Annual Report of Research and Monitoring in the Greater Kejimkujik Ecosystem 2016

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Mersey Tobeatic Research Institute

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Cover Photos, clockwise from top left:
- Atlantic Coastal Plain Flora Sweet pepperbush on Mudflat Lake, NS, by L. Phinney
- T. Holmes Canoeing, by J. Headley
- NS coastal zone, by B. Caverhill
- L. Phinney and N. Nickerson with Loon nesting platform on Mudflat Lake, by C. Gray
- T. Holmes in old forest at Lake Torment in Queens County, by J. Headley

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Annual Report of Research and Monitoring in the Greater Kejimkujik Ecosystem 2016

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 2017 and is a compilation of the research and monitoring projects that were conducted in the Kejimkujik area in 2016 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.

Rationale

The European green crab, a marine invasive species and 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.

The larger male green crabs (>35mm) cause the most damage to eelgrass meadows in our estuaries (Parks Canada)

The highest ever green crab catch in one 'Russel' trap at Keji Seaside was 1,186 crabs! (Parks Canada)

Monitoring

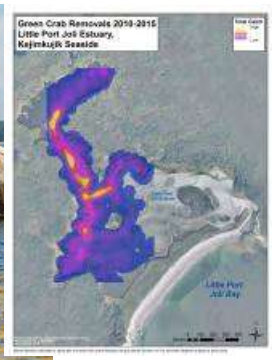
EUROPEAN GREEN CRAB COASTAL MONITORING

OBJECTIVES

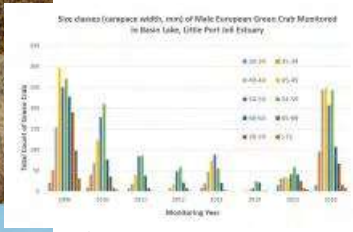
- To control impacts on native species by conducting green crab removal operations according to prescribed rates of catch per unit effort.
- In combination with other research and monitoring projects, assess the ecological consequences of overabundant green crab populations in Kejimkujik Seaside ecosystems.
- 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

- 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 bycatch and other pertinent data were recorded throughout all sampling investigations to determine population structure, distribution



European green crab removal hotspots for Little Port Joli Estuary from 2010-2015 (J. Woodruff)



Size classes of male European green crab monitored in Basin Lake, Little Port Joli Estuary (G. Beaulieu)

The width of the carapace is measured to determine the size of the crab. (Parks Canada)

RESULTS

- European green crab removal efforts in Little Port Joli Estuary were initiated in 2010 and efforts were expanded into St. Catherine's River Estuary in 2015. Initial monitoring at St. Catherine's River and Little Port Joli indicated similar green crab densities in both estuaries before removals began.
- Approximately 2 million green crabs have been removed from Kejimkujik Seaside estuaries. Size, sex ratios, distribution and trap location efficiencies have been determined and the proportion of larger males (most damaging to ecosystem) has declined in areas where the greatest removal efforts occurred in Little Port Joli Estuary.
- Overall green crab numbers continue to fluctuate as the recovered state of the upper reaches of Little Port Joli Estuary facilitates a new ecosystem equilibrium.
- Native species indicative of high quality marine habitat, including Atlantic silversides and Northern pipefish, have been observed more regularly and native crab species are now consistently being caught as bycatch and released.
- Results from this project have enabled ecosystem recovery projects (Eelgrass transplanting) to enhance native species populations and ecosystem processes.
- Green crab removal efforts peaked in 2014 and Parks Canada is now focusing on identifying the level of effort necessary to best mitigate the impacts of this invasive species in years to come.

YEARS OF DATA

- Ongoing project since 2009

PARTNERS

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

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Rationale

Eelgrass is the dominant seagrass species of marine ecosystems in Atlantic Canada. Eelgrass habitats offer important ecological services in coastal waters and this seagrass is often referred to as a 'keystone species' due to its ability to enhance biodiversity and productivity. 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. Eelgrass beds also provide nursery habitat for juvenile stages of fish and invertebrates and important feeding habitat for migrating waterfowl. 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.

Intact Eelgrass bed in Little Port Joli Estuary (L. Ross)

Monitoring

EELGRASS COASTAL MONITORING AND RECOVERY

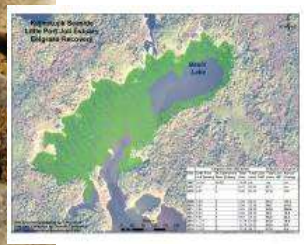
OBJECTIVES

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

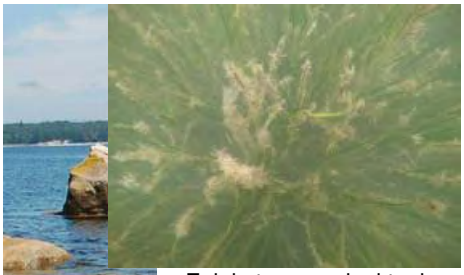
Preparing Eelgrass shoots for transplanting (L. Ross)

METHODS

- Suitable Eelgrass habitat at St. Catherine's River and Little Port Joli estuaries was 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 the edge of beds for later mapping and area determinations.
- An internationally recognized monitoring protocol was used to also measure eelgrass condition along transects established within Eelgrass beds including morphology, grazing, epiphyte load, wasting disease and water quality variables.
- Eelgrass transplanting occurred in the river section of Little Port Joli Estuary in 2016 and monitored for general condition and survival.



Extent of Eelgrass recovered in Little Port Joli Estuary (J. Woodruff)



Epiphytes are planktonic organisms like algae, bacteria and invertebrates that settle on eelgrass and contribute to the overall diversity of organisms in eelgrass meadows (G. Beaulieu)

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, a restoration rate of ~10% per year has consistently been observed at Little Port Joli Estuary.

- Using donor plugs from within the estuary, and with the assistance of volunteers, Eelgrass transplanting applied the 'steel washer' method and contributed over 700 plants to the spread of Eelgrass outside of the upper estuary at Little Port Joli. Keeping green crabs under control continues to facilitate Eelgrass recovery, and targeting areas near transplant locations was a priority in 2016.

- New Eelgrass beds were detected at St. Catherine's River Estuary in 2016, and total approximately 5m^2 in area.

- Future monitoring will continue to assess the success of green crab mitigations and transplant success on Eelgrass recovery at Kejimkujik Seaside.

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

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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 and Little Port Joli Beach at Kejimkujik Seaside. In the past 20 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.

E9, banded as a chick in Round Bay, Roseway NS in 2014, was a regular visitor to the Seaside as a single in 2016 (A. DiMarco)

Monitoring

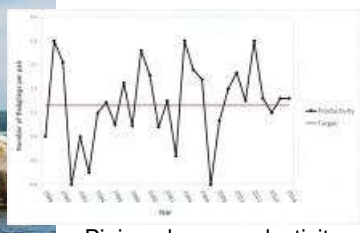
PIPING PLOVER MONITORING PROGRAM

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.
- To record observations of predators or evidence of predators.

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. Other observations, including predators, garbage and stewardship indicators were recorded.
- 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.



Piping plover productivity (chicks fledged/monitored pair) at the Kejimkujik Seaside from 1988-2016 (Parks Canada)

First nest to hatch at St. Catherine's River Beach in 2016 (A. DiMarco)

Volunteers finishing up a plover survey at St. Catherine's River Beach (L. Lawrence)

RESULTS

- As in previous years, St. Catherine's River Beach and Little Port Joli Beach at the Kejimkujik Seaside were surveyed in 2016 from May-August.
- At St. Catherine's River Beach, four Piping plover pairs, seven nests (three re-nests), fourteen chicks and nine fledglings were observed. At Little Port Joli, one pair and one unsuccessful nest was observed.
- Of the five pairs monitored at Kejimkujik Seaside, productivity was estimated at 2.25 chicks fledged/pair; fledgling success was 64.3%.
- This season, 5 volunteers assisted with Piping plover monitoring surveys totalling 67.5 hours. A Piping plover information day was held in July where staff educated over 50 park visitors about plovers and how to help in their recovery.
- No birds were banded in the summer of 2016, although E9, banded as a chick outside the park in 2014, was seen at the Seaside throughout the summer as a single plover on both Little Port Joli and St. Catherine's River beaches.

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

CONTACT

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Rationale

Salt marshes at Kejimkujik fringe both St. Catherine's River Basin and Little Port Joli Basin. The salt marsh surface, creeks and pannes provide spawning grounds, nursery habitat, shelter and food for many ocean fish and invertebrate species. Salt marshes also provide critical nesting and staging areas for several species of waterfowl and migratory shorebirds. They are extremely productive ecosystems; they subsidize marine food webs through the export of organic material and serve as carbon sinks through the accretion of salt marsh peat. Salt marshes improve surface water quality and mitigate eutrophication of nearshore waters by filtering, storing, diluting and detoxifying nutrients and pollutants. Finally, salt marshes help buffer coastal areas from storm and wave damage. The intention of long-term monitoring of salt marshes at Kejimkujik Seaside is to document changes or shifts in overall salt marsh extent that provide an early warning system to larger ecosystem threats or alterations.

Salt Marsh, Little Port Joli Estuary (C. McCarthy)

Monitoring

SALT MARSH EXTENT MONITORING

Salt Marsh Extent Monitoring (C. McCarthy)

Changes in Salt Marsh Extent, 2008 - 2016 (Parks Canada)

OBJECTIVES

- To detect long-term changes in salt marsh extent that are outside the normal range of variation.
- To provide insight into the causes of these changes.

METHODS

- Salt marsh extent was measured on each of the 21 permanent transects. The distance between the upland post and the marsh edge was measured by stretching a measuring tape from the upland edge of the upland post to the salt marsh edge along the compass bearing recorded for the transect.

RESULTS

- Between 2008 and 2013, the mean length of salt marsh transects decreased by 80 cm with a standard deviation of +/-128cm indicating that the rate of loss since 2008 was 16cm per year with a variability of 3cm.
- Between 2008 and 2016, the mean length of salt marsh transects decreased by 100cm with a standard deviation of +/-217cm indicating that the rate of loss since 2008 was 13cm per year with a variability of 2cm.
- Overall, salt marsh extent continues to decrease, however, the rate of loss is decreasing. It is important to note that there are some sites each year where the salt marsh extent is increasing.
- Salt marsh transects 5L-UP and 4L-UP saw the greatest decrease in length between 2008 and 2016, at -5.5m and -5.8m respectively.

Salt Marsh Monitoring Results (J. Woodruff)

YEARS OF DATA

-

PARTNERS

- Parks Canada

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Rationale

The rate of change in dune movement and morphology is assessed through geomorphological profiling. Surveyed profiles provide a cross-section of relief along nine permanent transects at Little Port Joli Beach for comparison of dune crest movement and morphological change. The measure for reporting on the status and trends in dune movement is a Barrier Beach Stability Index, comprised of rate of change in dune profiles and crest movement.

Little Port Joli Barrier Beach, Kejimkujik Seaside (G .Beaulieau)

Monitoring

BARRIER BEACH STABILITY MONITORING

OBJECTIVES

- To assess and detect changes in barrier beach stability, using a Barrier Beach Stability Index.

METHODS

- Along each transect, points for location and elevation were recorded using a total station at paced 10m intervals. Vegetation species were recorded as well.

- The entire edge of the dune crest was delineated in paced 10 metre intervals using a total station.

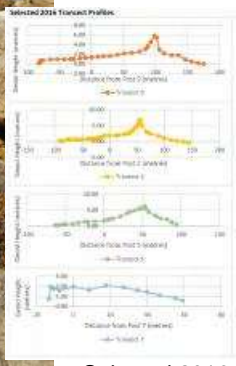
Total Station Measurements along Transects and Barrier Beach Crest (J. Woodruff)

RESULTS

- From 2008 to 2016, the crest of the Little Port Joli Barrier Beach moved landward an average of 4.7m, at an average rate of 0.6m/year.

- The volume of sand in the Little Port Joli Barrier Beach has increased by 44% from 2008 to 2016 and the tortuosity of the dune profiles has decreased by 23% during this time frame, indicating that the dune is smoothing. These measurements combine to give a Barrier Beach Vertical Stability Index of 0.11.

- When the Barrier Beach Vertical Stability Index (0.11) and the average crest movement are combined, the overall score for the Barrier Beach Stability Index is 0.10 which is within the acceptable threshold of 20% change over 10 years, indicating that the Barrier Beach Stability is currently unimpaired.



Selected 2016 Barrier Beach Transect Profiles (Parks Canada)

Using a total station to survey the Barrier Beach (J. Woodruff)

YEARS OF DATA

- 2008, 2009, 2011, 2016

PARTNERS

- Saint Mary's University Geography Department
- Parks Canada

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Rationale

Bank swallows are listed as Threatened by Committee on the Status of Endangered Wildlife in Canada, as the Canadian population has experienced a 98% decline over the past 40 years. Contributing factors to the decline of Bank swallows include habitat loss, destruction of nests during aggregate excavation, impacts of climate change, pesticide use affecting prey abundance and collision with vehicles. Like many species facing steep declines (bats, aerial insectivores) little inventory effort was put forth when the species was more abundant. While records exist for some colonies through the Maritime Breeding Bird Atlas, a greater number of sites have been identified through eBird and social media birding sites. This project conducted a thorough inventory of Bank swallow colonies by engaging birders, naturalists and the public at large. Site visits were carried out to document habitat characteristics and threats these colonies face. This baseline data can be used, if and when the species is listed to the Species at Risk Act. Protection of Bank swallow habitat and threat reduction will be essential for the future recovery of Bank swallows.

Bank swallows and their burrows in Pictou County, Nova Scotia (J. Headley)

Research

NOVA SCOTIA BANK SWALLOW HABITAT AND THREAT ASSESSMENT

OBJECTIVES

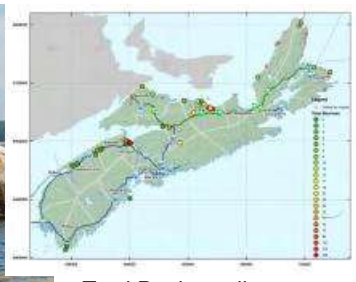
- To document inactive and active Bank swallow colony locations and habitat characteristics.
- To assess colony sites for threats.
- To raise the profile of Bank swallows in Nova Scotia.

METHODS

- Established a collective inventory on historic and current knowledge of Bank swallow sightings within the province using information from eBird, Maritime Breeding Bird Atlas, Maritimes Nest Record Scheme, Canadian Wildlife Service, the public and Nova Scotia Bird Society.
- Visually crossed referenced Bank swallow observations using GIS layers to find concentrations of sightings for site selection.
- Used existing Bank swallow survey protocols to develop one to fit the needs of this survey.
- Conducted site surveys and assessments from July to August, 2016.

Bank swallow burrows in a Kings County sandpit (J. Headley)

Observed Bank swallows in Nova Scotia (MTRI)



Total Bank swallow burrows in Nova Scotia colony sites (MTRI)

Presence of development in Nova Scotia Bank swallow colony locations (MTRI)

RESULTS

- Ninety six locations were visited and examined for Bank swallow activity, of these 45 were recently used or active colonies with assessments conducted, while the remaining 51 had no evidence of Bank swallows and no assessment performed.
- Of the 45 sites with an assessment conducted, approximately half (23/45) had Bank swallows present, while 37 had Bank swallows and/or burrows present.
- An inventory of the sites visited including information on location, habitat characteristics such as structure, burrows, vegetation and habitat type and photos was generated.
- Various forms of threats at the colony sites were documented including sheet erosion, gullies, overhang/undercuts, rill erosion, development, erosion control, human activity and predators.
- One hundred and forty-four volunteer hours were accumulated from individuals discussing their sightings, assisting with assessments, showing observers colony locations or even the observers giving their time to complete the surveys.

YEARS OF DATA

- Single year project

PARTNERS

- Habitat Stewardship Program
- Mersey Tobeatic Research Institute
- Nova Scotia Bird Society
- Environment Canada (CWS)
- Dalhousie University (Leonard Lab)

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Rationale

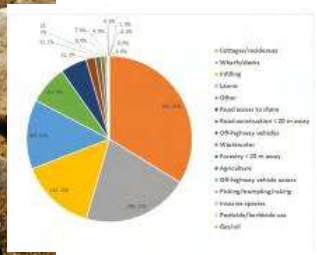
Atlantic coastal plain flora (ACPF) is a group of plants found along the low lying land of the Atlantic coastal plain. These plants are typically poor competitors against other plants and therefore they often thrive in the areas where other plants are not able to grow quickly. These are typically found 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.

Redroot, an at-risk ACPF found on 8 lakes in NS (MTRI)

Research

ATLANTIC COASTAL PLAIN FLORA THREATS AND EDUCATION ON HIGH PRIORITY LAKES

ACPF information sign put up in 2016 on Ponhook Lake (M. Heim)



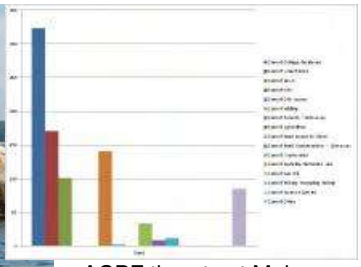
ACPF threats at the 36 "High Priority Lakes" (MTRI)

OBJECTIVES

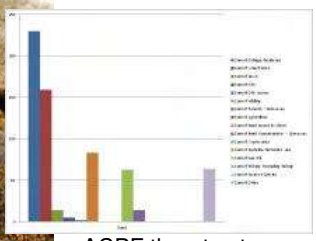
- To analyze the ACPF threats documented from 2010-2015 at 35 of the 36 “High Priority Lakes” in southwest Nova Scotia.
- To raise awareness about ACPF habitat and threats to ACPF.
- To present preliminary results from the five year ACPF project to community members, landowners on the “High Priority Lakes” and partners.

METHODS

- Graphically represented each category of threat found at the lakes including cottage/residence, wharf/dock, lawn, off-highway vehicle (OHV), OHV access, infilling, forestry less than 20 m away, agriculture, road access to shore, road construction less than 20 m away, wastewater, pesticide/herbicide use, gas/oil, picking/trampling/raking, invasive species and other (for example: beach, rock wall, fence, rock clearing, campsite, gazebo, fire pit, excavation).
- Analyzed the threat data for the most common threats found on each lake.
- Conducted door-to-door visits on two of the 36 “High Priority lakes” (Molega and Ponhook) to complete the outreach goals for the ACPF Atlas project.
- Educated homeowners about ACPF by handing out both the Atlantic Coastal Plain Flora in Nova Scotia Identification and Information guide and the Healthy Lakes and Wetland guide, demonstrated how to use the guides, highlighted at-risk plants on their lake and good stewardship practices to reduce threats to ACPF.
- Conducted presentations about ACPF, the status of the five-year project and good stewardship practices open to the public in Carleton and to the Greater Molega Lake Lot Owners Association.



ACPF threats at Molega Lake (MTRI)



ACPF threats at Ponhook Lake (MTRI)

RESULTS

- Completed the final project phase by conducting outreach visits at 259 homes on Molega and Ponhook Lakes over the course of July and August, 2016, of these 159 people were reached at 100 of the houses.
- Twelve people attended the Carleton ACPF presentation, mainly consisting of volunteers who had helped over the course of the project and were interested in being updated on the status of the project.
- Fifty-five people were present at the Greater Molega Lake Lot Owners Association presentation.
- The five most common threats on the 36 "High Priority Lakes" include 956 cottages/residences, 588 wharfs/docks, 415 infilling, 383 lawns and 214 other.

YEARS OF DATA

-

PARTNERS

- Habitat Stewardship Program
- Mersey Tobeatic Research Institute
- Nova Scotia Nature Trust
- Tusket River Environmental Protection Association
- Nature Conservancy Canada
- Dalhousie University

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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 across Nova Scotia, New Brunswick and Prince Edward Island to identify old forests on private and public land and to encourage landowners to steward theses special places and to restore old forests characteristics on their woodland since 2006. 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, coordinating a network and a science conference, reviewing regional policies and legislation, and educating the public about the importance of old forest and how they can be conserved and restored.

Moss covered Hemlock (J. Headley)

Research

OLD FOREST PROGRAM

OBJECTIVES

- To establish partnerships and build capacity with multiple organizations and stakeholders throughout the Maritimes.
- To collect field-truthed old forest data in geographic information systems (GIS) and the Old Forest Database.
- To host a Maritime-wide Old Forest Conference in order to engage and inspire scientists, researchers and the public of the value, restoration practices, and conservation efforts of the Acadian Forest.

MTRI staff member, Tarissa Holmes, measuring the diameter of an Eastern Hemlock. (J. Headley)

METHODS

- Used geographic information systems (GIS) to find areas of old growth forests in the Maritime provinces and map the current distributions of known old forests.
- Determined priority areas based on capacity of non-governmental organizations and paucity of field-truthed data.
- Measured old forests in priority areas and deposit data in new database.
- Encouraged stewardship of privately owned forests through outreach and education including social media.

MTRI staff member, Colin Gray, using a prism to determine the basal area factor of an old forest stand (J. Headley)

Using the Old Forest Scoring app to collect field data. (J. Headley)

Measuring the diameter of an Eastern Hemlock. (J. Headley)

RESULTS

- MTRI staff trained 49 people from 16 organizations to use the Old Forest Scoring app. A total of 17 sites have been scored in Nova Scotia, three in New Brunswick, and one in Prince Edward Island. The oldest tree aged was a Eastern hemlock, at roughly 417 years old, found at Toney Lake, Nova Scotia.

- An old forest database has been created to store all field data collected since 2006. In partnership with the Atlantic Canada Conservation Data Centre, a map was created to show field-truthed old forest sites in the Maritime provinces.

- The website (www.oldforests.ca) was developed to include a map, videos, a photo gallery, conference information, and resources for the public to further their knowledge of old growth. A team of students at Dalhousie University worked on the project's communication plan and conducted interviews with 455 people to understand factors that effect awareness about old forests. Work continued with Mi'kmaq elders to share stories about old forests.

- Over 100 Participants from Nova Scotia, New Brunswick and Prince Edward Island attended our multi-day Old Forest Science Conference in 2016. The conference topics ranged from research, monitoring and stewardship, First Nations perspectives, old forest associated species and policy analysis.

YEARS OF DATA

- Ongoing project since 2006

PARTNERS

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

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Rationale

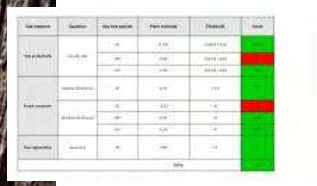
Kejimkujik is situated in the Acadian Forest region, a transition zone between more southerly species (e.g., maples, beech, oaks, pine and hemlock), and mostly coniferous species (e.g., spruces and balsam fir) of the boreal forest to the north. The Acadian Forest maintains itself through the process of gap dynamics – small openings in the forest created by insects, windthrow or general senescence of individual trees that are re-colonized largely by seedlings already occupying the understory. The assessment of trees and shrubs in permanently marked forest plots provides important information about the structure and composition of a forest and how it is changing over time.

Hemlock forest (M. Smith)

Monitoring

FOREST TREE GROWTH, REGENERATION AND SUCCESSION

Measuring a big hemlock at Big Dam site (Parks Canada)



Forest Tree Index for 2014 (Parks Canada)

OBJECTIVES

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

METHODS

- Tree growth, regeneration and succession were assessed at twelve long-term integrated forest plots that were established in 2004 in mixed and hemlock forests using a stratified random sampling design. The last year of data collection was 2014.
- Every five years marked trees within these plots are re-located and measured for Diameter at Breast Height (DBH). New trees are identified, enumerated and measured.
- Three submeasures were examined: 1) productivity- growth rate of mature trees, 2) forest succession- the change in dominance (basal area) of large trees, and 3) tree regeneration- basal area of small trees.
- Each submeasure was scored as poor, fair or good by comparing data to thresholds developed using historical data from forest plots across western Nova Scotia. The overall Forest Tree Index was calculated by combining the scores for each of these submeasures.

RESULTS

- Overall the status of the Forest Tree Index at Kejimkujik is currently good since productivity, forest succession and tree regeneration are all in the expected range.

- Red spruce dominance has declined since 2009, possible reasons for this decrease in dominance are unknown.

- White pine demonstrated growth rates that were higher than expected based on natural variation in the reference data for Nova Scotia.

YEARS OF DATA

- 15

PARTNERS

- Nova Scotia Department of Natural Resources

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Rationale

Glossy buckthorn (*Rhamnus frangula*) is an invasive alien species introduced to North America from Europe. It is now strongly established in the Southwest Nova Biosphere Reserve and Kejimkujik National Park and National Historic Site. It is listed as a Category 1 priority invasive plant in the park due to its ability to spread rapidly and dominate less shaded forest areas and wetlands. Since the presence of invasive plants are indicators of disturbance, pollution, climate change, and other ecological stressors, monitoring and controlling the abundance and distribution of this plant is in accordance with Parks Canada Agency's mandate to maintain ecological integrity.

Glossy buckthorn (M. Smith)

Research

GLOSSY BUCKTHORN REMOVAL AND MANAGEMENT

OBJECTIVES

- To reduce the footprint of adult Glossy buckthorn within Kejimkujik National Park by 25% each year between 2016-2019.
- To partner with Mersey Tobeatic Research Institute and other agencies on educating the public and local community about the impacts of Glossy buckthorn and management options.

Nova Scotia Community College (Bridgewater Campus) helping to remove Glossy buckthorn from Orde Stillwater (M. Smith)

METHODS

- Identify and map new and existing areas of Glossy buckthorn in Kejimkujik.
- Where possible pull smaller stems and seedlings by hand.
- Cut large stems of Glossy buckthorn and treat stumps with herbicide (stump-treatment of Roundup)- following Safe Work Practices and environmental assessment.

Historic Record of Glossy Buckthorn from 1972 from Cannon Brook Area. Misidentified as *Rhamnus alnifolia*.

Orde Stillwater picture taken by drone with Glossy buckthorn Area outline prior to removal (J. Woodruff)

RESULTS

- 5,969 saplings and seedlings were pulled in 2016- mostly in the forest nearby Orde Stillwater on the Upper Mersey River.
- Several large seed trees were cut at Minards Brook and Loon Lake.
- 22,000 m^2 area of adult Glossy buckthorn were removed and treated at the Orde Stillwater near the Kejimkujik Visitor Centre.
- Educational talk was given at Mersey Tobeatic Research Institute to 35 participants. Included a demonstration of different control techniques.
- Thirteen Nova Scotia Community College Students spent two days removing Glossy buckthorn with park staff at Orde Stillwater (a total of 130 person hours).
- Most Glossy buckthorn stems at Orde Stillwater were stump-treated with herbicide (Roundup) in the fall of 2016. The remaining stems will be freshly cut and treated in the summer of 2017.

YEARS OF DATA

- 1 of 4

PARTNERS

- Mersey Tobeatic Research Group
- Nova Scotia Community College- Natural Resources Program (Bridgewater)

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Rationale

Lichens are bioindicators of air quality, and have been used globally for monitoring air pollution for many years. Lichens obtain almost all their nutrients from the atmosphere. The lack of a cuticle allows them to readily uptake nutrients over the entire surface, and this makes them particularly sensitive to changes in their environment. As a result, lichens can provide an early warning for air pollution and acid rain impacts on forest ecosystems. Lichen species vary in their sensitivity to pollutants. Therefore, an understanding of the prevailing air quality in an area can be obtained by monitoring the assemblage and abundance of different species.

(D. Crossland)

Monitoring

LICHEN MONITORING

OBJECTIVES

- The objectives of monitoring park lichens were to determine whether: (i) the abundance of 50 field identifiable, pollution sensitive arboreal lichen species is decreasing over time in mixed forest ecosystems; and whether (ii) the overall lichen species richness is changing over time in mixed forests ecosystems at Kejimkujik.

METHODS

- Lichen species were surveyed at five year intervals at integrated forest plots in Red maple-Red oak-White pine stands at Kejimkujik National Park. Surveys were increased from six plots in 2006 to a total of 12 plots during 2011 and 2016.

Lichen Ladder being used to measure lichen abundance (D. Crossland)

- An Index of Air Purity was generated through recording the presence and abundance of 50 field-identifiable lichen species contained in permanent sampling quadrats (‘tree ladders’ consisting of five 10 X 10 cm cells that were vertically placed between 0.5-2 m on the North, South, East, and West sides of each trunk) on twelve Red maple trees at each forest plot.

- Lichen diversity was measured at each plot by recording all lichen species located on the lower boles of Red maple, Red oak and White pine trees (codominant trees), in addition to fallen tree branches (to assess canopy lichens).

Troy investigating a lichen (D. Crossland)

- Lichen diversity was measured at each plot by recording all lichen species located on the lower boles of Red maple, Red oak and White pine trees (codominant trees), in addition to fallen tree branches (to assess canopy lichens).

RESULTS

- The Index of Air Purity (IAP) showed consistent increases in the past five years across all forest plots in Kejimkujik.

- This may indicate an improvement in air quality and a reduction in acid rain. At some sites the IAP increased by 50 % or more, such as Still Brook (plot B), Channel Lake Trail (plot A), and Square Camp Brook (plot A).

- Some of the IAP increases may have been due to the continuing growth of lichens and increasing stand age, but some changes may also reflect differences in individual surveyors, or sampling error (e.g., tree ladders placed in slightly different locations).

- Lichen species richness ranged from 26 to 18 species at each plot. Among the most common macrophytic lichen species were *Cladonia* spp., *Hypogymnia physodes*, *Lobaria pulmonaria*, *Parmelia* spp. (*squarrosa*), *Pertusaria amara*, *Platismatia glauca*, and *L. quercizans*. The least common lichens inventoried were *Parmotrema crinitum*, *Ramalina americana*, *R. roesleri*, and *Tuckermanopsis* spp.

- A small increase in lichen species richness was detected over the 15 year monitoring period. Further analysis is required to determine statistical significance. Virtually all of the variation in species richness between survey years originated from canopy lichens found on fallen branches. Therefore, the increases recorded may not reflect changing stand conditions or better growing conditions for lichens.

YEARS OF DATA

- 10

PARTNERS

- Parks Canada
- Museum of Nature
- Mersey Tobeatic Research Group

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Rationale

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. Salamanders 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. In Kejimkujik, Eastern red-backed 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.

Red-backed salamander (M. Smith)

Monitoring

SALAMANDER MONITORING

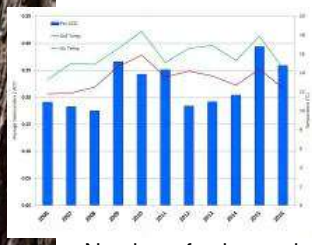
OBJECTIVES

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

Checking salamander boards (J. Reid)

METHODS

- Red-backed 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 4 weeks in mid-September to mid-October each year.
- At each plot, the number of salamanders observed under 40 thick wooden boards used as Artificial Cover Board (ACO) was counted and recorded. Though the monitoring focus was placed on Eastern red-backed salamanders, all other salamander species were recorded when present.
- The colour phase of the salamander is also recorded. Red-backed salamanders have 3 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.



Number of salamanders per Artificial Cover Object (ACO) including average soil and air temperature over all plots (Parks Canada)

RESULTS

- The average number of Eastern red-backed salamanders per artificial cover object (ACO) across all sites was 0.259. Although this is the 3rd highest value recorded since 2003, there was a reduction in the average number of salamanders per ACO from the 2015 values, however 2015 was the highest value recorded (0.294) since monitoring of salamanders began in 2003.

- Since monitoring of red-backed salamanders began in 2003, the salamander population has remained relatively stable in both the hemlock and mixed hardwood forest ecotypes. This indicates that possible environmental stressors are not affecting Red-backed salamander numbers in the Kejimkujik forest ecosystem.

- It appears the drought this summer in southwest Nova Scotia did not immediately affect salamander numbers, however it will be interesting to note in the next few years if this summer's drought will affect recruitment and overall numbers in the future.

YEARS OF DATA

- Ongoing project since 2003

PARTNERS

- Parks Canada

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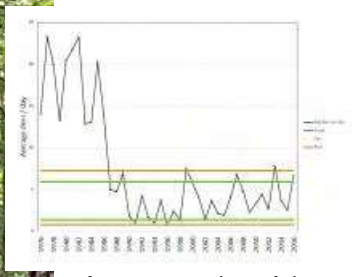
Rationale

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. 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 coyote and bobcat.

Female white tailed deer along the J-Line inside the park (J. Reid)

Monitoring

RELATIVE ABUNDANCE OF WHITE-TAILED DEER



Average number of deer observed along the roadside in Kejimkujik each morning of October, including thresholds for good, fair and poor indicator status (Parks Canada)

White-tailed deer feeding at the campground (M. Smith)

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 by the roadside population) is within the range of natural variation (i.e. between 1.4-5.9, 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 2015 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.

RESULTS

- The average number of deer seen per day in 2016 was 6.6, which places the indicator into a ‘fair’ condition, which differs from ‘good’, where the indicator had been for the last two years. It may be that the mild winter of 2015/16 is one of the contributing factors to the increase in numbers, as conversely the hard winter of 2014/15 likely resulted in the lower value seen last year (2.5 deer / day). The value of 6.6 deer / day is the fourth highest since 1986 and this rise in average deer per day value continues the ongoing cyclical relative deer abundance observed in Kejimkujik since 1976.

- 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 cannot find suitable browsing 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

- On going project since 1976

PARTNERS

- Parks Canada
- Department of Natural Resources

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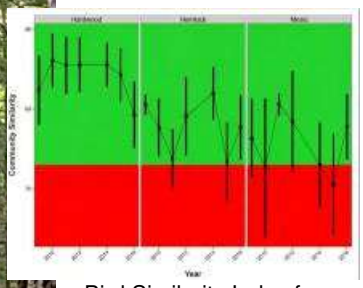
Rationale

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 each year during the spring reproductive season. Using both auditory and visual detections, point counts provide a tally of bird species and abundances. 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. Nova Scotia forests are also changing in response the climate change, increased wind storms, invasive species introductions and other stressors that may cause forest song bird populations to increase or decrease depending on habitat and food requirements of each bird species.

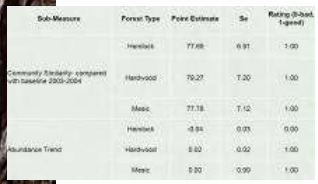
Hermit Warbler (D. Crossland)

Monitoring

FOREST BIRD MONITORING IN KEJIMKUJIK



Bird Similarity Index for hardwood, hemlock and mesic stands for Kejimkujik (Parks Canada)



Sub-Measure	Forest Type	Point Estimate	Se	Rating (0=bad, 1=good)
Community Similarity compared with baseline 2003-2004	Hemlock	77.68	6.91	1.00
	Hardwood	79.27	7.20	1.00
	Mesic	77.18	7.12	1.00
Abundance Trend	Hemlock	-0.04	0.03	0.00
	Hardwood	0.02	0.02	1.00
	Mesic	0.00	0.00	1.00

Estimates for community similarity and abundance trends for hemlock hardwood and mesic forests in Kejimkujik (Parks Canada)

OBJECTIVES

- To monitor trends in forest bird populations as an indicator of ecological integrity using point counts in mature stands of hardwood-dominated, hemlock-dominated, and mesic stands (white pine-dominated associations) 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 annually in mature forests on mesic sites (i.e., well-drained, fine to medium textured soils) consisting of three stand types: 1) hardwood-dominated, 2) hemlock-dominated, and 3) mesic (White pine-dominated associations) forests from 2003, 2004, and from 2009-2016.
- Twenty-two bird species were selected to monitor the three stand types. Focal birds were chosen that have strong associations with late-successional tree species with large structures (large diameter, tall heights) and closed canopies.
- 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.

- 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 and selecting the maximum number of bird pairs from either the first or second visit.

- A Community Similarity Index was generated to compare the similarities of the three focal bird species communities from the baseline years (2003-04) to later years.

- During some years, not all survey 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

- The Forest Bird Community Similarity Index indicated that the relative abundance of forest bird assemblages in both hemlock and hardwood stands have remained relatively stable and above the threshold of 73 %, (i.e., for which the condition of the community is assumed to be good and to be within the range of natural variability).

- The Forest Bird Abundance Data indicated a decline in the number of potential pairs in hemlock stands, no significant trend for mesic stands and a marginally significant trend for hardwood stands. More analysis will be conducted to investigate individual species trends in all stands.

YEARS OF DATA

- Current sites since 2008. Monitored every year.

PARTNERS

- Parks Canada
- Dalhousie University

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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 2014, MTRI partnered with both the FNSWO and the Nova Scotia Woodland 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.

Women in Forestry workshop participants learning about navigation (J. Barker)

Research

PRIVATE WOODLOT CERTIFICATION AND STEWARDSHIP PROGRAM

Women learning about machine harvesting at Women in Forestry workshop #3 (J. Barker)

2016 Western Woodlands Conference (J. Barker)

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 and education and landowner training to increase sustainable forest management and encourage diverse use of forest resources.
- To collaborate with other forest-based organizations to develop and improve landowner and sustainable management incentives and mechanisms.

METHODS

- Provided a range of training opportunities and in-field workshops in South West Nova Scotia to promote FSC certification and encourage ecologically-based, sustainable forest management and diversification of woodlot use, to a variety of audiences.
- 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, and support sustainable forestry initiatives on private and public land.
- Interviewed 19 landowners to find out more about their attitudes relating to machine harvesting and their "readiness" to engage in active management activities.

Woodland riparian zone
(J. Barker)

Women in forestry workshop #1 participants
(J. Barker)

RESULTS

- Through its connections with Bear River First Nation as an FSC certified pool member, MTRI's FSC certification group was invited for a day of learning in traditional Mi'kmaq knowledge at Stone Bear retreat. The day was attended by 11 certified woodlot owners, and was gave great insight and perspective to those who attended.

- Organized several workshops attended by over 100 people, including training on the Provincial Online Viewer and three unique and popular "Women in Forestry" workshops, as well as hosting our FSC pool Annual Gathering, and seminars forestry related seminars including invasive Glossy Buckthorn Control, lichens and wildlife.

- Two more woodlot owners joined our FSC Management pool. The pool currently has 44 woodlot owners and over 850 FSC certified acres.

- Worked with partners on the formation of the new Western Woodlot Services Cooperative, and on the unification of existing DNR supported FSC programs into the new Nova Scotia Private Woodland Certification Program.

- Provided support to the Forestry Lab and co-wrote and presented a report on the Western Private Land Contractor Capacity prototype.

- Supported and hosted booths at the western WOYA field day, Open Forest Day, and organized activities for the Kids in the Forest Day.

YEARS OF DATA

- Ongoing project since 2009

PARTNERS

- Nova Scotia Department of Natural Resources
- Federation of Nova Scotia Woodland Owners
- Nova Scotia Woodland Owners and Operators Association

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Rationale

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

Caledonia Christmas Bird Count 2016 (MTRI)

Monitoring

CALEDONIA CHRISTMAS BIRD COUNT

Whitebreasted nuthatch (J. Headley)

Purple finch (J. Headley)

OBJECTIVES

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

METHODS

- Annually, a one day Christmas Bird Count has been held between specific dates determined by the Audubon Society between mid-December and early January.
- The count was held on one specific day from midnight to midnight.
- The count has always been held in the same area: a circle of 24 kilometers diameter centered where a brook flows northward out of Donnellan Lake in West Caledonia.
- The coordinator organized volunteers to cover different areas so the maximum number of habitats 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.

RESULTS

- The 2016 Caledonia Bird Count occurred on December 18th when 28 species and 841 individual birds were observed. There was heavy rain and snow cover on the count date which limited volunteer participation.

- There were 58.5 hours spent observing at feeders and a total of 79.5 hours volunteered.

- There were 37 observers who participated this year, compared to 49 in 2015 and 31 in 2014.

- The total number of kilometers walked was 22.5 and driven was 31.

- Unusual birds sighted this year included the following: Northern goshawk, Red-winged blackbird and Snow bunting. Species observed during the week of the count, but not during the specific count day, were Northern harrier, Northern cardinal, Red-tailed hawk, Sharp-shinned hawk and Canadian goose.

YEARS OF DATA

- Ongoing project since 1991

PARTNERS

- Nova Scotia Bird Society
- Mersey Tobeatic Research Institute

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Rationale

The species composition of vegetation in forest ecosystems is an important measure of forest ecological integrity (EI). Forest species diversity is assessed from repeated sampling of forest vegetation in plots located in selected forest ecosystems. In addition to changes in native species richness, monitoring forest composition will also provide information on the colonization of forest plots by invasive species. Forest species diversity data also provide valuable information related to shifts in ecological processes and succession associated with local, regional and global factors.

Dry heathland barren ecosystem (A. Belliveau)

Monitoring

KEJI SEASIDE VEGETATION MONITORING FOLLOWING FIRE ON THE LANDSCAPE

OBJECTIVES

- To sample and compare long-term forest monitoring plots in Kejimkujik Seaside with 2007 baseline data on vascular plant and ground moss species composition and cover.
- To collect additional semi-quantitative data on species composition and occurrence for the ecosystems in which the plots are located.

METHODS

- Vegetation plots were assessed using a method adopted by Canadian National Vegetation Classification protocol. Ground species with their percent cover in each of seven possible layers on 20 x 20 m plots were recorded.
- Thirteen plots were burned in 2006, and 4 control plots were set outside the burn.
- A Local Ecosystem Floristic List (LEFL) was developed for each plot. All ground species that can be found in a homogenous stand of vegetation during an hour survey by a botanist were recorded.

Huckleberry, a dominant barren species, and cinnamon fern (A. Belliveau)

A. Belliveau standing in 20x20m plot while MTRI staff member, J. Barker, records species percent cover in 5x5m sub plot (A. Belliveau)

20x20m plot layout in mesic woodland habitat at the seaside barrens (A. Belliveau)

MTRI staff member, J. Barker, recording species percent cover in 5x5m plots (A. Belliveau)

RESULTS

- Plant lists were developed of late summer vascular plant species within the 15 forest monitoring plots representing three different ecosystems.
- In 2016, there was a total of 59 species of plants recorded for the 5x5 m plots including: 1 lichen, 1 moss, 57 vascular plant species.
- This is a decrease from 64 species in 2013 and 73 species in 2010.
- New species observed in 2016 include Atlantic sedge at two plots, American red raspberry at one plot, Balsam fir at one plot, Green alder at two plots, and Cow wheat at one plot. In 2013, the new species recorded compared to 2010 included Yellow birch in one plot, Three-toothed cinquefoil in one plot, Button sedge in two plots, Blue ridge sedge in three plots, Whorled-wood aster in one plot, Downy goldenrod in six plots, Foxberry in one plot and Virginia chain fern in one plot.
- No invasive plants were recorded in any year.
- Within the 5x5m the number of Red oak declined from 41 trees (average DBH 7.9 cm) in 2010 to 13 trees (average DBH 8.5 cm) in 2016, three of which were dead. The number of Red maple declined from 23 trees in 2010 (average DBH 7.9 cm) to three live trees (average DBH 12.9 cm) in 2016.
- Within the Dry Heathland and Mesic Woodland burned sites, there was a significantly higher plant species richness in 2010 compared to 2007. Within the burned 20 x 20 m plots, plant species richness was significantly higher in 2010, 2013, and 2016 compared to 2007 for the three plant communities. Highest species richness was always found in 2013.
- Although the analyses of the two scales provided different statistically significant results, they showed similar trends and successional stages (e.g., shrub cover increase and herb decrease in 2016) likely due to low sample sizes.

YEARS OF DATA

- 2007, 2010, 2013, 2016

PARTNERS

- Mersey Tobeatic Research Institute
- Nova Scotia Department of Natural Resources
- Parks Canada
- Nature Serve Canada

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Rationale

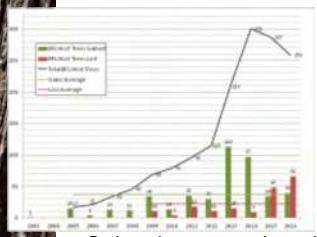
Boreal felt lichen and other rare lichens that inhabit coastal forests in Nova Scotia are at risk because of air pollution and habitat loss. Boreal felt lichen and other rare cyanolichens are difficult to detect and as a result the knowledge of their ranges and distributions is incomplete. Little is known about which sources of air pollution pose the greatest threats and at what levels. A GIS habitat algorithm was developed by the NS 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 Boreal felt 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 NS populations of Boreal felt lichen.

Slug on lichen (B. Toms)

Monitoring

BOREAL FELT LICHEN MONITORING IN NOVA SCOTIA

Boreal felt lichen (T. Neily)



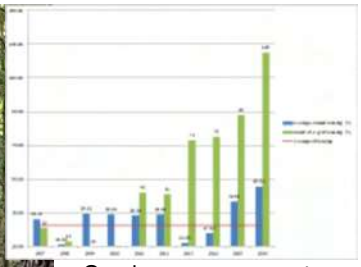
Gains, losses and total host trees of Boreal felt lichen in Nova Scotia 2003-2016 (MTRI)

OBJECTIVES

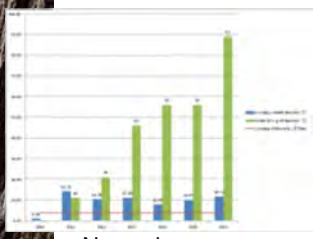
- To increase knowledge of habitat characteristics and severity of threats at Boreal felt lichen sites over time.
- To raise the profile of rare lichens in Nova Scotia.
- To find and protect Boreal felt lichen and other at risk lichen sites in Nova Scotia.

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.
- Worked with partner organizations to centrally curate all lichen location data.
- A workshop, taught by Frances Anderson was held in St. Peters, Cape Breton Island, Nova Scotia.



Grazing measurements (Percent Boreal felt lichen surface) 2007-2016 (MTRI)



Necrosis measurements (Percent Boreal felt lichen surface) 2010-2016 (MTRI)

RESULTS

- Four hundred and forty-three trees with Boreal felt lichen were discovered from 2005 to 2015 through this project and during the same time monitoring revealed 182 of those trees no longer contained Boreal felt lichen.
- In 2016, 39 new trees containing Boreal felt lichen were found.
- Monitoring occurred at 235 trees known to contain Boreal felt lichen. Sixty-six no longer hosted Boreal felt lichen and it was re-found at one site from which it had disappeared. This is the largest single year loss of Boreal felt lichen sites. The total Boreal felt lichen declined 14% from 2015-2016.
- Long term monitoring data for Grazing, Necrosis and Health were summarized.
- Twenty people attended the lichen workshop which consisted of lab and field time. One attendee used the skills they learned, dedicated the time to learning and mentoring and has since become a trusted lichenologist.

YEARS OF DATA

- Ongoing Project since 2007

PARTNERS

- Environment Canada
- Nova Scotia Department of Natural Resources
- Nova Scotia Department of Environment
- Port Hawksbury Paper
- Mersey Tobeatic Research Institute
- Northern Pulp
- Atlantic Canada Conservation Data Center

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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 Species at Risk Act (SARA) in 2008. 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 bring current monitoring in line with other Canadian programs. The result was the Maritime Swiftwatch program managed 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.

Swifts in Air (B. Toms)

Monitoring

MCGOWAN LAKE CHIMNEY SWIFT MONITORING

Interior of McGowan smithy building (T. Holmes)

Counting swifts at McGowan Lake (B. Toms)

OBJECTIVES

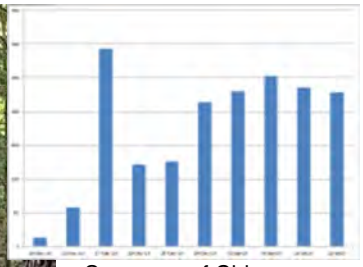
- To conduct counts at the McGowan Lake roost site on standardized dates and other dates during migration and nesting seasons.
- To introduce new volunteers to Chimney swift monitoring to expand the base of available volunteers.
- To increase awareness of Chimney swifts and other aerial insectivore population declines.

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.

RESULTS

- Ten counts took place from 10 May to 25 July 2016 including four counts on standardized dates. The highest count was 293 and the lowest was 13. The average count was 177.
- 2016 had the highest average count of the last six years.



Summary of Chimney swift counts at McGowan Lake in 2016 (MTRI)

Year	Minimum Count	Maximum Count	Average (n)
2011	14	162	80 (12)
2012	9	99	56 (10)
2013	4	241	132 (14)
2014	2	137	70 (8)*
2015	9	231	137 (6)
2016	13	293	177 (10)

*Two counts (1used and 2 used) took place in August likely after the roost was no longer in use

Summary of Chimney swift counts at McGowan Lake 2011-2016 (MTRI)

YEARS OF DATA

- 2010-2016

PARTNERS

- Bird Studies Canada
- Blomidon Naturalist Society
- Environment and Climate Change Canada
- Mersey Tobeatic Research Institute
- Nova Scotia Power

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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 disturbance of Red oaks 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 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. These proposed experiments, using prescribed burns and mechanical harvesting, will help build a better understanding of optimal hardwood regeneration conditions and management techniques to be used in Kejimkujik and other parts of the Acadian Forest region.

Red Oak sapling (J. Barker)

Research

RED OAK REGENERATION IN MIXEDWOOD STANDS

MTRI staff member, T. Holmes, measuring the diameter of a mature Red Oak (J. Barker)

The 2016 low-intensity controlled burn that took place within the Kejimkujik National Park boundaries for the Red

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 species that are within White-tailed deer exclosures which protect hardwood seedlings and saplings from browsing by large herbivores.
- To assess defoliation damage to mature Red oaks.
- To assess changes in Cancer root (parasitic on Red oak) populations within control and prescribed burn sites.
- To compare the effects of mechanical harvest treatments with the effects of prescribed burning.

METHODS

- 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 the park.
- Data was 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, and taking photos ground flora, canopy, and 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.

Mature Red oaks along Eel Weir Road transect (J. Barker)

MTRI staff member, T. Holmes, taking compass bearing along transect (J. Barker)

RESULTS

- Transect data for 2016 showed virtually no change in the number of deer browsed Red oak saplings (0.08%) from 2015, although the data for 2016 and 2015 has had the greatest percentage of deer browse with an average of 13.8% compared 7.2% in 2014.
- Red oak defoliation has varied among years. In 2016, Big Dam Lake treatment site has showed a slight increase in Red oak defoliation (1.5%) while Eel Weir Bridge treatment site has shown a decrease of Red oak defoliation (4%). Loon Lake and Eel Weir Road has not seen a significant increase or decline.
- Red oak sapling regeneration has decreased 11.7% from 2015 - 2016 on treatment sites, as well has also seen a slight decrease of 2.8% on control sites.
- High numbers of Red maple, Witch hazel and White pine saplings have been recorded in all years on treatment sites. The number of White pine saplings have been steadily increasing on treatment and control sites, along with Balsam fir and Black spruce with more saplings growing above 50 - 200 m. American beech seedlings 0 - 50 cm declined from 75 in 2015 to just 13 in 2016 on treatment and control sites, which could be due to high amounts of deer browse.
- Exclosure data dating back to 2011 did not show any significant differences numbers of Red oak seedlings between control and prescribed burn sites.
- The number of Cancer root clumps showed an increase to 19 clumps in 2016 from 9 clumps in 2015, but has seen a significant decrease from 52 clumps in 2014. Numbers have fluctuated considerably since monitoring of this rare parasitic plant species began, and more work is needed to track variables that may affect its growth.

YEARS OF DATA

- 2005 - ongoing

PARTNERS

- Mersey Tobeatic Research Institute
- Parks Canada
- Department of Labour and Advanced Education

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Rationale

The Eastern white cedar is an evergreen tree species. Although its distribution includes much of temperate to boreal regions of eastern North America, it is only known from approximately 30 sites in Nova Scotia. The reasons for its scarcity are not well understood and likely vary locally, but undoubtedly include land clearing, forest harvesting, road-building, and possibly deer browse, drought-related mortality and relatively low soil pH. Despite its large size, easy identification, and previous work by other researchers, the spatial distribution of cedar in Nova Scotia is still not well known. In 2016, efforts to map known cedar stands and also to discover new stands began, in order to provide valuable information towards the recovery of this species, a commitment outlined in the Nova Scotia's Endangered Species Act.

Cedar forest in Cumberland County (Z. Metcalfe)

Monitoring

MAPPING CEDAR FORESTS IN NOVA SCOTIA

Volunteer mapping out cedar in Annapolis County (Z. Metcalfe)

Cedar in Annapolis County (Z. Metcalfe)

OBJECTIVES

- To improve our collective knowledge of cedar locations and populations by monitoring known sites and by detecting new populations.
- To develop a useful, polygon-based spatial database of cedar stands for use in species recovery efforts.

METHODS

- Cedar stand polygons were developed by delineating the outline of the stand using a GPS of approximately 10 m accuracy or less. The outlined was defined as the outer reaches of a tree, including trunk and crown. Seedlings were considered part of the stand. A separation of 20 m between cedar occurrences triggered a new polygon.
- Rapid, randomized density plots were also established in some stands in order to estimate the number of trees for each site. In some instances where trees were very scattered, individual trees were counted.
- Generally, an area of approximately 500 m to 1000 m outside of known cedar sites was investigated on foot in an attempt at discovering new stands.

The known distribution range of cedar in Nova Scotia (ACCDC)

RESULTS

- In 2016 (including one day in late December 2015), five known sites were at least partially mapped and estimated for the number of trees. Sites were located in Digby, Annapolis, and Cumberland counties.

- In addition to two already fairly well mapped cedar stands in Berwick and in Hectanooga, the total area of mapped cedar forest now represents 40.5 hectares, spread across 26 different polygons.

- Two of those three sites have produced new, previously unrecorded cedar stands. Based on preliminary analysis of density plots, the number of new trees added to the provincial population estimate is in the thousands.

- Recent cutting of trees and significant dieback of trees were noted at one site, while the complete or near complete lack of regenerating cedar was noted on all sites except those in Digby County.

YEARS OF DATA

- Year 1 of ongoing project

PARTNERS

- Atlantic Canada Conservation Data Centre
- Mersey Tobeatic Research Institute
- Nature Conservancy of Canada
- Nova Scotia Nature Trust
- Nova Scotia Department of Natural Resources

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Rationale

Vole ears lichen was designated Endangered by COSEWIC in 2010 and is listed as Endangered under the Species At Risk Act and Nova Scotia Endangered Species Act. It currently occurs in Nova Scotia and Newfoundland. The majority of the Canadian population resides in Nova Scotia. Even though the species has been listed for several years, it has not been monitored systematically the way Boreal felt lichen has. This monitoring will constitute the first single year complete monitoring of the population.

Vole ears lichen (A. Lavers)

Monitoring

MONITORING OF VOLE EARS LICHEN

Vole ears lichen habitat (B. Toms)

Adult Vole ears lichen (H. Clapp)

OBJECTIVES

- To visit all Vole ears sites in Nova Scotia.
- To quantify the current status of the population.
- To record threats to the population.

METHODS

- Points from the Mersey Tobeatic Research Institute database of Vole ears lichen sites were uploaded to GPS units and each site was visited.
- Each site (where feasible) was flagged on either side of the tree containing the lichen in the same manner as Boreal felt lichen. This will provide a higher confidence level when the status monitoring of sites in the future. At sites with a high number of trees with Vole ears each tree was not marked.
- Lichen Health Score (1 most health to 5 least healthy) was recorded for each lichen as well as the percent of the surface that was grazed and the percent of necrosis on the lichen thallus.
- Researchers documented when there was no longer Vole ears lichen found at the site.

RESULTS

- One hundred and twenty nine trees with Vole ears lichen (sites) were visited out of the 163 in the database. Several sites constituted many trees within the database that were not easily distinguished by geographic coordinate because of the abundance of trees with Vole ears at the site. The 129 sites constitutes a visit to all known places in Nova Scotia that have Vole ears lichen.

- The presence of Vole ears lichen was confirmed at 108 sites. Twenty one sites no longer contained Vole ears.

- Losses occurred at three sites in Queens County, 17 in Shelburne County and one in Yarmouth County.

- The average health score (1-5) was 1.75. The average grazing was 3.0 % and the average necrosis was 5.8 %.

YEARS OF DATA

- 2016

PARTNERS

- Mersey Tobeatic Research Institute
- Environment Climate Change Canada's Habitat Stewardship Program (HSP)
- Nova Scotia Department of Natural Resources
- Nature Conservancy Canada
- Nova Scotia Nature Trust

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Rationale

In Nova Scotia, Blanding's turtles in Nova Scotia are only known to occur in four small populations and a few smaller concentrations in the southwest area of the province. 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.

Rustetta nesting (© W. Pitts)

Monitoring

BLANDING'S TURTLE NEST PROTECTION

Newly emerged Blanding's turtle (© J. McNeil)

Preparing to measure a hatchling (© J. McNeil)

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

- Known nesting sites were monitored on a nightly basis during nesting season in late spring-early summer. 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.
- 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.
- Nests were monitored periodically until the first hatchlings emerged in late summer 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.

RESULTS

- Nesting season was unusually long in 2016, with the first nesting activity observed on May 31st and the last nested recorded on July 7th.
- Fifty-one Blanding's turtle nests were located and protected across three populations.
- More than 100 volunteers contributed close to 3600 volunteer hours to nesting and emergence.
- Hatchling emergence was early, beginning before August 24th in one population and ending by October 3rd.
- A total of 365 hatchlings emerged from the protected nests, giving a hatching success rate of ~78%. Emergence success was similar in all three populations (67%-80%).
- In Kejimkujik, volunteers radio tracked seven hatchlings following emergence from a nest along the J-Line Road.

YEARS OF DATA

- Ongoing

PARTNERS

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

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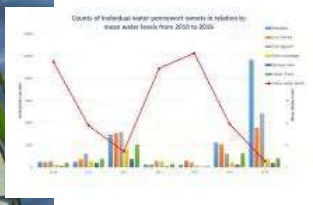
Rationale

Atlantic Coastal Plain Flora (ACPF) is a unique group of unrelated plants that are mainly found along lake and river shores, wetlands and saltmarshes in southwest Nova Scotia. Almost half of these species are listed as by the Nova Scotia General Status Ranks and some are globally rare. Water-pennywort, one of over 90 species of ACPF in Nova Scotia, 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 a few lakes in all of Canada. It is listed as 'Threatened' under the Species at Risk Act, 'Endangered' under the Nova Scotia Endangered Species Act and was recently re-assessed as 'Special Concern' by the COSEWIC. It is monitored annually by park staff and volunteers to assess its distribution and abundance.

Park staff conducting Water-pennywort transect surveys (Parks Canada)

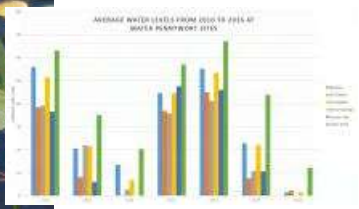
Monitoring

WATER-PENNYWORT MONITORING



Count of individual Water-pennywort ramets in relation to mean water levels from 2010 to 2016

(Parks Canada)



Average water levels (cm) from 2010 to 2016 at Kejimkujik Water-pennywort sites

(Parks Canada)

OBJECTIVES

- To monitor Water-pennywort population abundance and density on Kejimkujik and George Lakes.
- 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.
- Survey results were compared to historic data in order to determine population size fluctuations.

RESULTS

- Park staff and volunteers monitored Water-pennywort at seven sites in Kejimkujik on August 2 to 8, 2016. Sites included both Ell Island and Mill Bay, which were visited in 2015 but not regularly in the past.

- In 2016, water levels were the lowest recorded at Kejimkujik during annual monitoring. Total individual counts of ramets at sites appear to be correlated to water level. Consequently, Water penny-wort stands at the Meadow Beach, Jim Charles and Petroglyph sites had the highest numbers ever recorded.

- 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

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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.

Eastern ribbonsnake (© D. Clapp)

Research

EASTERN RIBBONSNAKE OVERWINTERING HABITATS

Overwintering habitat at Grafton Lake (© J. McNeil)

Ribbonsnake on leaf litter (©MTRI)

OBJECTIVES

- To monitor the three known overwintering sites 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 and McGowan Lake. Surveys took place from late February to mid April and again 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.

Sniffer dog finds a ribbonsnake (© Jeffie McNeil)

RESULTS

- The first snakes were found on February 29 at Grafton Lake; the earliest recorded emergence at this site.
- Snake presence was confirmed at both known overwintering sites near Grafton Lake in spring and fall. Only one snake was found at Site 1, continuing the trend of fewer sightings in the past few years. Seven snakes were found at Site 2.
- At McGowan Lake, four snakes were found at the recently discovered overwintering site from March 8 to March 31. One snake was also found in the nearby wetland on March 31.
- Snakes continued to show fidelity to overwintering sites, with two snakes returning to the same site for three years in a row.

YEARS OF DATA

- Ongoing project since 2009

PARTNERS

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

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Rationale

Wetlands are an important ecosystem at Kejimkujik ranging from forested wetlands (Black spruce swamps, Red maple flood plains), fens, marshes and peatland bogs. These wetlands provide habitat for species at risk (e.g., Blanding's turtle, Eastern ribbonsnake) and rare coastal plain flora (e.g., Long's bullrush). Wetlands also form an important component of the landscape - filtering water, reducing flooding and slowly releasing water during dry periods. Wetlands provide a wet refugia for wildlife that require wet cool environments. Due to human-caused climate change, wetlands could become warmer and drier due to increase evaporation or reduced precipitation, resulting in peat land bogs becoming drier thereby increasing rates of vegetation. By measuring the area of treeless bog using historic aerial photographs can be used to develop a baseline for vegetation succession on wetlands over the past 80 years.

(Yates Collection)

Monitoring

WETLAND EXTENT MONITORING IN KEJIMKUJIK NATIONAL PARK

OBJECTIVES

- To track the change in the area of treeless bogs over time using historical airphoto imagery.
- To track future changes in the treeless area of bogs.

METHODS

- 10 bogs (>15 ha in size) were selected from a random stratified sample in Kejimkujik National Park.
- Airphotos were digitized for each year including; 1928, 1945, 1963, 1992, 2010 for each of the 10 bogs.
- Airphotos were georeferenced in ArcMap using control points. A maximum error of 10m was allowed for georeferencing.
- The total area of treeless bog was digitized onscreen for each wetland for each year.

Mud Lake bog in 1945 with the treeless area outlined in purple (Parks Canada)

Mud Lake bog in 2010 with treeless area outlined in green (Parks Canada)

Kyle flying drone in Mud Lake bog area (M. Smith)

Drone picture taken at Mud Lake bog (K. Rowter)

RESULTS

- Between 1928 and 2010 large declines in the area of treeless bog was observed. The mean drop in area was 70% over the 82 years. The largest decline was recorded at Channel Lake Bog (90.5%) and the smallest at Cranberry Bog (39%).
- By investigating the airphotos it was observed that Cranberry bog was influenced by road building between 1945-1963. A logging road blocked off the main outlet of the wetland which flooded the southern half of the bog, creating a new treeless bog area.
- Herber Marsh was less impacted by bog succession likely due to annual flooding from Kejimkujik Lake.
- Large treeless areas around several bogs including Mud Lake, Channel, Atkins indicate that fire and/or forestry may have impacted these bogs historically reducing forest cover in the early part of the 1900's.

YEARS OF DATA

- 82 years (1928-2010)

PARTNERS

- Nova Scotia Community College - Centre of Geographical Sciences

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Rationale

The purpose of this survey was to census breeding species of gulls on Brier Island and Peters Island in Digby County, Nova Scotia. Concurrently a restoration project is restoring hydrology in Big Meadow Bog (in support of Eastern mountain avens conservation) where one of the Herring gull colonies has resided for several decades.

Herring Gull (B. Toms)

Monitoring

SURVEY OF BREEDING GULLS ON BRIER ISLAND 2016

Herring Gull chick in vegetation (B. Toms)

Colony locations and counts of breeding gulls on Brier Island and Peters Island, Nova Scotia (MTRI)

OBJECTIVES

- To count the entire population of breeding Herring gulls and Great black-backed gulls on Brier Island and Peter Island, Nova Scotia.
- To set a baseline for future studies and to determine the impact of hydrology restoration efforts in Big Meadow Bog on breeding Herring gulls and to locate previously unknown breeding colonies that may exist.

METHODS

- An approved protocol was approved by the Canadian Wildlife Service and used to complete the surveys.
- Ground surveys were conducted by researchers walking parallel transects. If researchers continued to find nests, the transects continued until no nests were observed or the habitat became unsuitable for nesting birds (tall dense shrubs, forest). The outside of each transect was marked with survey flags which were picked up during the following transect.
- Clutch sizes, dead birds, broken eggs nests of other species, and depredated eggs, were communicated to a single person who curated the data. Each nest was marked with a half of a wooden tounge depressor in order to avoid double counting of nests.
- Survey tracks were recorded using a Garmin eTrex 20. Resampling occurred by going back through a counted area finding 50 nests and marking how many of them contained wooden tongue depressors and how many did not. This was used to calculate a correction factor for nest counts.
- Permission was obtained to land on Peters Island, owned by Nova Scotia Nature Trust (NSNT), and a NSNT staff member accompanied researchers to the island.
- Clutch size was calculated by calculating the average number of eggs per nest. Empty nests were excluded from the calculation assuming that the survey preceded egg-laying for those nests.
- A correction factor for nest counts was determined by re-sampling a surveyed area in Big Meadow Bog and recording the number of unmarked vs. marked nests observed (see above).

Researcher tracks on Brier Island searching for and surveying breeding gull colonies (MTRI)

RESULTS

- During surveys on May 27th, 28th and June 1st, 2nd 2016, 2665 nests with eggs and 3848 total Herring gull nests were physically counted on Brier Island.
- On Brier Island, 1183 Herring gull nests were empty, 388 had one egg, 736 had two eggs. One thousand five hundred and forty had three eggs and one nest had four eggs. The total effort to survey all sites was 51 person hours plus about seven person hours to circumnavigate the coast of the island on foot looking for colonies of gulls.
- Re-sampling in order to establish a correction factor allowed us to determine that six nests out of 50 were unmarked (44 were marked) for a correction factor of 1.136 (50/44=1.136). After applying the correction factor of 1.136 the total number of Herring Gull nests with eggs on Brier Island was 3028 and the total number of nests was 4372.
- Peters Island had 643 Herring gull nests with eggs and 774 total nests with eggs. The number of Great black-backed gull nests on Peters Island was 63 with eggs and 76 total nests.
- Colonies were located and counted at Big Meadow Bog, Western Light, South of Round Rocks, Whipple Point, New Road Cove, South Point, West Side Big Cove, Peters Island.

YEARS OF DATA

- 2016

PARTNERS

- Fernhill Institute for Plant Conservation
- Environment and Climate Change Canada
- Nature Conservancy Canada
- Nova Scotia Nature Trust
- St. Francis Xavier University

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Rationale

Thread-leaved sundew is a part of the Atlantic Coastal Plain Flora group of plants in Nova Scotia. It is a carnivorous plant that lives in nutrient poor bogs. Its known range in Nova Scotia is restricted to Shelburne County in just 4 bogs all of which face anthropogenic threats such as damage from All Terrain Vehicles (ATV) and in the past proposals for peat extraction in those bogs. The purpose of this project was to document the current state of threats listed in the recovery strategy and to better document the extent of populations within the known bogs.

Bog changing to raised ombrotrophic bog (MTRI)

Monitoring

THREAD-LEAVED SUNDEW MONITORING IN NOVA SCOTIA, 2016

Thread-leaved sundew (MTRI)

Thread-leaved sundew (S. Blaney)

OBJECTIVES

- To gather data on previously identified areas within the five bogs and collaborate with those who have recently visited the sites.
- To visit all five bogs known to contain Thread-leaved sundew.
- To document threats to Thread-leaved sundew and better document the extent of areas occupied by Thread-leaved sundew.
- To use remote sensing data sources to document the extent of anthropogenic damage to the five bogs.

METHODS

- Previous data was gathered using the Altantic Costal Plain Flora buffers layer from Nova Scotia Department of Natural Resources (NSDNR) and the rare species export from Atlantic Canada Conservation Data Center.
- Sites were visited between 26 August and 22 September 2016.
- The occupied areas within the bog were traveled until an edge of the population or habitat was found. This edge was followed and recorded using a GPS track and points.
- At each GPS point, the number of plants was recorded, along with whether the site was natural pits and hummocks or in ATV ruts. Any direct damage to the plants from ATV activity was recorded. All other rare species were recorded as well.
- Using remote sensing sources combined with knowledge gained while on site, ATV tracks were outlined using aerial imagery from 4 sources at each site. Minimum Convex Polygons were calculated for each site to approximate Area of Occupancy.

Raised bog at Quinns Meadow (MTRI)

ATV damage to Long's bullrush in Quinns Meadow (MTRI)

RESULTS

- All sites had recent ATV use within the bogs and adjacent to the areas of occupation for Thread-leaved sundew.
- At all sites Thread-leaved sundew was growing in former ATV damaged habitat but not all sites had recent damage to plants.
- The extent of each population was better documented using GPS tracks and points. The total occupied area was estimated to be 120 hectares.
- Rerouting of trails at some sites could alleviate the threat of damage to the plants from ATV activity in the bogs.
- Recent ATV damage to Long's bullrush habitat was observed at Quinns Meadow and had caused the plants to flower.

YEARS OF DATA

- 2016

PARTNERS

- Environment Climate Change Canada's Habitat Stewardship Program (HSP)
- Atlantic Canada Conservation Data Center
- Nova Scotia Department of Natural Resources

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Rationale

The Atlantic Coastal Plain Flora (ACPF) are a group of plants that exist largely on lakeshores and wetland habitats in Nova Scotia. Their populations are largely disjunct from other ACPF populations in Canada and several species have been listed under SARA. In 2010 MTRI, in partnership with the ACPF Recovery Team, Nova Scotia Nature Trust, Parks Canada, and the Atlantic Canada Conservation Data Centre (ACCDC) initiated a project to collect baseline data for the Species at Risk Act listed ACPF populations and establish monitoring protocols.

Atlantic Coastal Plain Flora habitat on Kejimkujik Lake (M. Smith)

Monitoring

ATLANTIC COASTAL PLAIN FLORA MONITORING IN KEJIMKUJIK NATIONAL PARK

Perforated ruffle lichen, the first record for Canada (M. Smith)

Botanist A. Belliveau surveying for lichens (D.Crossland)

OBJECTIVES

- To complete the monitoring and detection efforts for populations of endangered, threatened and special concern ACPF on 36 high priority lakes identified in the recovery strategy.
- To complete monitoring surveys on the shorelines of Kejimkujik and George lakes, in Kejimkujik National Park, which represented the last incompletely surveyed lake among the 36 high priority lakes.

METHODS

- Populations of Species At Risk Act listed ACPF species were inventoried and geo-referenced along lake shores by ACCDC botanists. Field surveys were predominantly on foot, except for some portions of a few islands between Kejimkujik Lake and George Lake which were covered by slow canoeing close to shore. Survey effort was strongly concentrated along lakeshores and shoreline peatlands, but also included some coverage of floodplain and uplands adjacent to lakeshores.
- Areas covered were documented using a GPS unit set to save position coordinates every 20 seconds.
- Full vascular plant species lists were compiled for Kejimkujik Lake and George Lake survey sites by each botanist, and other non-vascular plant species were also incidentally noted.
- For provincially rare species (those species with provincial status ranks [S-ranks], of S1 to S3S4 and/or provincial General Status Ranks of At Risk, May Be At Risk or Sensitive), we recorded locations by GPS (accurate to 10 m or less), along with information on population size and extent, habitat and associated species.
- All data collected through this project has been incorporated into the ACCDC database for permanent storage.

RESULTS

- A total of approximately 104km of shoreline surveys, or paddling between shorelines, was travelled by two ACCDC botanists on parts of Kejimkujik and George lakes for a combined total of 11 person days.

- Fieldwork documented 1,968 records of 236 (231 native, 5 exotic) vascular plant species. Of these, 718 records were of nine provincially rare species. In addition, fieldwork documented 12 records of ten macrolichen, bird, insect, and reptile species that are provincially rare or federally listed.

- Rare species records included a new location in Jeremy's Bay for the federally Threatened Water pennywort (originally noted by volunteer Norm Green earlier in 2016 and described in this report), seven new locations of the Federal Special Concern Long's bulrush in shoreline peatlands of Kejimkujik Lake, one new location of the Federal Threatened Wrinkled shingle lichen on the shores of George Lake, six records of four bird species of provincial concern (Spotted sandpiper, Eastern wood-Pewee, Chimney swift, Yellow-bellied flycatcher), and four records of Snapping turtle (a Federal Special Concern species) or Snapping turtle nesting sites.

- A macrolichen species, Perforated ruffle lichen, was also documented on Kejimkujik Lake, and represents a new species for Canada.

- In addition, in 2016 botanist Nick Hill also discovered Slender Fimbri on the lakeshores of Loon Lake, and this represents the first confirmed report of this vascular plant species in the Maritime Provinces.

- In all, eight (seven native, one exotic) new species for Kejimkujik National Park were documented, and two new locations of the highly invasive Glossy buckthorn around Kejimkujik Lake, with one of those locations with two large, reproductive individuals.

YEARS OF DATA

- 2016

PARTNERS

- Kejimkujik National Park and National Historic Site
- Atlantic Canada Conservation Data Centre
- Mersey Tobeatic Research Institute

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Rationale

Transitions between plant communities on the landscape have become a focus of ecological research due to their relatively high diversity and sensitivity to global climate change. However, little is known about how vegetation changes across natural landscape boundaries such as transitions between forested wetlands and adjacent ecosystems. This project was a pilot study for a larger project on biodiversity and ecosystem functioning of forested wetlands across Atlantic Canada. Forested wetlands are an integral but understudied part of the broad landscape of the Atlantic provinces. Knowledge gained from our project can be used to provide insight into natural and anthropogenic processes influencing forested wetlands, to inform best management practices, and to serve as a framework for the conservation of forested wetlands.

Wet mixedwood forest at Mount Merritt (K. Harper)

Research

VEGETATION ACROSS TRANSITIONS IN FORESTED WETLAND LANDSCAPES

L. Gray in a wet deciduous forest that transitions into a shade-tolerant conifer forest near Lake Rossignol (K. Harper)

OBJECTIVES

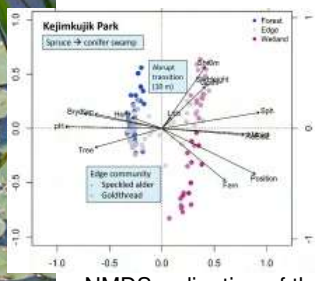
- To characterize different types of forested wetlands and associated plant communities in forested wetland landscapes.
- To compare patterns of vegetation structure across transitions.
- To develop different measures of structural diversity for forested wetlands.

METHODS

- We set up three 120 m transects across transitions between forested wetland and upland forest in southwest Nova Scotia; another was established across a bog to treed bog transition near Musquodobbit.
- We recorded cover of different plant types, presence/absence of plant species, soil moisture and pH for contiguous 1 x 1 m quadrats.
- We measured forest structure (trees, canopy cover) in 20 x 5 m plots evenly spaced every 20 m along each transect.
- We used NMDS ordinations to explore relationships between plant species, vegetation types and environmental variables along the transects and among sites. Later, spatial pattern analysis will be used to compare patterns of structural diversity across the transitions.

A. Ring and L. Gray at the edge between a bog and a treed bog near Musquodobbit (K. Harper)

Treed bog near Musquodobbit (K. Harper)



NMDS ordination of the transition from spruce forest to conifer swamp in Kejimikujik Park. An edge community of speckled alder and goldthread was found in an abrupt transition zone (K. Harper)

RESULTS

- Although patterns of vegetation across transitions varied for different forested wetland types and adjacent ecosystems, most boundaries between forested wetlands and upland forest were demarcated by an abrupt edge of Sphagnum moss cover.
- As expected, forested wetlands were associated with greater soil moisture and cover of Sphagnum spp, graminoids and short shrubs, whereas more abundant trees, tall shrubs, herbs and bryophytes were found in upland forests.
- Transitions were sometimes characterized by an abrupt transition or a distinct edge community with plants such as ferns, alders or huckleberry.

YEARS OF DATA

- Year 1 of a 3 Year project

PARTNERS

- Environment and Climate Change Canada
- Dalhousie University
- NSERC
- several others

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Rationale

In the spring of 2016, more than a dozen wilderness lakes in the Medway area were opened to the public for the first time. While there is a long history of angling in this area, the roads have always been gated. Open roads are likely to change the amount of angling in this area and increase the possibility of illegal introductions of invasive fish. With no baseline data about angling effort or catch in this area the creel census survey will help fishery managers understand the impact of changes in road access in this area and help provincial crown land managers understand how best to manage road use. Through roadside surveys at the Albany New and Dalhousie gates, we can work with anglers to better understand the Medway trout fishery and prevent the introduction of invasive species like the Chain pickerel and Smallmouth bass through outreach and education. Through the creel census survey we hope to inform decision making for recreational fisheries in the Medway and ensure its sustainability.

Creel Census 2016 (A. Lavers)

Research

CREEL CENSUS

OBJECTIVES

- To assess the status of the trout fishery and determine species composition and abundance of freshwater fish in newly accessible waterways in the Medway.
- To determine whether Smallmouth bass and Chain pickerel are present in the upper Medway watershed.
- To educate anglers about the risk of introducing invasive fish to local biodiversity.

Measuring fork length of a Brook trout (J. Headley)

METHODS

- Daily roadside surveys were set up for seven hours each day of data collection at Albany New and Dalhousie gates in the Medway District between May 4th and June 4th.
- A table was set up the with necessary equipment, informative posters, and small gifts for volunteers and signs were erected 20 m from the table asking anglers to stop.
- At each roadside survey the weather and number of vehicles were recorded. When vehicles stopped, anglers were asked to voluntarily provide their fish for measurements including weight and length. Scale and adipose fin samples were taken to determine age and as DNA samples.
- At each roadside survey anglers reported their time spent fishing, the location of where they were fishing, their method of fishing, any invasive and endangered species sightings, and additional notes were taken.
- Catch per unit effort (CPUE) was presented by number of trout caught per hour of effort.
- An Eco-Counter was used to observe and assess traffic in the area. There were some malfunctions, likely due to weather on eight of twenty eight collection days so outliers were removed from the analysis.
- Wherever possible, methods were aligned with other studies in Tangier Wilderness Area and Kejimkujik for future comparison.

Brook trout scale under a microscope (J. Headley)

Weighing a Brook trout (J. Headley)

Collected scale samples of a Brook trout (J. Headley)

RESULTS

- Over the 28 days of data collection, 66 group and individual interviews were completed with 136 anglers.
- Anglers reported 259.5 hours of fishing time, with 66% of angling parties using bait, 9% only used lures, and 25% only used flies.
- Of the 741 Brook trout reportedly caught, 197 were kept and 544 were released (27% retained and 73% released).
- Participants in the survey were a mix of returning visitors who had had access to the area in the past and new visitors who had been using the area for the first time this year. This information was collected informally but if possible should be quantified next year.
- The average Brook trout fork length (with adjustments for trout without head/pel fin) was 25 cm with an average weight of 180 g.
- Our anglers spent 573 hours to catch 197 trout (0.34 trout per hour).
- Yellow perch were plentiful in the Medway and released 100% of the time.
- There was a reported White perch and Smallmouth bass caught at the Stillwater behind basecamp. A Smolt was reportedly caught but no location was documented.
- Of the 197 Brook trout that were kept, 173 were used to take DNA and scale samples, where the scale samples were used to find an average age of 2.15 years.
- The average number of vehicles recorded by the eco-counter was 23 per day. The average number of vehicles observed by researchers was six per seven hour observation period.
- There was an average of two interviews per day; the maximum number was seven interviews per day and there were five days when no interviews took place.
- The busiest time of day for traffic and interviews was 4 pm. During weekends, there was more traffic later in the day.
- Friday was the busiest day of the week for interviews and Wednesdays had the most traffic recorded by the Eco-Counter.

YEARS OF DATA

- Year 1 of a 2 Year project

PARTNERS

- Freshwater Fisheries Research Cooperative
- Nova Scotia Department of Fisheries and Aquaculture
- Canada Summer Jobs
- Nova Scotia Skills Development
- Medway Salmon Association
- Queens County Fish and Game Association
- Parks Canada

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Rationale

The Common loon is an iconic water bird inhabiting many lakes in southwest Nova Scotia. The haunting cries of the loon are integral to the wilderness experience. Its beauty and large, distinct form allow the novice to quickly become familiar with it during outdoor excursions. Concerns have been raised about the health of loons after a study by the Canadian Wildlife Service (CWS) found very high blood mercury concentrations in Kejimkujik loons. These levels have been associated with impaired reproduction and altered breeding behavior in some areas. LoonWatch began on 22 survey lakes within Kejimkujik in 1996, with the monitoring focus reduced to 19 lakes in 2004.

Common loon (M. Smith)

Monitoring

LOON MONITORING KEJIMKUJIK

OBJECTIVES

- To observe Common loon abundance and breeding success on lakes within Kejimkujik.
- To determine status and trends in loon abundance, lake use and reproductive success of resident birds.

Group photo of August Loon Watchers at Mill Falls (D. Crossland)

METHODS

- LoonWatch uses trained volunteers to simultaneously survey a large number of lakes within a three hour observation period, during spring (usually late May) to assess the number of territorial, resident pairs and single adult loons, and during a second survey in late August to assess the number of surviving juvenile loons.
- Loons present on each lake were recorded. Any potential stressors on the loon population, such as competitors, predators or human disturbances, were also recorded.
- Baseline data from LoonWatch surveys was combined with ancillary observations gathered throughout the season on loon pairs and chick survivorship, as well as field verifications where required, to produce the most accurate possible total annual loon numbers.

Loon platform being installed at Peskawesk Lake by C. Gray (D. Crossland)

RESULTS

- Approximately 50 people contributed to LoonWatch in 2016, with some long-time participants (21 years) and some new and keen volunteers recruited.

- The Kejimkujik spring LoonWatch reported 39 adult loons (10 pairs and 19 not detected as paired) on 15 lakes (4 lakes were not surveyed). No chicks were yet hatched.

- A total of 55 adult Common loons were tallied on Kejimkujik lakes during August surveys, with 12 juvenile loons having survived the summer season. The year 2016 was another relatively good year for loon productivity.

- Five Bald eagles were observed during the August LoonWatch, a record number for a three hour period. Of note, one eagle was attempting to take prey from two ospreys on Grafton Lake (thanks to the observations of Rick Lindsay and Janice Ring). Growing populations of food-supplemented Bald eagles (e.g., from agricultural operations) continues to be a potential concern for increased loon chick predation.

YEARS OF DATA

- 1996 was the first year for the Kejimkujik program (surveys incomplete during 2002, 2007 and 2009 due to inclement weather)

PARTNERS

- Parks Canada
- Mersey Tobeatic Research Group
- Friends of Keji
- Canadian Wildlife Service

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Rationale

The Common loon is a wilderness icon that captivates people through its beauty and haunting calls. As a species that inhabits many of the lakes in Southwest Nova Scotia, it has been a focus of research and monitoring at MTRI. Loons in this area are imperilled by many threats, including water fluctuation related to climate change. Our research with the Canadian Wildlife Service at Environment Canada over the last decade shows that their reproductive rates here in the Kejimkujik area are lower than anywhere else on the continent. Nest platforms have been shown to increase the nesting success of loon pairs that have repeatedly lost nests because of changing water levels, human disturbance or lack of natural nesting sites. Construction, installment, and monitoring of nesting platforms will provide more nest habitat to loons on lakes with a history of low reproductive success.

Volunteer platform steward T. Shupe and MTRI staff C. Gray with new platform on Menchan Lake (J. Headley)

Research

COMMON LOON NESTING PLATFORM PROJECT

Loon on artificial platform in Fancy Lake Photo (C. Gray)

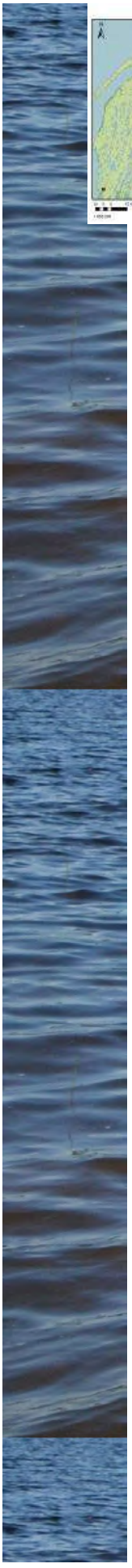
Nest builders L. Phinney and N. Nickerson on Mudflat Lake (C. Gray)

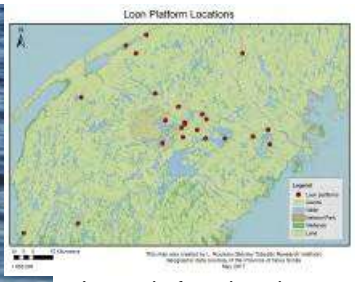
OBJECTIVES

- To construct, install and monitor 10 nest platforms.
- To recruit dedicated LoonWatchers as stewards of each platform.
- To monitor the loon usage of each platform.
- To research the use of avian predator guards on the nest platform to mitigate predator threat.
- To identify the priority messages and target audience, and match these with the appropriate media to execute a strategic awareness-raising campaign about aquatic health and Common loons.

METHODS

- A set of criteria were developed and used to prioritize nest platform installment looking at the numbers of years of LoonWatch, number of year-round islands, number of banded loons, history of reproductive success, history of flooded nests, surface area, max and mean depth, mean pH, and mean color.
- Ten nest platforms were constructed through the help of volunteers using PVC pipe, plastic mesh and cinder block anchors.
- All the platforms were constructed, launched, towed by canoes and anchored to their respective lakes.
- Platforms were installed on lakes based on the criteria, monitored by volunteer LoonWatch Stewards and brought in during the winter months for storage.





Loon platform locations in Southwestern Nova Scotia (L. Rouleau)

RESULTS

- The year 2016 is the first year of an ongoing project to construct 20 nest platforms. The ten platforms were successfully installed on the following lakes: Donnellan, Mary, Menchan, First Christopher, Fancy, Mudflat, Peskowesk, Tupper, Harmony, and Jake's Landing.

- Platform stewards were successfully recruited for all the platforms. Loons were observed around the platforms, although most platforms were constructed and deployed post-nesting season.

YEARS OF DATA

- This is year 1 of an ongoing project.

PARTNERS

- Mersey Tobeatic Research Institute
- Parks Canada
- Mountain Equipment Co-op
- Nova Scotia Habitat Conservation Fund

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Rationale

The Common loon is widely used as an indicator of the health of lake ecosystems because of its high trophic position in aquatic food chains. The number of chicks produced each year depends on the number of fish in a lake for the adults and chicks to feed on as well as environmental threats. Productivity of the Common loon is adversely affected by such things as acid rain, structural and recreational development of lake shorelines, disturbance by boaters, water-level fluctuations, predators, and mercury pollution. Data collected by MTRI and Environment Canada show that the lowest rate of chick production in all of North America is found in southwestern Nova Scotia. In 2006 the LoonWatch program expanded from Kejimkujik National Park to include the lakes of the Southwest Nova Biosphere Reserve. MTRI has taken the lead in recruiting and training LoonWatch volunteers to observe and record loon activity on their assigned lakes throughout the summer.

Nesting loon (C. Gray)

Monitoring

MTRI LOONWATCH

OBJECTIVES

- To observe loon abundance and breeding success on lakes in the Southwest Biosphere Reserve with a focus on the Mersey and Medway watersheds.
- To determine status and trends in loon abundance, lake use and reproductive potential of resident birds.

Banded loon (C. Gray)

METHODS

- 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. Volunteers and MTRI staff data were collected and compiled, then shared with Bird Studies Canada.

RESULTS

- In 2016, the MTRI LoonWatch program had 11 volunteers monitoring loons on 11 lakes in the Southwest Biosphere Reserve.
- Nine loon chicks were recorded on 11 lakes. Overall productivity was good in 2016. Water level fluctuations were minimal during the spring nesting season, which helped to eliminate nest failure due to flooding or stranding.
- Out of the 11 lakes surveyed, 9 lakes were reported by LoonWatch volunteers as having observed Bald eagles often or occasionally on their lake.

LoonWatcher M. Brunel (C. Gray)

YEARS OF DATA

- Ongoing project since 2006

PARTNERS

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

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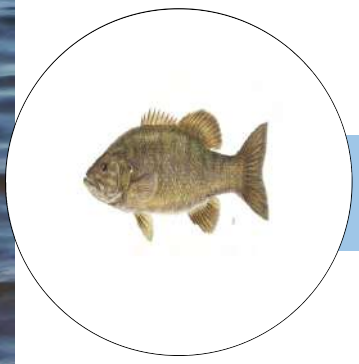
Rationale

Kejimkujik's freshwater ecosystem is under immediate threat from two highly invasive predatory fish species. 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 30km downstream of the park. Preventing the entry of these invasive species into Kejimkujik is paramount. Should either species become established, there would be significant negative impacts to the freshwater ecosystem. In 2016, we continued our monitoring of high risk watersheds in the park in collaboration with MTRI and the NS Inland Fisheries Division. Parks Canada also assisted with a Smallmouth bass removal program in Cannon Lake just outside the park boundary. Looking to the future, efforts are proceeding to assess options for long term protection of Kejimkujik's largest sub-watershed, the Peskowesk system.



Smallmouth bass (Wiki Commons)

Research

PROTECTING KEJIMKUJIK'S TROUT FISHING LEGACY

OBJECTIVES

- To Monitor Kejimkujik watersheds deemed high risk for invasive fish introduction for evidence of invasive fish.
- To assist, along with MTRI, and NS 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 evaluate long term methods of protecting the Peskowesk watershed from the threat of invasive fish.
- To Collect data from park anglers through the Angler Diary.

Park staff set up a fyke net in Peskowesk Brook in order to monitor fish movement and check for invasive fish entry (Parks Canada)

METHODS

- Invasive fish monitoring within the park included minnow trapping, angling, fyke nets and Angler Diary results.
- Smallmouth bass information posters were placed throughout the park to inform visitors of the threat and to help in species identification. In addition, invasive fish posters were provided to all external sellers of park fishing licenses.
- Each park fishing license comes with an Angler Diary to record effort and species caught. When the completed Diary was returned anglers were given a commemorative crest.
- Cannon Lake Smallmouth bass removals were completed using a modified fyke net, angling, minnow trapping and electro-fishing (boat and backpack). Each bass caught was measured for length, weight, sex and gut contents.
- Investigation into fish species assemblage in Peskowesk Brook began using angling, fyke-net and minnow trapping and engagement with volunteer anglers.

Remains of an old logging dam in the upper reaches of Peskowesk Brook (D. Reid)

Mud, Little Peskowesk, Hilchemakaar and Peskowesk Lakes are all being considered for protection from invasive fish entry in the future (D. Reid)

RESULTS

- No invasive fish were caught within the park in 2016.
- The data from 190 returned Angler Diaries provided an additional 1198 hours of recorded angling in the park with no reports of invasive fish.
- Electrofishing CPUE in Cannon Lake dropped to 6.9 bass/hour in 2016 from 13.4 bass/hour in 2015. Similarly, angling CPUE dropped dramatically from an estimated 0.82 bass/hour in 2015 to 0.11 bass/hour in 2016.
- A total of 76 bass were removed from Cannon Lake this year, consisting of 37 juveniles, 27 male and 12 female, all 12 of which were gravid and had yet to spawn, which should reduce population recruitment.
- Smallmouth bass from Cannon Lake had a mean length = 18.7 cm and mean weight = 212.1 g, which are lower values than in 2015, however a higher proportion of young of the year were caught in 2016.
- Smaller systems in the park are being examined for potential protection from invasive fish through enhancement of existing barriers both natural and artificial.
- A second population of Smallmouth bass with direct access to the park was confirmed in 2016 in Big Sixteen Mile Bay Lake on the SE corner of Lake Rossignol.

YEARS OF DATA

- Year 3 of a 4 year Project

PARTNERS

- Parks Canada
- Kejimkujik's Trout Fishing Volunteers
- Mersey Tobeatic Research Institute
- Nova Scotia Department of Inland Fisheries
- Department of Fisheries and Oceans Canada
- Acadia University

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Rationale

As the Southern Upland (SU) Atlantic salmon populations have been plummeting, the acidic conditions of rivers in South Western Nova Scotia (SWNS) may be a factor in their decline. In acidic freshwater conditions, aluminum is mobilized in rivers, where aluminum can speciate into ionic aluminum (Ali). Ionic aluminum, a toxin to salmon, has been documented in two surveys of SWNS for being greater than 15 ug/L, the toxic threshold for salmon suggested by the European Inland Fisheries Advisory Council (EIFAC): once in a fall survey of SWNS in 2006, and once in the summer of 2014; however, the current concentrations and seasonal trends of Ali in SWNS remain unknown. The aim of this research was to measure Ali concentrations in the SWNS rivers over several seasons to determine if Ali concentrations exceed the toxic threshold (15 ug/L for Atlantic salmon) and should be considered a factor in the declines of the SU Atlantic salmon populations.

Water chemistry data being recorded at the Mersey River (K. Boggild)

Research

INVESTIGATION OF IONIC ALUMINUM LEVELS IN SWNS RIVERS

Field-speciation and separation of ionic aluminum in water samples (S. MacLeod)

OBJECTIVES

- To determine if current Ali concentrations exceed the 15 ug/L toxic threshold for Atlantic salmon.
- To monitor the seasonal and long-term variations in Ali concentrations in the Mersey River (located within the Kejimkujik National Park), and Moose Pit Brook (located 15 km North East of Kejimkujik).

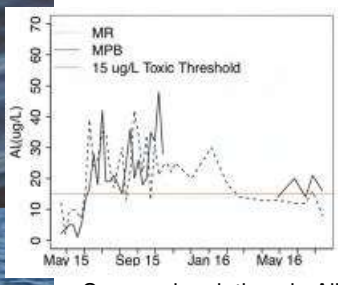
METHODS

- Grab samples were collected weekly/monthly in the Mersey River and Moose Pit Brook from 2015-present.
- Water samples were pushed through filters and columns to separate Ali in the field.
- Water samples were analyzed at the Maxxam Laboratories and Health and Environments Research Centre (HERC) labs.

RESULTS

- Ali concentrations exceeded the 15 ug/L for 64% of samples (N=39) collected from the Mersey River between April 2015 and July 2016.
- Ali concentrations peaked during the late-summer in the Mersey River and in the fall for Moose Pit Brook.
- Ali concentrations were consistently lowest and did not exceed the toxic threshold in Mersey River and Moose Pit Brook during the spring months.

Field-crew member measuring temperature, conductivity and pH of water samples (S. MacLeod)



Seasonal variations in Ali concentrations for the Mersey River (MR) and Moose Pit Brook (MPB), between April 2015 and July 2016 (S. MacLeod)

YEARS OF DATA

- Ongoing project since 2015

PARTNERS

- Dalhousie University
- Nova Scotia Museum
- The Salamander Foundation
- Environment Canada
- Natural Sciences and Engineering Research
- Council of Canada
- Shell Canada
- The Atlantic Salmon Conservation Federation

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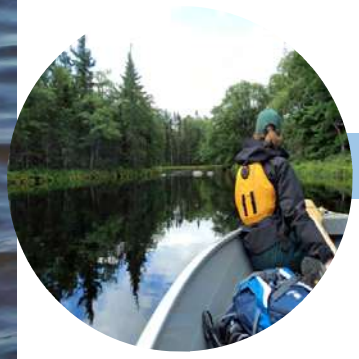
Rationale

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. These parameter are: mean annual daily flow (m3/sec), 30-day minimum flow (m3/sec), Julian date of annual minimum flow, number of high flow pluses, and Richards-Baker Index (a measurement of flashiness). These parameters are combined to create a stream flow index (SFI) which assesses the overall condition of the water flow for each stream.



Heading up West River to the stream flow site (K. Rowter)

Monitoring

STREAM FLOW MONITORING

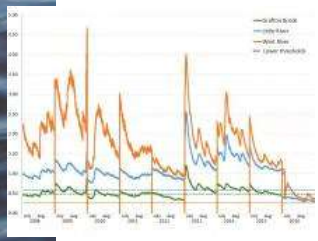
OBJECTIVES

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

Scott and Holly conducting stream flow monitoring at Peskawesk Brook (K. Rowter)

METHODS

- Stream flow was monitored at each of the following five major transboundary watersheds at Kejimkujik: Mersey River, Little River, West River, Grafton Brook and Peskowesk Brook. The Mersey River has been monitored at two locations (Mill Falls and Eel Weir) by the Water Survey of Canada since 1968 and Parks Canada has been monitoring the other sites since 2008.
- A 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 comparison of July and August water levels since 2008, in Little River, West River and Grafton Brook, with lower thresholds indicated (Parks Canada)

- A time series of discharge data was generated from the measured water level data using the defined rating curve for each site.

- Thresholds for each watershed were established based on statistical variability in historical data from each site. (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.

- Thresholds for Mersey River (Mill Falls) were calculated based on 1968-1988 while thresholds for Peskowesk and West River were calculated based on data collected 2008-2013. The data for Little River and Grafton Book were not analyzed at this time.

RESULTS

- The drought of 2016 in Southwest Nova resulted in some of the lowest water levels recorded since data collection began.

- Grafton Brook and Little River dropped below the historical lower thresholds for water depth, established for each river. Little River in particular was well below historic thresholds.

- Although West was historically low it did not drop below the established threshold. This is likely due to a large standard deviation in threshold establishment for West River as it is the flashiest of Kejimkujik monitored streams.

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 and Climate Change Canada

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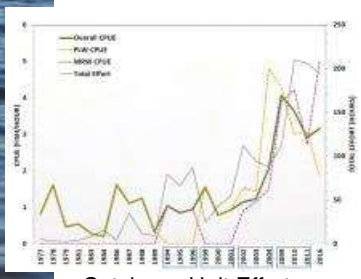
Rationale

Brook trout (*Salvelinus fontinalis*) is the most popular sport-fish in Nova Scotia and the primary fish species targeted by anglers in Kejimkujik. Brook trout are excellent indicators of freshwater ecosystem health. They are susceptible to environmental degradation due to pollutants or toxic substances, poor land use practices, invasive species and climate change, in particular increased water temperatures. Changes in their abundance and condition can inform park managers about environmental threats and fishing pressure throughout the upper Mersey watershed. Since 1994 the Kejimkujik creel census monitoring program has been conducted between April 1 and June 30, for a 3 year period with a 5 year interval between censuses. As the effects of climate change and the threat of invasive species continue to increase it is imperative that we continue to monitor the Brook trout population in Kejimkujik for early indications of changes.

Juvenile Brook trout (K. Rowter)

Monitoring

KEJIMKUJIK BROOK TROUT CREEL CENSUS



Catch per Unit Effort (CPUE) overall CPUE and in each monitored watershed, Peskowesk Lake (PLW) and Mersey River (MRW) as well as total effort each year. Note the start of the monitoring cycle in 1994 (Parks Canada)

OBJECTIVES

- To monitor the status and trend of Brook trout numbers in two benchmark watersheds (Mersey River (MRW) and Peskowesk Lake watersheds (PLW)) (fig.1.). These two watersheds were shown to be the most heavily fished and representative of the Kejimkujik Brook trout population.
- To record 100 hours of effort in each watershed.
- To calculate Relative Weight (RW) and catch per unit effort (CPUE) as measures of Brook trout population health and abundance respectively (Table 1.).

METHODS

- Between April 1 and June 30, data was recorded for each hour fished by volunteer anglers using artificial fly and includes angler's name, date, time, fish species caught, and fork length (mm) and weight (g) of all Brook trout.
- Catch Per Unit Effort (CPUE) was calculated as number of fish caught / hour.
- Relative weight (Rw) was calculated as an index for measuring fish condition; it compares a fish's weight to an ideal weight for a fish of its length (log10Ws = -5.186 + 3.103 log10L; where Ws is the ideal weight and L is length).
- Angling only occurs when water temperatures are between 5.5oC - 15.5oC as fish stress and hooking mortality are significantly reduced. Volunteers are instructed to not remove fish from the water if water

Condition Index (Relative Weight)	Relative Abundance (CPUE) >0.78 ↑	0.27-0.78 ↔	0.26 ↓
>101.4 ↑	Good ↑	Fair ↔	Fair ↔
90.5-101.4 ↔	Fair ↔	Fair ↔	Poor ↓
<90.4 ↓	Fair ↔	Poor ↓	Poor ↓

Monitoring thresholds for conditions and relative abundance which indicate overall Brook trout population health within the park (Parks Canada)

Map indicating the two monitored watersheds, the Peskowesk Lake Watershed (PLW) and the Mersey River Watershed (MRW) (J. Woodruff)

RESULTS

- The overall status and trend of the Brook trout ecological indicator is good and improving. The overall CPUE of 3.16 Brook trout caught per hour is well above the 0.78 threshold, as is the 5.0 and 1.86 values in the Mersey and Peskowesk areas respectively.
- Relative weight values were well above the threshold limit of 101.4 (overall 120.39), and showed larger fish sizes in the PLW (129.39) vs MRW (119.16).
- Total hours recorded were over the ideal 100 in the Peskowesk system, but were slightly lower (81) in the Mersey area. This can easily be corrected in future years by dedicating more staff time and engaging fly fishermen in that area as it one of the most popular fishing areas in the park.
- We had 194 total hours of dedicated volunteer angling effort toward the creel census.
- Although the trend in overall CPUE is up, the PLW CPUE has dropped in 3 of the last 4 creel censuses, and bears more close scrutiny moving forward.
- It will be interesting to see what effects, if any, the 2016 drought in Southwest Nova will have on Brook trout numbers in 2017.

YEARS OF DATA

-

PARTNERS

- Kejimkujik Trout Volunteers
- Parks Canada
- Nova Scotia Inland Fisheries

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Rationale

The estimated area of old growth forest (OGF) in the Maritime Provinces is less than one percent of the total forest cover. This is drastically lower than that of the temperate coastal rainforest found on the Pacific coast of British Columbia where OGF constitutes 55 percent of total forest cover. This demonstrates the dire need for the conservation of OGF as well as the restoration and protection of forested areas that have the potential to develop into OGF in the Maritimes. MTRI and partners have conducted a comprehensive comparative analysis of OGF policy in Nova Scotia, New Brunswick and British Columbia to offer recommendations as to improve the protection of OGF in the Maritime provinces.

OGF comparative analysis session in Sackville, NB (A. Lavers)

Research

COMPARATIVE ANALYSIS OF OLD FOREST POLICY

OGF comparative analysis session in Sackville, NB (A. Lavers)

OGF comparative analysis session in Sackville, NB (MTRI)

OBJECTIVES

- To collaborate with government officials, policy analysts, academics, students and environmental organizations to mobilize knowledge and conversation regarding old forest policy.
- To analyze relevant old forest legislation, regulatory frameworks and policy in Nova Scotia, New Brunswick and British Columbia.
- To provide recommendations to improve the current old forest regulatory framework and policy in the Maritime provinces.

METHODS

- A list of 32 comparative analysis criteria was developed and reviewed by members of MTRI's Old Forest Working Group, which is comprised of leading forest experts, scientists and policy makers in the Maritimes.
- Six students were recruited to participate in the preliminary analysis and contributed 150 volunteer hours.
- East Coast Environmental Law Association was contracted to complete the analysis of regulatory frameworks and legislation and create a report.
- MTRI held a participatory comparative analysis session in Sackville, New Brunswick, where leading forest experts, scientists and policy makers in the Maritimes were invited to provide feedback on the report.
- MTRI transcribed the feedback from the meeting and conducted a comprehensive policy analysis examining relevant forest policy from Nova Scotia, New Brunswick and British Columbia.
- MTRI presented these findings at their Old Forest Conference and facilitated a participatory discussion titled: "Discussion about Future Directions for Old Forest Policy in the Maritimes" alongside partners, Canadian Parks and Wilderness Society and Environment Canada.

RESULTS

- Nova Scotia's OGF policy is a great model for other Atlantic provinces, in demonstrating the ways in which science can be integrated into the conservation of OGF. The old forest score sheet is scientific, quantitative and can be utilized to guide best management practices. Moreover, Nova Scotia has an old forest GIS layer and Old Forest Coordinator to oversee all matters relating to old forests. That being said, although there is an Old Forest Policy, there are currently no provisions in place to ensure that eight percent of the land within each of the 38 eco-districts is preserved for OGF conservation or restoration. Moreover, although the policy suggests representation of topography typical to a given ecodistrict, it may prioritize the conservation of stands that have the least commercial value, whereas it should prioritize the stand with the highest conservation value. There is no guarantee that an area protected within the eight percent of each ecodistrict will remain protected in perpetuity, unless it is designated a protected area and can be exchanged for another stand in the same ecodistrict.

- Old Forest Wildlife Habitat (OFWH) definitions in New Brunswick incorporate science and ecological knowledge. Moreover, through integrating empirical evidence demonstrating the reliance of various vertebrate species on old forest conditions, New Brunswick is promoting the preservation of Old Forest Communities and OFWH. This information could be leveraged by other provinces as a strategy for enhancing the protection of OGF as special habitats. That being said, New Brunswick allows the harvesting of timber in old forest areas, which would make it difficult for these areas to transition into proper OGF, being dependent on minimal human disturbance.

- Neither Nova Scotia nor New Brunswick have regulatory frameworks that require the conservation or protection of OGF. Whereas, British Columbia has legally enforceable tools to promote the retention of OGF through Old Growth Management Areas.

- The objectives of Old Growth Management Areas (OGMA) are legally binding. All forest licensees in British Columbia, with approved Forest Stewardship Plans, are subject to these objectives and old growth retention requirements. Any OGMA in a given licensee's harvesting or development region, must be included in their Forest Stewardship Plan. That being said, British Columbia does not have a legally mandated provincial monitoring program to assess the effectiveness of old-growth retention and could improve their current framework by implementing such a program.

YEARS OF DATA

- Year 1 of a 2 Year project

PARTNERS

- East Coast Environmental Law
- Environment Canada
- Habitat Conservation Fund
- Nova Scotia Department of Labour and Advanced Education

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Rationale

The Monarch butterfly is a species that captivates a wide audience. 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 its threats 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. The education, motivation and empowerment of individuals and communities to help this species are key to the recovery process.

Monarch caterpillar (C. Feltham)

Monitoring
MONARCH BUTTERFLY STEWARDSHIP

OBJECTIVES

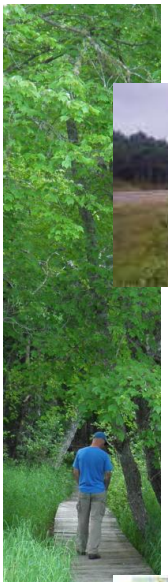
- To reduce knowledge gaps.
- To conserve and enhance Monarch butterfly breeding and nectaring habitat along roadsides where Common milkweed is growing.
- To encourage private landowners to create chemical-free butterfly gardens using Swamp milkweed for Monarchs.
- To contribute to Monarch butterfly tagging and monitoring programs to assess population sizes, migration pathways, and staging areas.

MTRI staff gardening (C. Feltham)

METHODS

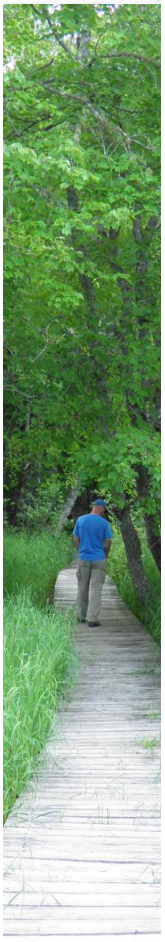
- Butterfly Club kits including 2 Swamp Milkweed plants and educational information were at farmers' markets, public events, the Mersey Gift Shop in Kejimkijik and at MTRI's field station.
- Mass media were employed to advertise the Butterfly Club and recruit new members.
- To partner with three commercial nurseries to host informative displays about Monarch butterflies, Swamp milkweed, native nectar plants, and chemical-free gardening.
- To partner with our agricultural and Aboriginal communities to increase awareness of Monarchs and help increase habitat.

Volunteer taken photo of a Monarch chrysalis



N. Allen and S. MacDonald, volunteers searching for monarchs during the Monarch Blitz survey (C. Feltham)

A map of all the Monarch Butterfly Club members and their monarch friendly gardens (MTRI)



RESULTS

- The overwintering numbers of monarchs has increased from the all-time low in 2013-2014 (0.67 ha) but is still unstable for the 2015-2016 season (4.01 ha).

- Over 1000 Butterfly Club members have planted butterfly gardens at their homes, schools, community centers and businesses. For the summer of 2016, Keji Park staff, MTRI staff and volunteers obtained over 225 new members.

- MTRI attended over 15 farmers' markets including markets located in the Halifax area, to educate the public about monarchs and milkweed.

- Volunteer Connie Jefferson, a nursery owner and partner donated 100 milkweed plants, and a butterfly club member donated 500 plants to MTRI's stock for sale at markets.

- Three commercial nurseries; Baldwins, Wile's Lake Farm Market and Oceanview, have promoted increasing habitat for Monarchs. The nurseries sold a total of 930 swamp milkweed plants, Oceanview 130, Wileville 250, Connie Jefferson 300, and Baldwins sold 250 and had 16 Monarch caterpillars.

- 150+ Butterfly Club members responded to an online survey, 55% reported their milkweed was healthy, flowering and growing well. Another 22% of members expressed interest in additional help with growing their butterfly gardens.

- Record numbers of monarchs were observed in 2016, with over 200 adults and 180+ caterpillars observed in gardens. On average those who reported monarch sightings saw 1-2 individuals in their gardens. Two butterflies and 19 caterpillars were found during a volunteer conducted survey in the Annapolis Valley.

YEARS OF DATA

- Ongoing project since 2008

PARTNERS

- Parks Canada
- Friends of Keji Cooperating Association
- Monarch Watch

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