Wapusk
National Park
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Report on Research and Monitoring in Wapusk National Park

2011-2012

Parks Canada Parcs Canada

Canada

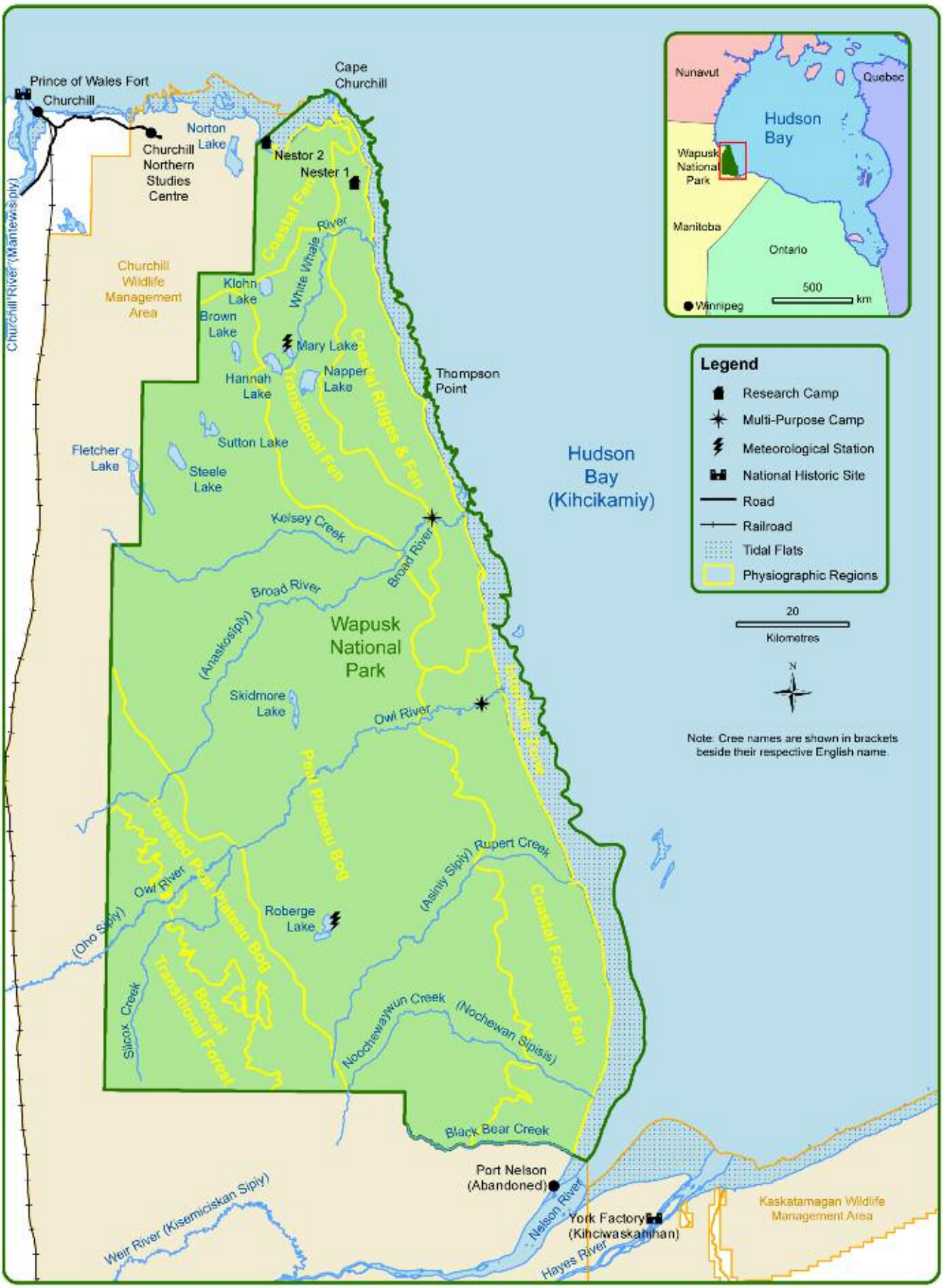
Prince of Wales Fort
Churchill
Cape Churchill
Norton Lake
Churchill Northern Studies Centre
Nestor 2
Nester 1
Churchill River (Mantewisipiy)
Coastal Fen
White Whale River
Churchill Wildlife Management Area
Klohn Lake
Brown Lake
Mary Lake
Hannah Lake
Napper Lake
Transitional Fen
Coastal Ridges & Fen
Thompson Point
Sutton Lake
Fletcher Lake
Steele Lake
Hudson Bay (Kihcikamiy)
Kelsey Creek
Broad River
Broad River (Anaskosipiy)
Wapusk National Park
Skidmore Lake
Owl River
Peat Plateau Bog
Forested Peat Plateau Bog
Rupert Creek
(Asiniy Sipiy)
Owl River
(Oho Sipiy)
Roberge Lake
Coastal Forested Fen
Silcox Creek
Boreal Transitional Forest
Noochewayyun Creek
(Nochewan Sipisis)
Black Bear Creek
Port Nelson (Abandoned)
Weir River (Kisemiciskan Sipiy)
Nelson River
York Factory (Kihciwaskahihan)
Hayes River
Kaskatamagan Wildlife Management Area
Nunavut
Quebec
Hudson Bay
Wapusk National Park
Manitoba
Ontario
500
km
Winnipeg
Legend
Research Camp
Multi-Purpose Camp
Meteorological Station
National Historic Site
Road
Railroad
Tidal Flats
Physiographic Regions
20
Kilometres
N
Note: Cree names are shown in brackets beside their respective English name.

Table of Contents

We are pleased to share this 5th research and monitoring report for Wapusk National Park. Scientists have been conducting a variety of projects in the area now known as Wapusk National Park for nearly half a century, and hundreds of papers can be found in the scientific literature detailing their results. The 2011-2012 research and monitoring report highlights 24 current projects. As a series, these reports will map the continuing evolution of research and monitoring in Wapusk and will increase the communication of research findings to the general public.

The Wapusk National Park Management Plan re-affirms Parks Canada's responsibility for maintaining and monitoring the ecological integrity (EI) of the Park. Research collaborations enhance our ability to monitor critical issues that may affect EI in the Park, and to better understand them. Parks Canada is becoming more directly involved in research in Wapusk and this research and monitoring report presents summaries of projects we are currently piloting or developing.

Many of these projects contribute directly to park management, as well as regular reporting to Canadians on the conditions of the Park, via a State of the Park Report. In addition, we present summaries of projects relevant for Management Effectiveness Monitoring (MEM). As new visitor opportunities are implemented and infrastructure is developed or upgraded to support these activities, Parks Canada will continuously monitor EI to ensure this infrastructure minimizes impact on EI. One example of MEM includes looking at the types and rates of polar bear/ human interactions at three of the research camps. Through the use of remote wildlife cameras and trail counters, polar bear activity near two park-owned management compounds (at Broad River and Owl River) and at Nester One is being monitored in conjunction with human activity.

As new visitor opportunities are offered in the park, we anticipate an increase in human – polar bear interactions. By distributing bear-human interaction forms to visitors, staff and commercial operators, we are simplifying the collection of information on these interactions and will be able to track any changes over time. The collection of these forms, and of other wildlife observations, as well as monitoring EI and other processes within the park boundary will help guide management decisions, and achieve strategic goals within our management plan; “Ecological Integrity is maintained by keepers of the land”.

We hope this report provides a glimpse into the diversity of research and monitoring programs carried out on the ground in Wapusk National Park and the greater Churchill region in 2011-12. If you wish to learn more about a specific project please contact the lead researcher listed. If you wish to contribute to a future report please contact Parks Canada staff in Churchill. We welcome any questions or feedback on this research and monitoring report.

Melissa Gibbons
(Resource Conservation Manager)

Natalie Asselin
(Ecologist)

Zooplankton response to environmental change in Wapusk National Park

Rationale:

In Wapusk National Park, rapidly increasing snow goose populations have resulted in catastrophic changes to vegetation and soil conditions. Removal of vegetation by geese, results in dramatic increases in salinity of nearby water bodies. The observed increases in salinity may act as a new force of selection on the freshwater species and will have a large impact on the aquatic community. The zooplankton genus Daphnia produces resting eggs that are preserved in lake sediments. As sediments accumulate within a pond so do resting eggs; these eggs can then be used to track historical changes in species composition. Additionally, resting eggs can be hatched even decades after they were produced and these individuals can be used in direct comparisons in morphology and fitness between individuals.

Objectives:

- To assess zooplankton adaption to increased nutrient and salt loading to Wapusk ponds

Methods:

- Fieldwork was conducted between July 24 and 28, 2012.
- 30 ponds were sampled for water chemistry, chlorophyll a, phytoplankton and zooplankton communities.
- Sediment cores (eight per pond) were collected for three ponds: one from an area with high snow goose grazing intensity and two from non-impacted ponds.
- Sediment cores were sectioned into 0.5 cm intervals; top layers represent time periods after goose impact and layers further down in the core represent time before.
- Daphnia resting eggs were removed from each layer classified as either Daphnia magna or Daphnia tenebrosa based on appearance.
- Daphnia were hatched from resting eggs from each time period and used in experiments to investigate changes in salinity tolerance.

Years of data collection:

Portion of ongoing project since 2008

Partners:

- Queen's University
- Parks Canada

Results:

- Egg bank densities in the non-impacted pond were significantly less than those found in the two goose impacted ponds throughout the core and were dominated by D. tenebrosa.
- In the goose impacted pond the Daphnia community shifted from being composed of several species including D. magna and D. tenebrosa to a community dominated by D. magna after the expansion of goose populations.
- No significant different in short term salinity tolerance were observed in Daphnia from before and after goose impact.
- Subtle differences in life history characteristics between pre and post impact genotypes may be responsible for the observed increase in abundance and will be investigated using long-term performance measures.

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***Figure 1**. Differences in a) conductivity and b) chlorophyll a in goose impacted and non-impacted ponds.*
Credit: Kimberley Lemmen

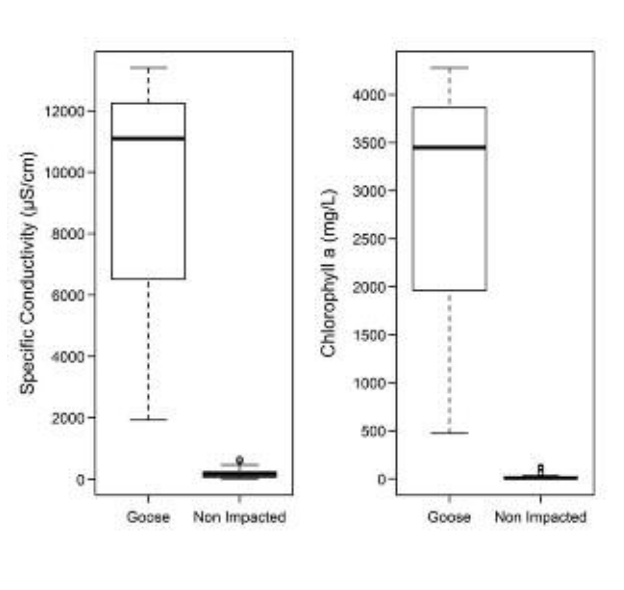
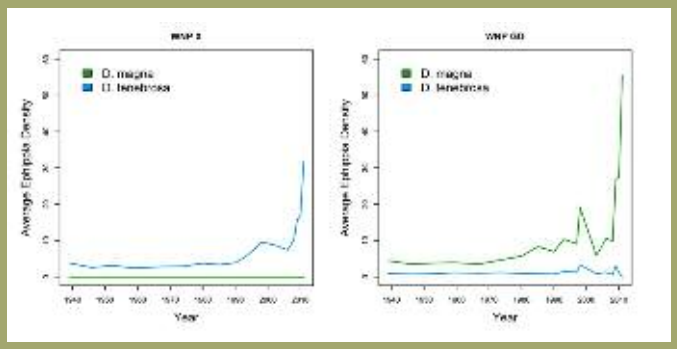
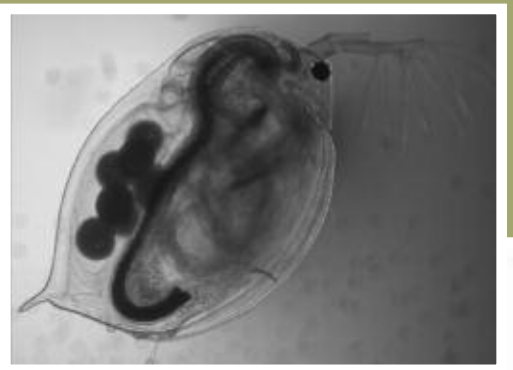


***Figure 2.** Changes in Daphnia community composition over time in a goose non-impacted (WAP X) and a goose impacted (WAP GG). Goose impacted begins in 1990s in WAP GG.*
Credit: Kimberley Lemmen



Resting eggs of the two dominant Daphnia species in Wapusk National Park
Credit: Kimberley Lemmen



Daphnia magna- adult female
Credit: Kimberley Lemmen

Graduate student Kimberley Lemmen with sediment core from goose impacted pond Credit: Shelley Arnott

Manitoba Breeding Bird Atlas

Rationale:

The Manitoba Breeding Bird Atlas surveys are designed to provide useful data to Parks Canada on bird distributions and the relative abundance of species. All Species at Risk data will be georeferenced and provided to Parks Canada and the Manitoba Conservation Data Centre. Special efforts are made to record Species at Risk. These surveys will serve as a basis for recommendations to establish a long-term monitoring project to effectively monitor potential changes in distribution and abundance of Wapusk's birdlife. Recommendations for long-term monitoring will factor in financial and logistical limitations, bird community distribution and habitat-based distributional patterns.

Table of records of Species at Risk and Species of Interest

Species and Atlas Code	MB S-rank	CAT	Max BE	# Records (individuals)	Total # Squares	# Point Counts (Total Count)
Golden Eagle *Aquila chrysaetos*	SHB		FY	4 (7)	3	0
Trumpeter Swan *Cygnus buccinator*	S1S2B		H	1 (3)	1	0
Short-eared Owl *Asio flammeus*	S2S3B	SC	P	5 (6)	5	1 (1)
Horned Grebe *Podiceps auritus*	S3B	SC	P	1 (2)	1	1 (2)
Semipalmated Sandpiper *Calidris pusilla*	S3B		D	48 (69)	18	47 (67)
Olive-sided Flycatcher *Contopus cooperi*	S3S4B	TH	S	1 (1)	1	0
Barn Swallow *Hirundo rustica*	S4B	TH	H	3 (3)	0	0
Lapland Longspur *Calcarius lapponicus*	S3B		P	247 (567)	6	244 (564)
Smith's Longspur *Calcarius pictus*	S3B		S	49 (76)	12	48 (75)
Rusty Blackbird *Euphagus carolinus*	S3S4B	SC	S	48 (78)	18	37 (61)

For an explanation of Manitoba S-ranks, please see http://www.gov.mb.ca/conservation/cdc/consranks.html. Cat = COSEWIC category: SC = Special Concern, TH = Threatened.. Max BE indicates the highest breeding evidence code obtained on the expedition: H = bird in suitable habitat; possible breeding, S = bird singing territorial song or equivalent (e.g. display boom of Common Nighthawk), possible breeding; P = pair, probable breeding; D = display (territorial display involving two or more individuals), probable breeding; FY = fledged young, confirmed breeding; NE = nest with eggs, confirmed breeding. Numbers in brackets indicate the number of individuals.

Objectives:

- Complete avian survey of park over 4 years
- Establish basis for effective long-term monitoring
- Document avian communities and Species at Risk distribution throughout park

Methods:

- Survey protocols detailed at: http://birdatlas.mb.ca/pdfkit_en.jsp
- Point count surveys and general atlassing surveys conducted in most atlas grid squares (10km x 10km UTM grid squares) along prescribed routes (Owl River in 2011, Broad River and portion of coast in 2012), as well as some special (playback) surveys for Yellow Rail (Special Concern) in suitable habitat.

Years of data collection:

Year 2 of a 4-year project

Partners:

- Bird Studies Canada
- Parks Canada
- Environment Canada
- Manitoba Conservation
- Manitoba Hydro
- Nature Manitoba
- The Nature Conservancy of Canada
- The Manitoba Museum.

Results:

- In 2012, 334.5 hours of survey effort and 448 point counts were completed, resulting in 1,148 records of 123 species in 33 atlas grid squares.
- First confirmed breeding of Golden Eagle (three nests) in nearly a century in Manitoba (manuscript submitted for publication).
- See Table for records of Species At Risk and Species of Interest.

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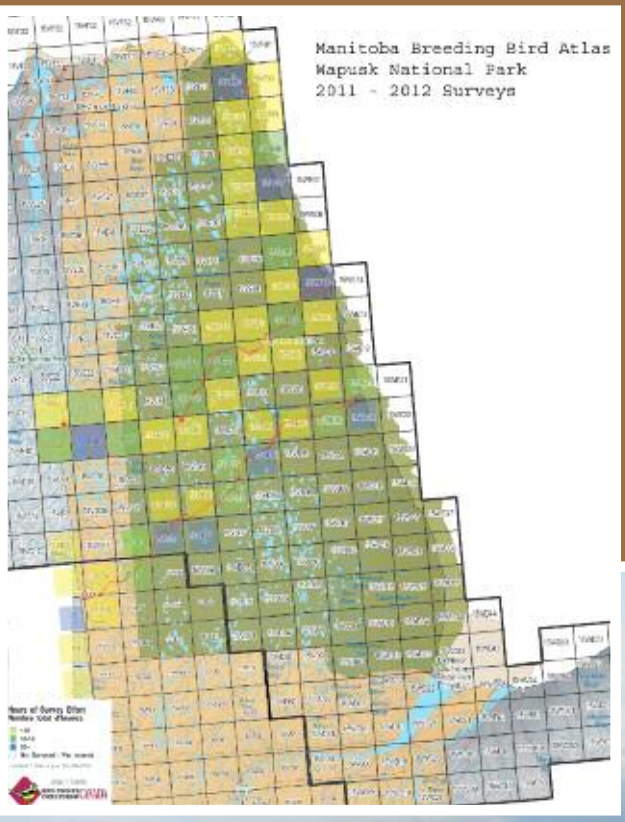
Short-eared owl
Credit: Ryan McDonald

Daniel Giesbrecht and Natalie Asselin (L-R) canoeing on the Broad River
Credit: Ryan McDonald

Ken DeSmet, Martin Scott, David Wright, Ken Kingdon and Jill Larkin (L-R) hiking along a beach ridge
Credit: Ryan McDonald



Dunlin
Credit: Ryan McDonald

Campsite along the Broad River
Credit: Ryan McDonald

Monitoring the abundance of Cape Churchill caribou in Wapusk National Park

Rationale:

Caribou are known to aggregate in summer on beach ridges and mud flats along the coast in Wapusk National Park. The Cape Churchill caribou population was last surveyed in the late 1990s and estimated to number approximately 3000 animals. This abundance estimate was based on two coastal flights to photograph tanders (tight groupings of caribou) and can be considered a minimum population size as inland animals were not included. More recently, one photograph of a caribou tander, taken in 2007 by Dr. Ryan Brook (University of Saskatchewan), contained approximately 2900 caribou.

Objectives:

- Conduct an aerial survey of the Cape Churchill caribou herd
- Assess the feasibility of using aerial surveys to determine the abundance of caribou in the park
- Refine the research methods as needed to include the abundance of Cape Churchill caribou in the Ecological Integrity monitoring program for Wapusk National Park

Methods:

- Survey extent was based on locations of 10 female Cape Churchill caribou equipped with satellite-linked collars (data from Manitoba Conservation) and opportunistic sightings of caribou in Wapusk by Parks Canada staff and other researchers.
- We used a combination of systematic random line-transect survey design and flight lines parallel to the coast to search for large coastal groups.
- Aerial surveys were flown on 6 August 2012 using a Bell 206 LongRanger helicopter and flying at a ground speed of 120-130 km/hour and at an altitude of 120 metres.
- Aerial photographs of groups with >50 caribou were taken.
- We added additional transects over the area of highest density to double the survey coverage in this portion of the study area.
- The analysis combined the results of the systematic survey and one large coastal group to determine the overall abundance of Cape Churchill caribou.
- When possible, males, females and calves were identified.

Years of data collection:

- Pilot survey completed in 2012
- Survey to be repeated in 2013 to increase precision and accuracy of results
- Monitoring surveys to be conducted every five years thereafter

Partners:

- Parks Canada
- Manitoba Conservation

Results:

- One large coastal group of 582 caribou was observed.
- The use of photographs in conjunction with visual sightings successfully captured caribou in large groups along the coast and those distributed at low density farther inland.
- An insufficient number of caribou groups were observed during the systematic survey for Distance Analysis. A minimum of 60 to 80 observations are recommended to produce an accurate and precise abundance estimate.
- Future surveys should include higher coverage to increase the number of sightings.

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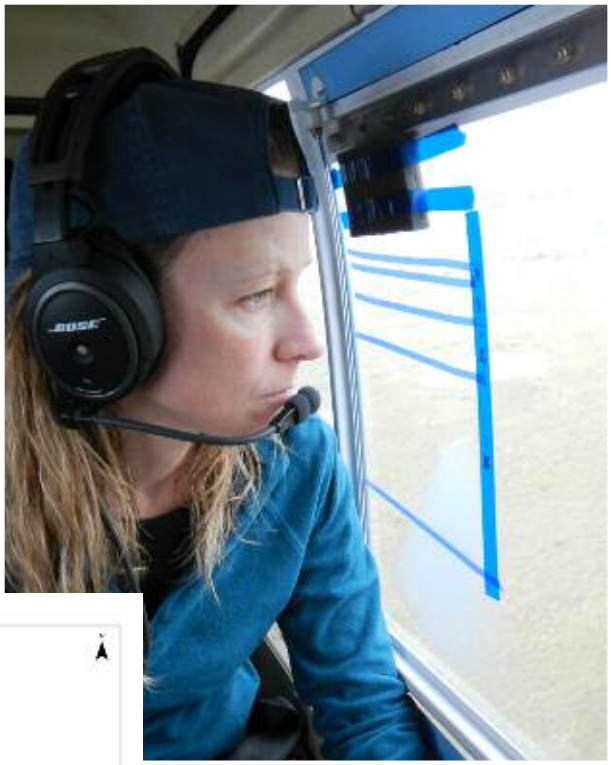
Coastal caribou habitat Credit: Parks Canada

Vicki Trim (observer) during survey (blue tape on the window was used to mark the distance bins)
Credit: Parks Canada



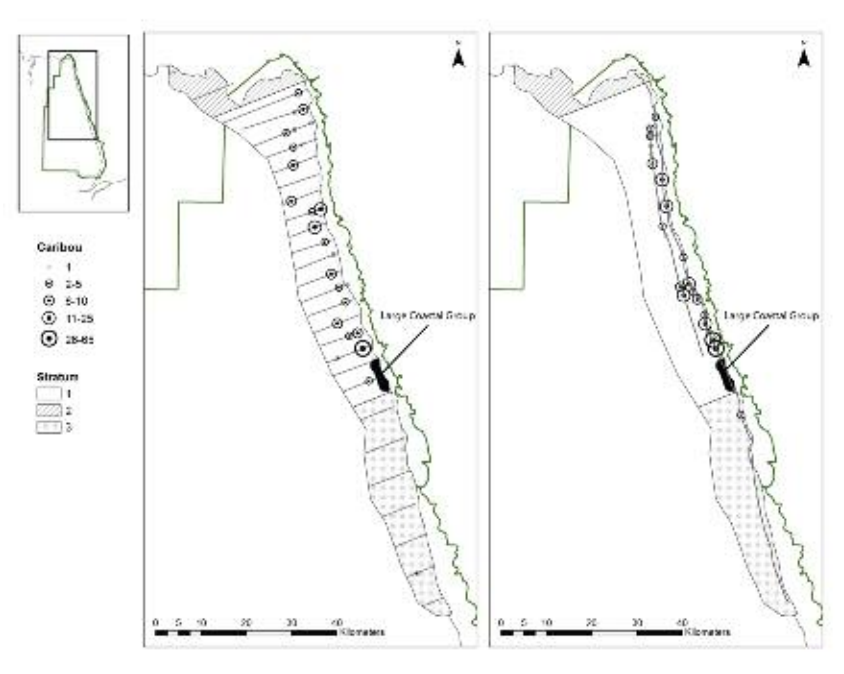
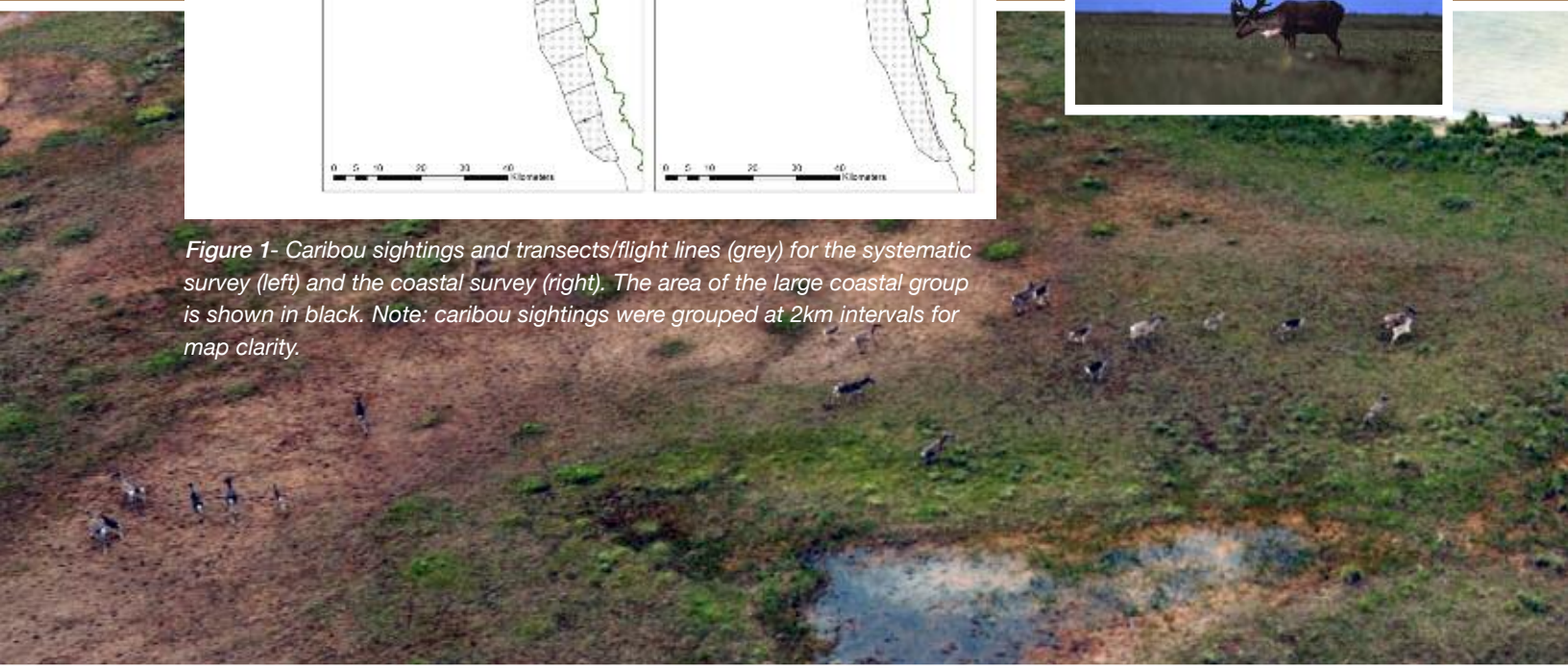


Figure 1- *Caribou sightings and transects/flight lines (grey) for the systematic survey (left) and the coastal survey (right). The area of the large coastal group is shown in black. Note: caribou sightings were grouped at 2km intervals for map clarity.*

Male caribou
Credit: Parks Canada, Kevin Burke



Caribou group Credit: Daryll Hedman

Polar bear den emergence track survey - pilot project

Rationale:

Female polar bears emerge from their dens in Wapusk National from approximately mid-February to early April. A couple of weeks after emergence, they travel to their feeding grounds on the sea ice of Hudson Bay with their young cubs. Previous research has shown that these family groups maintain a relatively constant heading while travelling from their dens to the sea ice and do not 'double-back'. Track surveys can be a cost-effective, non-invasive method for assessing wildlife populations.

Objectives:

The purpose of this project was to assess the feasibility of using snowmobile-based track surveys to:

- Monitor the number of polar bears denning in Wapusk
- Monitor the reproductive success of polar bears denning in Wapusk
- Determine when females with cubs are traveling from their maternity dens to the sea ice

Methods:

- The survey path traversed an area between the known polar bear den locations in the park (provided by Environment Canada) and the Hudson Bay coast
- Two observers travelled by snowmobile at speeds below 30 km/hr along the survey path
- At each set of polar bear tracks, observers recorded the number of adult and cub tracks, width of the tracks, directional heading of the tracks and an estimate of the age of the tracks (within a day, 1-3 days, older than 3 days)
- To quantify snow conditions, at 17 stations and at each track sightings, the observers measured the snow depth (10 samples), collected one RAM penetrometer profile and described the snow quality in terms of tracking animals (i.e. very poor, poor, ok, good, very good, excellent)
- Four surveys were conducted between February 20 and April 12. Each survey was conducted over a 2 to 6 day period, dependent on weather conditions.

Years of data collection:

Single year project 2012

Partners:

- Parks Canada

Results:

- Eight sets of tracks were recorded with the first tracks spotted on 22 February 2012 and the last on 29 March 2012.
- Three sets of tracks had one adult and one cub and four sets had one adult and two cubs. The number of cubs could not be determined for one set of tracks.
- No tracks were found during the last survey (11-12 April).
- Seven of the eight sets of tracks were found south of Owl River but, generally, snow conditions were not as good for tracking north of Owl River.
- One overnight dugout was recorded south of Owl River.
- An insufficient number of polar bear tracks were identified to allow for further analysis. An increase in the frequency of the surveys is needed to increase the number of track detections.
- Helicopter surveys are recommended as they would decrease the amount of time needed to complete a survey (from ~4 days by snowmobile to ~4 hours by helicopter) and allow for a larger detection area.

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Kevin Burke beside an overnight dugout
Credit: Parks Canada

Polar bear tracks Credit: Parks Canada

Measuring the width of a polar bear track
Credit: Parks Canada

Figure 1. *Locations of polar bear tracks, snow sampling stations and survey path*

Jill Larkin preparing to start a survey Credit: Parks Canada

Western Hudson Bay polar bear aerial survey

Rationale:

We conducted the first comprehensive aerial survey of polar bears across Western Hudson Bay (WH) in 2011. The survey was conducted in response to on-going concerns regarding the state of this population, as well as interest in the development of aerial surveying as a rapid, less invasive alternative to the tagging methods currently used for monitoring.

Objectives:

- Accurately estimate polar bear abundance in WH using aerial surveys
- Compare results obtained from aerial surveying with those derived from tagging studies
- Evaluate the use of aerial surveying as a tool for future monitoring of polar bears in WH
- Evaluate the distribution of polar bears in WH during the ice-free season with respect to ecological variables

Methods:

- The study area encompassed the entire summer and fall range of the WH polar bear population from Nunavut through Manitoba to western Ontario **(figure 1)**.
- Two teams of 4 observers each flew in either a helicopter or a fixed wing-aircraft to search for bears. Survey flights followed a series of transects across the study area extending inland up to 100 km, along the coastline and offshore to islands in WH **(figure 1)**. To enhance precision, spacing of transects was varied across the study area dependent on expected densities of bears. As a result, survey intensity was highest in areas where bear density was highest such as in Wapusk National Park.
- Data on sightings of polar bears were collected using a technique known as sight-resight distance sampling which corrects for factors affecting an observer's ability to spot bears such as distance from the survey aircraft, terrain, habitat (i.e. trees, bushes, open ground), weather conditions, group size and bear behaviour (i.e. running, standing, lying).

Years of data collection:

Single year project 2011

Partners:

- Department of Environment-Government of Nunavut
- Manitoba Conservation
- University of Minnesota
- Environment Canada
- Nunavut Wildlife Management Board
- Nunavut General Monitoring Program
- Parks Canada
- Ontario Ministry of Natural Resources
- Arviat Hunters' and Trappers' Organization
- Rankin Inlet Hunters' and Trappers' Organization

Results:

- From August 13-19 2011, we flew more than 100 hours covering approximately 8000 km of inland transects and 95% of the Western Hudson Bay coastline.
- A total of 711 polar bear sightings were recorded. The highest concentrations of bears were found south and east of Churchill including Wapusk National Park, and the Cape Tatnum region southeast of the Nelson River **(figure 1)**. Bears were highly concentrated near the coast throughout the study area although some individuals were observed up to 75 km inland; in particular within Wapusk.
- In comparison to similar aerial surveys conducted in the neighbouring Foxe Basin and Southern Hudson Bay populations, we observed relatively few cubs (50 individuals) and yearling (22 individuals) polar bears. Litter sizes were the lowest recorded in recent studies in Western Hudson Bay and surrounding populations. Cubs and yearling made up a significantly smaller proportion of the overall population. These findings are a strong indication that WH is currently less productive than other subpopulations in the Hudson Bay complex, and nearby regions.
- Data analysis resulted in a final population abundance estimate of 1000 bears (95% C.I. 713-1398). Based on the outcome of this survey we conclude that aerial surveying is a suitable method for monitoring the distribution and abundance of polar bears in Western Hudson Bay. Tagging based studies remain an important source of detailed information on things such as survival, reproduction and body condition since this type of information is not provided by aerial surveys.

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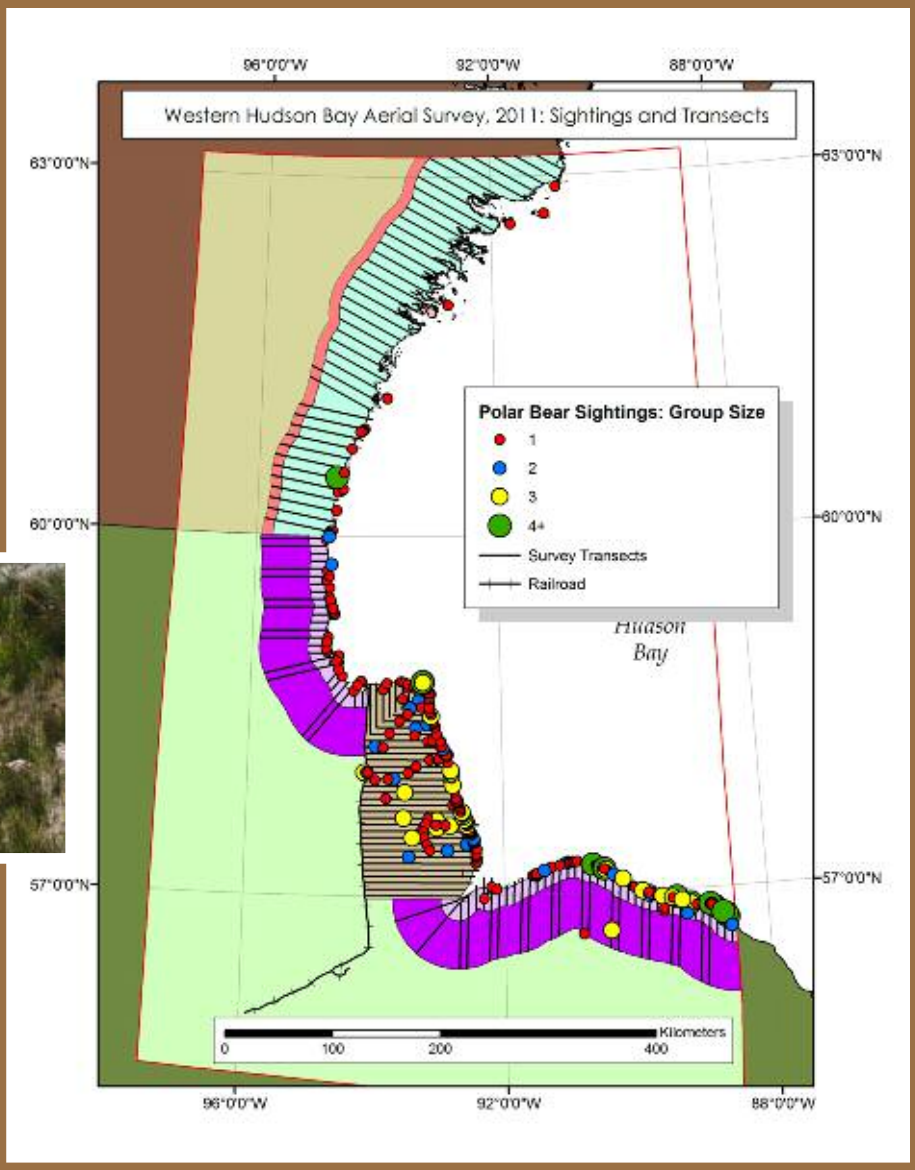

Figure 1. *Transects flown and polar bear sightings recorded during the Western Hudson Bay aerial survey; August, 2011*

A group of adult males spotted during the survey
Credit: Stephen Atkinson

A group of relaxed looking bears spotted at Cape Churchill
Credit: Stephen Atkinson

Surveying near Cape Tatnum
Credit: Stephen Atkinson

York Factory served as a basecamp for part of the survey
Credit: Stephen Atkinson

Management of Eastern Prairie Population (EPP) Canada geese

Rationale:

Eastern Prairie Population (EPP) Canada geese breed in northern Manitoba and migrate through Manitoba, Minnesota, Iowa, Illinois and Missouri where they are harvested during fall and winter. Annual information on population size and harvest rates is used to establish harvest strategies (hunting season lengths and bag limits) in Canada and in the USA. Since the late 1960s and early 1970s, annual management programs have included aerial breeding ground surveys and marking of flightless geese throughout the breeding range.

Objectives:

- Estimate breeding population and trend in components of population (transect-based aerial survey stratified by habitat type)
- Estimate harvest rate of juvenile and adult EPP Canada geese and trends (banding of flightless adults and their young through breeding range)

Methods:

- During the Canada goose nesting season, survey transects established in the early 1970s are flown using a fixed-wing survey plane. The entire breeding range is surveyed and pairs, singles, and groups of Canada geese are counted during the nesting season. Four observers, two on either side of the aircraft, are used so that the abundance estimate can be corrected for visibility bias.
- Using a helicopter, 4 personnel and drive nets, family groups of Canada geese are captured and banded during their flightless period. Sample size analyses for this population indicate 600 adult and 1200 juvenile geese marked annually produce acceptable levels of precision without over-investment of banding effort. Harvest rate is corrected for reporting bias using estimates produced from reward banding efforts.

Years of data collection:

- Aerial surveys since 1972
- EPP breeding grounds banding since 1968
- Nest density and productivity at Nestor One from 1976 to 2010

Partners:

- Manitoba Conservation and Water Stewardship
- U.S. Fish and Wildlife Service
- Canadian Wildlife Service
- Minnesota Department of Natural Resources
- Iowa Department of Natural Resources
- Missouri Department of Conservation
- Illinois Department of Natural Resources

Results:

- Long term estimates of breeding population, which have remained fairly stable
- Long term estimates of harvest rate (~10% for juveniles and~5% for adults in last five years), which have been unaltered by recent harvest liberalizations in Canada and in the USA

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EPP Canada goose banding- family group along the Hudson Bay coast Credit: Frank Baldwin

EPP Canada goose banding- closing in the net
Credit: Frank Baldwin

EPP Canada goose nest with Nester One in the background
Credit: Frank Baldwin

EPP aerial breeding population survey- view from the plane
Credit: Frank Baldwin

Cultural resource management in Wapusk National Park

Rationale:

An inventory and evaluation of cultural resources in Wapusk began in conjunction with management planning for park establishment in 1998. A background study and helicopter survey of Cape Churchill and the mouths of Broad and Owl Rivers recorded 52 sites north of the Owl River, largely on gravel beach ridges and river mouths. Tent rings, cairns/caches are ubiquitous but provide little in the way of diagnostic evidence.

A compilation of land use history and field work determined that sites reflect a variety of occupations—pre-contact, 19th- and 20th-century aboriginal and Euro-Canadian, fur trading, military and research operations, and recent hunting and trapping camps. The area was used extensively for seasonal, short term purposes by aboriginal and Euro-Canadian groups but has never been intensively occupied. A total of 103 sites have been recorded.

In 2011, sites selected for their potential to increase our understanding of the parks culture history were visited and recorded **(figure 1)**.

Objectives:

- Revisit, conduct a condition assessment and map selected sites
- Record and photograph features on each site

Methods:

For each site, these major tasks were accomplished:

- Identifying and interpreting each feature, using previous field notes as a starting point
- Identifying and interpreting features not observed in the first surveys
- Digitally photographing each feature on a site
- Recording the GPS coordinates of each feature and making a track of the major topographical traits in the site area
- Making a map of each site using QuickBird Imagery

Years of data collection:

Single year project 2011

Partners:

- Parks Canada

Results:

- Over 20 sites were visited and recorded in detail. Most of the sites are small with fewer than 10-12 tent rings and associated features such as caches and hearths. Diagnostic artifacts are often lacking. Generally, the tent rings are fairly large (4 m – 5 m in diameter) and made with small loosely-spaced rocks, indicating occupations in the later historic period. All of the sites are located on beach ridges on which chert is a common component and detritus from chert knapping appeared on many sites. Because of its ubiquity and occurrence in glacial till, the presence of chert may not indicate a pre-contact site, as had originally been inferred.
- Notably, two larger sites contained evidence of Historic Inuit occupation in the form of a heavy tent ring and igaviit, the typical Inuit three-stone hearth.
- One site was the location of an isolated find of an almost complete but fragmented kaolin pipe.
- A series of sites on a ridge between Klohn and Napper lakes, originally described as containing possible Arctic Small Tool tradition (ASTt) lithic artefacts, were revisited. Most of these artifacts were relocated and found to be chipping detritus and not artifacts (burin, burin spall and microblade) diagnostic of ASTt.

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Aquitaine Relay Camp, Broad River
Credit: Parks Canada

Rodney Redhead taking a GPS reading at a boulder cache site near Broad River Credit: Parks Canada

Figure 1. *Locations of sites visited in 2011*
Credit: Parks Canada

Typical Inuit igaviit or three-stone hearth near Cape Churchill Credit: Parks Canada

Blind/work area near Cape Churchill
Credit: Parks Canada

University of Saskatchewan and University of Manitoba wildlife and ethnoecology field course in Wapusk National Park

Rationale:

While classroom learning provides an important basis for understanding ecological processes and the role of humans in the environment, practical hands-on fieldwork is a critical component of training the next generation of researchers and park managers. The Wildlife and Ethnoecology program provides the opportunity for students to immerse themselves in the Hudson Bay Lowlands Ecosystem and learn from local people. Participants in the program work together as an interdisciplinary team of researchers to produce outcomes that are of real value to natural resource managers and the local community.

Objectives:

- Expose students to the unique ecology, wildlife, human impacts, and challenges of working in Wapusk National Park.
- Develop critical thinking, communication, and practical field research skills.
- Consider the role of protected areas in tourism and conservation and identify ways to use science as a tool to support management.
- Present the results of our research to Parks Canada, Manitoba Conservation, and the broader scientific community through presentations and written reports.

Methods:

- Students spend approximately one week at the Nester One research camp in Wapusk National Park and one week at the Churchill Northern Studies Centre learning and conducting research.
- Permafrost active layer thickness is measured at three fen sites annually and associated vegetation cover is described.
- Sites are sampled and re-sampled to determine species and life form cover to support vegetation mapping and change detection.
- Locations of arctic and red fox dens are mapped annually and we determine if they are active each year, what species are present in each, and we monitor the number of entrances, entrance size, and vegetation cover.
- We assess tourism options for Wapusk National Park.
- Students choose individual or group research projects to be conducted in an area of interest.

Years of data collection:

Ongoing Project since 2005

Partners:

- Parks Canada
- Manitoba Conservation
- Canada Centre for Remote Sensing

Results:

- From 2005 to 2012, 135 undergraduate and graduate students visited Wapusk National Park as part of the course and contributed individual projects and collected field data for the permafrost active layer and vegetation datasets.
- We have >1400 measurements of active layer thickness and we have documented the associated vegetation cover. This year we will be relating these measures to ALOS satellite predictions of active layer thickness.
- We have developed a database of vegetation communities and permafrost active layer thickness for a total of >1300 sites within the Greater Wapusk Ecosystem.

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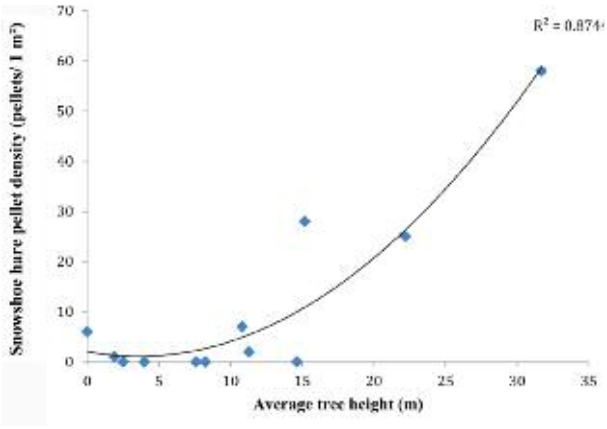
Students on the course sampling permafrost and vegetation cover Credit: Ryan Brook

Polar bear visiting Nester One camp
Credit: Ryan Brook

Two male caribou near Cape Churchill
Credit: Molly Patterson

Figure 1. *Snowshoe hare pellet density is highly influenced by tree cover* Credit: Michelle Ewacha



Research team at Cape Churchill
Credit: Michelle Ewacha

Sensitivity of circum-arctic peatland carbon to Holocene warm climates and climate seasonality

Rationale:

We are interested in understanding how climate and other factors, such as geology, affect carbon biogeochemistry in northern Manitoba. The main focus of our work was the collection of peat cores from approximately 16 sites, one of which is located in Wapusk National Park, in the Churchill region to quantify carbon accumulation rates. We are examining how past climatic changes, such as the Holocene Thermal Maximum, might affect rates of carbon sequestration in high-latitude soils. The Hudson Bay Lowlands is one of the largest soil carbon sinks in the world, and future climate warming may cause this soil carbon to decompose, causing a release of carbon dioxide to the atmosphere, thereby further accelerating warming. We were also interested in sampling the regional rivers for Dissolved Organic Carbon (DOC), Dissolved Inorganic Carbon (DIC) and Total Dissolved Nitrogen (TDN) to better understand how geological substrate and wetlands affect the transport of carbon from landscapes to Hudson Bay.

Objectives:

- To collect peat cores from Hudson Bay lowlands in the greater Churchill, Manitoba region
- To quantify carbon accumulation rates in these peat cores using radiocarbon dating and elemental analysis
- To collect water samples from the major rivers draining into Hudson Bay, including the Broad and Owl Rivers located in Wapusk Park
- To analyze these water samples for biogeochemical properties, including DOC, DIC, TDN, pH, conductivity, and cations

Methods:

- In Wapusk, we collected replicate peat cores from one peatland site (informally called Lake 3: Lat/Long = 57.498443N, -93.847353W) along with water from the Broad and Owl Rivers.
- Peat samples are currently being processed and analyzed at Bowdoin College.
- Water was collected at all three sample sites. At the lake site, water was taken from both the lake and a small collapse scar wetland. pH and conductivity were measured, and a Secchi disk reading, to measure water transparency, was taken for the lake.
- Water samples were filtered and subsampled. The subsample for DOC and TDN analysis was acidified for cations while the subsample intended for dissolved silica and anion analysis was not acidified.
- The water samples were analyzed for DIC/DOC Fall 2012 at St. Olaf College.

Years of data collection:

Single year project 2012

Partners:

- Bowdoin College, Brunswick, Maine, USA
- St. Olaf College, Northfield, MN, USA
- National Science Foundation

Results:

- Peat cores at Lake 3 were 150 and 203 cm thick, which is fairly typical for peat depth in the region (the maximum depth we cored in 2012 was 331 cm west of Churchill).
- We do not yet have carbon data for the peat cores, as the cores from the 16 sites are currently being processed for elemental analysis.
- Data for the water samples are presented in **Table 1**. In general, these waters were high pH/DIC, reflecting the underlying basic geology. This differs substantially from rivers farther north draining granitic substrates, where buffering and pH are lower.

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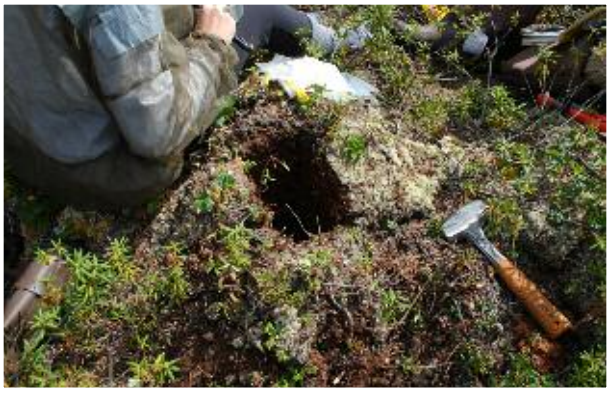
Table 1. Water biogeochemical properties from Lake 3 and Broad/Owl Rivers for samples collected July, 2012

Table 1.

Property	Broad River	Owl River	Lake 3
Ca (ppm)	27.19	30.21	20.58
Mg (ppm)	13.11	7.44	4.88
Na (ppm)	26.9	14.26	1.19
K (ppm)	5.2	3.9	0.6
Fe (ppb)	172	207	56
Al (ppb)	61	53	72
DIC (ppm)	16.01	12.53	NA
DOC (ppm)	10.06	10.75	15.32
TDN (ppm)	0.72	0.43	0.35
Temp (°C)	18.5	18.0	19.5
Secchi (m)	NA	NA	0.9
Conductivity(uS cm^{-1} C)	527.0	171.3	123.6
pH (YSI meter)	8.1	7.8	7.8
pH (Orion meter)	8.4	8.1	8.2

Close-up photo of one of the core holes from which peat was sampled Credit: Phil Camill



Close-up view of the permafrost peatland surface. Standing dead spruce trees indicate that the peatland was burned (date unknown). The vegetative surface cover was dominated by Labrador tea and lichen. Credit: Phil Camill

Aerial photo above Lake 3 showing the elevated permafrost peat plateau landscape. The reddish color is Labrador tea growing on burned peatland surfaces. Credit: Phil Camill

Research team collecting permafrost peat cores with a Hoffer probe. Turbo beaver float plane is visible in background. Credit: Phil Camill

Development of non-invasive methods for detection and analysis of polar bear-human interactions at field camps in Wapusk National Park

Rationale:

Parks Canada recently constructed two remote camps at Broad River and Owl River within Wapusk National Park (WNP). Park personnel reported that the new camps appear to be attracting polar bears, which raises potential management concerns about the safety of visitors, park staff, and infrastructure, as well as potential negative impacts on the bears themselves from those interactions. At the invitation of Parks Canada we have undertaken a research project to respond to this situation.

Objectives:

The research questions we intend to address include:

- Are bears attracted to the new camps at greater frequency than established camps, and if so, why?
- Are there relationships between specific parameters of human activity at these camps and polar bear-human interactions?
- What can be done to minimize the likelihood of polar bear-human conflicts at these camps?
- What, if anything, can be learned about the causal mechanisms of polar bear-human interactions and polar bear behaviour at these camps?

Methods:

- Parks Canada personnel initiated remote-camera monitoring at Broad River camp in 2010 and we are continuing this work. In addition, we have installed a series of remote cameras on the perimeter fencing of two other camps: Nester One (with permission from Manitoba Conservation) and Owl River. These cameras detect and photograph polar bears as they approach.
- Where possible, images will be used to: detect bears' approaches at specific times and dates that can be linked to other observations (e.g. camp occupancy at the time, bear observation reports by occupants), identify individual bears (in order to account for bears that may make repeat approaches to the camps), and assess the body condition of bears approaching camps.
- A simple, unobtrusive and measurable index of human activity is needed in order to assess the effects of activity – as opposed to simply the presence of infrastructure – on the behaviour of polar bears. We plan to continue testing a commercial infrared trail counter system in a range of locations in Broad River and Nester One

Years of data collection:

Ongoing Project since 2011

Partners:

- University of Saskatchewan
- Parks Canada
- Social Sciences and Humanities Research Council of Canada

Results:

- All twelve cameras deployed in 2011 survived the winter and investigation by many curious bears.
- In approximately six weeks of deployment in summer 2011, the six cameras mounted at Broad River detected five approaches by polar bears (in one case, by a family group), and the trail counters reliably logged human activity at three different locations. Seven approaches by bears were detected during approximately the same time period in 2012.
- Polar bears were photographed at Broad River until late November, and at Nester One until mid-December, 2011.
- Other species photographed include caribou, wolf, wolverine, arctic fox, red fox, arctic hare, moose, black bear, lemming or vole (unidentified species), Canada goose, snow goose, raven, common redpoll, and willow ptarmigan.

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Doug Clark installs a remote camera on the Broad River Multi-Use Compound Credit: Parks Canada

Trail counter installed over the kitchen door at Broad River Multi-Use Compound Credit: Doug Clark

Image captured by remote wildlife camera, 2011
Credit: University of Saskatchewan, Doug Clark

Doug Clark installing the protective case over a remote camera
Credit: Parks Canada

Monitoring polar bear-human interactions in Wapusk National Park

Rationale:

The ice on Hudson Bay melts annually, forcing polar bears ashore from approximately July to November each year. The bears of the Western Hudson Bay sub-population can be observed on the three sites managed by Parks Canada in northern Manitoba: Wapusk National Park (WNP), York Factory National Historic Site (YFNHS) and Prince of Wales Fort National Historic Site (PWFNHS; includes Cape Merry, Sloop Cove and Prince of Wales Fort). Polar bears can be seen in Wapusk National Park at any time of the year, although the chance of observing a bear during the ice-free period is much higher. These interactions present a safety risk that must be monitored and managed.

To ensure the safety of both humans and bears, everyone visiting or working on these Parks Canada sites must be prepared to deal with the risk of encountering polar bears. The Manitoba Field Unit has a polar bear safety plan which provides direction to staff on training requirements and methods of polar bear management. Implementing effective risk management strategies is essential for Parks Canada staff, researchers and commercial operators working in the park.

Objectives:

- To engage Parks Canada staff, research partners and commercial operators in recording the number of polar bears observed as well as the number of human-polar bear interactions in Wapusk National Park. Expand this program in the future to include all visitors to the park
- To monitor the number of bears observed over time, including their locations as well as the number of human-polar bear interactions
- To use the information collected to develop relevant safety information and for risk management purposes

Methods:

- Bears observed from the ground are classified into two broad categories: those where there was no deterrent action (encounters) and those where one or more deterrent actions were taken (occurrences). These observations are recorded on standard forms.
- Sightings and aerial observations are recorded along with GPS locations when possible.
- Information on deterrent use is tracked to look at trends.
- A database has been established to manage this information.
- The information is summarized in an annual report.
- Occurrences are shared with the Polar Bear Range States Polar Bear Human Information Management Database.

Years of data collection:

Ongoing Project since 2007

Partners:

- Wapusk National Park Researchers
- Parks Canada

Results:

- In 2011 and 2012, there were 558 and 313 bears observed, respectively, at Parks Canada sites in northern Manitoba. Within Wapusk, 432 and 213 observations were reported in 2011 and 2012, respectively **(figure 1)**.
- In 2011, there were eight occurrences and nine encounters in the park. Two occurrences and nine encounters were recorded in the park in 2012.
- All three species of North American bears (209 polar, two grizzly and two black) were observed in Wapusk National Park in 2012. Grizzly bears have been observed in each of the last three years on Parks Canada sites in northern Manitoba.
- Data for this project were provided by Parks Canada employees, researchers and commercial operators who collectively spent over 2000 user days in the park in 2012 and 2552 user days in 2011.

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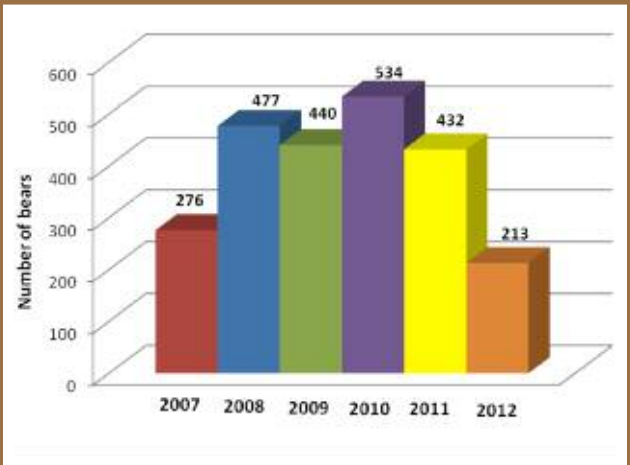
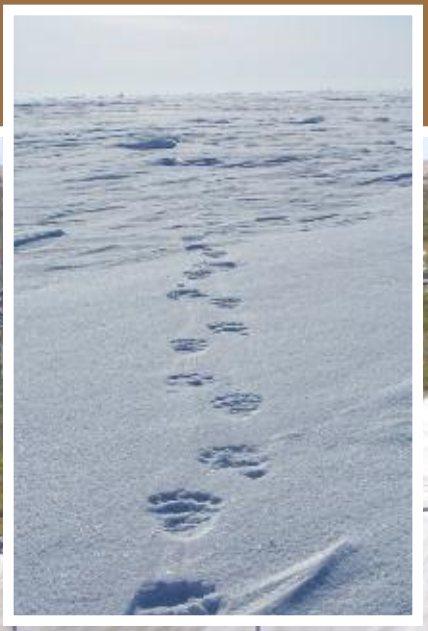
Figure 1. *Wapusk National Park bear observations by year (2007-2012)*



Watching a polar bear at Nester One research camp
Credit: Parks Canada

Polar bear tracks in the snow
Credit: Parks Canada



Polar bears sparring, waiting for the ice to form near Cape Churchill
Credit: Parks Canada

Polar bear at fence at Nester One research camp in August
Credit: Parks Canada

Non-invasive polar bear monitoring in western Hudson Bay

Rationale:

Polar bears in western Hudson Bay are being affected by changing ice and climate conditions and need to be monitored to track population changes over time. When the ice melts, polar bears are forced ashore in large numbers, where they leave behind scat (feces) and hair (in beds) as they move across the tundra. Using molecular analyses of scat (collected using a trained dog) and hair we employed an innovative way to estimate abundance, survival, and other population parameters of polar bears so that no animals needed to be handled or marked. Data are then analyzed using the same mathematics as traditional capture-mark-recapture approaches allowing for direct comparison of results.

With longer ice-free seasons, polar bears will likely seek alternative foods while on land. By documenting items in scat piles, we can identify past and future shifts in diet, especially in response to changing food supplies.

Objectives:

- Monitor local population size of polar bears within the sampling area
- Determine individual and sex-specific movement patterns of polar bears along the coast of western Hudson Bay
- Examine relatedness of polar bears that gather in large groups along the coast or that den in clusters
- Establish baseline data on polar bear diet during the ice-free season to document past and future shifts in response to climate change

Methods:

- Molecular analyses of hair (from beds and dens) and scat to generate DNA profiles for individual polar bears.
- Use traditional mark-recapture and rarefaction analytic approaches to estimate abundance and survival of polar bears using DNA from samples.
- Use spatial coordinates, DNA and sex-specific markers to track movement patterns of bears while on land.
- Use nuclear and mitochondrial DNA to examine relatedness of bears from hair collected from clusters of beds or dens to infer genetic structuring across the landscape.
- Identify and quantify vegetation and animal items in polar bear scat piles; compare data with previous studies to document foraging shifts that may have occurred in the last 40 years.

Years of data collection:

Ongoing Project since 2006

Partners:

- American Museum of Natural History
- Arctic Institute of North America
- Churchill Northern Studies Centre
- City University of New York
- Great White Bear Tours
- Manitoba Conservation - Sustainable Development Innovations Fund

Results:

- We collected a total of 420 hair samples from coastal day beds between the Ontario Manitoba border and Churchill.
- Polar bear DNA has been successfully amplified from both spring and summer scat samples; further genetic analyses are currently ongoing.
- Article by LJ Gormezano and RF Rockwell: *Fasting or feasting on land? Shifts in polar bear diet during the ice-free period in western Hudson Bay* is currently under revision for BMC Ecology.
- We surveyed the coastline of Wapusk National Park five times.

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Some day beds are full of shed hair
Credit: L.J. Gormezano

Day beds in gravel at Cape Churchill
Credit: L.J. Gormezano

Robert F. Rockwell collects hair from a large elymus day bed
Credit: L.J. Gormezano

Linda Gormezano collects hair in a day bed
Credit: R.F. Rockwell

Microclimate, snowpack, dendroclimatology and permafrost degradation in Wapusk National Park

Rationale:

There is a lack of information on the past and present climate in Wapusk National Park. Prior to the start of this project, there were no permanent weather stations within the park. Mid-winter snowpack conditions significantly impact ecological and permafrost characteristics.

Objectives:

- Establish and maintain microclimate monitoring stations
- Collect data from established snowpack monitoring sites
- Develop a proxy climate record using annual growth rings of trees and shrubs

Methods:

- Install and maintain microclimate recording stations that operate year-round. Sensors measure snow depth, rain, wind speed, wind direction, air temperature, air relative humidity, near surface soil and permafrost temperature.
- Using Adirondack snow core and RAM penetrometer equipment, measure snowpack depth, density, snow water equivalent and hardness.
- Collect samples; annual growth rings in shrubs and trees can be used to reconstruct past climate and permafrost thaw.

Years of data collection:

Ongoing Project since 2004

Partners:

- International Polar Year – PPS Arctic Canada, Government of Canada
- University of Alberta
- Churchill Northern Studies Centre (CNSC)
- Earthwatch International
- Parks Canada

Results:

- Two microclimate stations have been established within Wapusk National Park – Mary Lake and Roberge Lake.
- Permanent snowpack monitoring sites have been established in association with the microclimate stations and at other representative sites.
- Dendroclimatology interpretations have been published based on trees sampled throughout the park and in the adjacent Churchill Wildlife Management Area.

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Figure 1. *Heat transfer coefficients at Owl River (OR) and Broad River (BR) sampling sites in Wapusk National Park (B: Beach ridge, S: Shrub, F: Forest, digits for year 2007 to 2012). Heat transfer coefficient is the potential heat loss through the snowpack (log scale). Higher values occur with thin, dense snow on beach ridges while the deeper, less dense forest snowpack insulates the ground*

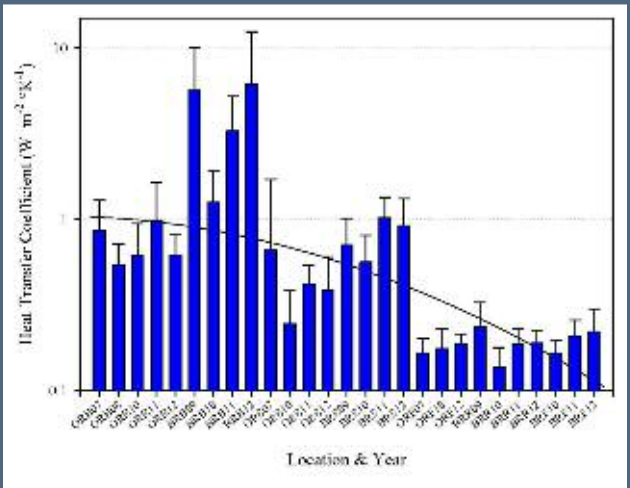
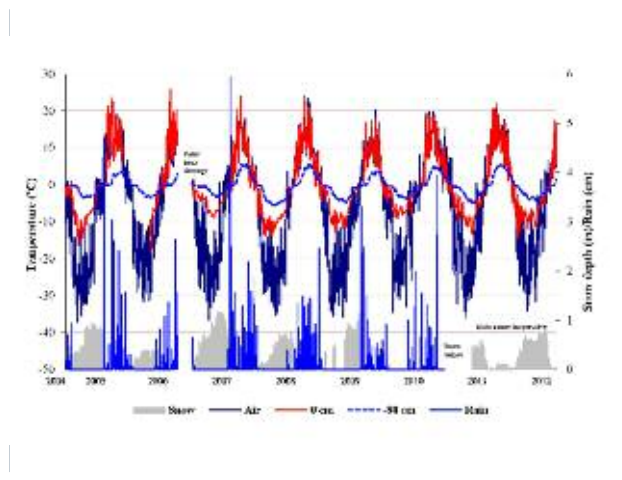


Figure 2. *Temperature and snowpack characteristics at Mary Lake, Wapusk National Park, Manitoba. Data gaps resulted from damage by polar bears and other animals. No trends are apparent after almost eight years*



Snow sampling pit on a beach ridge near Owl River, Wapusk National Park Credit: GP Kershaw

Kevin Burke (Parks Canada), Katrina Jensen (CNSC) and Natalie Asselin (Parks Canada) (L-R) collect snow cores on a polygonal peat plateau at Roberge Lake – February 2012 Credit: GP Kershaw

Polar bear streaming camera: Wapusk National Park

Rationale:

In November 2012, Polar Bears International (PBI), in cooperation with explore.org, installed a high-definition streaming camera on the tower at Cape Churchill, Wapusk National Park. The live-streaming video was shown on two websites allowing viewers to see polar bears and other wildlife. The goal of this pilot project was to determine if a camera system could be successfully installed and maintained at Cape Churchill, while also testing new streaming and viewing technologies on the web.

PBI has been streaming video footage from the Churchill area for nearly a decade. Early technology was cutting edge at the time, but less reliable, with poorer image quality, and compressing and transmitting video from the remote location to the internet required large, bulky equipment.

Objectives:

- Capture video of polar bears from Cape Churchill, Wapusk National Park, stream the video on PBI's and explore.org's websites and record the video for later use
- Use this technology to educate and raise awareness about Western Hudson Bay polar bears in Wapusk National Park, and motivate people to take action to reduce their greenhouse gas emissions

Methods:

- Installation of a single Sony SNC-EP550 PTZ camera, Dotworkz Ring of Fire waterproof and heated camera housing, methanol fuel cell, insulated enclosure for the fuel cell, battery box, six AGM batteries, and miscellaneous gear to power and regulate power to the camera and radio on the tower at Cape Churchill
- Bandwidth provided via a 5.8 GHz wireless backhaul system. The head end of the network was located in Churchill, with parabolic antenna located midrange (at the Churchill Northern Studies Centre) and on the tower at Cape Churchill
- Equipment was assembled in Churchill, and transported to Cape Churchill by helicopter for installation on October 28, 2012.
- On November 5, 2012, the camera and mounting screws were replaced due to a camera malfunction. Strong winds had caused a vibration in the camera lens.
- The camera was removed on November 26, 2012. All peripherals were removed except for three wires and conduit. These were left in place due to strong winds and freezing temperatures which posed a personnel safety risk for removal.

Years of Data Collection:

Single Year Project 2012

Partners:

- Polar Bears International
- explore.org
- Parks Canada
- L & D Cable
- Hudson Bay Port Company
- Churchill Northern Studies Centre
- Frontiers North Adventures

Results:

- Broadcasting during the 2012 polar bear migration was highly successful: we were able to maintain a system at Cape Churchill for four weeks; the streaming technology transmitted HD video from a remote location to viewers on the internet; the test demonstrated that web viewers are interested in this content.
- Website analytics have been received for one of two web destinations; between October 2012 and January 2013, the My Planet, My Part site served 624 days of video to internet viewers, with 224 days going to viewers in the USA and 56 to viewers in Canada. The remaining 344 days served international viewers.
- During the camera's operational season, 8-gigabytes of HD video were recorded. This information will be shared with Parks Canada and other partners.

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BJ Kirschhoffer installing the camera on Cape Churchill Tower, Wapusk National Park Credit: Polar Bears International

Helicopter slinging camera to Wapusk National Park
Credit: Polar Bears International

Camera and batteries, housed in a waterproof case
Credit: BJ Kirschhoffer

Female polar bear and cub, still image captured from Cape Churchill camera, 2012 Credit: Polar Bears International

The ecology and population dynamics of Common Eiders at La Pérouse Bay

Rationale:

Common eiders at La Pérouse Bay have been monitored for nearly 40 years. Typical of the species, they display a boom and bust pattern of reproductive success with years of high success punctuated by years of complete failure. Biological factors, such as predators (e.g. polar bears), and non-biological factors (e.g. flooding) play a role in this reproductive failure. Both polar bear arrival (and depredation) and spring flooding will be increasingly affected by global climate change. We will continue to monitor the success of this colony over time.

In addition to monitoring, we are developing projection models that examine the effects of such boom and bust reproductive success on the population's dynamics. One of the specific questions to be addressed is what frequency and pattern of catastrophic failures can the population sustain without declining or being extirpated.

Objectives:

- Monitor local common eider population abundance, nesting density, reproductive success and juvenile and adult survival
- Determine the pattern and frequency of depredation events
- Develop a population model incorporating catastrophic events

Methods:

- Visit and map nests in the Mast and Wao Wao River systems near the La Pérouse Bay Research Station
- Use egg candling to determine the nesting phenology
- Monitor the nests regularly and estimate daily failure rates
- Capture females on their nests and band them or record band numbers of those previously marked
- Generate population projection models
- Use game cameras deployed at nests to determine predators and predation rates

Years of data collection:

Ongoing Project since 2009

Partners:

- American Museum of Natural History
- Utah State University

Results:

- We found and mapped a total of 399 nests.
- The average clutch size was 4.1.
- Nesting success was 0.23, a return to more normal success.
- Among predators photographed were herring gulls, ravens and a grizzly bear.
- Article by D.T Iles et al. *Predators, alternative prey, and climate influence annual breeding success of a long-lived sea duck*, is currently under revision for Journal of Animal Ecology.

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Remote cameras used to monitor nest predation
Credit: D.T. Iles

Predators get male eiders as well
Credit: D.T. Iles

Female common eider on a nest
Credit: D.T. Iles

Eider nests can be difficult to spot on the landscape
Credit: D.T. Iles

Wapusk wolverine project: pilot year 1

Rationale:

The purpose of the Wapusk Wolverine Project is to develop a long-term monitoring program using DNA mark-recapture techniques to non-invasively track changes in wolverine distribution and population size in Wapusk National Park. Developing a practical monitoring program for a species that is secretive, occurs in low-densities and occupies large home ranges is challenging. A pilot project is underway to determine the feasibility of a long-term monitoring program for wolverines in Wapusk National Park.

Objectives:

- Determine if there is enough genetic variation within the wolverine population to use microsatellite analysis to successfully identify individuals.
- Estimate wolverine density, which will be used to determine the size of the study area and number of sample units required to obtain enough samples for statistical analysis of the data.
- Familiarize staff with the field methods, refine the methodology and overcome logistical challenges.

Methods:

- A hair snag grid was established within the forest between the Broad and Owl Rivers. The rectangular grid consisted of 50 six-foot snag posts, constructed of 4"x4" lumber wrapped with a 6m length of barbwire, arranged in 5 rows of 10 posts spaced 3 km apart.
- Posts were baited with half of a marten carcass and three different artificial scent lures for two, 14-day hair snagging sessions in March and April 2012.
- At the end of each snagging session, hair samples were removed from the snag posts.
- Wolverine skulls were collected local trappers.
- The samples were analyzed for microsatellite genotype, individual identification with 7 microsatellites, sex, and error-checking. The microsatellite genotype that was used for individual ID confirmed species (wolverine or not wolverine).

Years of data collection:

Year 1 of a 2 Year project

Partners:

- Parks Canada
- Local trappers from the Town of Churchill.
- Jim Roth, University of Manitoba

Results:

- Three hair samples from non-target species were obtained from the hair snag posts. No wolverine hair samples were obtained. Without wolverine hair samples in the grid, we were not able to estimate density. During fieldwork, one wolverine was sighted south east of the grid and one set of wolverine tracks was observed in the grid.
- Eighteen wolverine skulls were provided by trappers. Microsatellite analysis indicated that there is enough genetic diversity in this population to identify individual wolverines. Tissue samples from the skulls were sent to Jim Roth at the University of Manitoba for his work on stable isotopes.
- A second pilot year is planned for 2012/13, with modifications to the protocol with the objective of increasing the number of samples obtained from the snag posts. The skull collection will continue and the skulls will be aged and examined for parasites in the future.

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Rodney Redhead attaching the bait to a wolverine snag post Credit: Parks Canada

Jill Larkin and Kevin Burke assembling wolverine posts at the Owl River camp Credit: Parks Canada

Frozen wolverine skull submitted by a local trapper
Credit: Parks Canada

Jessica Lankshear hauling out the final wolverine post of the day by snowmobile Credit: Parks Canada

Population ecology of polar bears in relation to environmental change

Rationale:

Over the past several decades, there's been documented reductions in sea-ice cover in parts of the Arctic, thinning of multiyear ice in the polar basin and seasonal ice in Hudson Bay, and changes in dates of sea-ice breakup and freeze-up as a consequence of climate warming. If the Arctic continues to warm as projected, the diminished ice cover and extended ice-free seasons will have profound negative impacts on polar bears. As a keystone species, polar bears provide insight into overall health of biodiversity within the Arctic marine ecosystem.

Environment Canada initiated a long-term study of polar bears in western Hudson Bay in 1981. This study has resulted in an ongoing, consistent record from which to examine past, present, and future trends and impacts. The research increases scientific knowledge of population dynamics, furthers understanding of barriers to potential recovery, and aids the development and implementation of effective conservation actions.

Objectives:

- Continue ongoing, long-term research on the ecology, population dynamics, and status of polar bears in western Hudson Bay in relation to environmental change.
- Obtain information on habitat use, migration timing, population delineation and regional sea ice projection modelling through the application of telemetry.
- Assess shifts in polar bear foraging ecology in western Hudson Bay in relation to environmental change.

Methods:

- Polar bears (up to 125 individuals in fall and 20 family groups in spring) are located and captured from a helicopter using standard immobilization techniques.
- Polar bears are caught and handled in locations that are safe for their overall well-being. During handling procedures, vital signs and responses are monitored.
- Standard measurements are taken from each animal; those captured for the first time are permanently identified by unique numbers applied as both tattoos and ear tags.
- Blood, hair, fat, and skin samples are collected.
- GPS–ARGOS satellite linked telemetry collars are fitted to a sample of adult females.
- A small temporary mark is placed on the back to ensure that an individual bear is not handled more than once in the season.

Years of Data Collection:

Ongoing Project since 1981

Partners:

- Canadian Northern Studies Trust (Association of Canadian Universities for Northern Studies)
- Care for the Wild International
- Churchill Northern Studies Centre
- Circumpolar/Boreal Alberta Research Grant
- Earth Rangers Foundation
- Environment Canada
- Isdell Family Foundation
- Manitoba Conservation
- Natural Sciences and Engineering Research Council
- Northern Scientific Training Program (Aboriginal Affairs and Northern Development Canada)
- Parks Canada
- Schad Foundation
- University of Alberta
- W. Garfield Weston Foundation
- Wildlife Media
- World Wildlife Fund Canada
- York University

Results:

- In 2012, we had low encounter rates for bears of all age- and sex-classes, particularly family groups.
- There is correlation between date of sea-ice breakup and overall condition of polar bears when they come ashore; earlier breakup results in polar bears coming ashore with less fat resources.
- Earlier breakup and decline in condition have had negative impacts on litter size; cub mass; survival of dependent young, independent juveniles, and older adults; and, on overall abundance.
- 10 GPS satellite collars were deployed on adult female polar bears accompanied by cubs in September 2012
- Analyses of data from satellite collars are ongoing.

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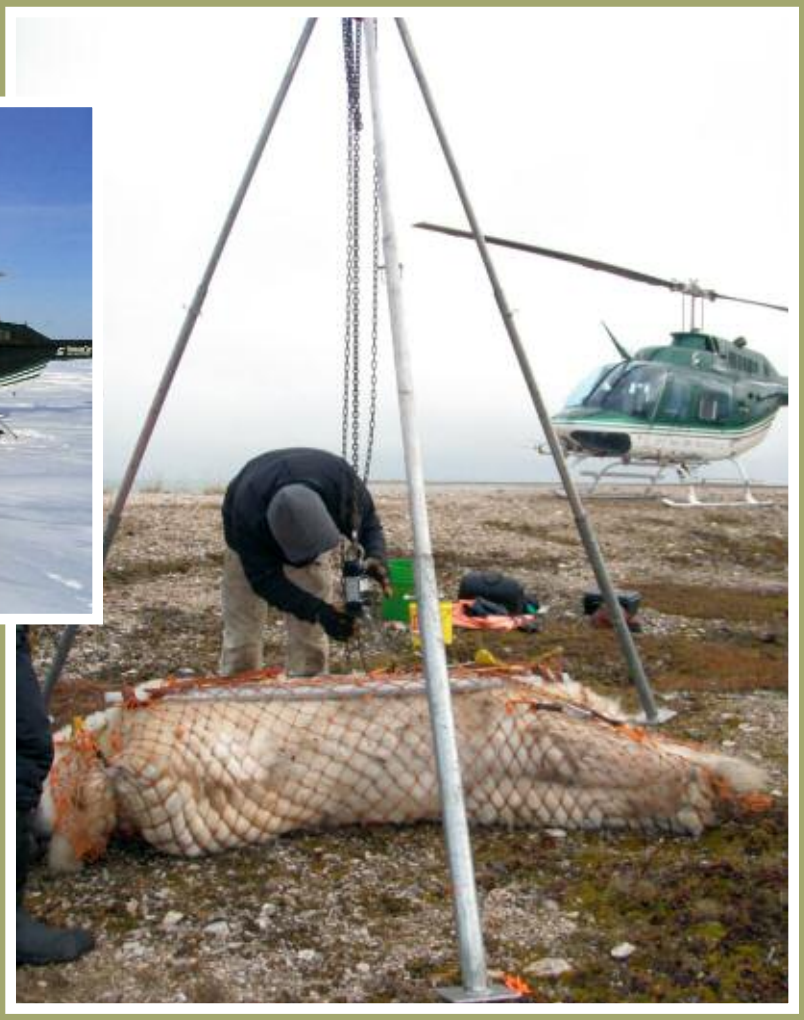
Refuelling helicopter, Nester One, Wapusk National Park
Credit: Greg Thiemann

Weighing polar bear, Wapusk National Park
Credit: Luana Sciullo



Vacant maternity den, Wapusk National Park
Credit: Luana Sciullo

Sub-adult bear along tidal flats, Churchill, Manitoba
Credit: Nick Lunn

A tree ring chronology for the Broad River, Wapusk National Park and York Factory

Rationale:

Tree ring chronologies are useful tools to help date historic building and structures, built from local wood, within Wapusk National Park. The chronologies can indicate past environmental events such as fire, insect outbreak and changes in climate due to volcanic eruption.

Objectives:

- Collect tree ring cores along the Broad River in Wapusk National Park, the Hayes River up-stream of York Factory and at the York Factory National Historic Site
- Create master tree-ring chronologies for white spruce, black spruce and tamarack for the middle and southern portions of Wapusk National Park

Methods:

- Identify potential sites for tree sampling.
- Using a tree corer, extract two cores per tree (at right angles to each other) from eight trees of each species at each site.
- Air-dry the tree cores, mount the cores with glue onto core holder, sand the cores and cross-date each core.
- Measure the width of each tree ring on each core using a velmax measuring device connected to a computer.
- Create graphs of the tree-ring chronologies for white spruce, black spruce and tamarack (using ARSTAN software).

Years of data collection:

Single year project 2012

Partners:

- Parks Canada
- University of Winnipeg
- Bird Studies Canada – Breeding Bird Atlas

Results:

- Because of cost and logistical limitations, only two sites along the Broad River were sampled in 2012 **(figure 1)**. No tree cores were collected from the York Factory area in 2012.
- The maximum tree age for site 1 was 333 years (dated to 1678 AD) and indicates there has been no ecological disturbance (e.g. fire) at this site for more than 300 years.
- The maximum tree age for site 2 was 96 years with the oldest core dating to 1915 AD. This forest is considerably younger than site 1 and has experienced a burn event within the last 100 years.
- The chronology for the area will aid in dating local wood used to construct the historical structures found in the park and help provide ages of the forest for biologists working in the park.

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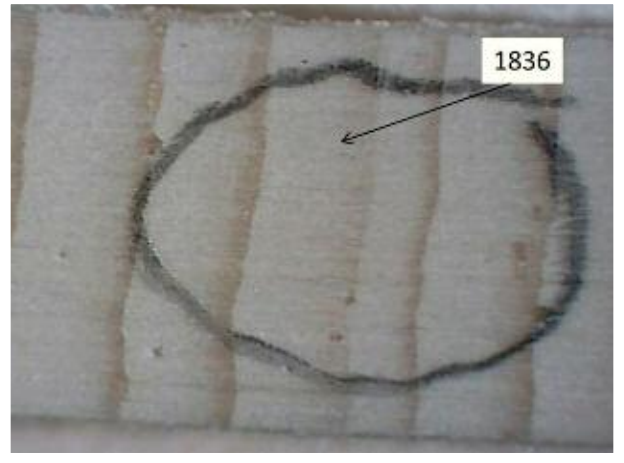
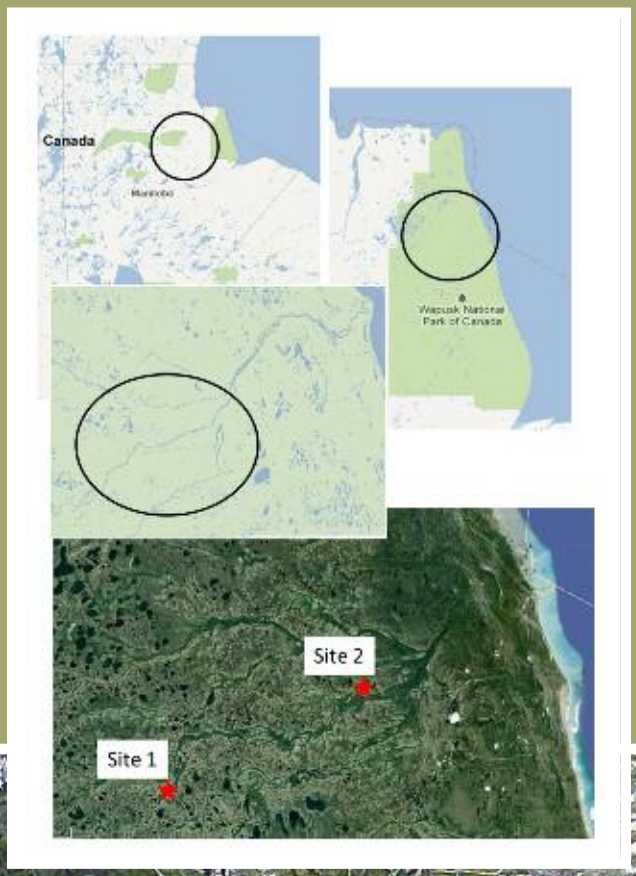
Site 1 tree core showing an example of the 1836 AD pale latewood ring, caused by the eruption of the Cosigüina Volcano in Nicaragua, used as a marker ring that aids in properly cross-dating the trees
Credit: Kimberly Monson



Tree cores glued onto corer holder, ready to be sanded
Credit: Kimberly Monson

Figure 1. *Location of the two sampling sites along the Broad River* Credit: Kimberly Monson



David Wright removing a tree core at Site 2 along the Broad River
Credit: Jack Dubois

Ecology and impact of Lesser Snow Geese

Rationale:

Traditional knowledge indicates Lesser Snow Geese have nested at La Pérouse Bay since at least 1933. We began studying the colony of 2,500 pairs in 1969 and have seen it increase numerically to >50,000 pairs and spatially from 4 km^2 to more than 300 km^2, extending now to Rupert Creek. The goals of this long-term study are to examine the interplay of this keystone herbivore and its habitat, especially in response to increasing goose numbers and climate change.

Objectives:

- Monitor the size and nesting density of snow geese
- Determine the impact of snow geese on vegetation and other animal species
- Ascertain the recovery potential of degraded salt and fresh water habitat
- Examine whether reproductive success changes over time and space and relate this to habitat quality
- Estimate survival of adult snow geese and determine its dependency on habitat quality

Methods:

- Conduct aerial surveys of nesting colony boundaries
- Monitor permanent nesting plots
- Deploy game cameras to detect predators and determine predation rates
- Score 21 recovery exclosures and associated control plots
- Collect aerial photographs of brood flocks
- Conduct a standard banding and recapture operation

Years of data collection:

Ongoing Project since 1969

Partners:

- American Museum of Natural History
- Arctic Goose Joint Venture
- Central and Mississippi Flyway Councils
- Canadian Wildlife Service
- Great White Bear Tours
- US Fish and Wildlife Service
- Parks Canada

Results:

- The hatch date was 7.5 days earlier in 2012 than the 44 year mean.
- Nesting density was lower than expected due to flooding.
- After seven years, there is substantial recovery in exclosed, degraded freshwater habitat.
- During our annual aerial brood survey and banding operations we found that productivity had returned to historic levels.
- Grizzly and black bears depredated snow goose nests
- Polar, grizzly and black bears predated snow goose broods.

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A successful brood of Lesser Snow Geese
Credit: K.F. Abraham

Extreme degradation along the coast of La Pérouse Bay
Credit: K.F. Abraham

A blue phase Lesser Snow Goose gosling feeding
Credit: K.F. Abraham

Seven year exclosure in freshwater habitat is fully recovered Credit: K. Uvino

Little recovery in seven years at this supratidal marsh site
Credit: K. Uvino

Expansion of Lesser Snow Goose nesting in Wapusk National Park

Rationale:

As the abundance of Lesser Snow Geese in Wapusk National Park has increased, their destructive foraging has degraded local habitat. Since their continued success depends on the quality of the habitat, one might expect their survival and reproductive success to decline. This should limit the population's growth and control the population's size through density-dependent regulation. For that to happen, the geese must remain in the degraded areas. Our long-term research at La Pérouse Bay indicates this is unlikely.

Objectives:

- Establish a route and annually monitor the entire coast of Wapusk National Park and the inland interface of the tundra and boreal forest for nesting Lesser Snow Geese
- Perform a preliminary ground inventory of any location that has more than 1 nest per hectare

Methods:

- Surveys are flown in a Bell 206B Jet Ranger at 250 to 300m of altitude.
- GPS locations of any nesting Lesser Snow Geese are recorded.
- Any area with an apparent density of >1 nest/hectare is circled and may be examined from the ground.
- Areas recorded as having been used are specifically checked.

Years of data collection:

Ongoing Project since 2005

Partners:

- American Museum of Natural History
- Arctic Goose Joint Venture
- Central and Mississippi Flyway Councils
- Canadian Wildlife Service
- Great White Bear Tours
- US Fish and Wildlife Service
- Parks Canada

Results:

- The Thompson Point Lesser Snow Goose colony now extends from just south of the White Whale River to just north of the Broad River.
- The highest nesting density is at two points – one north and one south of Thompson Point.
- Snow goose nesting now extends at low density from 10km south of the Broad River to Rupert Creek.
- Nesting in 2012 was lower due to near-coastal flooding related to late breakup of landfast ice.
- Serious habitat degradation is occurring at more inland sites – likely related to the unavailability of flooded near-coastal habitat.

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Extremely degraded habitat south of Thompson Point
Credit: K.F. Abraham

Randy's flats was once a lush sward of graminoids
Credit: K.F. Abraham

Freshwater marsh degradation near Cape Churchill
Credit: K.F. Abraham

New degradation in a freshwater marsh inland of Thompson point Credit: K.F. Abraham

Degraded salt marsh adjacent to Nester 1 research camp
Credit: K.F. Abraham

Habitat assessment in the Thompson Point region

Rationale:

Millions of Lesser Snow Geese use the east coast of Wapusk National Park for spring staging. In 2001, a large number stayed and nested near Thompson Point. Their offspring consider this area "home" and have now established a new nesting colony. The destructive foraging of both spring migrants and residents has led to rapid degradation of both coastal and inland freshwater habitat in the area. We have established a monitoring system for the area and are investigating processes underlying degradation in the freshwater habitat.

Objectives:

- Establish a habitat classification system integrating effects of foraging
- Establish and monitor vegetation transects using this habitat classification system
- Establish and monitor nesting density of Lesser Snow Geese
- Determine the recovery potential

Methods:

- Score the habitat along 5km transects perpendicular to the coast.
- Score nesting density at two sets of transect plots.
- Erect recovery exclosures and mark adjacent control plots.

Years of data collection:

Ongoing project since 2005

Partners:

- American Museum of Natural History
- Arctic Goose Joint Venture
- Central and Mississippi Flyway Councils
- Canadian Wildlife Service
- Great White Bear Tours
- US Fish and Wildlife Service
- Parks Canada

Results:

- Less than 30% of the vegetation in the region is intact.
- Nesting colony has expanded inland.
- Nesting density has returned to more normal historical levels.
- Recovery has begun in 4-year-old exclosures that incorporate dead willows.
- Exclosures erected in an area converted from graminoid cover to a peat barren do not yet show any signs of recovery.

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Minimal recovery at Thompson Point north exclosures
Credit: K.F. Abraham

Kit Uvino at Thompson Point exclosure site
Credit: K.F. Abraham

Minimal recovery at Thompson Point south site after five years
Credit: K.F. Abraham

Small islands of intact habitat at Thompson Point
Credit: K.F. Abraham

Dead willows at Thompson Point south site
Credit: K. Uvino

Indirect effects in arctic food webs

Rationale:

Arctic foxes are the primary terrestrial predator throughout the Arctic and, through predation, can directly affect many prey species, including lemmings, geese, shorebirds and seals. Furthermore, population changes in one prey can indirectly influence another by affecting abundance and predation rates of shared predators. For example, many Arctic-nesting birds, especially geese and shorebirds, suffer much higher rates of nest predation when cyclic lemming numbers initially decline, as arctic fox and other lemming predators switch to alternative food sources. Examining indirect effects in arctic food webs is important for understanding ecosystem structure and predicting the effect of species loss or environmental perturbation. We are also interested in understanding mechanisms for how predator densities respond to lemming declines, and interactions between arctic fox and red fox, a competitor and predator of arctic fox, that may intrude northward with the warming climate.

Objectives:

- Examine indirect interactions involving arctic fox and lemmings using estimates of annual changes in abundance.
- Investigate the arctic fox stress response to food shortage, which can reduce reproduction, lowering recruitment and leading to predator declines.
- Examine parasite abundance and diversity in arctic fox and red fox, which may introduce novel parasites to which arctic foxes are not adapted.

Methods:

- We estimated lemming abundance using mark-recapture methods at three sites in Wapusk National Park and one outside the park boundary.
- We estimated fox activity and den success at 116 fox dens in and around Wapusk National Park (the 23 dens closest to Churchill historically have been used by red fox).
- We collected shed hair and feces from arctic fox dens and measured concentrations of cortisol, the primary stress hormone.
- We estimated parasite abundance from fecal samples and carcasses collected from local fur trappers.
- We reconstructed fox diets using stable isotope analysis to compare with prey abundance, hormone concentrations, and parasites.

Years of data collection:

- Ongoing Project since 2010

Partners:

- Natural Sciences and Engineering Research Council of Canada
- University of Manitoba Field Work Support Program
- Parks Canada
- Manitoba Conservation
- Northern Scientific Training Program
- Churchill Northern Studies Centre

Results:

- Rodent populations in 2012 started to recover from the substantial lows of the previous two years, although they are still well below previous peak density estimates.
- Arctic fox reproduction, a good index of population dynamics because of their large litters and short lifespan, increased with lemming numbers in 2012, but red fox den success declined.
- Annual variation in arctic fox cortisol levels suggested a stress response to low lemming densities. Consumption of cached eggs did not lower cortisol levels, suggesting stored eggs provide insufficient energy to make up for energetic challenges.
- Parasite infections were greater in arctic fox than sympatric red fox, and rodent consumption increased tapeworm infections in both species. However, parasites did not affect body condition.

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Olwyn Friesen investigates a fox burrow
Credit: Olwyn Friesen

Collared lemming in its burrow
Credit: Ryan McDonald

Arctic fox curled next to burrow in April
Credit: James Roth

Arctic fox trotting on tundra in summer
Credit: Ryan McDonald

Investigation of Earth Observation (EO) polarimetric radar information for operational mapping and monitoring of Wapusk subarctic peatlands and their surrounding natural environments

Rationale:

Climate change is modifying the vegetation structure of subarctic ecosystems, which impacts the wildlife that depends on these ecosystems. Raised bogs may be transformed into fens, impacting polar bear habitat and there may be reductions in the extent of arctic tundra, with impacts on caribou. Earth Observation (EO) polarimetric radar (ALOS and RADARSAT-2) may provide an efficient method to conduct terrestrial inventories and monitor the ecological integrity of the vegetation of northern parks. Depending on the results of this work, the remote sensing radar based approach developed may become an operational standard for conducting terrestrial inventories in arctic national parks. The method developed could also serve as a common baseline for assessing wetland ecosystem change at local (ground plots) and landscape (remote sensing) scales in northern national parks.

Objectives:

- Investigation of polarimetric ALOS and Radarsat2 data for park wetland mapping and monitoring
- Investigation of polarization information and permafrost active layer thickness for fen-bog discrimination and for treed upland/bog separation
- Investigation of interferometric ALOS for permafrost active layer thickness measurement

Methods:

- RADARSAT- 2 and ALOS polarimetric capability provides unique information for target scattering classification. This should significantly improve the characterization of wetlands and their surrounding natural environment. The Touzi decomposition will be investigated for characterization and classification of wetlands.
- Preliminary results have shown that the L-band ALOS is sensitive to the peatland subsurface water flow. Field data will be collected jointly with Parks Canada to validate such unique potential for various peatlands.
- The L-band ALOS and C-band Radarsat2 provide key information on wetland surface and subsurface hydrology which should permit better characterization, classification, mapping, and monitoring of Wapusk wetlands.
- The additional information provided by ALOS and Radarsat2 will be used to enhance the park classification obtained with optic sensors (Landsat and Spot).

Years of data collection:

Year 1 of a 3 year project

Partners:

- Canada Center for Remote Sensing
- Parks Canada
- Canadian Space Agency
- University of Saskatchewan

Results:

- Subsurface water flow was imaged using ALOS **(figures 1 and 2)**.
- Results show promise for the operational monitoring of bog-fen transformation using satellite imagery.

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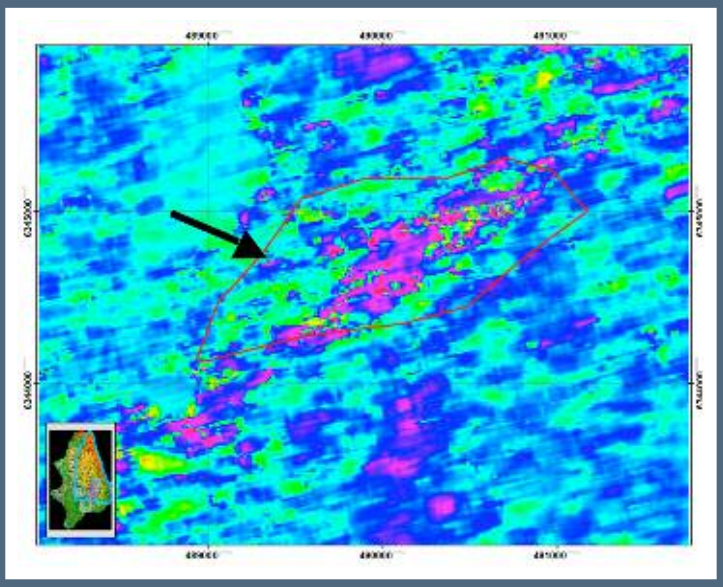
Gabriel Gosselin and Jill Larkin collecting data on bog vegetation and peat thickness
Credit: R. Touzi



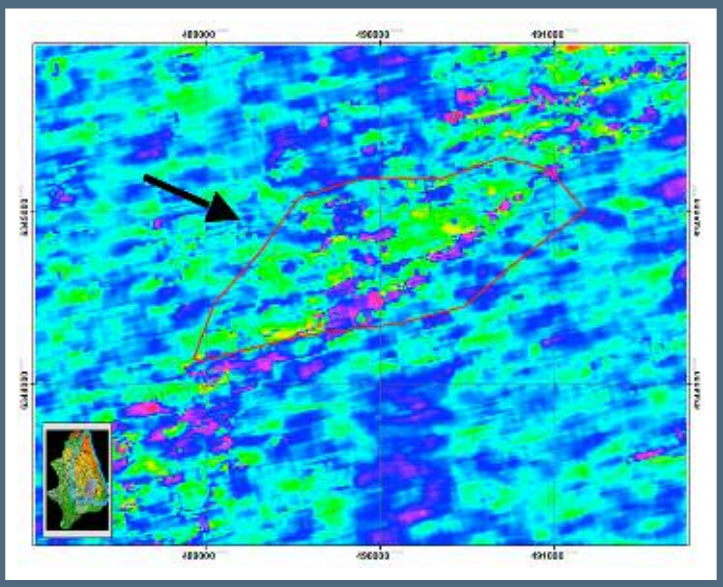


Figure 1. *ALOS images over a lichen peat plateau bog and sedge bulrush fen from 8 June 2010 (top) and 24 July 2010 (bottom). The pink color indicates the presence of peat subsurface water that becomes shallower with the permafrost melting (Active layer: 13 cm in June and > 20 cm in July). Bog areas, which do not have water on the permafrost surface, remain dark blue in the two images*

Gabriel Gosselin collecting vegetation data
Credit: R. Touzi

Ridha Touzi measuring the thickness of the active layer thickness and the water level Credit: G. Gosselin

Hydroecology of lakes in Wapusk National Park – past and present

Rationale:

Shallow ponds are a dominant feature of Wapusk National Park (WNP) and provide habitat and resources for wildlife and waterfowl populations. The shallow nature of these ponds makes them sensitive to multiple stressors (e.g., climate change, waterfowl populations). Currently, there is a lack of baseline information on the hydroecological and biogeochemical conditions of these ponds, which hinders the ability to assess the roles of stressors on pond conditions. Our research focuses on characterizing current and past hydroecological and biogeochemical conditions over spatial and temporal scales using leading-edge contemporary and paleolimnological approaches. Findings will provide knowledge to discern the relative roles of stressors and information to help predict future conditions of ponds under conditions of continued warming and landscape disturbance.

Objectives:

- Characterize the importance of hydrological processes controlling pond water balances and the relationship with fluctuating meteorological conditions.
- Quantify relations among hydrological, limnological and biogeochemical, and how conditions differ spatially (e.g., among ecoregions), seasonally and inter-annually.
- Use analyses of pond sediment cores to reconstruct changes in hydroecological conditions to assess the role of stressors (climate change, snow goose population expansion, long-distance nutrient transport).
- Anticipate future hydroecological and biogeochemical conditions of ponds under conditions of continued warming and landscape disturbance.

Methods:

- Water samples were collected from 37 ponds spanning vegetation gradients (coastal tundra, peatland, boreal spruce forest) in June, July and September 2010-2012 for analysis of water isotope composition and water chemistry conditions.
- Particulate organic matter was collected for geochemical analysis to provide information on carbon dynamics (sources, sinks and cycling).
- Beginning in 2012, 15 (of 37) ponds were also sampled for CO_2 and CH_4 concentrations.
- Surface sediments were collected from the 37 ponds in September 2012 and will be analyzed for a suite of biological and geochemical indicators.

Years of data collection:

Year 3 of a 5 year project

Partners:

- Parks Canada
- Natural Sciences and Engineering Research Council of Canada
- Natural Resources Canada
- Aboriginal Affairs and Northern Development Canada Northern Scientific Training Program
- Churchill Northern Studies Centre

Results:

- There is seasonal and spatial variability of hydroecological conditions in response to variable meteorological conditions. Peatland and coastal ponds were more susceptible to evaporative drawdown during the ice-free season than boreal ponds, reflecting the effects of snowmelt offsetting evaporation in boreal.
- Sediment core analyses identify two distinct hydroecological changes which have comparable timing in three coastal ponds within the zone disturbed by the lesser snow goose (LSG) population. The first shift occurred in the early 1900s and corresponds with documented onset of climate warming. The second shift occurs ~1970 and corresponds with exponential increase in the LSG population. Analyses of a sediment core from a fourth coastal pond not disturbed by the LSG population only displayed the first shift. These findings suggest population expansion of the LSG has been altering limnological conditions and carbon dynamics in ponds.
- Preliminary surface-sediments results show a wide range in mineral and organic content. Moreover, “mineral” lakes (sand/gravel sediments) are distinguished from “organic” lakes (peat/mud), regardless of the ecotype **(figure 1)**.
- Preliminary results on greenhouse gas concentrations indicate ponds are sources of CH_4, but often sinks of CO_2 in spring and summer. However, by fall most ponds become sources of both CO_2 and CH_4 and approach gas saturation.

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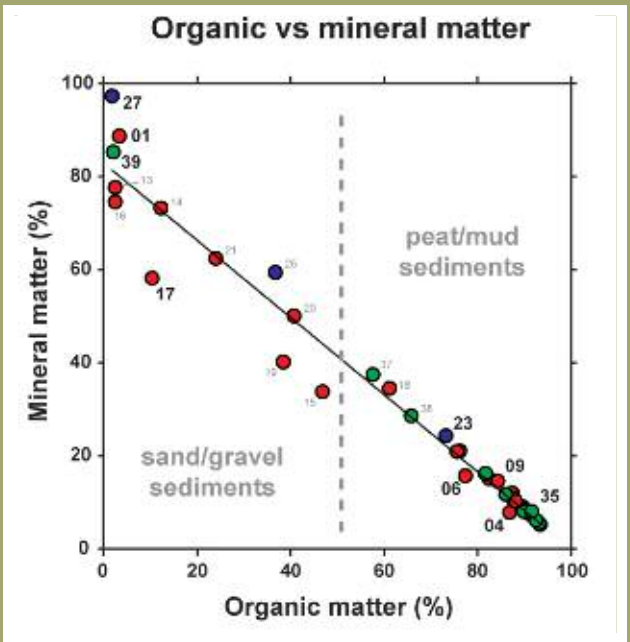
Hilary White sampling for greenhouse gas concentrations in pond water Credit: Lauren MacDonald

Figure 1. *Organic matter and mineral matter content of surface sediments from 37 ponds in WNP. Red circles represent ponds located in the coastal fen, green circles represent ponds located in the interior peatland and blue circles represent ponds located in the boreal spruce forest.* Credit: Dr. Frederic Bouchard



Dr. Jon Sweetman with a sediment core taken from a coastal pond with high disturbance from the lesser snow goose population Credit: Celia Symons

Several ponds from the interior peatland ecotype of Wapusk National Park that desiccated mid-summer (July 2010) Credit: Nicole Farquharson

Shallow thermokarst ponds within Wapusk National Park
Credit: Lauren MacDonald

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Cover Photo: *On the bank of the Broad River*
Credit: Parks Canada

Sunset over winter tundra
Credit: Parks Canada

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