory populations in Mexico. In 2014-2015 the extent of overwintering habitat increased from the all-time low (in 2013-2014) of 0.67 ha to 1.13 ha but there is still a lot of work to do across the species' range.

YEARS OF DATA

- Ongoing project since 2008

PARTNERS

- Parks Canada
- Friends of Keji Cooporating Association
- Mersey Tobeatic Research Institute
- Monarch Watch
- Nova Scotia Department of Seniors
- Government of Canada through the federal Department of the Environment: Habitat Stewardship Program for Species at Risk

L. Veinot, MTRI

Fourth Annual Butterfly Social gathering at Art of Germany B&B

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Rationale

The Southwest Nova Biosphere Reserve (SNBR) is one of Canada's "biodiversity hotspots". There are over 65 species at risk in the province and southwest Nova Scotia is home to over 80% of these plants and animals. Ecologists and Resouce Management Officers from Kejimkujik have partnered with MTRI and other organizations such as Mi'kmaq groups, schools, community groups, industry and all levels of government to help recover the species at risk that live in this special region. Their work is to learn about species at risk in the SNBR, share their knowledge with the public and engage and empower interested families and communities in monitoring and hands-on recovery actions for these species and the habitats that they depend on.

Atlantic Coastal Plain Flora Survey

Research

SPECIES AT RISK STEWARDSHIP IN SNBR

OBJECTIVES

- To promote environmental stewardship actions and advocacy and to create ambassadors for species at risk.
- To increase awareness and understanding within the general public about species at risk in the SNBR and generate sighting reports.
- To engage and involve Canadians in monitoring and hands-on recovery actions that help recover key species at risk including Blanding's turtle (Endangered), Eastern ribbonsnake (Threatened), Monarch butterfly (Special Concern), Piping plover (Endangered) and Atlantic Coastal Plain Flora.

METHODS

- Species at risk stewardship volunteer opportunities in the SNBR include: Blanding's turtle nesting monitoring, trapping, radio-tracking and visual surveys; Eastern ribbonsnake surveys; Piping plover monitoring and habitat restoration; Atlantic Coastal Plain Flora surveys; Butterfly Club gardening; water quality sampling; rare lichen surveys and more.
- Partnerships continue to be established with individuals and organizations that work with species at risk in Nova Scotia to enhance communication and collaboration and ultimately the recovery of species at risk in the SNBR.
- Outreach strategies were developed to link science and stewardship to achieve awareness and appreciation for species at risk.

Species at Risk Guide, 2nd Edition

RESULTS

- In 2015, over 260 volunteers contributed over 11,700 hours of their time toward environmental conservation in the SNBR. Since 2000, this is over 157,000 hours.
- At the 10th annual volunteer banquet in Nov 2015, approximately 100 people gathered to celebrate these achievements. There were three volunteers who moved from bronze to gold in the Kejimkujik Walk of Honour and two who were promoted to platinum.
- A Walk of Honour BBQ was held in June to celebrate the volunteers inducted at the 2014 banquet. The Walk of Honour is behind the Kejimkujik Visitor Center and recognizes the

RESULTS
Continued

volunteers who have cumulatively contributed volunteer hours reaching over 250 (bronze), 1000 (gold) or 2000 (platinum). Ethan and Wendy Whynot, Norma and Clifford Snair, Wesley Pitts, Greg Noddin, James Moores, Paul MacDonald, Sylvia and Art Hamilton, and Jean Douglas all added their stones to the bronze section of the walk. David Murray moved his stone from bronze to gold.

- The second edition of the Species at Risk in Nova Scotia Guide was printed this year through partnerships with Parks Canada, MTRI, Nova Scotia Department of Natural Resources and Environment Canada. Sixty-seven new species were added, including the marine species at risk found off of the coast of Nova Scotia.
- To learn more and keep informed about upcoming opportunities, visit the "Kejimkujik-Southwest Nova Volunteer Programs" Facebook page. Google "Volunteers in Action" on the Parks Canada YouTube Channel to view a slideshow video.

YEARS OF DATA

- Ongoing project since 2006

PARTNERS

- Parks Canada
- Friends of Keji Cooperating Association
- Mersey Tobeatic Research Institute
- Bear River First Nation
- Acadia First Nation
- Acadia University
- Dalhousie University
- Bird Studies Canada
- Southwest Nova Biosphere Reserve Association
- Government of Canada through the federal Department of the Environment: Habitat Stewardship Program for Species at Risk

M. Crowley, Parks Canada

Blanding's turtle volunteers in Kejimkujik 2015

M. Crowley, Parks Canada

Volunteers celebrating their efforts at the 2015 volunteer banquet

Bird Studies Canada

Bird Studies Canada Piping plover volunteer event

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Rationale

Since November 2009, MTRI has been promoting Forest Stewardship Council (FSC) certification of small woodland owners in Nova Scotia and providing training opportunities as a tool to achieve greater landowner engagement and to foster responsible forest stewardship on private land. In 2010, MTRI partnered with the Federation of Nova Scotia Woodland Owners (FNSWO) to facilitate affordable FSC certification for small private woodlot owners. Forest certification has been developing since the early 1990's as a response to public concern about unsustainable forest management systems around the world. It is a voluntary, market-based process developed to certify forest management practices to a set of globally recognized environmental, social and economic standards. In addition, in 2014, MTRI partnered with both the FNSWO and the Nova Scotia Woodlot Owners and Operators Association to organize field days led by experienced woodlot owner "mentors" as a part of a new joint Woodlot Management Mentorship Program.

S. Sheppard marking a tree at MTRI's tree marking workshop in November

Research

WOODLAND STEWARDSHIP PROGRAM

OBJECTIVES

- To continue to work collaboratively to promote FSC certification in the Southwest Nova Biosphere Reserve (SNBR) and facilitate the certification of small, privately-owned woodlots.
- To prioritize outreach, education and landowner training to increase sustainable forest management and to encourage diverse use of forest resources.
- To collaborate with other forest-based organizations to develop and improve landowner engagement tools and sustainable management incentives and mechanisms.

METHODS

- Surveyed owners of small privately-owned woodlots about preferred locations, costs and topics of training workshops.
- Provided a range of presentations, training courses and in-field workshops in southwest Nova Scotia to promote FSC certification and to encourage ecologically-based, sustainable forest management and diversification of woodlot use to a variety of audiences, including youth.
- Worked on a one-to-one basis with landowners to develop FSC compliant management plans and certify small privately owned woodlots.
- Collaborated with partners to explore new ideas and innovations in the forestry sector that support sustainable forest management.

An old wooden maple syrup spigot found at a Woodlot Mentorship Day held at D. Thomas' woodlot

RESULTS

- Four new woodlot owners joined our FSC Management pool. Several others have committed to, or expressed interest in, joining our Management pool and receiving a plan in 2016. The pool currently has 43 woodlot owners and a total of 8887 FSC certified acres.
- A woodlot mentorship field day was held at Dave Thomas' woodlot in North Range, Digby County. Twenty-eight people attended, 17 of which were new to MTRI Woodland membership events.
- A best management practices course was hosted at MTRI and had an attendance of 18.

RESULTS
Continued

- A tree marking workshop was hosted at MTRI, there were 11 people in attendance. The workshop consisted of a classroom session at MTRI followed by a field session where everyone involved had the opportunity to mark trees in a small mixedwood stand in West Caledonia.
- Approximately 120 people attended the annual Western Woodlands Conference in Saulnierville on March 7th.
- MTRI was present at the Kids in the Forest day, as well as the Western Woodland Owner of the Year day. The western regional award winner was for the Melanson woodlot owned and managed by Norman, Gary and Brian Melanson in Digby County.
- MTRI had representatives at the first annual Open Forest Day at the Maskwa Paddling Club in Halifax. This day was focussed on reaching out to urban dwellers who are also rural landowners, to encourage them to become

YEARS OF DATA

- Ongoing project since 2009

PARTNERS

- Nova Scotia Department of Natural Resources
- Federation of Nova Scotia Woodland Owners
- Nova Scotia Woodlot Owners and Operators Association
- Mersey Tobeatic Research Institute

MTRI

J. Crooker marking a tree at the tree marking workshop in November

MTRI

Participants of best management practices courses using angle gauges in a Red pine stand

J. Barker, MTRI

North Range Mill tour organized through the Woodlot Mentorship Program

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Rationale

In 1927, the Tobeatic Game Sanctuary was established containing approximately 200 square miles. The boundaries took in parts of four counties: Queens, Shelburne, Yarmouth and Digby. Cofan and seven other cabins were built around these boundaries to accommodate the Sanctuary Wardens. In 1968, the Tobeatic Game Sanctuary became the Tobeatic Wilderness Management Area and the need for patrol cabins no longer existed. Today, Cofan is one of a few remaining functional warden cabins still standing in the Tobeatic. It sits on an ancient transit route of the Mi' kmaq on the Shelburne Heritage River System and has been a popular stopping place for hundreds of wilderness adventurers since the early seventies. In 2010, a small group of paddlers expressed their concern about the deteriorating condition of the cabin. Cofan received a minimal amount of maintenance during the 1980's, but the structure was slowly sinking into the ground. Several of the bottom logs had rotted and the woodstove was becoming a safety hazard. With the help of private donations, MTRI and Nova Scotia Environment (NSE) have partnered to rehabilitate Cofan. The project used both volunteers and professional log builders and took two years to complete.

Monitoring

COFAN CABIN REHABILITATION PROJECT

A. Belliveau, ACCDC

Cofan Cabin in 2015 after rehabilitation efforts

OBJECTIVES

- To rehabilitate a culturally significant heritage cabin in the Tobeatic Wilderness Area.
- To provide a base camp for research and monitoring purposes.
- To provide a destination point, a stopover and a safe refuge for wilderness travellers in the Tobeatic as they journey through the Shelburne Heritage River System.

METHODS

- With the generous financial support of private donors, MTRI agreed to oversee the Cofan Cabin Rehabilitation Project in a joint partnership with NSE.
- A public consultation meeting was held and recommendations were implemented.
- A formal Management Agreement and Construction Plan was developed and approved by NSE.
- NSE and Nova Scotia Department of Natural Resources contributed staff and resources to help with the selection and cutting of Red pine logs on site in the spring of 2014. Signage was posted in and around the cabin to inform potential users of the temporary closure during rehabilitation.
- NSE and Nova Scotia Department of Natural Resources contributed staff and resources to help with the selection and cutting of Red pine logs on site in the spring of 2014. Signage was posted in and around the cabin to inform potential users of the temporary closure during rehabilitation.
- In September and October 2015, volunteers and log builders returned to Cofan and replaced the remaining rotten logs and installed new windows and a door. The roof rafters were reinforced and a metal roof was installed. A new CSA approved wood stove and chimney replaces the old stove and chimney.

A. Belliveau, ACCDC

Sign found in the Tobeatic Wilderness Area

RESULTS

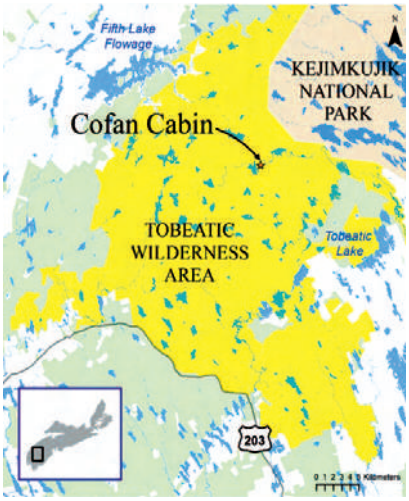
- The final phase of the rehabilitation project at Cofan has been completed. The cabin is now open for public use.
- MTRI will continue to act as stewards for Cofan Cabin. An annual inspection will be completed. Signage will be posted to encourage the public to respect the pack in pack out rule, and overall general cabin etiquette.
- MTRI will promote usage of the cabin and encourage paddlers to experience the remoteness and beauty of the Tobeatic Wilderness Protected Area.
- An interpretive panel will be erected, which will provide a brief history of the cabin and the surrounding area.

YEARS OF DATA

- Ongoing project since 2010

PARTNERS

- Mersey Tobeatic Research Institute
- Nova Scotia Environment
- Private donors
- Nova Scotia Department of Natural Resources



A. Belliveau, ACCDC

Location of Cofan Cabin in the Tobeatic Wilderness Area

S. Steele, NSE

Aerial view of Cofan Cabin's location on the Shelburne River

A. Belliveau, ACCDC

Volunteers in front of Cofan Cabin following the completion of rehabilitation

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Rationale

Bats have become increasingly at risk in Canada due to White-nose syndrome since it was first observed in New York in 2006. Since then it has spread through bat-to-bat contact, arriving in Nova Scotia in 2010/2011. White-nose syndrome is caused by Pseudogymnascus destructans, a fungus which invades the body of bats while they overwinter in caves. The fungal infection causes the bats to awaken and burn their fat stores resulting in death by starvation or hypothermia. In 2013, MTRI and the Nova Scotia Department of Natural Resources (NSDNR) collaborated to create www.batconservation.ca. The website consists of a web portal for reporting bats and also directs users to the rare species reporting hotline where they can also submit reports of bats.

L. Grant

Bat seen flying suring the daytime

Monitoring

PUBLIC REPORTING OF BATS IN NOVA SCOTIA

OBJECTIVES

- To advertise the bat conservation website and rare species reporting hotline to Nova Scotians.
- To raise awareness of White-nose syndrome and the decline of bat populations.
- To collect information on bats observed in Nova Scotia.

METHODS

- The website was re-launched in May 2014 and advertised widely in Nova Scotia. The site was closed to submissions October 31 2014 and all sightings were referred to Nova Scotia Department of Natural Resources after that date.
- Records were spatially proofed and phone call data were added to the online database.

RESULTS

- The website received over 11953 page views by 6396 unique visitors.
- There were 235 individuals who used the site to provide 259 records to the database.
- Bats were reported from each of the 18 counties in Nova Scotia.
- Bats were observed mostly as individuals and groups of less than five.
- The most common structures used were in descending order, houses (18), barns (11), bat boxes (6), trees (4), bridges (2).
- Reports of large concentrations of bats, nuisance bats and injured bats were forwarded to NSDNR.

H. Flemming

Bat reported in 2015

YEARS OF DATA

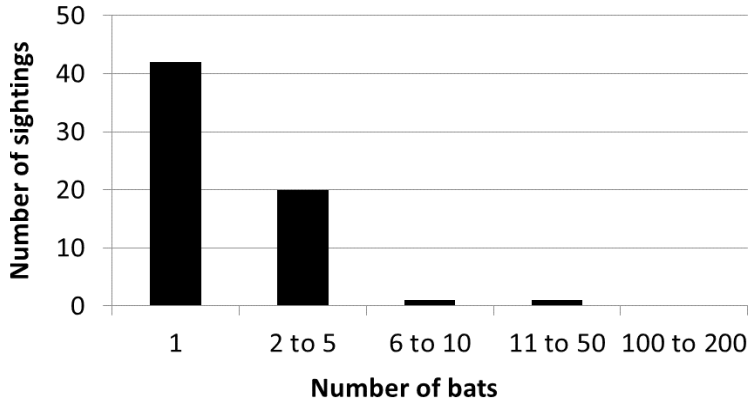
- Ongoing project since 2013

PARTNERS

- Nova Scotia Department of Natural Resources
- Mersey Tobeatic Research Institute
- Canadian Cooperative Wildlife Health Network

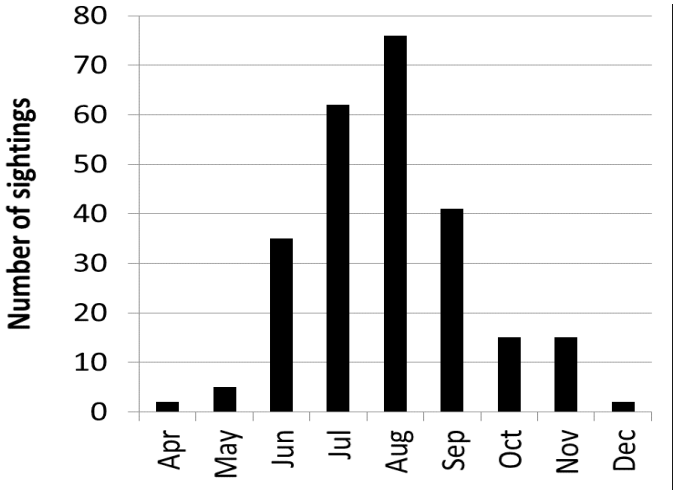
Unknown bat reporter

Silver haired bat reported in 2015



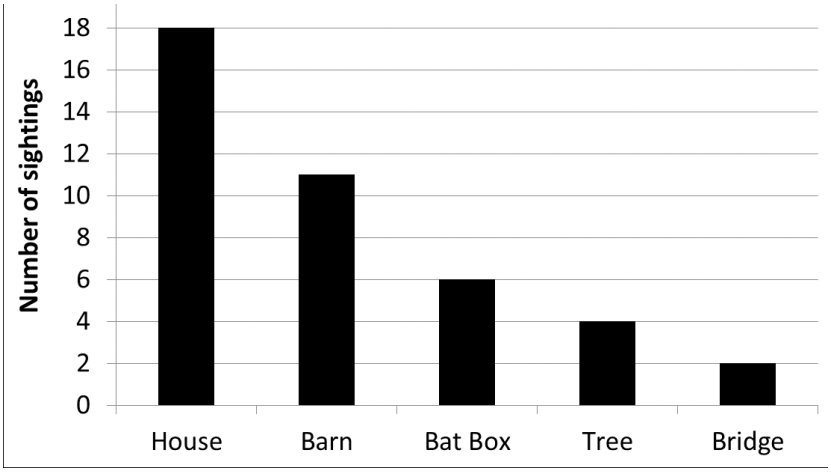
B. Toms, MTRI

Sightings by group size



B. Toms, MTRI

Sightings by month



B. Toms, MTRI

Sightings by structure

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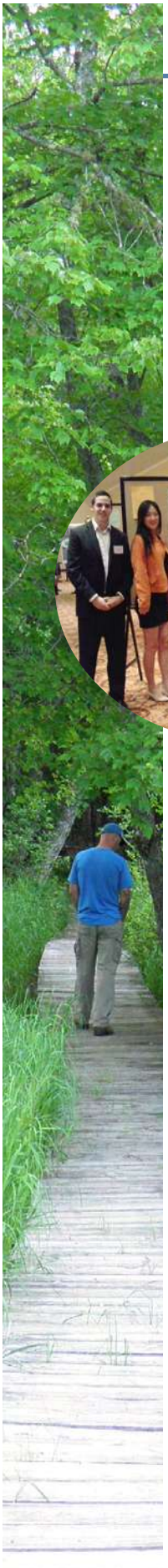


Rationale

This research project was the result of a joint effort between students in the Faculty of Management at Dalhousie University and the Mersey Tobeatic Research Institute (MTRI). The research provided an analysis of North American case studies in which innovation and diversification of wood products led to a successful rebound from recession in the forest industry. The case studies were then used to generate recommendations specific to Queens County for MTRI to use in guiding the region in their recovery from the closure of the Bowater Mersey Paper Company in 2012.

Dalhousie Management Without Borders team presenting their research findings at the Lord Nelson Hotel in Halifax

Research

BUILDING RESILIENCY IN QUEENS COUNTY, NS

OBJECTIVES

- To analyze case studies in which innovation and diversification of wood products was successful in helping communities in North America affected by recession in the forest industry.
- To help make recommendations to guide Queens County in its recovery from the closure of the Bowater Mersey mill in 2012.

METHODS

- Performed an environmental analysis that assessed the factors that shape the current forest industry.
- Completed a case study analysis that helped identify the best practices in communities recovering from a forest industry recession.
- Executed a feasibility analysis of the researched case studies to assess the best practices in the context of Queens County.

RESULTS

The researched best practices included:

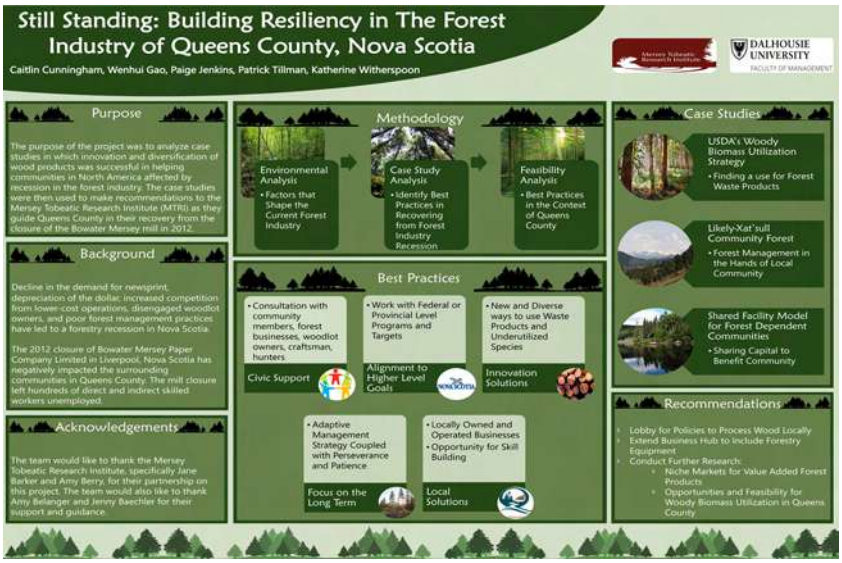
- Rallying civic support by establishing consultation with community members, forest businesses, woodlot owners, craftsmen, and hunters.
- Alignment with higher level goals by working with federal and provincial level programs.
- Provide innovative solutions through new and diverse ways to use waste products and under-utilized species.
- Focusing on the long term by using adaptive management strategies coupled with perseverance and patience.
- Provide local solutions by targeting locally owned and operated businesses, ultimately establishing an opportunity for skill building in the community.

YEARS OF DATA

- Single year project

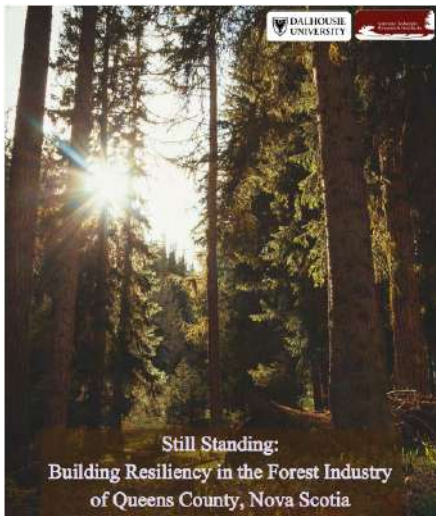
PARTNERS

- Dalhousie University
- Mersey Tobeatic Research Institute



Management Without Borders

Poster composed by MTRI's Managment Without Borders team at Dalhousie University



Management Without Borders

Final Report composed by MTRI's Managment Without Borders team at Dalhousie University

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Rationale

Parks Canada installed electrical services to campsites in the Jim Charles Loop at Jeremey's Bay Campground. The campground is located on the shore of Kejimkujik Lake. Numerous archaeological sites are known around the lakeshore including campsites, a large habitation site, petroglyphs and a burial site. The known sites attest to the Mi'kmaw occupancy of the area since time immemorial. As such, archaeological testing was required to determine if any cultural resources were present in the areas that were impacted by mechanical trenching for the electrical services. Parks Canada retained Kelman Heritage Consulting to conduct the archaeological testing program.

General view of study area

Research

ARCHAEOLOGICAL TESTING AT JIM CHARLES LOOP

OBJECTIVES

- To conduct archaeological testing to determine if buried cultural resources were present in the areas impacted by mechanical trenching during installation of buried electrical services at Jim Charles Loop.

METHODS

- Trench alignments where electrical infrastructure was installed were systematically shovel-tested at a 5 m interval prior to construction.
- Study area consisted of several main trench alignments, varying in length from 10 m to 50 m long.
- Shovel test pits, at least 40 cm wide, were excavated through the topsoil into sterile subsoil.
- Shovel test pits were primarily excavated using spade and shovel. In areas where hard, compacted gravels were present (road alignments/camp ground areas), a heavy iron pry-bar was used to break through the gravel.
- All soil removed from the test pits was screened through 6 mm hardware cloth to standardize artifact recovery, had they been present, in the excavated soils.
- Details of the archaeological testing program were documented in field notes, site plans, stratigraphic drawings and photographs.

Shovel testing site ST17

RESULTS

- Sixty-five shovel test pits were excavated along the trench alignments with none registering as positive for significant archaeological features, deposits or artifacts.
- Thirty of the shovel test pits displayed evidence of disturbance related to road and/or campsite construction. In these units, the gravel that comprises the current surface, overlaid either mixed, disturbed subsoil, or undisturbed sterile subsoil, with all traces of topsoil having been removed.
- The remainder of the shovel test pits did not show signs of disturbance.

RESULTS
Continued

- Sterile subsoil was typically encountered between 20 and 50 cm below the current surface.
- Very few modern items were recovered during the testing program. These included bottle caps, batteries, corks and various plastic wrappers/ containers. None of these items were considered archaeologically or historically significant.
- As a result of the archaeological shovel testing program, no further cultural resource management work was required for the overall project.

YEARS OF DATA

- Single Year Project

PARTNERS

- Kelman Heritage Consulting
- Parks Canada

D. Kelman

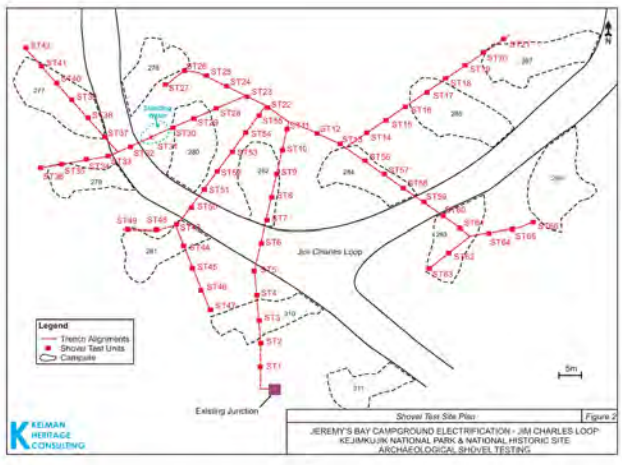
Example of undisturbed soil profile - ST24; west profile

D. Kelman

Example of disturbed soil profile - ST6; east profile

Parks Canada

Location of study area



D. Kelman

Shovel test locations

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APPENDIX I: 2015 PROJECTS IN KEJIMKUJIK AND THE GREATER KEJIMKUJIK ECOSYSTEM

	Kejimkujik	Greater Kejimkujik Ecosystem	Monitoring	Research
COASTAL				
Piping Plover Monitoring Program	X		X	
European Green Crab Coastal Monitoring	X		X	
Genetic Assessment of Green Crab Invasions	X			X
Eelgrass Coastal Monitoring and Recovery	X		X	
Monitoring the Health of the Annapolis River Estuary		X	X	
Foraging Ecology of Roseate Terns in Southwest NS		X		X
FOREST				
Forest Bird Monitoring in Kejimkujik	X		X	
Caledonia Christmas Bird Count	X	X	X	
McGowan Lake Chimney Swift Monitoring		X	X	
Jack Pine Budworm Population and Damage Assessments	X	X	X	
Boreal Felt Lichen Monitoring in Nova Scotia		X	X	
Relative Abundance of White-Tailed Deer in Kejimkujik	X		X	
Invasive Plant Monitoring and Restoration	X		X	
Plethodontid Salamander Monitoring	X		X	
Red Oak Regeneration in Mixedwood Stands	X	X		X
Old Forest Program	X	X		X
To Detect Presence of Cougar in Southwest NS	X	X		X
Migration and Habitat Use by Northern Saw-Whet Owls		X		X
FRESHWATER				
Increasing Shoreline Stewardship for ACPF Habitat	X	X	X	
Water Quality in ACPF Habitat		X	X	
Habitat Characteristics of ACPF		X		X
Community Based Monitoring and Management		X	X	
Lake Water Quality Monitoring in Kejimkujik	X		X	
Aquatic Connectivity in the Annapolis River Watershed		X	X	
Freshwater Inventory and Surveillance of Mercury	X			X
The Kejimkujik-Mersey LoonWatch Program	X	X	X	
Adult Survivorship of Common Loons	X	X		X
Protecting Kejimkujik's Trout Fishing Legacy	X		X	
Stream Flow Monitoring	X		X	
Benthic Invertebrate Monitoring	X		X	
Wood Turtle Monitoring and Stewardship		X	X	
WETLAND				
Water-Pennywort Monitoring	X		X	
Blanding's Turtle Nest Protection	X	X		X

	Kejimkujik	Greater Kejimkujik Ecosystem	Monitoring	Research
Blanding's Turtle Distribution and Monitoring	X	X		X
Eastern Ribbonsnake Overwintering Habitats	X	X		X
ACPF Assessment Along Upper Peskowesk Brook		X		X
Index of Forested Wetland Integrity		X		X
Big Meadow Gulls		X		X
Wetland Water Quality Monitoring in Kejimkujik	X		X	
Endophyte Diversity of Eastern Mountain Avens		X		X
Wetland Vegetation Monitoring		X		X
2015 Eastern Waterfowl Surveys	X		X	
HUMAN DIMENSIONS				
Monarch Butterfly Stewardship in SNBR	X	X		X
Species at Risk Stewardship in SNBR	X	X		X
Woodland Stewardship Program		X		X
Cofan Cabin Rehabilitation Project		X	X	
Public Reporting of Bats in Nova Scotia		X	X	
Building Resiliency in Southwest Nova Scotia		X		X
Archaeological Testing At Slapfoot Loop	X			X

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Annual Report of Research and Monitoring in the Greater Kejimkujik Ecosystem 2015

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