Annual Report of Research and Monitoring in National Parks of the Western Arctic 2008

Parks Canada Parcs Canada

Canada

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Photos for the front cover were provided by the following Parks Canada staff: Top left photo - M. Gillis; Top right photo: R. Drummond; Middle right photo: L. Cary; Bottom photo: J. F. Bisaillon.

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Structure of the Report

This report is divided into two sections. Section 1 summarizes research projects conducted in 2008 and Section 2 summarizes all monitoring projects carried out in 2008. These monitoring projects are divided into six categories: Wildlife, Habitat, Human Use, Cultural Resources, Environmental Process, and Solid Waste.

Summaries for each project include:

Rationale
A short paragraph describing why the project was conducted and why it is important.

Objectives
A description of the main objectives of the project.

Methods and Information Collected
A brief description of where the work was conducted, how the project was conducted and what information was collected.

Update/Results
A summary of results, or recent activities, related to the project.

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Other organizations that were involved in the project.

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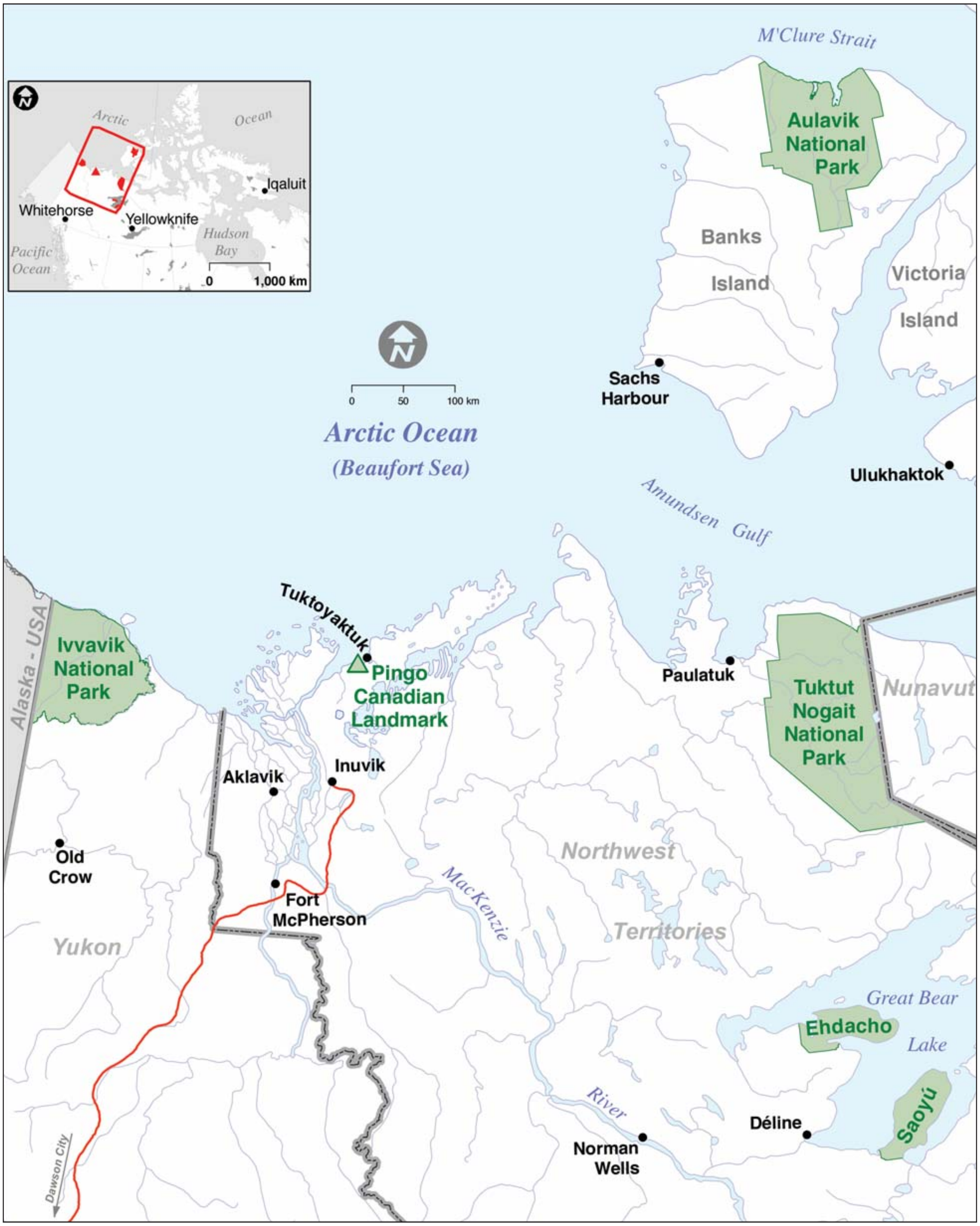

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The Western Arctic Field Unit of Parks Canada

Canada

Research and Monitoring Activities in National Parks of the Western Arctic

	Aulavik National Park	Ivvavik National Park	Tuktut Nogait National Park	Pingo Canadian Landmark
RESEARCH				
Aulavik National Park Archaeology Project	X			
Quaternary Environments of Banks Island, NWT: Implications for the Nature of High Latitude Environmental Change	X			
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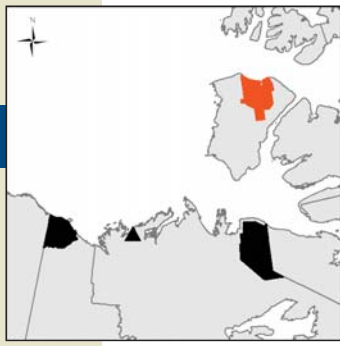
Bluenose-West Caribou Monitoring			X	
Porcupine Caribou Monitoring		X		
Habitat				
Satellite Monitoring of Northern Ecosystems	X	X	X	
Pingo Monitoring				X
Human Use				
Firth River Campsite Monitoring		X		
Human Use Monitoring	X	X	X	
Cultural Resources				
Tuktut Nogait National Park Cultural Resource Monitoring			X	
Environmental Processes				
Weather Monitoring	X	X	X	
River Water Flow Monitoring		X	X	
Water Quality Monitoring	X	X	X	
Fresh Surface Water Mapping and Monitoring using RADARSAT Synthetic Aperture Radar (SAR) Imagery			X	
Solid Waste				
Groundwater Monitoring Wells Installation at Komakuk Beach		X		

RESEARCH

Rationale

This project represented the first systematic archaeological survey of Painted Sands Creek and Dissection Creek in Aulavik National Park. It was an important opportunity to add to the archaeological site inventory within the Park and to gain a deeper understanding of past human land use patterns in the region. Animal bones collected from archaeological sites during the survey have the potential to reveal long-term trends in muskox and Peary caribou populations on Banks Island.



Research

AULAVIK NATIONAL PARK ARCHAEOLOGY PROJECT

Dr. Lisa Hodgetts, The University of Western Ontario

Objectives

- Locate and document previously unrecorded archaeological sites in the study area.
- Collect a small representative sample of artifacts and animal bones from the surface of selected sites.

Methods and Information Collected

We surveyed two main drainages, Painted Sands Creek and Dissection Creek, on the east side of the Thomsen River, as well as a smaller area west of Green Cabin:

- The five member field crew walked along creek edges, terraces, and ridge tops in these areas;
- When archaeological sites were encountered, GPS coordinates were taken, a written description was completed, features (e.g. tent rings, caches etc) were photographed, and sites with single tent rings or multiple features were drawn to scale;
- In some cases diagnostic artifacts and/or animal bones were collected from the surface of these sites.
- No test-pits were excavated.
- Approximately 10 artifacts, a few stone flakes (from stone tool manufacture) and approximately 100 animal bones were collected from the surface of archaeological sites.

Circular tent ring with a cooking platform.
PHOTO: L. HODGETTS

Update/Results

Meat cache. PHOTO: L. HODGETTS

- Located and recorded 76 previously undocumented archaeological sites (see Figure 1).
- Revisited and recorded 9 previously documented archaeological sites
- Analysis of site distribution, artifacts and animal bones is ongoing.
- A range of site types was documented including several types of tent rings, which suggest different social groups. Meat caches and graves were also recorded.
- Few surface artifacts were found, but most of the sites appear to date from the early historic period. They were perhaps associated with Inuinnait (Copper Inuit) groups en route to the Investigator cache at Mercy Bay. Only two sites had stone tools indicating prehistoric occupation.

Partners

- The University of Western Ontario
- Parks Canada Agency

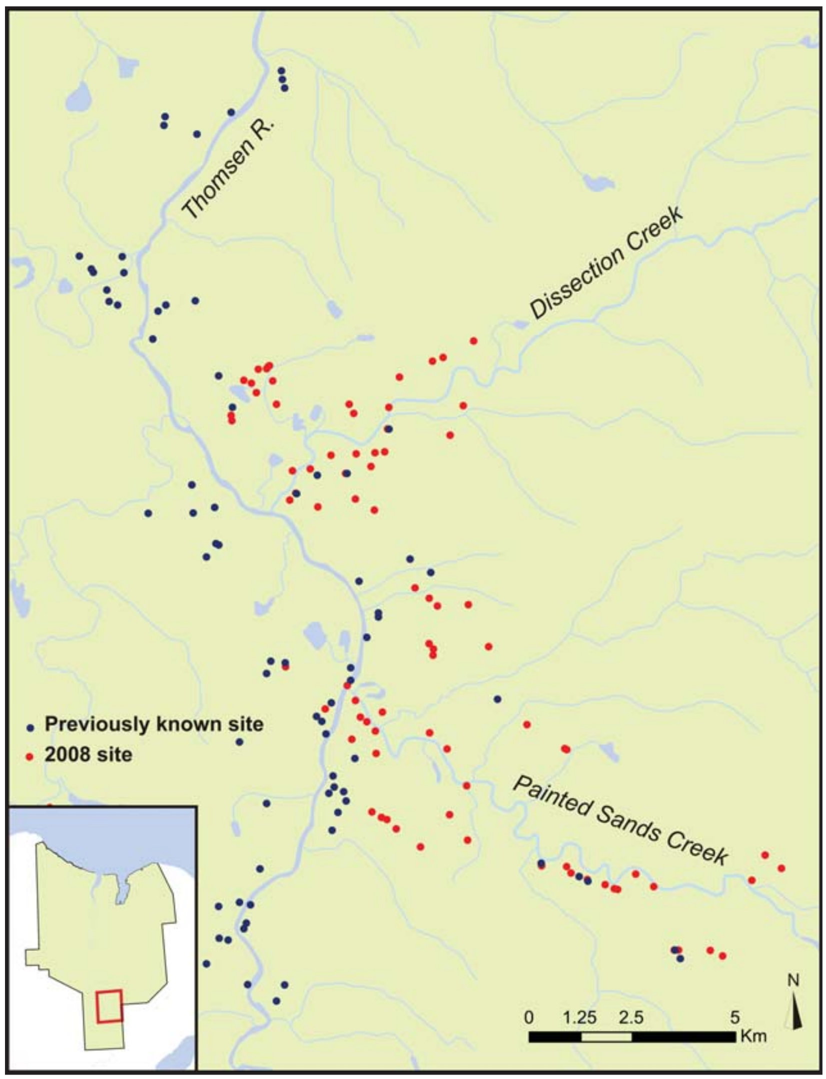


FIGURE 1. Map of archaeological sites in study area. New sites from 2008 are in red. Previously known sites are in blue.

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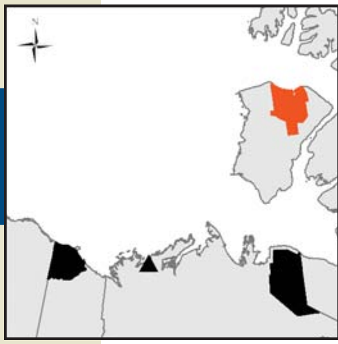
Rationale

The long-term natural history of Aulavik National Park is largely based on studies of past glaciations conducted more than two decades ago. This model suggests that most of Banks Island has been ice-free for greater than 120,000 years and served as a biological refugium during late Wisconsinan glaciation (25,000-10,000 years before present). Our research concerns the Quaternary (2.6 million years ago to present) environmental history of Banks Island including the timing and extent of late Wisconsinan glaciation, which has remained a matter of debate for over 30 years. Previous studies proposed that continental ice sheets inundated Banks Island on at least three separate occasions. However, the limits and ages of these glaciations remain undocumented. Furthermore, the pattern and magnitude of relative sea level change resulting from glacioisostatic crustal adjustments following ice sheet retreat are poorly constrained. The focus of this study is the paleoenvironmental record of Quaternary landforms and sediments on Banks Island.



Research

QUATERNARY ENVIRONMENTS OF BANKS ISLAND, NWT: IMPLICATIONS FOR THE NATURE OF HIGH LATITUDE ENVIRONMENTAL CHANGE

Dr. John England, University of Alberta

Objectives

- Determine the extent, chronology, and pattern of retreat for the late Wisconsinan Laurentide Ice Sheet (LIS).
- Test the validity of published evidence for older glaciations and interglaciations (i.e. greater than 30,000 years before present).
- Document the pattern and rate of postglacial (~12,000 years before present to present) relative sea level change.

Methods and Information Collected

- Between June and August 2008, two field parties were positioned in Aulavik National Park. The Thomsen River valley and Castel Bay were surveyed by canoe and helicopter, and the north coast of Banks Island, including Mercy Bay were surveyed by helicopter.
- Quaternary sediments were mapped, described, and sampled for grain size analysis, plant and animal fossils, tephras, and cosmogenic dating. Glacial and marine landforms and sediments were mapped and investigated in the field using available aerial photography. The extent and pattern of retreat for the LIS was determined using crosscutting relationships among mapped glacial landforms. The elevation of raised marine deltas and beaches was measured by altimetry, and their ages will be established by radiocarbon dating of fossil molluscs collected from the deposits.
- The chronology of late Wisconsinan glaciation and the pattern of postglacial relative sea level change will be estimated by: 1) radiocarbon dating of macrofossils collected from glacial and marine sediments, and 2) cosmogenic dating of erratics collected from mapped landforms.

The landscape of Aulavik National Park.
PHOTO: PARKS CANADA

Methods and Information Collected (continued)

- The following information was collected:
  - 20 samples of peat (each <200 grams in size) were collected at various sedimentary exposures along the Thomsen River valley;
  - 20 samples of sediment (each <1 kg in size) were collected at various sedimentary exposures along the Thomsen River valley;
  - 10 samples of fossil marine molluscs (each <250 grams in size; <10 whole valves) were collected from various sample sites near Castel Bay;
  - 10 rock samples (small cobbles <30cm in diameter) were collected from various sites along the Thomsen River valley;
  - 10 samples of fossil marine molluscs (each <250 grams in size; <10 whole valves) were collected from various sample sites in Mercy Bay;
  - 10 samples of moss (each <100 grams in size) were collected at various sites along the north coast of Banks Island.

Update/Results

- Geomorphic mapping of late Wisconsinan glacial and marine landforms indicates that the Laurentide Ice Sheet advanced westwards across Banks Island from an ice divide situated over Victoria Island. A lobe of fast flowing ice in the Thomsen River valley fed ice northwards into Mercy and Castel bays, where it combined with grounded ice in M'Clure Strait.
- A survey of raised marine sediments along the north coast of Banks Island indicates that marine limit (i.e. the highest relative sea level, attained immediately after deglaciation) descends from ~45 metres above sea level in Mercy Bay to ~30 metres above sea level near the Desert River. The age of marine limit and the rate of regression (i.e. falling relative sea level) will be constrained by radiocarbon dating of fossil marine molluscs collected from the deposits.
- Organic samples collected for radiocarbon dating are in preparation for analysis.
- The results to date constrain the history of late Wisconsinan glaciation in Aulavik National Park. Anticipated radiocarbon dates from fossil marine molluscs will provide a precise chronology for ice sheet retreat from northern Banks Island during the last glaciation. The radiocarbon dates will also constrain the pattern and magnitude of postglacial relative sea level change that continues to affect the coastlines of Arctic Canada. Dating of erratic boulders will facilitate their correlation to distinct terranes on the mainland, Canadian Shield, which has implications for former ice flow trajectories and profiles. Peat collected from the Thomsen River valley will be dated to estimate the timing and rate of postglacial valley incision by the Thomsen River. Analysis of preserved macrofossils will enable a basic reconstruction of former plant ecosystems and paleoclimates.
- This research contributes to knowledge of environmental change in northern Canada by documenting terrestrial and marine evidence for past changes in climate, ice sheets, sea ice, and sea level. These data help to test atmospheric and oceanic general circulation models that are used to project future environmental changes, helping to identify adaptive strategies.

Partners

- University of Alberta
- Polar Continental Shelf Program

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Rationale

The response of permafrost terrain to changing environmental conditions is in large part a function of its ground ice content. This is particularly important in areas of ice-rich unconsolidated sediments, such as the western Canadian Arctic, where ice can constitute up to 95% by volume of the upper portion of permafrost. The thaw of ground ice on slopes, often along the coast, produces mass movements of soil material known as retrogressive thaw slumps. These slumps can retreat upslope quite quickly, producing rapid geomorphic changes. Warming environmental conditions will enhance such processes. The goal of this study is to better understand the origin and distribution of ground ice along the Yukon coast with an emphasis on Herschel Island, a Yukon territorial park and an area known to be extremely ice-rich. As such, we are attempting to establish the origin of the different types of ground ice bodies to help in assessing their distribution. Physical measurements of the ice properties further this goal, but also assists in determining how likely and how extensive geomorphic changes may be. The coast of Herschel Island is a particular focus since it is subject not only to changes in air and soil temperatures, but also to changes in wind, water and sea ice conditions. Together, this information can allow us to predict how the area's permafrost will respond to a changing climate and what the implications might be for the area's natural and cultural resources.

Research

AN INTEGRATED STUDY OF PERMAFROST CONDITIONS ON HERSCHEL ISLAND AND ALONG THE YUKON COAST

Dr. Wayne Pollard, McGill University

Objectives

- To understand the conditions under which ground ice formed.
- To gain insights on the distribution of ground ice.
- To provide an integrated assessment of the implications of thermokarst development on the island (thermokarst is an uneven land surface that forms as ice-rich permafrost thaws).

Methods and Information Collected

- Work was conducted by M. Fritz to begin data collection for reconstructing paleoenvironmental conditions at the time of permafrost formation. Assessments were also carried out to select sites for fieldwork in subsequent years.
- In addition, the impacts of permafrost thaw were being examined by four undergraduate students (M. Angelopoulos, N. Arkell, A. Cassidy and H. Cray), each with a specific project and objectives.
- M. Fritz recovered lake bottom sediments from two sites. The sedimentation rates provided by the samples will help to understand Holocene environmental conditions. Depending on the results of laboratory testing, one or both of these sites may be examined in more detail in 2009. We also collected samples of massive ground ice at two sites and are analyzing them to try to better understand the genesis and formation of the ice bodies.

Oblique aerial photograph of slumps at Collinson Head. PHOTO: W. POLLARD

Methods and Information Collected (continued)

- M. Angelopoulos conducted high density ground penetrating radar (GPR) surveys at two sites on Herschel Island using a variety of antenna configurations in order to delineate the extent of massive ground ice. The data is currently being processed.
- N. Arkell sampled the headwalls of retrogressive thaw slumps on Herschel Island and is analyzing the sedimentology and ice content of the different stratigraphic layers.
- A. Cassidy carried out detailed vegetation surveys along six transects on Herschel Island to elucidate patterns and timing of succession around retrogressive thaw slumps.
- H. Cray conducted comprehensive GPS surveys of the Simpson Point spit on Herschel Island and several retrogressive thaw slumps which have been monitored for several years. She also collected GPS data from several sites of interest to Herschel Island Territorial Park management. She is integrating the information into a geographic information system along with survey data from previous years and remote sensing imagery of all thermokarst sites on the island.
- Data from a water level recorder put into Pauline Cove in 2007 were recovered and the unit was redeployed. The information is being used in conjunction with meteorological information to better understand the impact of coastal processes. Climate data from a meteorological station at King Point were downloaded and basic maintenance on the station was performed.

Update/Results

Results of the fieldwork were presented at the Arctic Change 2008 conference in Quebec City. They include:

- Interpretation of ground ice origin at two sites based on cryostratigraphic analyses;
- Preliminary 3D maps of ground ice;
- Incorporation of several years of high resolution GPS surveys into a GIS to help characterize both the spatial pattern and rates of change;
- An analysis of vegetation diversity and species richness in zones within and adjacent to retrogressive thaw slumps. They are: Zone 1: the unstable slump floor; Zone 2: the area at the side of the slump floor beginning to stabilize; Zone 3: the area beside the slump that was recently stabilized; Zone 4: the stabilized area located above the headwall; and Zone 5: the undisturbed area upslope of the stabilized zone.

Update/Results (continued)

Taken together, the above results help to provide a comprehensive picture of ground ice conditions in the region. These include possible explanations for ground ice formation. For instance, at Collinson Head on Herschel Island, stratigraphic analysis supports an intrasedimental ice origin involving ground water migration in underlying gravel to form an ice-rich unit at the base of fine-grained marine sediments. A more complicated stratigraphy at a Thetis Bay site suggests the ground ice is probably segregated ice formed from subsurface waters during deglaciation. The GPR mapping helps to delineate the extent of the ground ice and so gain an understanding of the possible extent of thermokarst in a given area. We gain insight into the pace of thermokarst activity from the GPR surveys which shows that in two areas of thermokarst activity, annual retrogressive thaw slump retreat rates average 10-15 metres per year (see Figure 1). Our ongoing observations indicate annual coastal retreat rates of 0.5 to 1.0 m/yr and dramatic changes to coastal depositional landforms. The vegetation surveys provide a qualitative assessment of the pace of succession. In the vicinity of retrogressive thaw slumps, there is a dramatic increase in the number of vegetative species present when moving from Zone 1 to Zone 5, based on total species present and species grouping. Succession within the slumps begins with the development of grasses and culminates in willow development. However, non-dwarf willow species only occur in areas which have not been affected by retrogressive thaw slumps.

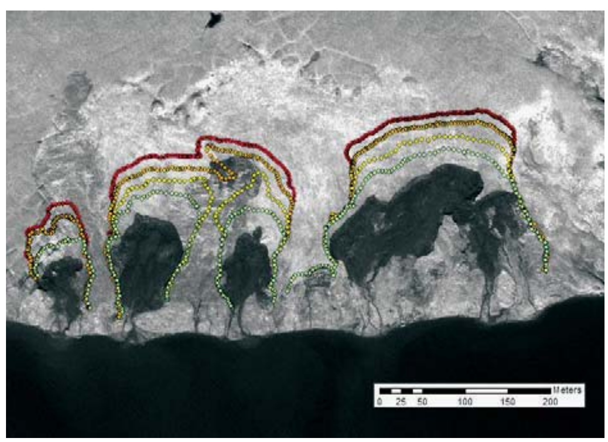

FIGURE 1. GPS survey positions of retreating headwalls mapped onto a satellite image. PHOTO: W. POLLARD

Partners

- Polar Continental Shelf Project
- Northern Scientific Training Program
- Royal Canadian Geographic Society
- ArcticNet
- Alfred Wegener Institute for Polar and Marine Science, Potsdam, Germany

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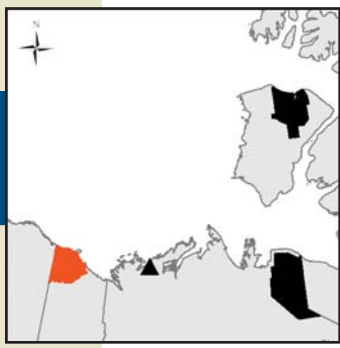
Rationale

For the past fifty years, Stokes Point in Ivvavik National Park of Canada has been the site of the former BAR-B DEW Line Station, as well as more recently being used as an oil exploration facility prior to the establishment of the park. The site has had numerous federal land managers over the years; consequently, site clean-up efforts to date have been piecemeal and no thorough contaminated investigation has ever been completed. In response to the concerns raised by the community of Aklavik and the Inuvialuit Regional Corporation, Parks Canada commissioned a preliminary study of the landfill at BAR-B in 2000 and 2001 that indicated the presence of contaminants of concern such as metals, fuel, PCBs, and pesticides. As the current federal land manager responsible for this site, Parks Canada is committed to taking a leading role in the detailed assessment and clean-up of BAR-B to enhance the ecological integrity of Ivvavik National Park of Canada.



Research

STOKES POINT (BAR-B) DEW LINE DETAILED CONTAMINATED SITE ASSESSMENT AND REMEDIATION ACTION PLAN DEVELOPMENT

Royal Military College and Department of National Defence

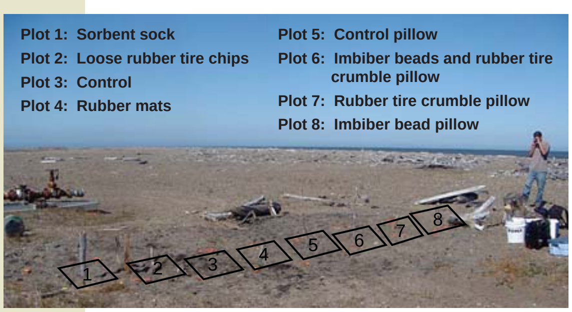
Objectives

Conventional contaminant excavation is expected to be difficult at two prominent areas on site because of their location and physical properties. In anticipation of the cleanup of the BAR-B, Stokes Point site scheduled for 2010, this research project examines a less intrusive alternative that would greatly minimize the environmental risk of a cleanup attempt. The objective of the research is to:

- To test the capabilities of polymer technology to passively remediate areas contaminated with hydrocarbons, PCBs and DDT at BAR-B, Stokes Point. Polymers (plastics) are known to have an affinity for organic compounds and can be used to recover organic contaminants from soil and water.

Methods and Information Collected

- *In-situ* experiments were conducted on eight plots located within the beach refuelling area subsurface hydrocarbon plume. Each plot was roughly 1 m by 1 m, to a depth at which significant seepage was encountered (generally 0.6-0.8 m during the initial visit). Each plot used polymer material in either a distinctive form or with slightly variable composition for comparison. Plot 1 used a 2-m-long, flexible, polymer-filled sorbent sock; Plot 2 used free pieces; Plot 3 served as a control and was not treated; Plot 4 employed hard polymer mats; and Plots 5-8 utilized three polymer pillows filled with unique mixtures.



In-situ experimental plot setup at BAR-B, Stokes Point.
PHOTO: N. BATTYE

Methods and Information Collected (continued)

The polymer products were placed in the centre of the plot and buried to facilitate contact with impacted soil and water and to reduce the potential for climate/animal interference.

- One water and three soil samples were taken from the base of each plot at the beginning of the experiment to determine the initial concentration of hydrocarbons. The soil samples were taken in a triangular configuration that generally had two sample locations in direct contact with the polymer material and a third that was slightly removed but still within the plot. During the second visit, the plots were re-excavated and a portion of the polymer material was removed (one of the three pillows per plot, two of the four mats, the free pieces and the sorbent sock). Three soil samples were again collected from the exact locations as the previous ones. The remainder of the polymer material was reburied and will be excavated, removed and sampled during the 2009 visit.
- *Ex-situ* remediation of hydrocarbon- and PCB-contaminated soil was also evaluated using polymer material mixed with contaminated soil in an ODDJOB manual mixer. The ODDJOB was placed on its side and rolled every hour during the day, over the course of two days, to facilitate mixing. Samples were taken at time zero, six hours, 12 hours, 24 hours and 48 hours. Additional soil samples were also collected from a DDT-contaminated area and will be used to test the remedial capabilities of polymer technology in a laboratory setting.

Update/Results

- The results of the *in-situ* treatment of hydrocarbon-contaminated soil using the polymer material indicate that it was successful in removing hydrocarbons from the system. However, due to water inundation, it was concluded that large-scale excavation, as would occur during a clean-up, could result in a significant and detrimental release of hydrocarbons into the nearby lagoon and Beaufort Sea.
- The results of the *ex-situ* treatment of hydrocarbon-contaminated soil indicate that it significantly reduces hydrocarbon concentrations.
- The results of the *ex-situ* treatment of PCB-contaminated soil indicate that it significantly reduces PCB concentrations.

Partners

- The Department of National Defence - North Warning System Office
- Parks Canada Agency

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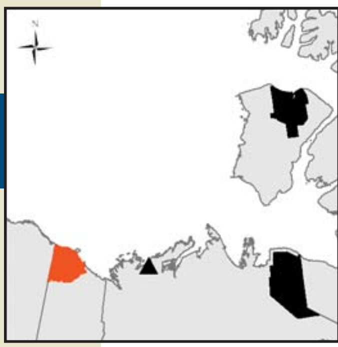
Rationale

In November 2002, members of the Inuvialuit Hunter and Trappers Committees (HTCs), the Wildlife Management Advisory boards, Yukon and Northwest Territory governments and Parks Canada met to discuss needs for managing grizzly bear (*Ursus arctos*) populations in the Inuvialuit Settlement Region (ISR). Members of the Aklavik HTC felt that there was a need to update population estimates for the North Slope. The Yukon North Slope Research and Monitoring Plan and the Co-management Plan for Grizzly Bears in the Inuvialuit Settlement Region, Yukon and Northwest Territories also indicated a need to update population estimates for grizzly bears, and to review harvest rates using population-specific information. The study we are conducting will provide information on grizzly bear population size, birth rate, death rate, and movement. This research will provide the Inuvialuit with the information needed to make the best use of bears, help develop appropriate management strategies that allow sensible and sustainable quotas, and ensure long-term survival of grizzly bears in the Yukon North Slope.



Research

YUKON NORTH SLOPE GRIZZLY BEAR POPULATION STUDY

Dr. Ramona Maraj, Government of Yukon

Objectives

- Determine parameter estimates for grizzly bear survival and reproduction by age, the number of bears in each age class, the number of males versus females, and the total number of bears. Once these values are found we can estimate the birth rate, the death rate, and the rate at which the population is changing.
- Update information on sex, age, physical characteristics and location of hunter-killed bears in the study area to understand how harvesting might affect population dynamics and structure.
- Gather local expert knowledge on grizzly bear population dynamics, movement, and Inuvialuit harvesting practices. Determine how to integrate local expert knowledge and scientific management frameworks.
- Collect and analyze information on the habitat use, the spatial distribution, and the movements of bears throughout the Yukon North Slope.
- Develop a program for long-term monitoring of grizzly bears in the Yukon North Slope.

Grizzly bear track. PHOTO: J. LUCAS/PARKS CANADA

Methods and Information Collected

- To date, 60 individuals have been collared in the study, with 17 to 35 individuals wearing collars each year. Canadian Council on Animal Care (CCAC) Guidelines were followed during captures.
- GPS locations for individual bears with GPS collars were taken a minimum of six times a day (every four hours), subject to optimum conditions for satellite uplink. Overflights were conducted annually to get a VHF fix on bears and to record survival information.
- We used hair snare stations and standard DNA mark-recapture techniques in 2006 and 2007. We divided a subset of the study area systematically into 107 cells and placed one hair snare site with a lure in each 7 km x 7 km cell. We trapped each cell for four-day sessions. All bait sites were at least 1 km apart. We collected all the hair at each station at the end of each trapping session.
- All grizzly bear samples were genotyped at six microsatellite loci. We assigned an individual identity to a sample when the sibling match probability is less than 0.05. Live captured bears were also genotyped at six loci.
- The degree of movement in and out of the DNA sampling grid can be estimated using a joint mark-recapture analysis of the telemetry relocations.
- Population estimates can be calculated using mark-recapture analysis.
- Annual survival rates will be calculated. The values used in calculating the population growth rate will include the initial population size, estimated age of first reproduction, estimated reproductive rate, and sex and age-specific annual survival rates for the female component of the population.
- Maximum annual allowable human-caused mortality, inclusive of maximum harvest and estimated non-hunting, human-caused mortality will be derived for the DNA mark-recapture study area. Kill will be applied to the population in a ratio according to hunter selectivity of age/sex strata for grizzly bears upon past records of human-caused mortality, and initially with vulnerability ratios from the standing sex/age structure.
- Some traditional and local knowledge of grizzly bears and bear habitat in the area was gathered prior to this study. There were also some written records of traditional and local knowledge of bears in the region. Through extensive searches of literature, historical documents, and interviews with researchers in the area, we consolidated this information in a written and spatially oriented, digital format.
- Further information was gathered through interviews. All the information gathered has been consolidated in one report, "Aklavik Local and Traditional Knowledge about Grizzly Bears of the Yukon North Slope (Available on the WMAC-NS website at http://www.wmacns.ca/resources/publications/).

Update/Results

- We conducted a telemetry flight in May to monitor cub survival rates.
- All but two collars from individuals in the study were either dropped by the bear and picked up by us, or replaced with a new collar. At the end of the collaring season 34 individuals were collared.
- Biological samples were collected from 34 bears during captures (including blood, hair, claw samples, teeth, fecal and fat samples).
- Biopsy (i.e.: tissue) samples were collected from 4 other males.
- Five of the captured-bear samples failed during lab analysis.
- Samples from hair trapping and capture work from 2006 and 2007 seasons were sent to Wildlife Genetics International for analysis. The 4,709 hair samples from the hair trapping grid were classified as follows:
  - 13% lacked suitable material for extraction;
  - 55% were excluded by sub-selection rules;
  - Less than 1% were visually judged to be from other species.
  - 12% failed during genetic analysis;
  - 1% showed > 2 alleles at multiple markers;
  - 20% were assigned individual identity;
  - 110 individuals were identified in 2006 and 105 in 2007, of which 56 were identified in both years;
  - 30 captured bears were identified in the 2006 hair samples and 29 in 2007, including 17 caught in both years of hair snaring;
  - 177 individuals have been identified as using the study area to date.
- We compared the DNA from our sampled bears to 119 bears sampled by Peter Clarkson in the Richardson Mountains, 336 bears sampled by the Government of Northwest Territories from a larger region around Inuvik, 8 bears sampled by Parks Canada from Ivvavik National Park, and 16 bears sampled by Harry Reynolds from Alaska National Wildlife Refuge in Alaska. There were 5 perfect DNA matches between our sampled bears and other grizzly bear datasets mentioned above: Two from Clarkson's dataset, two from the NWT dataset, and one from the Ivvavik dataset.
- We were able to identify 38 triads (76-parent–offspring relationships) that are very likely to be correct family groups, and 35 pairs that are expected to contain a mix of parent–offspring and sibling pairs.
- We will be conducting mark-recapture analysis over the coming year. Results will not be available until the completion of the study (anticipated 2010). Collars recovered to obtain relocation data and two more years of field monitoring is planned for survival analysis.
- While several hunters participated in the tracking program, only two hunters returned tracking units with tracks. These hunters were provided with GPS units. Tracking units were refurbished and returned to the community this March.

Update/Results (continued)

More details on this project are available in the "Yukon North Slope Grizzly Bear Population Study: Mid-Term Project Report" available online at http://www.wmacns.ca/resources/publications.

Partners

- Yukon Territorial Government
- Parks Canada
- Wildlife Management Advisory Council (North Slope)
- Government of Northwest Territories
- Herschel Island Territorial Parks
- Aklavik Hunter and Trappers Committee

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Rationale

Information on grizzly bear population size is needed to monitor the effects of development on grizzly bears and to manage for sustainable harvest. We currently lack an accurate population estimate for the Inuvialuit Settlement Region (ISR). Grizzly bears are vulnerable to the cumulative effects of climate change, human activities on the landscape, and environmental degradation. Northern ecosystems are expected to be the most vulnerable to the effects of changing climatic conditions and the impacts on Arctic grizzly bears are unknown. In other jurisdictions, grizzly bear population decline has been characterized by a lack of planning during the pre-development stages. An accurate population estimate is necessary as a baseline for development planning and ongoing monitoring.

Research

GRIZZLY BEAR POPULATION ESTIMATE FOR THE EASTERN INUVIALUIT SETTLEMENT REGION (ISR)

Government of the Northwest Territories

Objectives

- To determine the population density of grizzly bears in the ISR.
- To develop a genetic database of grizzly bears in the region.

Methods and Information Collected

- We used DNA mark-recapture sampling techniques to estimate population densities for grizzly bears based on aerial darting.
- Areas were searched for grizzly bears using an AStar helicopter.
- We used DNA biopsy darts (Pneu-Dart Inc., Williamsport, PA) fired from a standard dart rifle.
- The AStar had a sliding door for the darter on the same side as the pilot, which increased our range, allowing for another observer, and significantly reduced chase times.
- Two helicopter crews were used. Each crew consisted of a biologist, one or two local assistants, and a pilot.
- In a few instances, the dart either malfunctioned or the bear was missed. In these cases, efforts were made to re-dart, but this was not always possible based on fuel, ability to relocate the bear, and the need to call off the darting attempt to avoid undue stress on the animal.
- DNA samples were dried and sent to Wildlife Genetics International (Nelson, BC) for DNA analyses to identify individuals and the sex of the animal.

Grizzly bear with cubs. PHOTO: GOVERNMENT OF NORTHWEST TERRITORIES

Update/Results

- Due to the early spring and poor detectability of bears in the trees, most of the search effort occurred above treeline and as a result, all captures were above treeline.
- A total of 89 samples (biopsy tissues from darts, hair from dens, and scat samples) were submitted for DNA analysis, from which 86 had sufficient material to attempt DNA extraction.
- Overall, there were 61 successful samples to which 56 individual grizzly bear genotypes could be assigned.
- 41 new genotypes were added to our DNA archive.
- There were 14 recaptures (12 previously collared [7 females and 5 males] and 2 that were first darted in 2007 [1 female, 1 male]), and 1 was from a dead male bear that had been collared previously.
- Overall, there were 7 recaptures (4 on Richards Island and 3 at the western end of the Tuktoyaktuk Peninsula) amongst 17 DNA marks in the development area, and 7 recaptures amongst 44 DNA marks in the region east of the development area.
- A total of 6 bears were darted within Tuktut Nogait National Park (TNNP) or near its western boundary (Figure 1). Of the 3 bears darted within the park, 1 was a recapture (GM1066) but the other 2 samples failed to produce adequate DNA results (Xbombs, see Figure 1). Of the 3 animals darted at the western boundary, 1 was a new male, 1 was a new female, and the third failed DNA analysis.
- An accurate estimate of population density is currently limited due to low sample sizes.
- Recommendations to increase sample size include continuing to foster participation by communities to submit hair and fecal samples, and consider baited barbed wire posts to collect hair in addition to aerial darting.

Partners

- Dr. Andrew Derocher, University of Alberta
- Parks Canada Agency

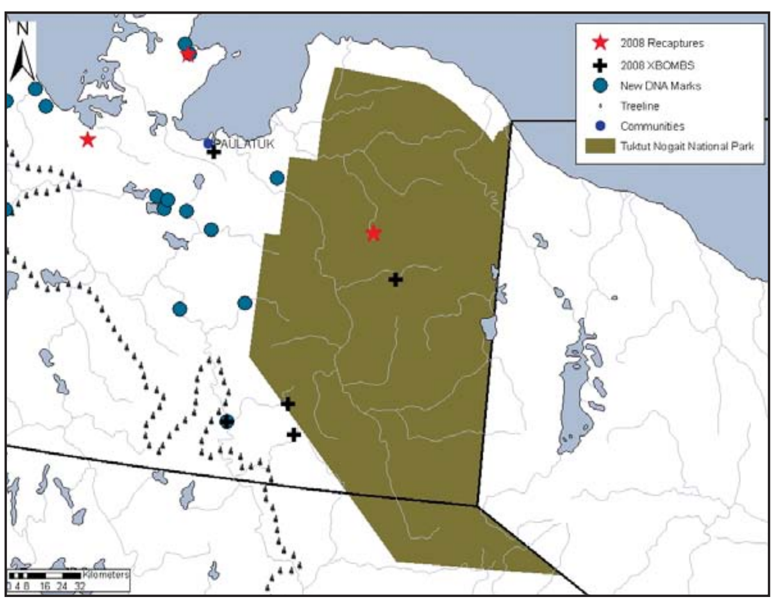

FIGURE 1. Grizzly bear darting locations in and near Tuktut Nogait National Park, spring 2008.

Contacts

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Rationale

Arctic tundra ecological communities are highly vulnerable to human activities and climate change. However, predicting the impact of these changes on ecological communities is hindered largely by our poor understanding of the processes that structure them. While several Arctic species have been relatively well-studied, trophic interactions, which are crucial for maintaining ecosystem integrity, have received little attention. In order to fill this knowledge gap, an international, Canadian-led project called Arctic Wildlife Observatories Linking Vulnerable EcoSystems (Arctic WOLVES) was developed. This circumpolar study of tundra ecosystems aims to understand food webs and ecosystem processes that affect them, measure current impact of climate change on wildlife, and project future impacts through monitoring and modelling. More than 40 researchers from 9 countries (Canada, USA, Denmark, Norway, Sweden, Netherlands, Finland, Germany, and Russia) are part of the project. Supporting institutions within Canada include the University of British Columbia's Zoology Department, the National Sciences and Engineering Research Council, the International Polar Year Secretariat, and Wildlife Conservation Society Canada. Within the Western Canadian Arctic, research occurred primarily on Herschel Island, YT, with a secondary field site at Komakuk Beach in Ivvavik National Park.

Research

ARCTIC WILDLIFE OBSERVATIONS LINKING VULNERABLE ECOSYSTEMS (ARCTIC WOLVES)

Dr. Donald G. Reid, Wildlife Conservation Society Canada
Dr. Charles J. Krebs, University of British Columbia

Objectives

- To build a network of circumpolar wildlife observatories in order to assess the current state of Arctic terrestrial food webs over a large geographic area.
- To determine the relative importance of bottom-up (resources) and top-down (predators) forces in structuring Arctic food webs.
- To document climate change impacts on biodiversity (insects, mammals, birds) of the tundra and predict how these changes will impact these ecosystems in the future.

Specific objectives for the Komakuk area in Ivvavik National Park were to:

- Estimate small mammal abundance (lemmings) and run a snow fence experiment to test the relationship between snow depth and lemming abundance;
- Document predator abundance;
- Determine fox den distribution and occupancy;
- Quantify gyrfalcon nesting density and ptarmigan abundance.

Maria Leung trapping lemmings. PHOTO: D. REID

Methods and Information Collected

- Small mammal abundance was measured by mark-recapture live trapping of two 9 hectare grids, and index lines in late June and late August. Winter nest counts and mapping was also conducted on both grids in late June.
- A snow fence treatment was established on one of the lemming grids and temperature button stakes were established to record temperatures at various heights above ground.
- Predator abundance was documented by general surveys of study area for evidence of breeding.
- Fox den distribution and occupancy was determined by flying an aerial survey of the North Slope from the Alaska border to the Babbage River. Visits were focused on historical den sites.
- Gyrfalcon and ptarmigan abundance were estimated based on aerial surveys completed in late June in a sample stretch of drainages of the British Mountains and transects on the coastal plain.

Update/Results

Small Mammals

- Small mammal densities were lower than the previous two years (2-4/ha). There was total of 21 captures on the index lines. Overall, small mammals declined over the winter likely due to poor winter conditions and weasel predation.
- Winter nest counts were lower than on Herschel Island, and a low proportion were occupied by weasels.
- Only 1 shrew was caught, and Microtus (voles) were the most common small mammal captured. Microtus has become more dominant in this system since 2006.

Predator Surveys

- Common raven, peregrine falcon, parasitic jaeger and rough-legged hawk fledged young within the study area.
- An Arctic fox natal den was found near the airstrip at Komakuk.
- Least weasels were breeding and active throughout the summer.

Fox Den Surveys

- 105 den sites were recorded, of which 12 used by Arctic fox (3 were reproductive) and 2 used by Red fox (none were reproductive).

Gyrfalcon and Ptarmigan Surveys

- Aerial surveys were completed through the British Mountains and coastal plain and showed that both species were at low densities compared to historical data, but still within the range of their cyclic population fluctuations.

Snow Fence Experiment

- Snow fencing was established along 4 of 6 potential transect lines. Temperature buttons were established on both grids. This experiment will continue in 2009.

Partners

- International Polar Year Secretariat
- University of British Columbia, Department of Zoology
- National Sciences and Engineering Research Council
- Wildlife Conservation Society of Canada
- Polar Continental Shelf Project
- Yukon Department of Environment
- Aurora Research Institute
- Aklavik Hunters and Trappers Committee

The snow fence experiment at Komakuk.
PHOTO: D. REID

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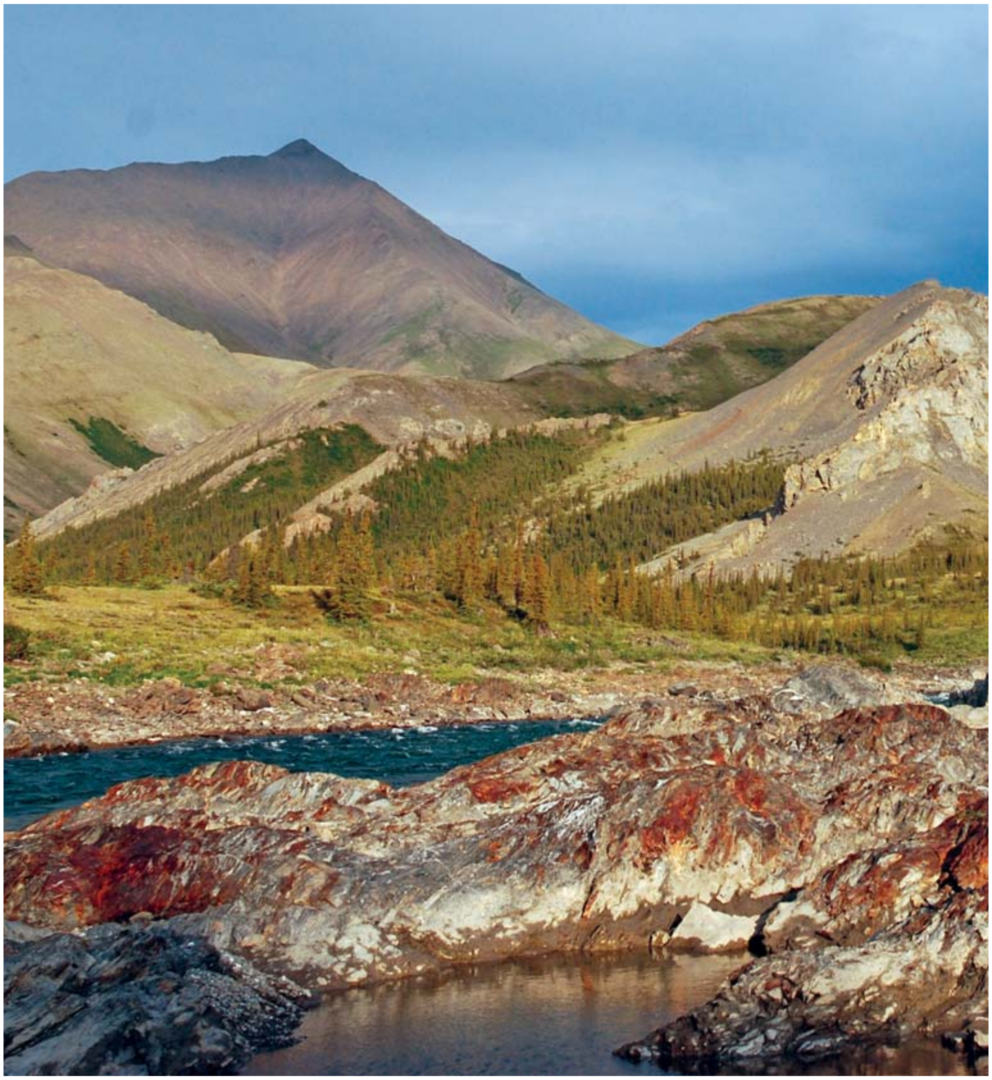

Ivvavik National Park. PHOTO: R. HANSEN/PARKS CANADA

Rationale

This project is a component of the arctic-wide International Polar Year (IPY) project "Climate Change Impacts on Canadian Arctic Tundra Ecosystems: Interdisciplinary and Multi-scale Assessments", which focuses on arctic vegetation mapping and change detection. Ivvavik National Park was selected as one of four IPY model parks. The project will result in an improved terrestrial ecosystem classification and inventory for Ivvavik, a methodology to measure and report vegetation and community change analysis, and will support park scale and arctic wide assessments of vegetation biomass and leaf area index data. The intention is that the project will help develop a deeper understanding of key terrestrial ecological components and processes in the context of climate change in Ivvavik National Park, and will provide map products that show their spatial and temporal relationships. Overall, the project is designed to develop cost effective ecological inventory methods that provide ecological baselines and support the development of park monitoring programs and park management applications.

Research

TERRESTRIAL ECOSYSTEM MAPPING, LAND COVER CHANGE AND TUNDRA BIOMASS CHANGE IN IVVAVIK NATIONAL PARK

Parks Canada

Objectives

- Complete a terrestrial ecosystem inventory focussed on description, classification, interpretation, and mapping of terrestrial ecotypes.
- Perform analysis of historical change (1985 to present) in shrub and other tundra vegetation types using archival Landsat imagery.
- Assess vegetation biomass and leaf area index for selected tundra vegetation units.
- Evaluate radar-based satellite methods for improved wetland delineation and detection.

Methods and Information Collected

- Existing ecological information on park ecosystems were reviewed prior to development of a field sampling plan. An existing terrestrial ecosystem map of the Firth River drainage was used as a baseline for describing ecotypes. A SPOT 5 satellite image was acquired that covered the whole park, and the draft landcover map generated from this image was used to guide field sampling.
- Consultations regarding the objectives of the work were held in Aklavik and arrangements were made to hire five youth from Aklavik for the duration of the field program.

Example of an ecotype plot in Ivvavik National Park. PHOTO: M. KIRK/PARKS CANADA

Methods and Information Collected (continued)

- The field program was based at Sheep Creek from July 14 to 25th, 2008.
- To complete the ecosystem inventory, 3-person crews hiked pre-planned sample transects across the landscape. Sample plots were established in areas of the landscape uniform in the targeted ecotype approximately 30x30m in size. This allows for uncertainty in geo-referencing of 10m SPOT pixels.
- Two types of geo-referenced ecosystem inventory plots were completed. Quick plots consisted of a rapid assessment of ecotype, an estimate of percentage cover of all dominant vascular and non-vascular plants, and some observations on plot location such as soil type, moisture regime, slope, aspect and drainage. Ground plots were more comprehensive and involved all data collected in the quick plots, plus identification and estimation of percentage cover all vascular and non-vascular plants in the plot. Unknown species were collected for identification at museums. Additionally, more plot location data were collected about ecosystem processes. For example, a more detailed description of soil types, rooting depth, water sources, and successional status were recorded.
- For biomass and leaf area index sample plots the following was collected: cover percentage and mean height of main vegetation species, fresh weight of above ground foliage, and root biomass of main vegetation species, leaf area index (ratio of total upper leaf surface divided by surface area of the land on which the vegetation grows) of main vegetation species.
- High-resolution aerial photos were taken by a digital camera mounted to the underside of a Bell Jet Ranger helicopter.
- New Radar-sat images were taken in 2008 to cover the test sites for the wetland study. Field data collected included active permafrost layer depth, water table level and water height above the ground, dominant vegetation strata, and percent coverage of main vegetation types.

Update/Results

- A total of 416 geo-referenced Ground and Quick plots were completed, focused primarily in the Firth watershed. Of these, 288 were Ground Plots, and 128 were Quick Plots. Some additional plots were also located outside the Firth in other areas of the park. Ten of the 14 ecodistricts in the park were sampled.
- 414 vascular plant taxa were collected and identified and the revised park vascular plant species list now has 437

Update/Results (continued)

taxa (species and subspecies). 68 taxa were new to Ivvavik National Park, and 23 previously reported taxa were not observed.

- A botanist from the Yukon Government produced an inventory of vascular plants in Ivvavik National Park, and provided an updated list of plant species including locations of rare plants.
- A formal ecotype classification will be completed for the final report based on field sample plots and the existing terrestrial ecosystem map. The first approximation of a predictive ecosystem map product showing distribution of ecotypes of Ivvavik National Park has been developed in draft form.
- Work on backcasting landcover change based on LandSat archive data in Ivvavik has begun but no results are ready at this time.
- A total of 11 sites were sampled for above ground biomass, foliage biomass and leaf area index. For the final draft report, a Landsat-based map of park biomass will be linked to a much broader area by up-scaling with satellite image data. Results will be linked to the ecotype classification and change over time will be assessed from the Landsat archive data created for backcasting.
- A total of 4,200 21-mega-pixel, geo-located air photos were acquired during the field season. To use the high resolution aerial photos as ground control references for land-class validation, areas of interest are being compiled based on site data and park interests. We are presently merging aerial photos using Photo Shop CS4 and geo-referencing these photos using ArcGIS. SPOT 5 data is being used for geo-correction, and hydrologic features are incorporated for some downstream direction.
- For the wetland study, radar-sat images were overlain on SPOT-5 data, and geo-referenced field data. As a first step, a visual analysis was conducted to interpret the information that can be extracted for wetland identification. This analysis aims to detect any significant visual differences between: upland classes and wetland classes; dominant vegetation strata within a wetland (mainly herbs and shrubs), and; the soil moisture content and/or water table level variability within a wetland.
- A final report will compile all results, including the full ecotype map, the results of the backcasting exercise, the biomass analysis and the wetland delineation study.

Partners

- Parks Canada Agency
- International Polar Year
- Natural Resources Canada – Canadian Centre for Remote Sensing

The Ivvavik National Park ecosystem mapping and biomass field crew .
PHOTO: D. MCLENNAN /PARKS CANADA

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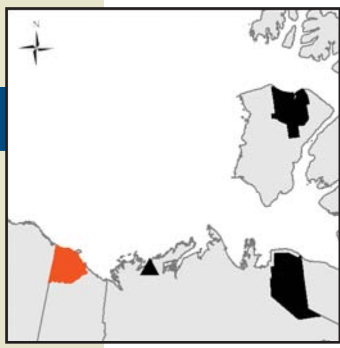
Rationale

We are searching for Alaskan marmots, a new species to Canada, in areas of Ivvavik National Park where Inuvialuit Elders recall seeing them in the 1950s. Locating current colonies of these marmots is important for 3 reasons. First, the discovery of a new species to Canada is significant, particularly when the discovery is guided by aboriginal traditional knowledge. Second, Ivvavik National Park would be the only place these marmots live in Canada. Third, a colony within walking distance of the Firth River valley would offer an opportunity for visiting river travelers to view these rare social animals.



Research

YUKON NORTH SLOPE MARMOT STUDIES

Yukon Government

Objectives

- The objectives of the 2008 field studies were to focus ground search efforts within suitable habitats within a day's walk of the Firth River, on the east side, between Sheep and Canyon Creeks.

Methods and Information Collected

- The 2-person crew came into the valley by helicopter on June 16. We suspended one food cache over the edge of the canyon at two locations. We minimized impacts on the wilderness experience of Park visitors by camping in locations hidden from the view of river travelers.
- The crew hiked to and examined habitats with large boulders where marmots live:
  - looking for scats and bones and burrows;
  - listening for 'whistles' made by calling marmots;
  - looking for resting and moving marmots;
  - looking for tracks in wet areas;
  - looking for remains of stone traps.
- In all the locations we visited we took GPS coordinates and photographs.
- We collected information on the size, characteristics and location of potential marmot habitats. We recorded sightings of birds, mammals, and unusual plants.

Areas within Ivvavik National Park were surveyed for marmots. PHOTO: J. LUCAS/PARKS CANADA

Results

- We backpacked to and examined potential marmot habitats on the east side of the Firth River valley from a valley opposite and just south of Sheep Creek north to Canyon Creek. In seven days between June 16 and 22, we walked the survey area and glassed extensively. We picked this time period because it was just before mosquitoes were abundant and marmots are active. We tried to be active when it was cool, especially during the hot weather in the last few days.
- We selected this survey area for four reasons: It was on the side of the valley and in the canyon portion of the river where Aklavik Elder Mrs. Nellie Arey had said she recalled visiting her grandfather's marmot trapping site. It was mostly downstream of the gold-bearing Sheep Creek where Mrs. Arey and her relatives searched in the canyon for gold in the 1950's. There were exposures of quaternary geological features (quartz, limestone, anticlines, and faults) that suggested this would offer some bouldery marmot habitats. And it was in a stretch of the river where there has been relatively limited time on the ground by river travelers or others in the summer since Inuvialuit families were there in the 1950's.
- We located and visited five sites that seemed to offer potential marmot habitat, but none were occupied by marmots. There were no burrows, scats found, call sounds, or bones.
- One of these sites that seemed consistent with Mrs. Arey's description was a lower ridge between Glacier and Canyon Creeks. Recent and old wolverine sign and several recent grizzly bear daybeds were found at this site. We saw one set of tracks in the mud by a creek that were indistinct, likely made by a small otter or a marmot.

Partners

- Parks Canada Agency
- Aklavik Hunters and Trappers Committee
- Wildlife Management Advisory Committee
- Polar Continental Shelf Program

Contacts

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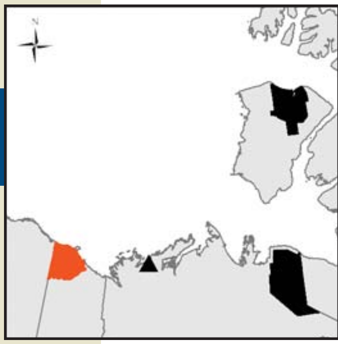
Rationale

There is growing concern over the long-term effects of climate change, exploitation and development on Arctic environments, and the subsequent consequences these changes will have for the people of this region. Aquatic ecosystems are of special concern. Nearshore coastal waters along the Yukon North Slope serve as an important migration corridor and feeding area for both anadromous and marine fish species and are an important component of the Beaufort Sea ecosystem. Certain fish species found in these waters, e.g., Dolly Varden char, ciscoes and whitefishes, are of considerable importance to the aboriginal people of the Inuvialuit Settlement Region. This project consists of a survey of the fish community in the nearshore waters of the Yukon coast, to help better understand the Beaufort Sea ecosystem and to help develop effective and efficient means to monitor changes to the fish populations of these waters.



Research

YUKON NORTH SLOPE NEARSHORE COASTAL FISH SURVEY

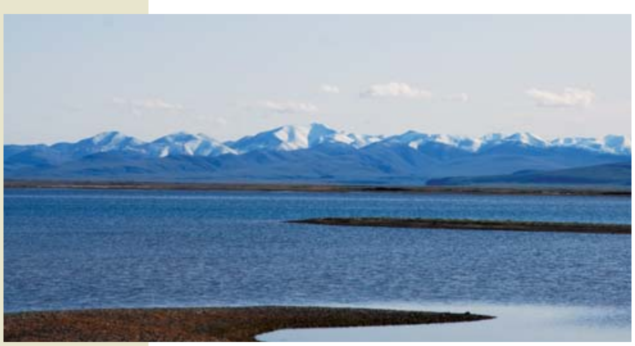
Jim Johnson, Department of Fisheries and Oceans

Objectives

- To determine changes that have occurred to the fish community of the nearshore waters of the Yukon North Slope over the past two decades.
- To establish new benchmark fish conditions for this region of the Beaufort Sea prior to major hydrocarbon development.
- To provide biological samples for follow-on research including stable isotope food web studies, char genetics studies and contaminants studies.

Methods and Information Collected

- The first two years of the project, 2007/08 and 2008/09, were dedicated primarily to field work. The remaining two years will be used for data analysis and reporting.
- The present study replicates, in large measure, a Department of Fisheries and Oceans survey conducted in the same area in 1986. Results of the two studies will be compared.
- Principle fishing gear was large trapnets set in shallow, nearshore waters (shore to 2 m depth), set perpendicular to the shore.
- Installed trapnets remain in place for the duration of the study (weather and ice permitting) and thus fish continuously until removed.
- The trapnets are checked a number of times per day; captured fish are placed in a temporary holding pen until processed.



The coast of Ivvavik National Park.
PHOTO: R. HANSEN/PARKS CANADA

Methods and Information Collected (continued)

- Most fish are identified, measured and released. A sub-sample of the catch is dead sampled.
- Two trapnets were installed at Niakolik Point. The first trapnet was installed inside the point and fished continuously between July 3rd and August 31st. The second trapnet was fished on the seaward side of the point from July 12th to August 31st except for days when weather necessitated removal. A third trapnet was installed along the coast just to the west of the mouth of the Spring River. This trapnet was only operated for a 7 day period in mid-August.
- In 2008 approximately 56,025 fish were trapped. Of this number:
  - 2,637 fish were killed and fully processed;
  - 25,972 fish were measured and then released unharmed;
  - 27,416 fish were simply counted and then released.
  - Table 1 summarizes, by species, the number of fish that were processed, measured and released or counted and then released. The last two columns of the table compare the contribution each species made to the total catch for 2008 versus 1986.
- Of special interest and concern were Dolly Varden char. In total 212 char were captured. All were released in good condition after being measured for length. No adipose fins were collected from char in 2008 for genetics work as the 400 fin clips collected in 2007 was seen as adequate for that study.
- Information was collected on species composition, relative abundance and size distribution of the fish community for the entire sampling period. Detailed biological data was collected from dead sampled fish including length, weight, sex, reproductive condition, etc. Aging structures (otoliths) were collected for later analysis.
- Basic environmental parameters such as water temperature and salinity were collected daily at trap locations throughout the sampling period.
- Additional samples collected during the field season in support of other research projects:
  - i) sampling for water chemistry, algae, meiofauna (microscopic zooplankton), macro-invertebrates in support of research into food web structure of lower trophic levels of the near shore regions of the Beaufort Sea utilizing taxonomy and stable isotope analyses;
  - ii) muscle samples (n=10) for each species of dead sampled fish for 4 different sampling periods throughout the summer (total samples = 40 per species). These samples are to be used for fatty acid analysis in food web studies;
  - iii) samples for ongoing contaminants research. Liver and muscle samples were collected from 10 fish of each species encountered.

Methods and Information Collected (continued)

- Photographs were taken of all species of fish encountered.
- All salmon (except 2) were returned to the Freshwater Institute for further examination by Erin Hiebert-Linn who is conducting PhD studies to determine the stock(s) of origin for salmon caught in the Canadian Arctic.

Results

- Table 1 shows the numbers of various species captured and compares this to the 1986 catch.
- The overall pattern of the proportions of the catch contributed by the various species is quite similar between the years 1986, 2007 and 2008.
- However, there appears to be significant differences in the relative abundance for some species e.g. increases in saffron cod, Pacific herring, starry flounder and rainbow smelt and decreases in Arctic cisco.
- A number of species previously unreported for this area are now being found e.g., starry flounder, pink and chum salmon.
- Data and tissue samples collected in the field were shipped to the Freshwater Institute in Winnipeg.
- Aging structures from the dead sampled fish have been forwarded to the fish aging lab at the Freshwater Institute. Aging of all 2007 samples is nearly complete and work will begin on the 2008 samples soon. Aging of all samples should be completed by the end of 2009/2010.
- Biological samples (for stable isotope, genetics, and contaminants work) have been archived at the Freshwater Institute or forwarded to other researchers; work on these samples will continue in 2008/2009 and continue throughout the remaining years of the project.
- Detailed analyses of the data are just getting underway. Analyses and appropriate reporting will be the focus of this project for the next two years 2009/2010 and 2010/2011.

Partners

- For the stable isotope/food web portion of the project we are collaborating with Dr. Michael Power, Department of Biology, University of Waterloo.

TABLE 1 **Summary of number and species of fish capture in 2008, with comparison to 1986.**

Species	*Killed and Processed*	*Measured and Released*	*Counted and Released*	*Total*	*% of 2008 Catch*	*% of 1986 Catch*
Arctic cisco	287	6291	6177	12755	22.8	37.1
Least cisco	287	3456	1986	5729	10.2	14.3
Rainbow smelt	284	3675	4343	8302	14.8	5.5
Lake whitefish	231	295	-	526	0.9	0.3
Broad whitefish	263	1257	35	1555	2.8	0.7
Dolly Varden	-	212	-	212	0.4	1.2
Inconnu	70	499	-	569	1	0.1
Other smelt	24	298	-	322	0.6	0
Pink salmon	13	1	-	14	<0.1	0
Chum salmon	4	-	-	4	<0.1	0
Arctic flounder	288	4620	11602	16510	29.5	31.5
Fourhorn sculpin	268	2517	677	3462	6.2	7.4
Saffron cod	314	2448	2596	5358	9.6	1.7
Starry flounder	191	154	-	345	0.6	0
Pacific herring	98	131	-	229	0.4	<0.1
Arctic cod	1	77	-	78	0.1	<0.1
Blackline prickleback						<0.1
Snailfish sp.	1	-	-	1	<0.1	<0.1
Threespine stickleback	1	-	-	1	<0.1	0
Arctic grayling	3	7	-	10	<0.1	<0.1
Ninespine stickleback						<0.1
Round whitefish	6	-				<0.1
Burbot	1	-	-	1	<0.1	<0.1
TOTALS	*2,637*	*25,972*	*27,416*	*56,025*		

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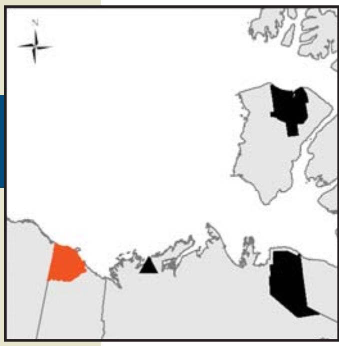
Rationale

Parks Canada is mandated to document, protect and present the cultural resources of Ivvavik National Park so that its rich human history is preserved, understood and appreciated. The cabin at Nunaluk Spit is one of the most intact surviving examples of 20th century Inuvialuit house construction in the park. In 1996, it sat 18.4m from the bank edge. Since then, aggressive coastal erosion has removed 16m of shoreline, and the house now sits less than 2.5m from the edge of the bank. Elsewhere in the park, houses threatened by erosion have been excavated to recover as much information as possible before they were destroyed. At Nunaluk, this may not be warranted. Differing versions of the house's history have been reported, and include the suggestion that it may have been moved in the past. If so, this would render full excavation irrelevant, since the building would no longer be sitting on the same footprint as it did when it was built and occupied. For this reason, initial testing of the house floor, rather than full-scale excavation, was completed. If artifacts dating predominantly to the 1930s or 1940s were recovered, it would be considered proof that the house sits on its original footprint, and a subsequent application would be made for more complete excavation in the summer of 2009. Additional recording was also undertaken at cultural sites on the Firth River and Fish Creek.



Research

CULTURAL RESOURCE INVESTIGATIONS, IVVAVIK NATIONAL PARK OF CANADA

Parks Canada

Objectives

- To determine whether buried cultural resources exist that should be salvaged before the house at Nunaluk is destroyed by coastal erosion.
- To confirm the presence of potential (previously unrecorded) cultural sites on the Firth River and Fish Creek.

Methods and Information Collected

Nunaluk Spit (69Y):

- 19 test pits were excavated, eight in the interior of the house and 11 around the exterior periphery.
- All artifacts found were recorded and placed in bags by excavation unit, for cleaning and identification at the Western and Northern Service Centre in Winnipeg.
- All test pits were backfilled following the investigation.

Firth River sites:

- Detailed written description and site photography at two cultural sites on the Firth River, near the junction of the Firth and Lloyd/Muskeg Creeks.

Fish Creek:

- Inspection and photography of several possible cultural features noted by Park staff along Fish Creek, on a ridge 9 km south of the Komakuk DEW line station.

Excavating at the house at Nunaluk.
PHOTO: S. THOMSON/ PARKS CANADA

Results

Nunaluk Spit

- Most artifacts were found in the top 10 cm of soil, with very few between 10-15 cm dbs (depth below surface).
- The floor was constructed from milled tongue and groove planks, 3 ½" wide by ¾" thick, laid on joists set directly on the ground surface.
- The house site was leveled prior to construction, as suggested by a thick layer of beach sand and fine gravel on top of the sandy loam substrate at the exterior west end of the house.
- No conclusive evidence was found to indicate the position of a stove, although charring on the central roof beam may be proof that it was located near the centre of the room.
- A layer of wood chips at the southeast corner indicated the former location of a wood pile.
- Excluding modern debris, 507 artifacts were recovered. Much of this consisted of fragments of window glass and animal bone. None could definitively be tied to a 1930s or 1940s occupation of the site. The overall impression is of a brief occupation, in which little was left behind.
- Despite the lack of artifacts that could definitively be dated to the 1930s or 1940s, it is considered unlikely that the house has been moved from its original footprint. Remnants of chinking still survive between some of the timbers. In the process of disassembling, moving and re-assembling the house, any chinking between its wall timbers would have been removed. Conversely, if the spaces between the timbers were re-filled after the house was relocated, more of the chinking should survive.
- It is possible that the account of the cabin having been moved may actually refer to the process of its construction. In other words, the "moving" refers to the removal of timbers from an older house nearby, which were re-used to construct this house in its present location.

Firth River Sites

- Evidence of human presence in a split tor (a prominent rocky hill) on a steep slope overlooking the Firth River near its junction with Lloyd Creek was first noted in 2006. The site was revisited in August 2008 to search for additional cultural remains and recorded as site 114Y.
- Heavy sticks wedged into a large cleft in a split tor formation have no visible staining or rope marks, but some are blackened as if exposed to fire.
- No other artifacts were noted, but some mammal bone fragments and a burned log were observed on the floor of the cleft.
- A second site about 1 km south was recorded as 115Y. It is an isolated find, consisting of a single stick wedged at one end into a rock face. Its position under an overhang and about 2m above the steep scree slope make it very unlikely it was not intentionally placed there by someone.

Results (continued)

- Firth River Sites 114Y and 115Y are both situated on steep slopes which are difficult to access, with excellent views up the Firth River and Muskeg Creek valleys to the south and southeast. No diagnostic artifacts have yet been found at 114Y and 115Y, and the sites cannot be assigned an age on that basis.

- The purpose of the heavy sticks wedged into the rock at sites 114Y and 115Y is not known. However, it seems plausible that 114Y (the Split Tor site) was a temporary hunting camp, and that the "tunnel" through the tor provided a convenient place to dry meat.

Fish Creek

- Several rock features spread over a linear distance of about 3km were inspected. Some consisted of pit-like structures filled with large rocks.
- Three features which displayed clear evidence of cultural origin or modification were assigned Parks Canada site numbers 116Y, 117Y and 118Y.
- A rock feature recorded as 116Y appeared to have been modified by people. It consisted of two large slabs of shale, one standing upright and the other horizontal. Several cobbles of white quartzite lay on the horizontal slab. Numerous smaller pieces of quartzite were spread over the slope in this vicinity. No bone or other cultural remains were visible on the ground surface or between the slabs of rock. The concentration of quartzite cobbles does suggest that they were purposely assembled as some form of marker. It is tentatively identified as a small, unopened cache.
- The second cultural feature recorded on the ridge (117Y) was found at its most westerly and highest point, at a location having excellent views of the valleys on either side. It consisted of a single cache, measuring 2.5 m x 2.0 m. The cache had been opened, and the distal half of a caribou femur was noted nearby. This piece fits together with another bone fragment found inside the opened cache.
- The feature recorded as 118Y is also thought to be a cache. This feature has the appearance of a slightly elongated pit, into which large boulders were placed. A single boulder is oriented upright.

Heavy sticks wedged into a tunnel at the Split Tor site (114Y)
PHOTO: S. THOMSON/ PARKS CANADA

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MONITORING

Rationale

Recording incidental wildlife observations is an inexpensive method of collecting information about wildlife populations. Observations of wildlife made in Aulavik, Ivvavik and Tuktut Nogait national parks, and surrounding areas, are recorded on wildlife cards and the information is stored in a computer database. The wildlife cards are used to track the occurrence of rare and at risk wildlife species.

Wildlife

WILDLIFE CARDS

Objectives

- To collect basic information (presence, distribution and relative abundance) about wildlife populations in Aulavik, Ivvavik and Tuktut Nogait national parks and surrounding regions.

Methods and Information Collected

- Parks Canada staff, researchers and park visitors record incidental observations of wildlife on wildlife cards.
- Information collected includes: date and time of observation, name of observer, species observed, number of individuals seen, location of observation, elevation, aspect, age, sex of animal, evidence of reproduction, habitat, weather, and remarks.
- Information from the wildlife cards is entered into a database.
- Summaries and maps of incidental observations are produced as required.

Update/Results

- From the beginning of the records in 1973 up to the end of 2008, there are a total of 2,726 observations in the wildlife cards database (Table 1). The large majority of records occur within Ivvavik National Park due to increased visitation by park staff, researchers and tourism.

Dall's sheep feeding in Ivvavik National Park.
PHOTO: J. LUCAS/PARKS CANADA

TABLE 1 **The total number of mammal, bird and fish wildlife card records by Park, 1973-2008**

Park Name	*Total Mammals Records*	*Total Bird Records*	*Total Fish Records*	*Grand Total*
Aulavik	266	439	5	710
Ivvavik	928	611	9	1548
Tuktut Nogait	209	246	3	458
Pingo Canadian Landmark	0	10	0	10
Grand Total	*1403*	*1306*	*17*	*2726*

- There were 268 wildlife card observations in 2008 (Table 2). Overall, bird observations were the most common, likely because the NWT/ Nunavut Bird Checklist Surveys are included in this database. A total of 52 bird species were observed in 2008, the most abundant of which were the waterfowl species (ducks, geese, swans and loons). Ten species of mammals were recorded, and ungulates such as Dall's Sheep and Muskox were the most commonly observed.

TABLE 2 **The total number of mammal, bird and fish wildlife card records by Park for 2008**

Park Name	*2008 Mammal Records*	*2008 Bird Records*	*2008 Fish Records*	*2008 Total*
Aulavik	18	100	1	119
Ivvavik	36	85	0	121
Tuktut Nogait	4	15	0	19
Pingo Canadian Landmark	0	9	0	9
Grand Total	*58*	*209*	*1*	*268*

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Rationale

The NWT-Nunavut Bird Checklist Survey is part of a national effort to collect scientific information about the distribution, abundance and breeding status of birds in the north. Checklist survey data can provide useful information about birds that is difficult to collect in large, remote areas, and can be used as baseline information for further studies, environmental assessments, mapping bird distributions and detecting major changes in bird populations. The survey was initiated in 1995 by the Canadian Wildlife Service in response to a need for information identified in the Canadian Landbirds Monitoring Strategy. Parks Canada collects data for the survey and has assisted with the project's development.

Wildlife

NWT-NUNAVUT BIRD CHECKLIST

Canadian Wildlife Service

Objectives

- To collect information about the geographic distribution, abundance, and breeding status of birds in the western Arctic for use with national bird monitoring efforts.

Methods and Information Collected

- Checklists are completed for Aulavik, Ivvavik and Tuktut Nogait national parks.
- The number of birds of each species, and evidence of breeding, is recorded on the checklists.
- Checklists are completed for a 24-hour or shorter period in a 10 x 10 km or smaller area.
- Additional information is also recorded on the checklist (e.g., birding ability of the observer, survey location, habitat, presence of predators).

Update/Results

- In 2008, 21 checklists were completed in Aulavik National Park and 11 were completed in Ivvavik National Park.
- Information about the NWT-Nunavut Bird Checklist Survey is available through the internet at www.pnr-rpn.ec.gc.ca/checklist.

Birdwatching in Ivvavik National Park.
PHOTO: J.F. BISAILLON/PARKS CANADA

Lesser Yellowlegs. PHOTO: P. HENRY

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Rationale

Chemical and physical water quality monitoring can be enhanced by using the presence or health of organisms (biota) living at a site as an indication of ecosystem condition. Observations of aquatic biota integrate river conditions for weeks or months before their collection. Aquatic macroinvertebrates (i.e. small animals without backbones that live in lakes and streams, like shrimp, worms, aquatic snails, and the aquatic stage of insect larvae) are commonly used biological indicators for freshwater resources. Benthic (bottom-dwelling) macroinvertebrates are often used as indicators of freshwater ecosystem health because of their limited mobility, relatively long residence times, and varying degrees of sensitivity to pollutants. Streams with high ecological integrity generally have a variety of species with representatives of all insect orders, including a high diversity of insects classed in the taxonomic orders of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies).

Wildlife

AQUATIC INVERTEBRATE MONITORING

Objectives

- To quantify the diversity and abundance of benthic invertebrates as baseline data in each of the Firth, Thomsen and Hornaday river systems.
- To monitor temporal changes in invertebrate communities in these rivers as part of Parks Canada's ecological integrity monitoring program.

Methods and Information Collected

- Sample site selection was based on: (1) habitat that is representative of the aquatic conditions in the park's primary watershed, and (2) access to the Park that is reliable on an annual basis. In 2008, samples were collected at Green Cabin in Aulavik National Park, and at Sheep Creek (mountain stream) and a coastal stream in Ivvavik National Park. Further investigation is required to identify appropriate sites in the Hornaday river watershed in Tuktut Nogait National Park.
- Habitat data for the selected reach of the stream or river is collected. Habitat type is classified as riffle, rapid, straight-run, or pool. The substrate is classed as organic matter, sand or silt, gravel, pebbles, cobbles or boulders. Bankful width, bankful-wetted depth, wetted width, water depth and velocity are also measured on site.
- A D-shaped metal frame net with a 500 µm mesh is used to take a kicknet sample of invertebrates at 3 locations within the reach. The kicknet is placed flush to the bottom, downstream of the sampler. The sampler walks backwards in the upstream direction, kicking the substrate to disturb it down to 5-10 cm. The sampler zig-zags upstream, kicknetting for a total of 5 minutes per sample.
- The sample is then rinsed into a jar and preserved for analysis.

Kick-netting in Sheep Creek, Ivvavik National Park.
PHOTO: K. AREY /PARKS CANADA

Methods and Information Collected (continued)

- In the laboratory, each sample is examined and all individual organisms are picked out and identified to Order. If the sample contains a high abundance of organisms (>200 individuals), only a measured subset of the sample is sorted.
- These methods follow the protocols developed by the Canadian Aquatic Biomonitoring Network (CABIN). For more information about CABIN, see: http://cabin.cciw.ca.

Update/Results

- All sample sites were dominated by stoneflies (Plecoptera). Stoneflies are the most sensitive order of aquatic insect with very low tolerance of contaminants, and they are restricted to running water habitats with high levels of dissolved oxygen.
- In the coastal streams of Ivvavik and in the Thomsen River there were also a high proportion of black flies, but very few were detected in Sheep Creek. Amphipods were abundant in Sheep Creek, while midges (chironomids) were fairly common on the coastal stream.
- The proportion of mayflies (Ephermeroptera), stoneflies (Plecoptera) and caddisflies (Trichoptera) ranged from 56% in Sheep Creek to 31% in the coastal stream, and was intermediate in the Thomsen River at 48%.
- A total of 16 orders of aquatic invertebrates were detected throughout all samples in 2008. The most diverse sites were the coastal streams in Ivvavik with a total of 13 orders observed, while Sheep Creek and the Thomsen River had 10, and 9 orders, respectively. Gastropods and bivalves were only observed in the slow-moving coastal plain streams.

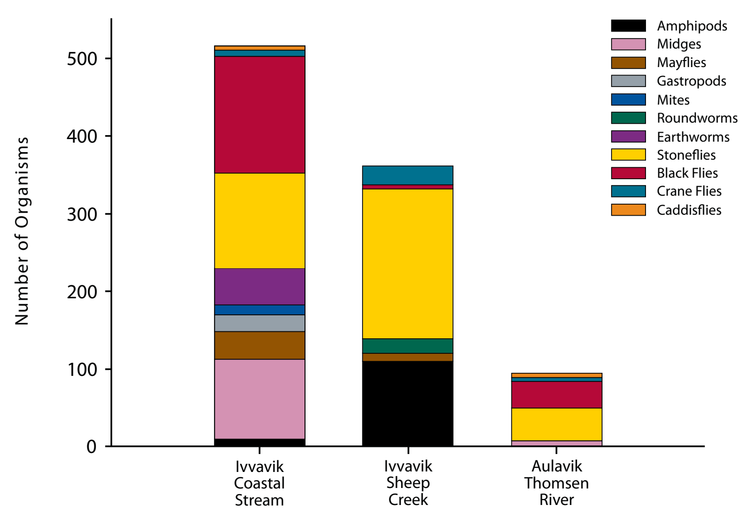

FIGURE 1. Total number by order of aquatic invertebrates collected in (1) Coastal stream site of Ivvavik, (2) Sheep Creek, a mountain stream in Ivvavik, and (3) the Thomsen River at Green Cabin in Aulavik.

Partners

- Environment Canada – Canadian Aquatic Biomonitoring Network (CABIN)

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Rationale

Lemmings are an important part of the Arctic ecosystem because they are a source of food for predators (e.g., Arctic foxes, wolves, ermines, and raptors). Lemming populations often fluctuate dramatically in size, typically growing and declining every 3-4 years. This cycle may inadvertently impact the biodiversity of Arctic ecosystems.

Lemmings are fairly easy to monitor because (1) they are abundant in Aulavik National Park, (2) they travel relatively short distances, and (3) their habitats are predictable. Surveys of lemming winter nests provide a relatively easy method of indirectly estimating lemming abundance without capturing or killing animals. Lemmings build winter nests of grasses and sedges under the snow and use them to keep warm. Nests are abandoned in spring and not reused, so they can be counted and handled without harming the animals.

Wildlife

LEMMING WINTER NEST MONITORING

Objectives

- To monitor the relative changes in the abundance of collared and brown lemming winter nests in Aulavik National Park.
- To monitor periods of high and low lemming populations in relation to predator numbers and weather.

Methods and Information Collected

- Winter nests of collared and brown lemmings were surveyed in 5, 1-ha plots and 11 transects varying in length (1.4 to 3.0 km) established near Green Cabin along the Thomsen River, Aulavik National Park.
- Lemming nests appeared like a ball of cut grass (approximately 12 cm in diameter). All nests found were ripped apart to avoid recounting them the next year.
- The number of ermine nests was also recorded during lemming surveys. They appeared similar to lemming nests but tended to be larger (>30 cm in diameter) and lined with fur.
- Incidental observations of potential lemming predators were also recorded during lemming surveys.
- Historical weather data of Green Cabin (available online at Environment Canada's website) were used to determine the correlation between lemming nest density and weather.

A lemming in its tundra habitat in Aulavik National Park. PHOTO: L. NGUYEN/ PARKS CANADA

Update/Results

- In 2008, an average of 2.0 lemming winter nests/ha were found in the 5, 1-ha plots, and an average of 0.2 nests/ha were found on the 11 transects (Figure 1). For the plot data, fluctuations in nest density highlighted a predictable 4-year cycle, where differences in magnitude between the high and low phases averaged 6 fold.
- Incidental observations of predators were primarily jaegers, comprising 81.3% of potential predators. Other predators included Arctic foxes, Snowy Owls, Peregrine Falcons, and gulls.
- Variation in monthly air temperature 12 months before the peak or low periods of lemming abundance did not differ from the normal temperature variation as a whole, suggesting that factors other than weather conditions may explain lemming cycles.

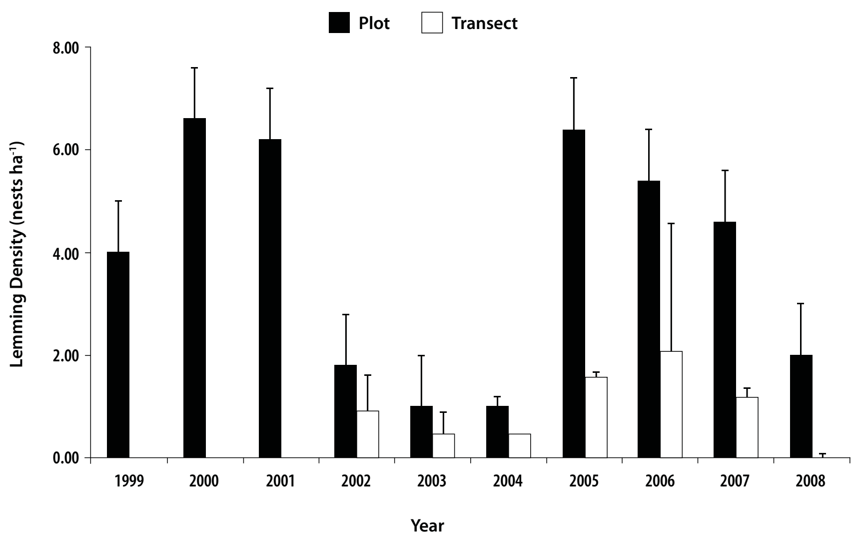

FIGURE 1. Two survey methods used to estimate winter nest density of lemmings in Aulavik National Park, 1999-2008.

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Rationale

The Bluenose-West caribou herd is a population of barren-ground caribou in the Northwest Territories. The core area of this herd's calving grounds is located in Tuktut Nogait National Park, and the winter range of the herd extends from Husky Lakes and the Anderson River in the northwest to Colville and Great Bear Lakes, and Fort Good Hope, in the southeast. Population estimates obtained for the Bluenose-West indicates that the herd declined between 2000 and 2005 with continued declines in 2006. Recovery of the herd will require increased birth rates and improved calf survival. Baseline data on productivity, composition, and recruitment of the herd is required to assess the impact of industry-related cumulative effects and monitor recovery of the herd. The Government of the Northwest Territories leads this project, with Parks Canada as its partner.

Wildlife

BLUENOSE-WEST CARIBOU HERD MONITORING

Government of the Northwest Territories

Objectives

- Obtain current estimates of the recruitment for the Bluenose-West barren-ground caribou herd.
- Obtain a current estimate of productivity for the Bluenose-West barren ground caribou herd.
- This information will be used to investigate potential causes of population decline and provide strategies for recovery.

Methods and Information Collected

Recruitment Surveys

- Recruitment surveys were conducted in April 2008, and groups of Bluenose-West caribou were classified.
- Two crews were used for the Bluenose-West herd recruitment surveys, one working in the Inuvialuit Settlement Region (ISR) and one working in the Sahtu region. A helicopter was used to fly to groups of caribou to be classified. Caribou were classified as cows, short yearlings, and bulls. Small groups were classified by flying over top of the animals if it could be done with minimal disturbance. Recruitment was estimated as the number of short yearlings per 100 cows.

Productivity surveys

- Productivity surveys were flown after calving and during a period in which caribou are spread out so that calves are easily visible. Productivity surveys are conducted in July, approximately a month after calving. The helicopter landed at a suitable vantage point near each group, and either a local assistant or biologist conducted the classifications from the ground using a spotting scope. Caribou were identified as cows, calves, yearlings, and young or mature bulls. Classification was based on the presence/ absence of antlers, antler size / configuration,

Bluenose caribou. PHOTO: GOVERNMENT OF THE NORTHWEST TERRITORIES

Methods and Information Collected (continued)

animal size, animal's association with calves, and the presence of a vulva patch or penis.

- The number of calves per 100 cows was calculated and compared with results of previous surveys to determine trends.

Update/Results

Recruitment Surveys

- The number of calves per 100 cows in April was:
  - 41.9 ± 1.4 for the Bluenose-West herd overall;
    - 41.0 ± 3.0 in the Sahtu region
    - 42.3 ± 1.4 in the Inuvialuit region.
- The cow:calf ratios are higher than last year's ratios and indicate good recruitment into the herd. They are closer to values found historically. The number of calves per 100 cows (± standard error) found in 1983, 1986, 1987, 1988, and 1991 were 44 ± 2.0, 51.8 ± 2.86, 64 ± 4.8, 46.0 ± 0.61, and 38.9 ± 2.57 calves/100 cow, respectively. These historic numbers are from when the three herds (Cape Bathurst, Bluenose-West and Bluenose-East) were all considered the Bluenose herd making it difficult to directly compare the results.

Productivity surveys

- July productivity, the number of calves per 100 cows was:
  - 59.6 ± 1.9 (SE, n = 27) for the Bluenose-West herd.
- This year's productivity survey for the Bluenose-West herd indicates that herd productivity is lower than observed in 2007. Given a significant portion of calf mortality amongst barren-ground caribou may occur between birth and their first fall, overall productivity of the Bluenose-West herd is higher than in previous years where productivity during peak calving in June was lower or similar to our July survey (which incorporates a month of calf mortality). Adjacent herds, Cape Bathurst and Bluenose-East, are showing similar trends.

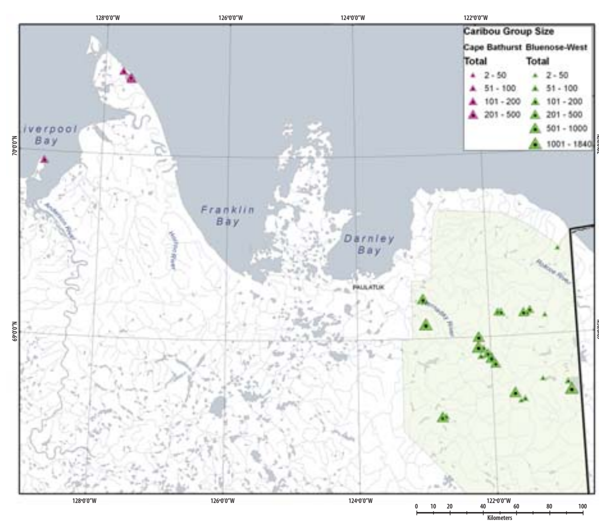

FIGURE 1. July 2008 productivity survey observations.

Partners

- Government of Northwest Territories (project lead)
- WMAC (NWT)
- Gwich'in Renewable Resource Board
- Parks Canada

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Rationale

The Porcupine caribou herd is a population of Grant's caribou whose range includes the northern Yukon, Alaska and the Northwest Territories. There is concern over the Porcupine caribou population because the size of the herd has declined steadily since 1989, when the size of the herd was estimated to be 178,000 caribou. The last photocensus occurred in 2001, and estimated the herd size at 123,000. Regularly scheduled counts have failed in recent years due to weather resulting in failure of the herd to aggregate on the coastal plain or forest fire smoke preventing flights. However, annual population monitoring indicators such as birth rate and adult female survival estimates suggest the herd has continued to decline since 2001. Current monitoring is important because of existing and planned developments within the range of the herd, and because of current and forecasted changes in the Arctic environment.

This work consists of numerous projects conducted by the Government of Yukon, the Alaska Department of Fish and Game, the U.S. Fish and Wildlife Service, the Government of the Northwest Territories, and the Canadian Wildlife Service under the direction of the Porcupine Caribou Management Board and the Porcupine Caribou Herd Management Plan. Parks Canada is a partner in this project, contributing funds and other resources towards different projects.

Wildlife

PORCUPINE CARIBOU HERD MONITORING

Government of Yukon and Alaska Department of Fish and Game

Objectives

- To estimate the population size, productivity, over-winter survival of caribou calves, annual survival of adult females, distribution and movements of the Porcupine Caribou Herd.

Methods and Information Collected

- Surveys are conducted throughout the range of the herd in northern Alaska, Yukon and the Northwest Territories.
- A photocensus of the Porcupine caribou herd is attempted every two to three years. This survey is conducted while the herd is congregated on their post-calving grounds.
- Productivity is estimated during a calving survey conducted by locating satellite and conventional radio-collared caribou starting in late May. Cows are located daily until they give birth and then located again in approximately one week to document perinatal calf mortality. Another survey is done in late June or early July to calculate calf survival rates to one month of age. Calf survival to nine months of age is documented during the March composition count.
- Annual survival of adult females is estimated using the proportion of radio collared adult females surviving each year.
- Satellite and conventional radio collars are used to determine the seasonal distribution and movements of the herd.

Porcupine caribou in the coastal plain in Ivvavik National Park. PHOTO: E. HART/PARKS CANADA

Methods and Information Collected (continued)

- In 2008, the annual calving survey was conducted from June 1st to 3rd and post-calving flights were conducted on June 23rd to 25th to estimate calf survival and the proportion of cows accompanied by calves. Arctic National Wildlife Refuge (ANWR) staff conducted additional radio tracking flights on May 28th and 29th and June 2nd to determine radiocollar distribution for the calving survey.

Update/Results

Winter Distribution and Spring Movement

- 73% of satellite collared caribou wintered in the southern foothills of the Brooks Range between the Coleen and the Junjik Rivers, Alaska, from mid October through February. Caribou were concentrated around Arctic Village between the Sheenjek and East Fork Chandalar River. Four of 15 satellite collared caribou wintered in the Ogilvie Basin, Upper Miner and Upper Whitestone River drainages in central Yukon from mid October through March. In April and May, the herd migrated from Alaska and Yukon to the coastal plain between the Malcolm and Babbage Rivers, Yukon. By early June the coastal plain was nearly snow free as far west as the Hulahula River, Alaska. However, caribou were mostly distributed from the Babbage River, Yukon to the Kongakut River, Alaska, at time of calving.

Calving Survey

- Parturition rate (percent of cows that had given birth or were judged to be pregnant) was 79% for cows ≥ 4 years old, 83% for 3-year-olds and 14% for 2-year-olds. Of the 69 cows that were ≥ 3 years old, 34 were observed with calves, 21 were judged to be pregnant or to have produced and lost a calf (based on the presence of hard antlers and enlarged udders), and 14 were judged to be barren (no hard antlers and udders not distended).
- On June 1st and 2nd, 64% and 57% of parturient cows were observed with calves, respectively. Most calves appeared to be 1-2 days old based on size and mobility. Therefore, peak of calving likely occurred on May 29th or 30th.
- During June 1st to 3rd, 25 radiocollared cows were located in ANWR, Alaska, and 51 were located in Ivvavik National Park, Yukon. Extent of calving occurred from the Aichilik River to the Babbage River and was concentrated around the Clarence River (Figure 1).

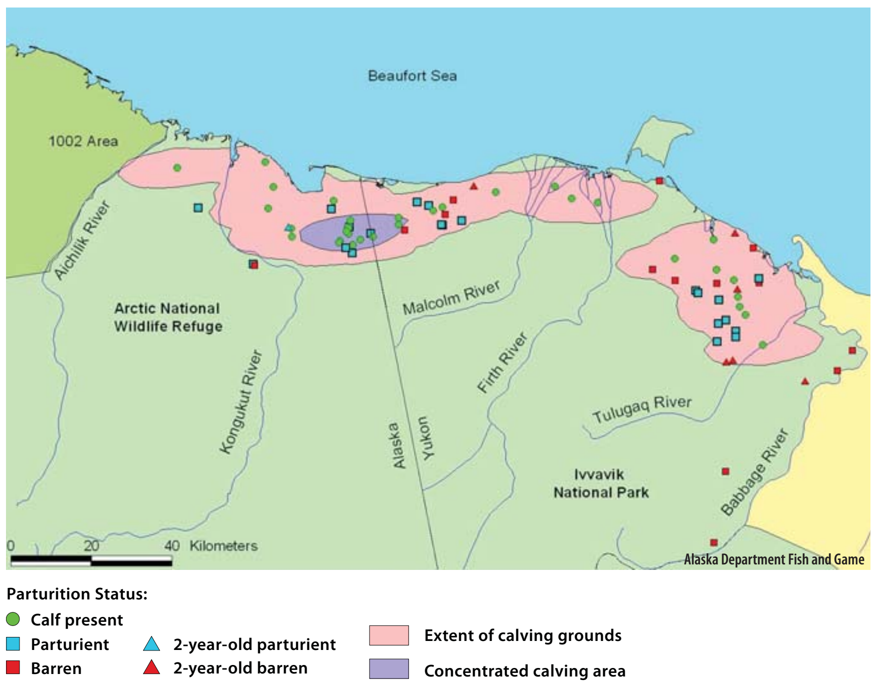
Post Calving Survey

- Post calving survival, estimated from cows observed with calves in early June whose dams were observed in late June was 92% for cows ≥ 4 years of age. Fifty-nine percent of radiocollared cows ≥ 4 years of age were observed with calves. Fifty percent of 3-year-olds were accompanied by calves and no 2-year-olds were observed with calves.

- During June 23rd to 25th, most of the Porcupine Caribou herd were distributed between the Kongukut and Hulahula Rivers, Alaska, at elevations from 2500-5000 feet.
- Cool weather in the mountains and an apparent lack of insects prevented adequate aggregations for a photocensus. We continued to monitor the Porcupine caribou herd with satellite collars for two weeks following post calving flights. By late June and early July, most of the herd moved south across the Continental Divide and into the upper Sheenjek River drainage. Three attempts were made to radiotrack and monitor the status for a photocensus on the south side of the Brooks Range. However, thunderstorms and a low cloud ceiling prevented flights.

Information about the movements and distribution of the Porcupine Caribou Herd can be found at www.taiga.net\satellite\index.html.

FIGURE 1. Locations of radiocollared Porcupine caribou cows, from June 1st to 3rd, 2008.



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Partners

- Government of Yukon
- Alaska Department of Fish and Game
- U.S. Fish and Wildlife Service
- Government of the Northwest Territories
- Canadian Wildlife Service
- Parks Canada

Porcupine caribou. PHOTO: J.F. BISAILLON/PARKS CANADA

Rationale

Low air and soil temperatures, a short growing season, and limited vegetation productivity characterize Arctic vegetation ecosystems. These ecosystems are sensitive to change caused by stressors (e.g., global warming). Efforts to monitor any changes may be best understood by looking at the landscape. Parks Canada has conducted a monitoring program that aims to understand vegetation productivity dynamics using Advanced Very High Resolution Radiometer (AVHRR) satellite images to look at temporal variation in the Normalized Difference Vegetation Index (NDVI), an indicator measuring greenness.

Habitat

SATELLITE MONITORING OF NORTHERN ECOSYSTEMS

Objectives

- To monitor spatial and temporal variation in vegetation productivity at the landscape level in Aulavik, Ivvavik, and Tuktut Nogait National Parks.

Methods and Information Collected

- 10-day, cloud-free composite AVHRR satellite images were taken 1 April to 31 October 1985-2008.
- Satellite images were adjusted for atmospheric quality and examined for consistency.
- NDVI compared red light to infra-red light as it is reflected off the ground surface to provide a index of vegetation productivity.
- Ecodistricts were used as sampling units in order to best integrate the satellite data with available landscape and biological data.
- Wavelet analysis was used to determine monthly and annual normals of NDVI for within-park ecoregions and within-park ecodistrict.
- The relationship between NDVI and climate (air temperature and precipitation) on vegetation productivity dynamics was also analyzed.

Update/Results

- Monthly and annual NDVI normals were established as baseline data for within-park ecoregions and ecodistricts to assess anomalies that may occur in the future. Significant relationships existed between NDVI and climate data, where temperature tended to explain more of NDVI variation than precipitation. Thus, water availability does not appear to be a major constraint to vegetation productivity.
- In general, annual NDVI values and growing-season temperature tended to increase across all Canadian ecozones.
- In general, increases in NDVI typically occurred when El Niño brought a favourable climate (warm) for vegetation growth, while decreases in NDVI when La Niña engendered a less favourable climate (cold).

Partners

- Parks Canada, Western and Northern Canada Service Centre (Winnipeg)
- University of Saskatchewan

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Rationale

Pingos are a permafrost feature represented in the Pingo Canadian Landmark (PCL) near Tuktoyaktuk. The community of Tuktoyaktuk in partnership with Parks Canada is interested in protecting the pingos, and in developing the landmark as an attraction for visitors. There is concern that recreational activities and environmental changes are causing the pingos to deteriorate at an accelerated rate. A fire in summer 2007 also damaged much of the vegetation on the southwest side of Ibyuk Pingo, the world's second tallest pingo. Damage to the surface vegetation and increased solar radiation from the charred ground may increase the active layer and lead to further degradation of Ibyuk.

Habitat

PINGO MONITORING

Objectives

- To monitor any physio-geographic damages to Ibyuk and Split Pingos.
- To monitor vegetation and active layer depth within and outside the burned area of Ibyuk Pingo.

Methods and Information Collected

- Pictures were taken at designated photopoints around Ibyuk and Split Pingos to monitor changes in vegetation cover and pingo shape.
- Vegetation surveys were conducted to determine the rate of revegetation within the burned area, and to compare vegetation composition and density to unburned sites.
- Active layer depth measurements were taken within and outside the burn area on Ibyuk Pingo to determine the effects of the fire.

Update/Results

- Photopoint monitoring revealed no change in vegetation and shape of Split Pingo. However, significant surface (vegetation) and shape damage have occurred on Ibyuk Pingo due to the presence of ATV traffic and the summer fire in June 2007.
- Analysis of the burn area on Ibyuk Pingo indicates that vegetation is regenerating and that most of the damage was confined to the vegetative layer with little (if any) damage to the mineral soil. Active layer measurements do not indicate increased thaw associated with the burn.

Pingo in fall colours. PHOTO: M. KIRK/PARKS CANADA

Partners

- Geological Survey of Canada (Atlantic)
- Hamlet of Tuktoyaktuk
- Inuvialuit Land Administration
- Tuktoyaktuk Hunters and Trappers Committee
- Tuktoyaktuk Community Corporation
- RCMP (Tuktoyaktuk Detachment)
- Government of Northwest Territories (Environment and Natural Resources)

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Rationale

Approximately 80 percent of the visitors to Ivvavik National Park use some of the 35 campsites along the Firth River. A number of these sites are used repeatedly each summer by large groups of people. Potential impacts to these campsites from human use include damage to vegetation, soil erosion, and improper disposal of human waste and garbage. All of these impacts can affect the park environment and the quality of the wilderness experience for park visitors. Campsites along the Firth River are monitored annually to identify impacts from human use, and to determine if sites should be closed and restored.

Human Use

FIRTH RIVER CAMPSITE MONITORING

Objectives

- To identify and track human caused impacts to campsites along the Firth River.
- To identify potential conflicts between wildlife and park visitors at campsites along the Firth River.
- To provide managers with information necessary to make decisions about campsite closures and restoration.

Methods and Information Collected

- Campsite monitoring is conducted in the fall every year.
- 35 campsites, at maximum, are monitored along the Firth River between Margaret Lake and Nunaluk Spit.
- The monitoring focuses on campsites that are not affected by spring flooding. These campsites are generally located upstream and downstream of the canyon section of the river. Campsites in the canyon section of the river that receive frequent use by large groups are also monitored.
- Monitoring is conducted to identify impacts resulting from human use of campsites during the summer. This involves comparing the composition and density of the vegetation at the campsite with the surrounding area, determining the presence and extent of bare soil, bank erosion, trails and root exposure caused by human use of the site, identifying damage to vegetation in the surrounding area and identifying any waste or garbage left by people.
- Photo monitoring points were established and photos taken at every campsite. These photos help with monitoring vegetation cover, and other changes to the campsite.

Crooked creek campsite along the Firth River.
PHOTO: J. LUCAS/PARKS CANADA

Methods and Information Collected (continued)

- A campsite use monitoring program asking park visitors to report which campsites they used was initiated in 2000. This information is used by Parks Canada to identify which campsites are likely to be most impacted by human use.

Update/Results

- In 2008, campsite monitoring was conducted at 9 sites that were assessed for human use impacts. Monitoring has been discontinued at sites located below the annual flood level.
- In general very little change was detected at the sites compared to previous seasons. Information was also gathered on these trips to assist with updating the protocol.
- The monitoring protocol is being reviewed to improve consistency and efficiency in monitoring change and/or impacts at campsites.
- Promotion of campsite use reporting by visitors will help improve the efficacy of the monitoring program, and aid in identifying areas most susceptible to impact.

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Rationale

Understanding the levels and patterns of human use of national parks in the western Arctic is required for effective park management. Human use monitoring involves recording the number of visits made to each park, the number of Parks Canada staff who are in the park, when and where these visits are made, and the types of activities that are conducted. This information is used by Parks Canada to develop and refine its activities with respect to public safety, resource management, and interpretation and education. It is also used to reduce conflicts between people involved in different activities in the parks, and conflicts between people and wildlife.

Human Use

HUMAN USE MONITORING

Objectives

- To document the extent and nature of human use of Aulavik, Ivvavik, and Tuktut Nogait national parks.

Methods and Information Collected

- Information is collected annually on visitation of the public, Parks Canada staff, researchers, and participants to Parks Canada's outreach programs to Aulavik, Ivvavik, and Tuktut Nogait national parks.
- The number of people in the park, the dates and duration of their visit, and the activities they pursue are recorded.

Update/Results

- In 2008, a total of 268 people, including researchers, students and volunteers visited the parks of the western Arctic (Table 1). Visitation to Tuktut Nogait (13) remained relatively low, while visitation to Aulavik (39) was higher than the previous year due research and youth camp activities. As in previous years, Ivvavik (216) had the highest numbers of visitors, due to increased numbers of researchers and students working within the park. Visitors used various means to travel through the parks, including canoeing, rafting, and hiking.

Students visiting Ivvavik National Park.
PHOTO: G. KISOUN/PARKS CANADA

TABLE 1 **Number of visitors to each of the western Arctic national parks in 2008.**

Park	*Number of Visitors*
Aulavik	39
Ivvavik	216
Tuktut Nogait	13
Total	*268*

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Rationale

Parks Canada is mandated to document, protect and present the cultural resources of Tuktut Nogait National Park so that its rich human history is preserved, understood and appreciated. The goal of this project was to test a monitoring protocol for four cultural sites along the Hornaday River.

Cultural Resources

TUKTUT NOGAIT NATIONAL PARK CULTURAL RESOURCE MONITORING

Objectives

- To identify threats to cultural resources at four sites in the Uyarsivik Lake area.
- To measure the rate and extent of change caused by known threats to cultural resources.
- To initiate action(s) to protect cultural resources when thresholds of change or degradation have been reached or exceeded.

Methods and Information Collected

We visited the following four sites:

1. 300X181 – a site located on the west side of the Hornaday River, on a well-developed terrace immediately south of a small unnamed creek;
2. 300X183 – a cache site which extended north-south along a rock outcrop on top of the edge of a hill, on the west side of the Hornaday River. There are many caches and other features at this site;
3. 300X189 – a grave located on the west side of the Hornaday River, atop the highest bluff in the area, just east of a small lake and south of a creek;
4. 300X284 – a grave high atop the ledge of a rocky outcrop, above the western bank of the Hornaday River. It is just east of a small tundra lake and approximately 100m north of a creek.

At each site detailed photographs were taken at established photo monitoring points, measurements were taken to track possible bank erosion or movement of artifacts on site and general observations were made to inform future monitoring at these sites.

Monitoring bank erosion near a cultural site along the Hornaday River.
PHOTO: R. DRUMMOND/PARKS CANADA

Update/Results

- There was movement of in *situ* objects at two sites: a wood fragment at 300X183 is no longer in its 2000 location and an artifact at 300X284 is now partially concealed under a rock. There is no evidence to account for movement at either site. We currently have no method to determine whether this movement is related to human activity or wildlife. Bank-edge erosion is evident at one site.

Recommendations

- We should continue to monitor these sites every two years as outlined in the monitoring schedule. 2010 monitoring should include a close examination of the eroding bank edge at 300X181.

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Rationale

Information about climate change indicates that the temperature of the earth has increased over the past 100 years. Human activities related to the emission of carbon dioxide and other greenhouse gasses are thought to have contributed to this increase. It is widely accepted that the greatest increases in temperature will take place in Polar Regions such as the Canadian Arctic. Long term monitoring of weather is required to track changes in the climate of the western Arctic, and to understand how these changes will affect the environment of the national parks of the western Arctic.

Environmental Processes

WEATHER MONITORING

Objectives

- To monitor weather in Aulavik, Ivvavik, and Tuktut Nogait National Parks.

Methods and Information Collected

- Two weather stations have been established in Aulavik since 1996-1997, in Ivvavik since 1995 & 1997, and Tuktut Nogait since 1998-1999.
- All weather stations recorded hourly, daily, and monthly data. The following parameters were typical for all weather stations, depending on the time period (i.e., hour, day, and month) specified:
  - air temperature
  - precipitation (rain and snow)
  - wind speed and direction
  - relative humidity
  - dew point
  - degree days (heating and cooling)
  - snow depth
  - atmospheric pressure.

Melville Hills weather station in Tuktut Nogait. PHOTO: PARKS CANADA

Update/Results

- Annual maintenance of weather stations was carried out to fix any interruptions in transmitting of weather data, which are freely available at the Environment Canada website (http://www.climate.weatheroffice.gc.ca/canada_e.html).
  - Historical weather data can be found doing a "Customized Search" and using the station names listed below:

Station	*Location*
Margaret Lake	Margaret Lake (68°48.00'N; 140°51.00'W)
Ivvavik National Park	Sheep Creek (69°09.60'N; 140°09.00'W)
Qavvik Lake	Qavvik Lake (68°15.00'N; 122°06.00'W)
Tuktut Nogait National Park	Melville Hills (69°12.00'N; 122°21.60'W)
Thomsen River	Green Cabin (73°13.80'N; 119°32.40'W)
Aulavik National Park	Polar Bear Cabin (74°08.40'N; 119°59.40'W)

Partners

- Environment Canada, Meteorological Service of Canada

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Rationale

Changes in the amount of water flowing in Arctic rivers, and the timing of peak and low water levels, can have a strong influence on the condition of freshwater ecosystems. River water flow monitoring is conducted on the Firth River in Ivvavik National Park and the Hornaday River near Tuktut Nogait National Park to determine current water cycles and to identify long-term changes to these cycles. River water flow information is also useful for visitors and park staff when canoeing, rafting, or kayaking the Hornaday or Firth rivers.

Environmental Processes

RIVER WATER FLOW MONITORING

Objectives

- To document and monitor water flow and discharge in the Firth River in Ivvavik National Park and the Hornaday River near Tuktut Nogait National Park.
- To provide park visitors with information about river navigability.

Methods and Information Collected

- Stations that measure water flow are located on the Firth River in Ivvavik National Park and on the Hornaday River near Tuktut Nogait National Park. The station on the Hornaday River is approximately 5 km downstream of the west park boundary.

Update/Results

- Regular maintenance was conducted at both stations in 2008.
- The Firth River station has data from 1972-1994 and from 1997 to present, and the Hornaday River station has data from 1998 to present.
- Information collected from the water gauges is available from the Environment Canada web site at *http://scitech.pyr.ec.gc.ca/waterweb*. Use either the text search or the map search feature to find the Firth River or the Hornaday River water gauge.

Water survey technicians taking flow measurements on the Hornaday River.
PHOTO: WATER SURVEY OF CANADA

Partners

- Environment Canada, Meteorological Service of Canada
- Department of Fisheries and Oceans
- Fisheries Joint Management Committee
- Polar Continental Shelf Project

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Rationale

Water quality monitoring uses chemical, physical and biological characteristics to assess the condition of the water, usually with respect to its suitability for a particular purpose (i.e., drinking, supporting aquatic life, recreation). Water quality parameters are important indicators of habitat quality for numerous aquatic species; these include nutrients such as phosphorus and nitrogen, physical characteristics such as temperature, acidity and turbidity, as well as metals, major ions and contaminants. Contaminants from sources within and outside the north are found in Arctic ecosystems, including rivers and lakes. The presence of contaminants such as persistent organic pollutants, heavy metals and radionuclides are a concern because they can have negative effects on Arctic ecosystems and human health. Water samples from the rivers in the Western Arctic National Parks are used to determine current water quality and to monitor the overall and ongoing condition of freshwater ecosystems.

Environmental Processes

WATER QUALITY MONITORING

Objectives

- To determine the current water quality of the Thomsen River in Aulavik National Park, the Firth River in Ivvavik National Park and the Hornaday River in Tuktut Nogait National Park.
- To determine if water quality parameters in these rivers change over time.

Methods and Information Collected

- Water quality samples are taken from the Thomsen River at Green Cabin, from the Firth River at the water survey site and at two sites on the upper Hornaday River.
- Three sets of water samples are taken at each site on the Firth and Hornaday rivers each summer. The first set of samples is typically taken in June, just after the ice breaks up on the river. The second set of samples is usually taken in July and the third set of samples is taken in September.
- One set of water samples are taken from the Thomsen River in July. Fewer sets of samples are taken from the Thomsen than the Firth or Hornaday rivers because of the expense of travelling to Aulavik National Park.
- Quality assurance and quality control samples are taken at some sites to test the quality of the samples and the accuracy of the laboratory analysis.
- Water temperature, conductivity and pH are measured in the field on site.
- Water quality samples are analysed for physicals, nutrients, major cations, major anions, trace metals and organics.
- Sediment samples are taken once at both sites on the Hornaday River and analysed for nutrients, metals, pesticides and hydrocarbons.

Taking water samples in Aulavik National Park.
PHOTO: PARKS CANADA

Update/Results

- Samples have been taken in Aulavik and Tuktut Nogait national parks since 1999 and in Ivvavik since 2000.
- Water quality data from 1999 to 2008 have been compiled into a database and analysis in the trends of water quality parameters will begin in the near future.

Partners

- Environment Canada

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Rationale

Lake ice dynamics can affect the productivity of freshwater ecosystems and is an indicator of species compositions. The objective of this project is to develop remote sensing-based tools for monitoring of lake ice dynamics. Synthetic aperture radar (SAR) offers the unique advantage that images of the earth can be acquired even under cloudy conditions. Open water, under calm wind conditions, produces a distinct radar signal and can be clearly identified in SAR imagery, and can be used to quickly create maps of open water over large areas. This work is an evaluation of a semi-automated method to extract open water maps from RADARSAT imagery for monitoring lake ice dynamics. The methodology and software were originally created for emergency flood mapping, and this work investigates the software's potential for repeat monitoring of surface water conditions.

Environmental Processes

FRESHWATER SURFACE MAPPING AND MONITORING USING RADARSAT SYNTHETIC APERTURE RADAR (SAR) IMAGERY

Objectives

- To monitor broad-scale variation in lake ice dynamics within and between years.

Methods and Information Collected

- Radarsat images dating as far back as 1997 are selected to represent a variety of open water conditions in Tuktut Nogait National Park, Vuntut National Park, and Ukkusiksalik National Park.
- Images are classified based on the SAR signal return from water.
- Geo-referencing and ortho-rectifying the classified images are conducted by Canadian Center for Remote Sensing, Natural Resources Canada.
- Vectors (map data) outlining water polygons are extracted from this classified image by a semi-automated processing method in ArcGIS.

Update/Results

- The SAR extracted water vectors are a quick and effective means of identifying areas of changing surface water distribution.
- The method works well to extract boundaries of medium to large water bodies (>1 ha), particularly through the summer. However, water bodies or narrow rivers less than 1 ha cannot be extracted, limiting our ability to compare all water bodies except those specifically identified.
- Because of shadow effects in SAR images, the method is most suitable for flat areas and those with modest relief. Wind and freeze up may also cause inaccuracies in extracting water vectors.

Lake ice freeze and thaw timing is monitored with satellite imagery. PHOTO: M. KIRK/PARKS CANADA

Partners

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Rationale

The BAR-1 Distant Early Warning system (DEW Line) station at Komakuk Beach was closed in 1993 as part of a general closure of the DEW Line. The site became part of Ivvavik National Park after an environmental clean up of the site was completed in 2000. Following an 800 litre spill of jet and aviation fuels at the Komakuk Beach airstrip in 2005, a Phase II Environmental Site Assessment (ESA) was conducted. The ESA determined that a relatively small volume of soil (8 m^3) was impacted by the spill. It was determined that the most efficient remediation technology would be natural attenuation, with continued monitoring to ensure the contaminant isn't migrating away from the spill location. In August 2008, the site was visited to install 6 groundwater monitoring wells.

Solid Waste

GROUNDWATER MONITORING WELLS INSTALLATION AT KOMAKUK BEACH

Department of National Defence

Objectives

- Install six groundwater monitoring wells, and collect samples of groundwater and soil.

Methods and Information Collected

- Field crew and equipment were mobilized to Komakuk Beach via twin otter from Inuvik.
- An ATV was used to move the drilling rig to various locations at the site;
- Five monitoring wells were installed at the spill site, one background well was installed.
- Groundwater and soil samples were collected and sent to an analytical laboratory for hydrocarbon analysis.
- Soil samples were collected from 50 CT increments within each borehole from the surface to the bottom of each borehole. Boreholes were advanced from the surface to the permafrost layer. Groundwater samples were collected from those wells which produced water.

Results

- Preliminary results show that the hydrocarbon concentrations are lower than those found in 2005. It also appears that the contaminant is not mobile.
- Soil and groundwater samples were analyzed for CCME Hydrocarbons at AGAT Laboratories in Calgary, AB. The data will be thoroughly analyzed as the technical report is competed.

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ANNUAL REPORT OF RESEARCH AND MONITORING IN NATIONAL PARKS OF THE WESTERN ARCTIC 2008

Canada