Annual Report of Research and Monitoring in National Parks of the Western Arctic 2007

Parks Canada Parcs Canada

Canada

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This report is divided into two sections. Section 1 summarizes research projects conducted in 2007 and Section 2 summarizes all monitoring projects carried out in 2007. These monitoring projects are divided into six categories: Wildlife, Habitat, Human Use, Climate Change, Solid Waste, and Long Range Transport of Pesticides.

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.

Years of Data
How many years of data currently exist.

Partners
Other organizations that were involved in the project.

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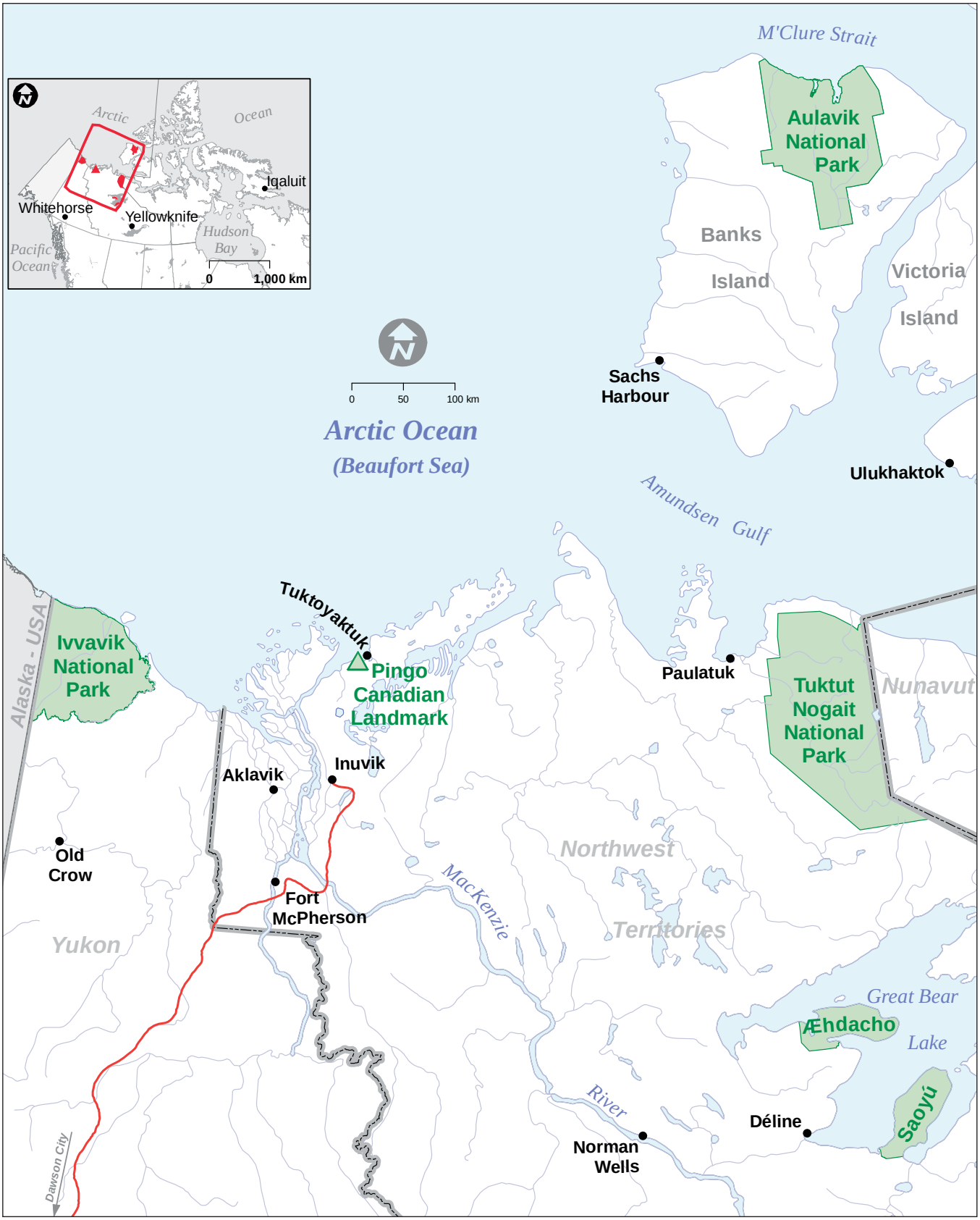

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The Western Arctic Field Unit of Parks Canada

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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				
Uncertainties in the Arctic Coastal Climate System: Climate Change Driven Inuts and Feedbacks		X		
Stokes Point (Bar-B) Dew Line Detailed Contaminated Site Assessment & Remediation Action Plan Development		X		
Yukon North Slope Grizzly Bear Population Study		X		
Eastern Inuvialuit Settlement Region Grizzly Bear Population Study - Phase II			X	
Arctic Wildlife Observatories Linking Vulnerable Ecosystems (Arctic WOLVES)		X		
Learning About Marmots in Northern Yukon + Butterflies		X		
Detailed Geological Mapping of Paleozoic Rocks in the Fish Creek Area		X		
Yukon North Slope Nearshore Coastal Fish Survey		X		
Ivvavik Cultural Resource Monitoring		X		
Aulavik Cultural Resource Monitoring	X			
MONITORING				
Wildlife				
Wildlife Cards	X	X	X	X
NWT-Nunavut Bird Checklist Survey	X	X	X	X
Lemming Monitoring	X			
Bluenose-West Caribou Herd Monitoring			X	
Porcupine Caribou Herd 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	
Climate Change				
Weather Monitoring	X	X	X	
River Water Flow Monitoring		X	X	
Solid Waste				
Komakuk Beach Clean-up Monitoring		X		
Long Range Transport of Pesticides				
Water Quality Monitoring	X	X	X	

RESEARCH

Rationale

Arctic coastlines are particularly vulnerable to climate change impacts because expected changes will affect the atmosphere (rising temperatures), the land (thawing permafrost, increased erosion) and the ocean (rising sea level, reduced sea ice extent and thickness, longer open water season). Dr. Wayne Pollard's team from McGill University has been investigating ground ice and permafrost conditions in the northern Yukon since the mid 1980s. The current focus of the research involves field and modelling programs to investigate how climate change can alter the coastal climate system along the south Beaufort Sea, and to see how this affects the thawing of permafrost and erosion along the Yukon coast. Thawing of the coast has the potential to affect a number of archaeological and cultural sites in Ivvavik. Organic carbon from eroding soils is being input into the ocean and since it can change the nearshore carbon balance, it may have implications for nearshore ecology. This research includes the Ph.D. work of Nicole Couture and post-doctoral studies by Dr. Azharul Hoque.

Research

UNCERTAINTIES IN THE ARCTIC COASTAL CLIMATE SYSTEM: CLIMATE CHANGE DRIVEN INPUTS AND FEEDBACKS

Dr. Wayne Pollard, McGill University

Objectives

- To determine the physical and climatic factors that influence erosion of ice-rich permafrost.
- To understand the mechanics of coastal erosion in a permafrost region.
- To establish how much organic carbon there is in permafrost soils and how much is currently being eroded.
- To determine how future climate change will affect rates of coastal erosion and the transfer of organic carbon to the ocean.

The specific objectives for the 2007 field season were:

- To gather data to validate a coastal erosion model, including continued monitoring of coastal retreat and shoreline changes
- To further develop a database of ground ice conditions and thermokarst activity begun in previous field seasons.

Methods and Information Collected

Research activities were conducted primarily on Herschel Island (69° 35.0′ N - 139° 00.0′ W), but helicopter surveys of ground ice conditions were conducted along the Yukon Coast as far as Clarence Lagoon (69° 37.0′ N -140° 45.0′ W) near the Alaska border to the west and as far as Sabine Point (69° 01.6′ N -137° 40.0′ W) to the east.

From July 29 to August 21, 2007, the following activities were undertaken:

- Several coastal sites were visited and GPS surveys were carried out for comparison with remote sensing imagery. Ground control points were also collected.
- Bathymetric data was collected for use in establishing wave energy for a coastal erosion model.

Methods and Information Collected (continued)

- Preliminary ground penetrating radar surveys were carried out to assess different equipment arrays and assess which would work best in this environment.
- Climate data from a meteorological station at King Point were downloaded and basic maintenance on the station was performed.
- A water level recorder was deployed in Pauline Cove to help monitor how changes in water level affect shoreline change.

Update/Results

- Preliminary results from an erosion model have been published (Couture et al. 2008) in the proceedings of the Ninth International Permafrost Conference. The model shows that overall transport of eroded sediment at different sites along the coast appears to be towards the west. The results of block failure modeling (Hoque and Pollard, 2008) also appear in this volume.
- The GPS ground control points that were collected will be used to georeference satellite images and air photos so that comparisons of exact shoreline changes can be made.
- Detailed GPS surveys from several coastal sites are being used for an undergraduate independent study project, which involves post-processing the GPS data, incorporating them into a GIS, and writing up a procedural manual.
- Results from previous years confirm that the different types of terrain along the Yukon Coastal Plain contain a significant amount of ground ice (as little as 5% in some cases, but up to 98% in others) and varying amounts of carbon in the soils (from <1% to 33%). Erosion rates are variable too, with some areas eroding, whereas other areas are stable or have sediment being deposited. Average erosion rates for the entire coast average about 0.6 metres/year. As a result, almost 1 million tonnes of organic carbon from the soils is being washed into the ocean each year, and much of it is being deposited in the nearshore zone. This is much less than what is being input from the Mackenzie River, but it does provide data for future studies on the implications of this carbon for ecological activity along the Yukon coast.

Funding

- NRCan's Polar Continental Shelf Project
- INAC's Northern Scientific Training Program
- Tri-Council NCE's ArcticNet
- NSERC

- Sampling in previous years and analysis is being done in conjunction with partners from the Alfred Wegener Institute for Polar and Marine Science, Potsdam, Germany.

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FIGURE 1. Block failures such as this one to the west of Komakuk Beach are common along the Yukon Coast. These failures usually occur along ice wedges (indicated by the troughs on the tundra surface) and the exposed ice wedge can be seen near the top of the coastal bluff. Now that the block has fallen to the beach, it is more easily eroded by waves, and the sediment and soil carbon will be washed into the ocean.
PHOTO CREDIT: N. COUTURE, AUGUST 2007

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 & REMEDIATION ACTION PLAN DEVELOPMENT

Objectives

- Complete detailed environmental site assessments of known and newly identified contaminated areas and landfill and debris areas at BAR-B.
- Complete engineering and archaeological assessment(s) of known and newly identified areas.
- Conduct ecological and human health risk assessments, including surface and sub-surface soil sampling, water and sediment sampling, and biotic (ground squirrels, sculpins, and plants) sampling programs.
- Develop a clean-up and monitoring plan for contaminated areas, landfill and debris areas.
- Promote and encourage public involvement in investigation and remediation planning processes through collaborative approaches.

Methods and Information Collected

- The Environmental Sciences Group at Royal Military College has been retained to manage this project on behalf of Parks Canada and Department of National Defence. The detailed site investigation of BAR-B is being carried out over two consecutive field seasons in order to collect the data necessary for the preparation of a cleanup plan. The first visit took place in August 2006, and the second in August 2007. Surface delineation, geophysical surveys of suspected landfill and debris areas, and a sampling program to assess the natural (background) levels of inorganic elements at the site were completed in 2006.
- The second visit included full delineation of all subsurface hydrocarbon-contaminated areas, full assessment of all identified landfill and debris areas, and a geotechnical assessment of landfills and borrow areas. This engineering assessment was done in conjunction with a cultural resources survey done by Sharon Thomson,

Taking samples at Stokes Point.
PHOTO: J. SNELL

Methods and Information Collected (continued)

a Parks Canada archaeologist. Parks Canada Agency has formed the Stokes Point Steering Committee to advise the Agency on this project. The Committee is made up of representatives from Aklavik HTC, Aklavik Community Corporation, Environmental Sciences Group, Inuvialuit Regional Corporation, Parks Canada, Department of National Defence and Wildlife Management Advisory Council (North Slope). A remediation action plan for the site is expected to be complete by 2008/09, in close consultation with the Steering Committee, Aklavik and other local communities, Inuvialuit organizations, co-management organizations, and other federal and territorial government departments.

Update/Results

- During the 2007 field season, a total of 1005 samples were collected at all potential areas of concern listed in previous reports, in addition to one newly identified area: the Construction Camp Dump. This sample quantity is comprised primarily of soil samples, but also includes 6 berry samples (aqpik, or cloudberry) and 7 water and sediment sample pairs. Although multiple attempts were made in a variety of locations and with various methods, no sculpin samples were obtained. This does not, however, negatively affect the progress of the project as all information continues to indicate a relatively clean site, with no apparent impacts to the marine environment.
- The hydrocarbon investigation and landfill assessment programs were a success. Select samples from these programs were tested in the field by test kits and other scientific instruments; a total of 135 samples were tested for PCBs (Polychlorinated Biphenyls), 189 samples were tested for TPH (Total Petroleum Hydrocarbons) and 143 samples for copper, lead and zinc by XRF (X-Ray Fluorescence). Although three new areas have been identified based on DEW Line Cleanup Criteria (DLCC), they are not likely to increase the overall risk posed by the site. Impacts from hydrocarbon-contaminated areas, as well as landfills and debris areas will be assessed using a risk evaluation matrix consistent with that used for the DEW Line Cleanup (DLCU) Project.
- The geotechnical program was also successfully executed during the 2007 field season. Bill Liu of IMG-Golder completed the following work: three potential locations of future landfills were identified, existing landfills and debris areas were assessed in terms of possible remedial options and the site as a whole was assessed for borrow material, as were the existing roads and pads for supporting heavy machinery.

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Funding

- Parks Canada
- Department of National Defence of Canada - North Warning System Office
- Government of Canada - Federal Contaminated Sites Action Program

Rationale

In November 2002, members of the Inuvialuit Hunter and Trappers Committees (HTCs), the Wildlife Management Advisory Committees (WMAC), 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 governments also indicated a need to update population estimates for grizzly bears, and to review harvest rates using population-specific information. The Yukon North Slope Grizzly Bear Population study was initiated to provide information on grizzly bear population size, birth rate, death rate, and movement. This research will provide resource managers 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 increasing.
- 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 hair-snagging sample.
PHOTO: R. MARAJ

Methods and Information Collected

The study area encompasses portions of Ivvavik National Park, and the Yukon North Slope. Most of the proposed study area falls into the Northern Mountain Coastal Plain Ecoregion, which includes portions of four physiographic units described by Bostock (1948), including the Arctic Coastal Plains, Arctic Plateau, Richardson Mountains and British Mountains (Oswald and Senyk 1977, Bostock 1948). During 2007, fieldwork was conducted from May 28th to August 30th including:

Methods and Information Collected (continued)

- A total of 31 GPS or VHF collars are active within the study area. For captures Canadian Council on Animal Care (CCAC) Guidelines were followed.
- GPS locations for individual bears with GPS collars were taken up to six times a day (every four hours). Overflights were conducted annually to get a VHF fix on bears and to record survival information.
- We used standard DNA mark recapture techniques for bears. We divided a subset of the study area systematically into 107 cells and place one baited hair snare site in each 7 km x 7 km cell. Methods for capturing hair from grizzly bears at bait sites have been presented in detail by Woods et al. (1999). We trapped each cell for five-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 will be genotyped at six microsatellite loci. We will assign an individual identity to each sample when the sibling match probability is less than 0.05 (Woods et al. 1999). Samples from live captured bears will also be 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 (Powell et al. 2000).
- Population estimates can be calculated using mark-recapture analysis (e.g., Pradel and Huggins models).
- Annual survival rates will be calculated using methods described by Heisey and Fuller (1985). The survival-fecundity exponential growth rate of the grizzly bear population will be estimated by known-fate analysis and iterating the Lotka equation (Caughley 1977). 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 has already been gathered (Department of Resources, Wildlife, and Economic Development, in prep.). There are also some written records of traditional and local knowledge of bears in the region. This information largely remains unconsolidated. 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 will be gathered through interviews. We will try to integrate local knowledge of grizzly bears with scientific knowledge using belief system modeling.

Update/Results

- Approximately 10 scat samples were collected by Parks Canada staff
- Biological samples were collected from three bears during captures (including blood, hair, claw samples, teeth, and fat)
- 107 hair trapping stations were set up in 2006 and 2007
- We ran 4 hair trapping sessions in each year. The first session was a station set-up session; the second session is a 'marking' or capture session; the third session was a recapture session; the fourth session was a recapture session and the stations were taken down
- 3154 samples were collected in 2006 (plus samples from bear captures)
- 1553 samples were collected from the hair trapping grid in 2007
- Greatest sampling success was found in the Firth River Valley and in the mountainous regions of the North Slope (See Figures 1, 2 and 3).
- There was less 'capture' success on the coastal plain region.
- Results will not be available until the completion of the study (anticipated 2010). Hair samples must be analyzed and collars recovered to obtain relocation data. These activities will take place over the next two years.

Partners

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

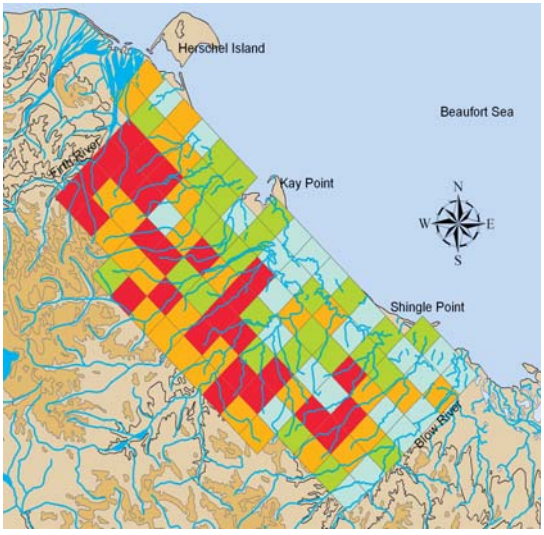

FIGURE 1. The hair sampling grid for 2006. Hair was never found at cells colored blue. Hair was found once at cells colored green, twice at cells colored orange, and three times at cells colored red.

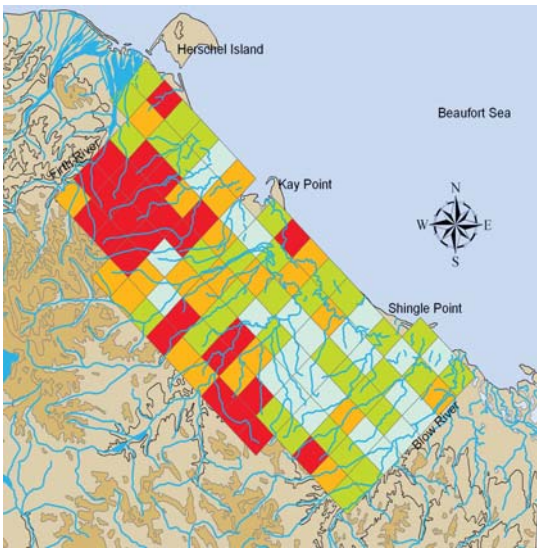

FIGURE 2. The hair sampling grid for 2007. Hair was never found at cells colored blue. Hair was found once at cells colored green, twice at cells colored orange, and three times at cells colored red.

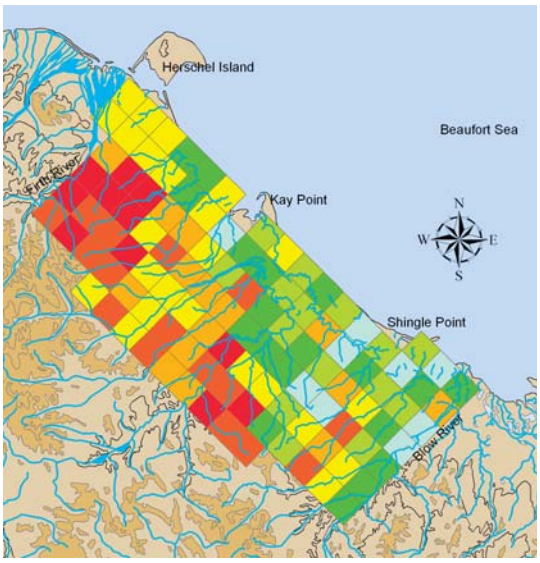

FIGURE 3. The hair sampling grid for both years (2006 and 2007). Values for both years were combined to produce a scale that ranged from 0 to 6. Hair was never found at cells colored blue. Hair was found once at cells colored dark green, twice at cells colored light green, and three times at cells colored yellow, four times at the cells color light orange, five times at the cells colored dark orange, and six times at the cells colored red.

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Rationale

Information on grizzly bear population size is needed as baseline information to monitor the effects of development on grizzly bears and to efficiently manage the sustainable harvest by the Inuvialuit. Grizzly bears are also vulnerable to the additive effects of climate change, human activities on the landscape, and environmental degradation. Northern ecosystems are expected to be the first regions to be influenced by the effects of changing climatic conditions and the impacts on Arctic grizzlies are unknown. From other jurisdictions we know that grizzly bear population decline has been characterized by a lack of planning in the pre-stages of development and an accurate population estimate is necessary as a baseline for planning activities and ongoing monitoring. Grizzly bears are harvested in the ISR under a quota system and local knowledge is indicating the population has increased since the implementation of the quota. We currently lack an accurate population estimate for the ISR area that falls to the east of the western edge of the Mackenzie Delta. The Department of Environment and Natural Resources, Government of the Northwest Territories is responsible for this project.

EASTERN INUVIALUIT SETTLEMENT REGION GRIZZLY BEAR POPULATION STUDY - PHASE II

Marsha Branigan, Government of the Northwest Territories

Objectives

- Using DNA techniques, provide an accurate and precise estimate of the grizzly bears living in the Inuvialuit Settlement Region in the area east of the Mackenzie Delta
- Collect additional reproductive parameters for the population (litter size, age structure and sex ratios),
- Use the data from the study to model the sustainable harvest of grizzly bears.

Methods and Information Collected

DNA Sampling

- DNA biopsy darts (Pneu-Dart Inc., Williamsport, PA) were fired from a standard dart rifle from a helicopter. Sometimes, where relocating the fired dart may be difficult, a radio transmitter inserted in the tail of the dart was used to help find the dart after the biopsy is collected. Two helicopter crews were used. Each crew consisted of a biologist, a local assistant, and a pilot. In most cases the local assistant was the one darting using the dart gun.
- The study area was broken down into search areas, which crews searched equally to locate bears. Attempts were made to dart all bears located, however in a few instances the dart did not work as well or the bear was missed and no DNA was

Methods and Information Collected (continued)

obtained (see Table 1). If the bear was missed, efforts were made to re-dart, however this was not always possible due to fuel limitations, inability to relocate the bear, or the need to call off the darting attempt due to prolonged chase times.

- Bear dens seen were noted and revisited later in the summer to collect hair samples.
- DNA samples were stored in desiccant and sent for DNA analyses to identify individuals and the sex of the animal.
- Mark and recapture analyses will follow standard analyses using Program MARK. All sources of information will be built into the study, including DNA samples from harvested animals and hair collected at cabin break-ins, and will be used in population estimates. Open population models will be applied because the population size may change over the study period (i.e., births, deaths, immigration, and emigration) and open populations are more common in nature.

GPS Collar Deployment

- For the western portion of the study time one helicopter was working on the capture and deployment of GPS collars on Grizzly Bears in the development area. DNA was also collected from these bears.
- Capture work was done in May/early June when most bears have emerged from their dens. Bears were immobilized by firing a dart from a helicopter.
- Weight, length, girth and other measurements were taken for each bear that is captured. A pre-molar is extracted to determine age.
- Blood samples were taken to determine condition and to test for exposure to rabies.
- Samples of fecal material, hair, skin, fat and claw shavings were taken for DNA and diet analyses.
- Each bear was tattooed with a unique number on the lower lip, and was ear tagged, to ensure identification once the collar is removed or lost.
- Bears were equipped with an ARGOS GPS collar programmed to provide three locations a day. Each collar is equipped with a VHF transmitter so that the collar/bear can be located from an aircraft or from the ground. These collars have a "breakaway" feature so they automatically fall off if the bears cannot be recaptured. There are still some satellite collars transmitting in the eastern portion of the study area.
- Female bears collared in previous years were located by fixed wing aircraft in mid June to determine reproductive status.
- Stationary collars are picked up in July/August to determine if the collar has slipped or if the bear has died.

Results

- Flights for all grizzly bear research (collaring bears, productivity surveys and DNA darting) were completed between May 24th, 2007 to September 6th, 2007. Flights were conducted in Tuktut Nogait National Park on May 24, May 28, June 7 and June 8.
- A total of 64 DNA samples were collected, 44 from darted bears, 8 from den sites and 12 from collared bears (see Table 1).

TABLE 1 Summary of number and species of fish captured

	Collared[a]	Den Site	Spotted/Darted	Grand Total
DNA sample taken	12	8	44	64
Unknown[b]	0	0	1	1
No DNA sample	1	3	6	10
Grand Total	**13**	**11**	**51**	**75**

[a] bears captured for collaring or bears with collared bears
[b] unknown if DNA analysis will yield genotype

Partners

- Government of the Northwest Territories, Department of Environment and Natural Resources (project lead)
- University of Alberta, Department of Biological Sciences
- Wildlife Management Advisory Council (Northwest Territories)

Funding

- Government of the Northwest Territories, Department of Environment and Natural Resources
- Parks Canada
- Polar Continental Shelf
- University of Alberta
- WMAC (NWT)

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Rationale

Arctic tundra ecological communities are highly vulnerable to human activities and climate change. However, predicting the impact of these perturbations on ecological communities is hindered largely by our poor understanding of 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 OBSERVATORIES 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)
- Investigate the possibility of using Komakuk as a site to run a snow fence experiment grid, which is used to test the relationship between snow depth and lemming abundance.
- Document predator abundance (raptors and foxes).

Methods and Information Collected

- During late August, at Komakuk, we estimated small mammal absolute abundance (9 ha trapping grid with 128 Longworth live-traps at alternate stations on a 20 m by 20 m grid), and small mammal relative abundance (live-trapping 40 stations spaced 15 m apart, each with 3 live traps for 48 hours).
- Traps were baited with apple, and provided with cotton bedding.
- The experimental snow fence, established in August 2006, was removed.

Update/Results

- The small mammal relative abundance index for August 2007 was 7.9/100 trap nights, which was similar to August 2006 (8.3/100 trap nights).
- On the absolute abundance grid the minimum number alive (MNA) estimate for lemmings (*Lemmus*) had declined from 28 in 2006 to 15 in 2007. The vole (*Microtus*) population had increased from a MNA of 0 to 21, and the Shrew (*Sorex*) population irrupted in 2007 going from a MNA of 0 to 20.
- These results indicate that the total population of arvicolid rodents changed little between years, and that predation combined with winter conditions precluded strong population growth, especially of *Lemmus*, during 2007.
- We identified two species of shrews: *Sorex ugyunak* (the majority) and *Sorex tundrensis*.
- Komakuk appears to be a suitable location for a snow-fencing experiment. The snow fences stood up reasonably well to 12 months of exposure. Temperature logger data showed that fencing enhanced snow depths from early November through to June, and that in the absence of fencing there was insufficient snow accumulation to buffer ground temperatures from ambient air temperatures on wind-exposed portions of the trapping grid. In August 2008 we will set up snow fencing over a 9 ha grid, and establish a non-fenced control grid.
- General surveys for avian and mammalian predators were completed. Peregrine falcons fledged 2 young within the study area, and rough-legged hawks appeared active. There was very little fox sign and minimal weasel sign with the study area. Somewhat low incidence of predators suggest that the lack of lemming population growth in 2007 may be partly due to harsh winter conditions. More regional searches for raptor nests and fox dens will be a priority in 2008.

A more comprehensive research program was completed in nearby Herschel Island Territorial Park, YT in 2007. More information about the Arctic WOLVES project can be found on the internet at http://www.cen.ulaval.ca/arcticwolves. The program will continue in 2008.

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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

Funding

- Canadian International Polar Year Program
- Natural Sciences and Engineering Research Council of Canada
- Polar Continental Shelf Project
- Wildlife Conservation Society Canada

Rationale

This project attempts to locate marmot "siggarkpuk" colonies that Inuvialuit Elders knew and visited in the past, and to collect photographs, hairs, and scats that would confirm the presence of a new mammal species to Canada, the Alaskan Marmot (*Marmota broweri*). This species was not documented in the resource analysis for the park. A colony in Ivvavik National Park would be the only place in Canada where this species is known. The research is an important demonstration of Canada's commitment to apply aboriginal traditional knowledge to the management of species at risk.

Research

LEARNING ABOUT MARMOTS IN NORTHERN YUKON

Barney Smith, Government of Yukon

Objectives

- To determine if marmot colonies still exist at sites in Ivvavik National Park identified by Inuvialuit elders.
- To gather scats and discarded hair to allow genetic analysis to determine if the marmots are hoary marmots (*Marmota caligata*) or Alaskan marmots (*Marmota broweri*).
- To record traditional knowledge about family activities and marmot use in the Firth River valley.
- To demonstrate an application of aboriginal traditional knowledge and elder involvement in rare species research.

Objectives of the July field work in Ivvavik National Park were:

- To do ground searches of ridges to look for marmots and their sign in the Buckland Hills between the Firth and Malcolm Rivers where, in a 1991 interview, Elder David Roland had described marmots being trapped in the past.
- To investigate distribution of insects and especially Lepidoptera (butterflies and moths) in the area, in particular to document any possible Beringian endemic species.

FIGURE 1. Alex Gordon surveys potential marmot habitat PHOTO : BARNEY SMITH

Methods and Information Collected

- From July 4 to 10, 2007, a 3 person crew walked potential boulder-strewn marmot habitat listening for whistle calls, looking for marmots and their burrows and scats in cool weather. The crew backpacked along ridges to access suitable habitats in the Buckland Hills between the Firth and Malcolm Rivers. Field notes and the technical report will contain descriptions and images of the ridges and slopes that were searched.
- Bird and mammal sightings were recorded. Plants were photographed.
- Five archaeological sites were seen, located by global positioning software equipped instruments, and photographed. This included 4 circular rock piles approximately 1.0 to 1.5 m in diameter, one partial ring of rocks about 4 m in diameter, and one stone deadfall trap suitable for a wolverine or small bear.
- Twenty four moths and butterflies were collected
- One raven colony was located.
- Ridge top sites with recent caribou calf remains (skins and bones) were photographed.
- All grizzly bears seen were photographed, and one had a collar.

Update/Results

- There was very limited occurrence of suitable marmot habitat in the areas we glassed and walked.
- All these potential habitats appeared to be occupied by wolverine.
- American Golden Plovers nesting in this area make a variety of calls that sound like marmot whistles.
- This set of ridges and valleys have high biodiversity values and appear well used by calving caribou in some years.
- The quote from Mr. Roland described a hunter travelling west of the Firth taking marmots on a low ridge on his way to get sheep. Given the lack of sign we found, this site is most likely in the ranges south of the Buckland Hills.
- 8 butterfly and 1 moth species were documented.

Partners

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- Aklavik Hunters and Trappers Committee
- Wildlife Management Advisory Committee (North Slope)
- NatureServe Yukon
- Environment Canada, Canadian Wildlife Service

Funding

- Government of Yukon, Department of Environment
- Parks Canada

FIGURE 2. Image of juvenile *Marmota broweri* taken in the Brooks Range. Alaska
PHOTO: JOHN HECHTEL

Acknowledgements

- Richard Pither, Acting Senior Supervisor, Critical Habitat co-led the field work and reporting.
- Alex Gordon of Aklavik assisted in all aspects of the field studies.
- The Inuvialuit Fisheries Joint Management Committee (FJMC) contributed Alex to the project, and provided daily satellite phone support.
- The Western Arctic Field Unit provided bear safety equipment and advice. We appreciated knowing they could provide support in an emergency.
- Polar Continental Shelf Project provided helicopter support for the project.

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Rationale

The geology of much of northwestern Canada is so poorly known that many basic questions about the region's geological history are unanswered. A recent study suggests that some of these rocks were deposited about 400 million years (Myr) ago as deep water sediments derived from a source area to the north. More detailed knowledge of these rocks, known only from the Firth-Malcolm area of Ivvavik National Park, will help to characterize the nature of the continent that collided with this area to create the folds which are well exposed in the Firth River canyon. That continent subsequently drifted away to create the Arctic Ocean. The present location of that continent is the subject of vigorous debate. This project will consist of ground-based geological mapping to accomplish two distinct goals. The first is to document the distribution and patterns of deposition of this sequence of ancient rocks, and how they were deformed and uplifted by a major mountain-building episode 400 Myr ago. A more detailed understanding of these events will help us to test existing hypotheses about the geological evolution of the entire Arctic region. The second purpose is to enable preparation of a new digital geological map for the Malcolm River map area (NTS 117C/08), of which some mapping was completed in the 1990's.

Research

DETAILED GEOLOGICAL MAPPING OF PALEOZOIC ROCKS IN THE FISH CREEK AREA, IVVAVIK NATIONAL PARK

Dr. Larry Lane, Geological Survey of Canada

Objectives

- To record the distribution of rock types of Paleozoic-age (550-250 Myr old);
- To record thicknesses of rock units and the contact relationships between them;
- To record the locations, orientations and displacements of folds and faults in the rocks;
- To record the presence and orientations of preserved current flow features that characterize the sedimentary source areas;
- To assess the ages and compositions of the rocks using chemical analyses and microscopic observations of collected hand-samples;
- To map at 1:50,000 scale, approximately 250 km^2 in Malcolm River map area;
- To spot check adjacent sites with the same above-noted objectives.

Methods and Information Collected

- The mapping occured during 11-18 July, 2007, and was completed by one geologist and one locally-hired field assistant (from Aklavik);
- Daily traverses were made on foot from a helicopter-deployed fly camp within the project area (Figure 1). Traverses follow ridge crests and/or stream-cut embankments to access exposed rock outcrops; and consisted of walking over the terrain, using maps and airphotos to mark large-scale geological features. Stops were made at outcrops to take measurements and make detailed

Methods and Information Collected (continued)

observations, and occasionally to collect hand-sized samples for later microscopic or laboratory analyses.

- 54 outcrops were described in detail and 6 traverses covered an area of approximately 60 square kilometres
- Using airphotos, this information allows the compilation of approximately 100 square kilometres of new map, covering approximately 10% of the Malcolm River map area.
- 19 samples were collected for microscopic and laboratory analysis totalling approx. 41 kg.

FIGURE 1. Campsite, upper Fish Creek (69^{0}25.5'N; 140^{0}35'W), showing talus-covered slopes and poor quality outcrops typical of this unglaciated study area. Traverses extended outward for approximately 5 km from camp
PHOTO: L. LANE

Update/Results

- Two limestone samples were dissolved in acid and the insoluble residue was examined for fragments of conodonts. (Conodonts are the "teeth" of tiny eel-like fish that lived through the Paleozoic and early Mesozoic eras. They are exceptional "index" fossils, used for documenting the precise age of carbonate rocks of Paleozoic and early Mesozoic age.) No conodonts were recovered and so the age of that succession remains imprecise.
- Parts of three sandstone samples were processed to separate microscopic grains of the uranium-bearing mineral zircon. Approximately 100 zircon grains from each sample were analysed in a specialized mass-spectrometer to measure the abundances of the isotopes of uranium and lead. From this information, the age of each zircon grain was calculated. Two Devonian samples yielded zircon populations ranging between 402 Myr and 2768 Myr old. The youngest populations, at 400-410 Myr demonstrates that these rocks can be no older than latest Early

Update/Results (continued)

Devonian. Interpretation of the geographic implications of these data are in progress. A third sample collected from an older (Precambrian) sandstone within a carbonate-dominated succession produced a zircon age distribution similar to that of Neruokpuk Formation sandstones from the same area, indicating that they were probably derived from the same source region. Also, the youngest population, 1070 Myr, is a maximum age for the sampled unit. This is the first evidence of any kind for the age of this succession, which is widespread in the Park.

- Other samples will undergo microscopic examination, which will provide additional information about the composition of these rocks.
- Compilation of the new mapping is ongoing.
- Fieldwork in 2007 extended and confirmed data collected elsewhere in 1990-94, that:
  a) shale, siltstone, sandstone (Figure 2) and minor sandy limestone of probable Early Devonian (> 400 Myr old) age were deformed by a severe deformation event that predates deposition of thick Carboniferous (<360 Myr old) limestone successions;
  b) significant changes occur in a N-S direction: in the south the Devonian rocks lie on Silurian shales in a logical succession, whereas in the north they lie directly on much older Cambrian (>500 Myr old) rocks, indicating that 100 million years of geological record is missing there;
  c) the sandstone beds appear to be concentrated in the lower part of the Devonian succession, implying that the major influx of sandy sediment (usually identified with a mountain building event in the source region) may be somewhat earlier than previously suggested;
  d) the Cambrian rocks lie directly on older Precambrian slate, chert and limestone, whereas farther south and east they lie on a thick sequence of sandstone and shale of the Neruokpuk Formation.
- A second priority for 2007 was to investigate an apparently abrupt termination of the Neruokpuk Formation in outcrops farther east. This had to be deferred. Careful investigation of this outcrop area will be necessary to properly display the stratigraphy on the geology map of the Malcolm River map area; and to understand the complex geological history of the area. This work will possibly be incorporated into a proposal for several weeks of additional strategic fieldwork designed to complete Empire Mountain (NTS 117C/1) and Muskeg Creek (NTS 117B/16) in 2009 or 2010.

FIGURE 2. Light coloured sandstone and darker siltstone beds are separated by cleaved (flaky) slate. The slaty cleavage is caused by a deformation that produced tight folds in these Devonian (and older) rocks PHOTO: L. LANE

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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 Area. 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. Possible end users of the information provided by this project include: aboriginal peoples (Inuvialuit, Gwich'in) and their co-management organizations (e.g., Fisheries Joint Management Committee; Gwich'in Renewable Resources Board); environmental impact assessors (e.g., Environmental Impact Review Board), regulatory agencies (e.g., DFO Habitat), and environmental stewards (e.g., DFO Oceans Sector; Parks Canada); and industry – hydrocarbon and fishery developers, related industries, and consulting groups retained by them.

Research

YUKON NORTH SLOPE NEARSHORE COASTAL FISH SURVEY

Jim Johnson, Fisheries and Oceans Canada

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 present study replicates, in large measure, a DFO survey conducted in the same area in 1986. Results of the two studies will be compared. Overall project duration will be four years; the first two years, 2007/08 and 2008/09, will be dedicated primarily to field work, and the remaining two years will be used for data analysis and reporting.
- A field camp was established in Ivvavik National Park, Phillips Bay, Yukon North Slope (69° 14.96´ N 138° 29.69´ W). Fishing was conducted in adjacent nearshore coastal waters.
- Principle fishing gear was large trapnets set in shallow, nearshore waters (shore to 2 m depth), set perpendicular to the shore. A trapnet was installed and fished continuously between July 1st and August 31st (except

Methods and Information Collected (continued)

for a few days when ice and/or weather necessitated removal and for a 9 day period in early August when our Zodiac boat was damaged).

- The trapnets are checked a number of times per day; captured fish are placed in a temporary holding pen until processed. Most fish are identified, measured and released. A sub-sample of the catch is dead sampled.
- Approximately 45,350 fish were trapped. This large sample size was required to accurately estimate population parameters for all the fish species encountered and to assess the seasonal variablity of these parameters. Of this number:
  - 5418 fish were killed and fully processed;
  - 14, 955 fish were measured and then released unharmed;
  - 24,977 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 2007 versus 1986.
- Of special interest and concern were Dolly Varden char. In total 452 char were captured. One char was killed accidentally; all others were released in good condition after being measured for length. Adipose fins were clipped from 400 of the char and preserved for later genetic analysis.
- 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. the above mentioned char adipose fins for North Slope char genetics work;
  ii. sampling for water chemistry, algae, meiofauna, 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;
  iii. muscle samples from 100 fish were collected for an inconnu genetics study;
  iv. 400 Arctic cisco muscle samples were collected over the course of the field period in support of Alaskan Arctic cisco work;
  v. samples for ongoing contaminants research. Liver and muscle samples were collected from 10 fish of each species encountered.

TABLE 1 Summary of number and species of fish captured

Species	Killed and Processed	Measured and Released	Counted and Released	Total	% of 2007 Catch	% of 1986 Catch
Arctic cisco	740	2502	6295	9537	21	37.1
Least cisco	644	2363	3839	6846	15.1	14.3
Rainbow smelt	553	1796	1627	3976	8.8	5.5
Lake whitefish	534	1136	408	2078	4.6	0.3
Broad whitefish	344	1128	428	1900	4.2	0.7
Dolly Varden char	-	451	-	451	1	1.2
Inconnu	240	121	-	361	0.8	0.1
Arctic flounder	648	3044	11622	15314	33.8	31.5
Fourhorn sculpin	651	1141	244	2036	4.5	7.4
Saffron cod	493	897	514	1904	4.2	1.7
Starry flounder	330	162	-	492	1.1	0
Pacific herring	230	151	-	381	0.8	<0.1
Arctic cod	2	22	-	24	<0.1	<0.1
Blackline prickleback	-	6	-	6	<0.1	<0.1
Arctic lamprey	1	-	-	1	<0.1	<0.1
Arctic grayling	2	34	-	36	<0.1	<0.1
Ninespine stickleback	-	5	-	5	<0.1	<0.1
Burbot	3	-	-	3	<0.1	<0.1
TOTALS	**5418**	**14955**	**24977**	**45350**	**<0.1**	**<0.1**

Results

- The overall pattern of the proportions of the catch contributed by the various species is quite similar between the years 1986 and 2007.
- However, there appears to be significant differences in the relative abundance for some species. For example: in 2007 Arctic cisco comprised 21% of the total catch, down from 37% in 1986; in 2007 we captured 492 starry flounder – a species not encountered in the 1986 study; and in 1986 only 7 Pacific herring were caught compared to the 381 captured in 2007.
- Data and tissue samples collected in the field were shipped to the Freshwater Institute (FWI) in Winnipeg.
- Aging structures from the dead sampled fish have been forwarded to the fish aging lab at the FWI. The aging lab will work on these samples throughout the remainder of this fiscal year and into 2008/2009 as time and resources allow.

Results (continued)

- Collection data and biological data have been entered into electronic files. Errors and omissions have been corrected and some preliminary analysis of these data has begun. A data report for the 2007 data will be written in 2008/2009.
- Biological samples (for stable isotope, genetics, and contaminants work) have been archived at the FWI or forwarded to other researchers; work on these samples will proceed in 2007/2008 and continue throughout the remaining years of the project.

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Rationale

Ivvavik National Park contains a rich record of Inuvialuit history. Some of the most visible evidence of Inuvialuit use of the land is found on the Beaufort Sea coast, where the remains of sod house foundations and old graves mark places which were occupied as recently as the 20th century. Many of these locations are being severely impacted by shoreline retreat, accelerated by permafrost degradation. Ivvavik's coastal monitoring strategy is a critical management tool in tracking the condition of threatened sites. It allows park managers to identify when intervention is necessary and to determine what level of intervention is appropriate. Previous monitoring assessment has led to excavations at Niaqulik (2001) and Quainiuqvik (2003), enabling the park to gather as much information as possible from threatened structures prior to their destruction.

Research

IVVAVIK NATIONAL PARK CULTURAL RESOURCE MONITORING

Objectives

- Gather quantitative and qualitative data in order to assess deterioration of cultural resources on site threatened by coastal erosion.
- Make recommendations on cultural resource protection.

Methods and Information Collected

- A total of 14 sites were to be visited in 2007: 12 coastal monitoring sites and two previously unrecorded sites on the Firth River. Three sites (30Y96, and the unrecorded Firth River sites) could not be reached in the time available due to adverse weather conditions.

At each of the remaining 11 sites, the following information was recorded:

- Description of observable impacts, including progression since last monitoring.
- Measurements to edge of shoreline for individual features most vulnerable to shoreline erosion.
- Photographs of individual features, from specified monitoring points, to allow visual comparison with photos from previous monitoring efforts.
- Inventory (presence/absence, description of condition) of artifacts and/or human remains associated with features.
- Updated geographic coordinates.

While in the field, two additional sites (30Y98 and 93Y) on the mainland south of Herschel Island were chosen for inspection. Although not threatened by

Cultural resource monitoring in Ivvavik National Park
PHOTO: PARKS CANADA

Methods and Information Collected (continued)

coastal erosion, 30Y98 represents the most complete example of a 20th century Inuvialuit sod house in Ivvavik NPC, and possibly on the entire Yukon North Slope. It had not been assessed since it was first recorded in 1987, so was revisited while in the area to conduct a condition assessment. Site 93Y had been recommended for monitoring (Adams 1998) but was omitted from the monitoring protocols followed by Cockney (2000, 2004).

Results

Niaqulik (82Y)

- Severe erosion of the NW part of the site continues.
- Houses excavated in 2001 (82Y23, 82Y24) are either destroyed or buried beneath driftwood at the very edge of the eroding shoreline.
- The only features remaining on the NW part of the site are a stage and a sod quarry, presumably associated with the two houses excavated in 2001.

Qargialuk (85Y)

- Graves are experiencing natural decay, but the shoreline in the immediate vicinity is stable. No shoreline slumping observed.

Paul Kayutuq cabin (83Y)

- Continuing erosion of the bank on the west side of the cabin as a result of storm surge in the bay.
- Development of large slump blocks along the shoreline has caused the west half of the cabin to subside, causing the south wall and roof to collapse.

Wilson Suplu cabin (84Y)

- No impact from slumping, but driftwood has encroached to within 3.5m of west wall.

Nunaluk (69Y)

- Erosion of the relict knob of tundra at the end of Nunaluk Spit has progressed dramatically since it was first recorded in 1987.
- In 1996, the Stefansson cabin was 18.4m from the eroding bank edge. In 2007, it was 6.5m to edge of bank. (11.9m recession in 11 years).
- A ground crack (bordering a large slump block) is developing 2.5m from the NE corner of the cabin.
- At current rates of erosion, the cabin will collapse within 2-3 years. The cabin floor should be excavated in 2008 to retrieve as much information as possible, before it is destroyed.

Results (continued)

Shinikruaq (68Y)

- Erosion of cultural resources at Shinikruaq is occurring primarily on the mainland south of the barrier spit, rather than on the part of the site adjacent to the coastal beach. Although the low mainland bluffs are protected from storm surge by Nunaluk Spit, they are receding slowly as ground ice melts and slump blocks break free (retrogressive thaw failure).
- A cache pit excavated in 1996 has slumped over the bank edge, and similar slump failure is approaching house foundation 68Y29.
- The position of the driftwood line bordering the site to the NW has not changed since it was last monitored in 2000.

Clarence Lagoon (Hudson's Bay Company store and warehouse, 74Y)

- The store and warehouse are open to the elements and are decaying.
- The warehouse has experienced recent damage: planks have been pulled off the interior ceiling.
- The position of the driftwood line encroaching on the north and west sides of the warehouse is unchanged since last monitored in 2000.

Clarence Lagoon (76Y)

- Comparison with monitoring photos taken in 2000 indicates no change in the position of driftwood encroaching on the sod house (76Y2).
- Grave 76Y14 is stable.

Whale Bay (86Y)

- Driftwood encroachment on the N and W sides of the site is severe.
- The NE corner of 86Y4, the house closest to the beach, is being undermined by a frost crack.
- House 86Y3, the southernmost house, has been filled with driftwood. It is at a lower elevation than the other two houses, so has been impacted to a greater degree by storm surge.

Roland Bay (87Y)

- The site is disappearing rapidly. The only features now left are a windbreak and a tent frame; a water well, visible in 2002, has now been destroyed by the receding bank edge.
- Vegetated tundra which formerly extended out onto the spit has receded by about 20m since 1987.
- Comparison with photos taken in 1987, 1997 and 2000 indicate that the site's cultural resources have been significantly moved around over the years.

Results (continued)

Stokes Point (Umiaq Site, 36Y)

- The slump block containing grave 36Y10 has dropped further in elevation.
- The shoreline has receded ~1.5m since 2000.
- Graves are experiencing natural decay. Vegetation obscures many grave goods.
- The coffin on the hillside south of the main site (36Y17) is now completely dismantled and its contents are scattered across and down the slope to the NE. This has occurred since the remains were replaced in the coffin in 2002 or 2004, after it was overturned sometime between 2000 and that date.

Stokes Point (91Y)

- The site is essentially unchanged since last visited in 2002 or 2004.
- Grave goods appear to be undisturbed. A whalebone sled runner fragment near 91Y8 and a lance fragment at 91Y4 were not observed, probably due to heavy vegetation.
- The spit north of the graves has been significantly altered by storm surge since last photographed in 2000. There is no sign of the modern camp recorded in 1997 at the base of the spit.
- In 1997, investigators were undecided as to whether a scatter of logs east of the main site represented a grave or a collapsed stage (Adams 1997). This feature closely resembles the graves in the main concentration to the east. Following re-inspection in 2007, we recommend treating the feature as a probable grave and tracking its condition along with the other graves at 91Y.

93Y

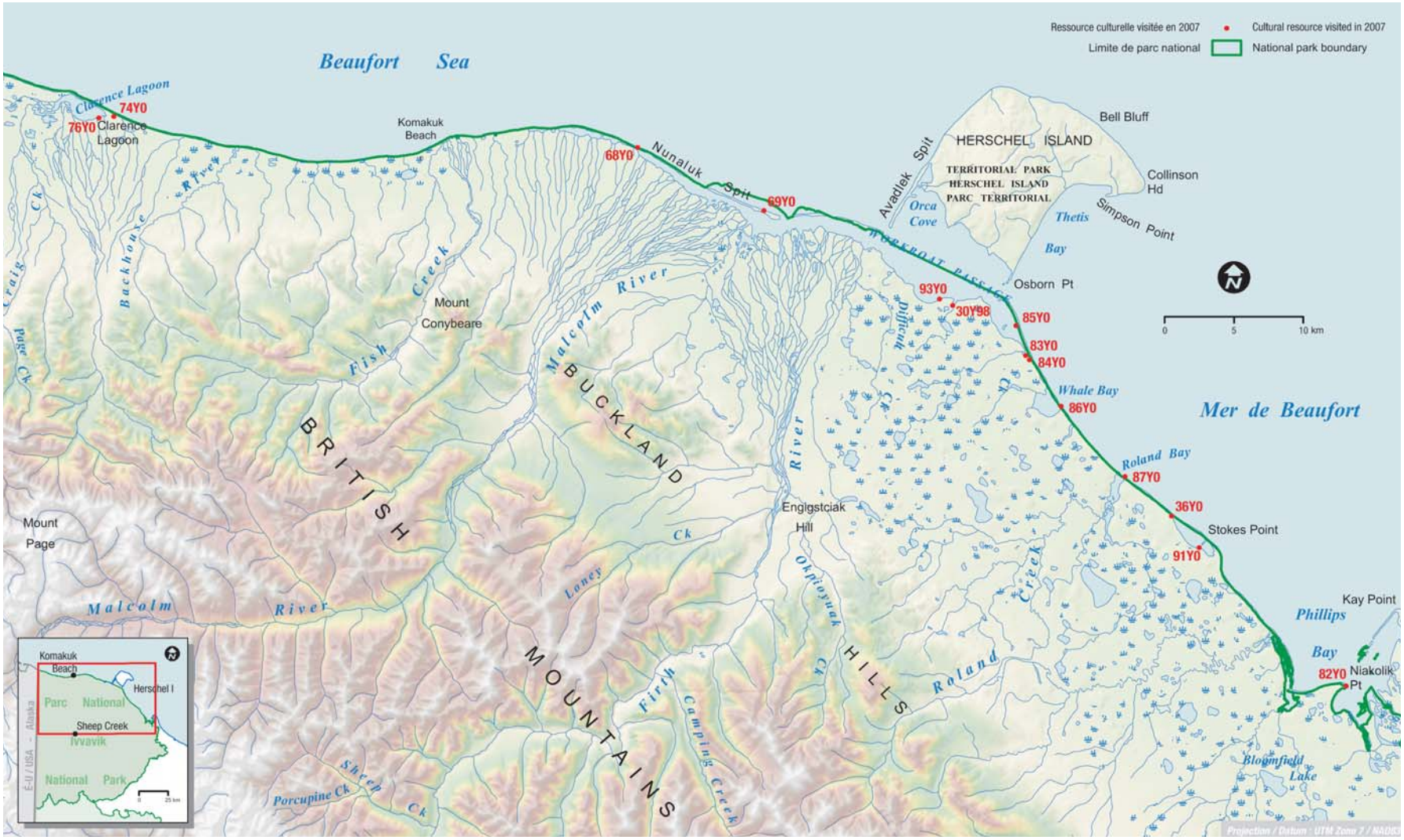
- Natural deterioration (weathering) of graves is progressing. Overall, the site is stable.

30Y98

- The sod house is undergoing natural deterioration (weathering).
- The SW corner of the house's porch has collapsed since 1987.
- New frost cracks are developing beneath a second, dismantled log cabin foundation on the site.

Ivvavik National Park of Canada

Map of cultural resources sites monitored in 2007



MAP: PARKS CANADA

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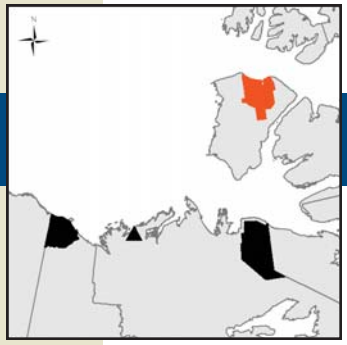
Rationale

There are over 275 recorded archaeological sites in Aulavik National Park ranging from 3,500-year-old occupations to more recent ones. Most of the sites recorded are along the Thomsen River. As significant cultural resources, these sites must be monitored for changes or loss. Potential threats to these resources are: natural weathering; trampling by animals; loss due to erosion (wind and water); disturbance from park visitors, and theft.



Research

AULAVIK NATIONAL PARK CULTURAL RESOURCE MONITORING

Objectives

- To identify threats to cultural resources in Aulavik National Park.
- To measure the rate and extent of change caused by known threats to the cultural resources.
- To initiate action(s) to protect the cultural resources (and the artifacts contained within them) when thresholds of change and/or degradation have been reached or exceeded.

Methods and Information Collected

- A total of three sites were visited in 2007. At each site a series of photographs, from specified monitoring points, were taken to allow for visual comparisons with photos taken during previous monitoring seasons. Measurements were taken, from specific points, to measure the movement of artifacts on site. Observable impacts were recorded.

Muskox Skulls at Head Hill
PHOTO: PARKS CANADA

Results

Nasogaluak

- There were no observable changes at this site from previous monitoring in 2003. Remedial or mitigative action was not required.

Head Hill

- Some objects identified in photopoints had moved since the site was last monitored in 2003. The site is stable. Mitigative action is not required.

Head Hill Grave

- This site is stable and mitigative actions are not required.

Years of Data

- 1997, 1999 - 2003 and 2007

Reference Cited

- Bertulli, Margaret and L. Croken. Cultural Resource Monitoring Program, Aulavik National Park, Banks Island, Handbook Version 4 , Western and Northern Service Centre, Parks Canada

Funding

- Parks Canada Western Arctic Field Unit

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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.

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 2007, there are a total of 2,457 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.

TABLE 1 The total number of mammal, bird and fish wildlife card records by Park, 1973-2007

Park Name	Total Mammals Records	Total Bird Records	Total Fish Records	Grand Total
Aulavik	248	339	4	591
Ivvavik	892	526	9	1427
Tuktut Nogait	205	231	3	439
Grand Total	**1345**	**1096**	**16**	**2457**

- There was a total of 369 wildlife card observations in 2007 (Table 2). As in the long-term records, most of the observations occurred with Ivvavik. Overall, bird observations were the most common, likely because the NWT/Nunavut Bird Checklist Surveys are included in this database. A total of 59 bird species were observed in 2007, the most abundant of which were the waterfowl species (ducks, geese, swans and loons).

TABLE 2 The total number of mammal, bird and fish wildlife card records by Park for 2007

Park Name	2007 Mammal Records	2007 Bird Records	2007 Fish Records	2007 Total
Aulavik	8	118	0	126
Ivvavik	113	112	2	227
Tuktut Nogait	9	5	2	16
Grand Total	**130**	**235**	**4**	**369**

Years of Data

- 1973 - ongoing

Funding

- Parks Canada

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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.

NWT-NUNAVUT BIRD CHECKLIST SURVEY

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

- Information about the NWT-Nunavut Bird Checklist Survey is available through the internet at www.pnr-rpn.ec.gc.ca/checklist.

Years of Data

- 1995 - ongoing

Funding

- Canadian Wildlife Service

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Rationale

Lemmings are an important part of many Arctic ecosystems. They are a source of food for predators such as Arctic foxes, wolves, ermine and raptors, and can affect soil and vegetation. Lemming populations typically grow and decline cyclically, affecting the rest of the ecosystem as their abundance changes. Monitoring lemming abundance in Aulavik National Park is important for understanding how these lemming populations change, and for interpreting some of the changes observed in the rest of the park ecosystem.

LEMMING MONITORING

Objectives

- To monitor the relative changes in the abundance of collared and brown lemmings in one area of Aulavik National Park.

Methods and Information Collected

- Lemming monitoring is conducted annually in Aulavik National Park near Green Cabin, in the Thomsen River watershed.
- Lemming winter nests are counted using both line transect and plot survey methods.
- Eleven parallel transects of varying lengths were created. The transects cross a variety of habitats, many of which are suitable for brown or collared lemmings.
- In early summer, soon after all of the snow has melted, observers walk the transects looking for lemming nests. When a nest is sighted, the observer measures its perpendicular distance from the line of travel. The density of lemming nests will be calculated using standard distance sampling methods, including the total distance the observer walked and the perpendicular distance measurements.
- Five one-hectare plots were created. The plots are located in areas that are typical habitat for brown and collared lemmings, such as depressions or drainages in the tundra that tend to hold snow until early summer.
- The plots are systematically searched for lemming nests in the early summer, preferably just after all of the snow has melted. The total number of nests in each plot is recorded.
- Species and abundance of lemming predators observed during the line transect survey are also recorded.

Lemming nest in Aulavik National Park
PHOTO: PARKS CANADA

Update/Results

- Line transects were surveyed on June 28, 2007 covering 24.1 km. A total of 13 lemming nests were counted, for an average of 0.67 nests per kilometre (min.=0; max.=2.85). No lemming nests were found on five of the 11 transects. Seven weasel nests were counted on four of the 11 transects.
- Five one-hectare plots were surveyed on June 29, 2007. A total of 23 lemming nests were found in the five plots surveyed. Nests were found in every plot, with an average of 4.6 nests/ha (min.=3, max.=9). There was no snow present in any of the plots.
- Few predators other than Jaegers were observed during the survey. One Arctic Fox and 13 Jaegers (two nests) were observed while walking the transects. One fox den with two adults and at least four young was observed near plot 5 and two nesting Jaegers were observed between plots 3 and 2.
- Survey data indicate that the number of nests detected in both transects and plots has decreased in the last three years (Figure 1). This may be an indication lemmings are in the natural decline phase of their population cycle. A full analysis will be completed in the near future that generates lemming abundance estimates that correct for nest detection biases.

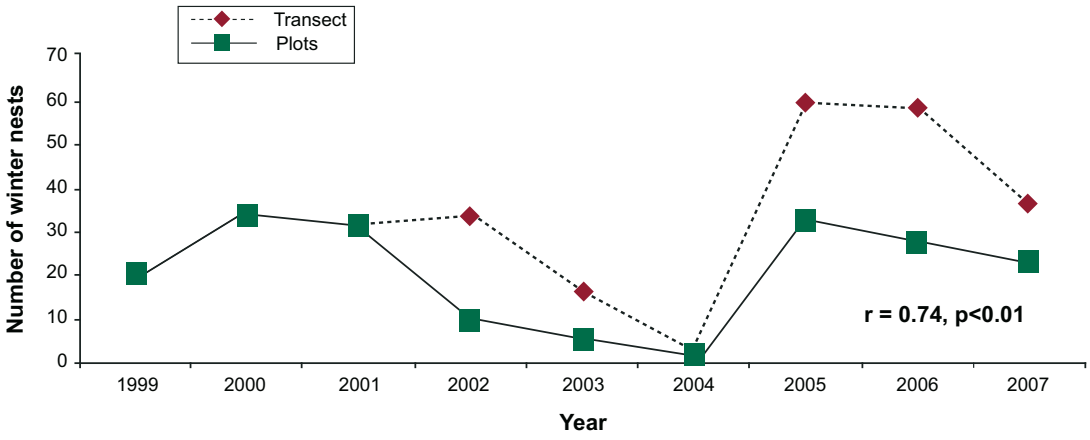

FIGURE 1. Number of winter nests recorded during transect (n = 11) and plot (n = 5) surveys for lemming nests. Aulavik National Park Winter Nest Survey, 1999-2007 (transect survey was initiated in 2001).

Years of Data

- 1999 - ongoing

Funding

- Parks Canada

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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 Cape Bathurst and Bluenose-West indicates that these herds declined between 2000 and 2005 with continued declines in 2006. Recovery of the herds will require increased birth rates and improved calf survival. Baseline data on productivity, composition, and recruitment of these herds is required to assess the impact of industry-related cumulative effects and monitor recovery of the herds. 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

- To determine the population size, productivity, recruitment of caribou calves, age and sex composition, mortality of females, parasite infection levels, distribution, and movements of the Bluenose-West caribou herd. This information will be used to investigate potential causes of population decline and provide strategies for recovery.

Methods and Information Collected

- Caribou movements and survey areas were monitored by the locations of collared caribou. To deploy GPS collars, caribou were captured with a net and immobilized with leg hobbles and eye blind. Blood, fecal and hair samples were collected and body measurements taken. The collars were sized for each animal, modified to fit, and then attached. From removal of the net to release of the animal, the average handling time was 13 minutes. No immobilization drugs were used.
- Recruitment surveys were conducted in April of 2007. The locations of collared caribou were used to guide the survey. Recruitment was defined as the number of calves that survive their first winter and are approximately one year old. Recruitment is expressed as the ratio of calves observed per 100 cows.
- The caribou calving areas of the Bluenose-West and Cape Bathurst herds and on the Tuktoyaktuk Peninsula were aerially surveyed between June 13th and 25th, 2007. The objective of this survey was to map the distribution and density of calving barren-ground caribou.

Methods and Information Collected (continued)

- Post-calving productivity surveys were conducted in July of 2007, approximately one month after peak calving. For these surveys, productivity was defined as the number of calves born which survive their first month, and was assessed through a classification of caribou.

Update/Results

- From February 28 to March 4, 2007, a total of 19 GPS Gen III collars (Telonics International Inc.) were deployed on adult caribou in the Cape Bathurst and Bluenose-West barren-ground caribou herds; 7 collars (all cows) were deployed on Bluenose-West animals. No animals were injured or killed during the capture program.
- The recruitment survey in April 2007 found the number of calves per 100 cows was: 25.7 ± 2.8 (Standard Error) for the Bluenose-West. The 2007 recruitment results are not as high as those seen in the late 1980s. It is also worth noting that the harvesting of females can impact recruitment survey results. If a large proportion of cows are harvested and the calves are not, then the number of calves per 100 cows left in the herd will be inflated and be an inaccurate reflection of the calf survival.
- Bad weather in the Tuktut Nogait National Park area caused problems with both starting and finishing the Bluenose-West calving survey – the area was surveyed on June 17th, 21st, and 22nd (16.7 hours flight time). Observations of barren-ground caribou cows and calves are shown in Figure 1.
- Productivity is expressed as the ratio of calves per 100 cows. For the Bluenose-West herd, the ratio was 86.7 ± 9.9 (Standard Error). Productivity in 2007 is better than it has been in the last few years.

Years of Data

- Surveys to obtain population estimates on the calving and post calving ranges have been conducted in 1987, 1992, 2000, 2005 and 2006.
- A productivity survey was conducted in 1981, and one age and sex composition survey was conducted in 1978.
- During calving ground surveys cow:calf ratios have been estimated annually between 2000 and 2005. No estimate was obtained in 2006.
- Eight recruitment surveys were conducted between 1983 and 1994.
- The presence and abundance of parasites was assessed in 2001.
- In 2007, recruitment (April), calving (June) and productivity (July) surveys were completed.

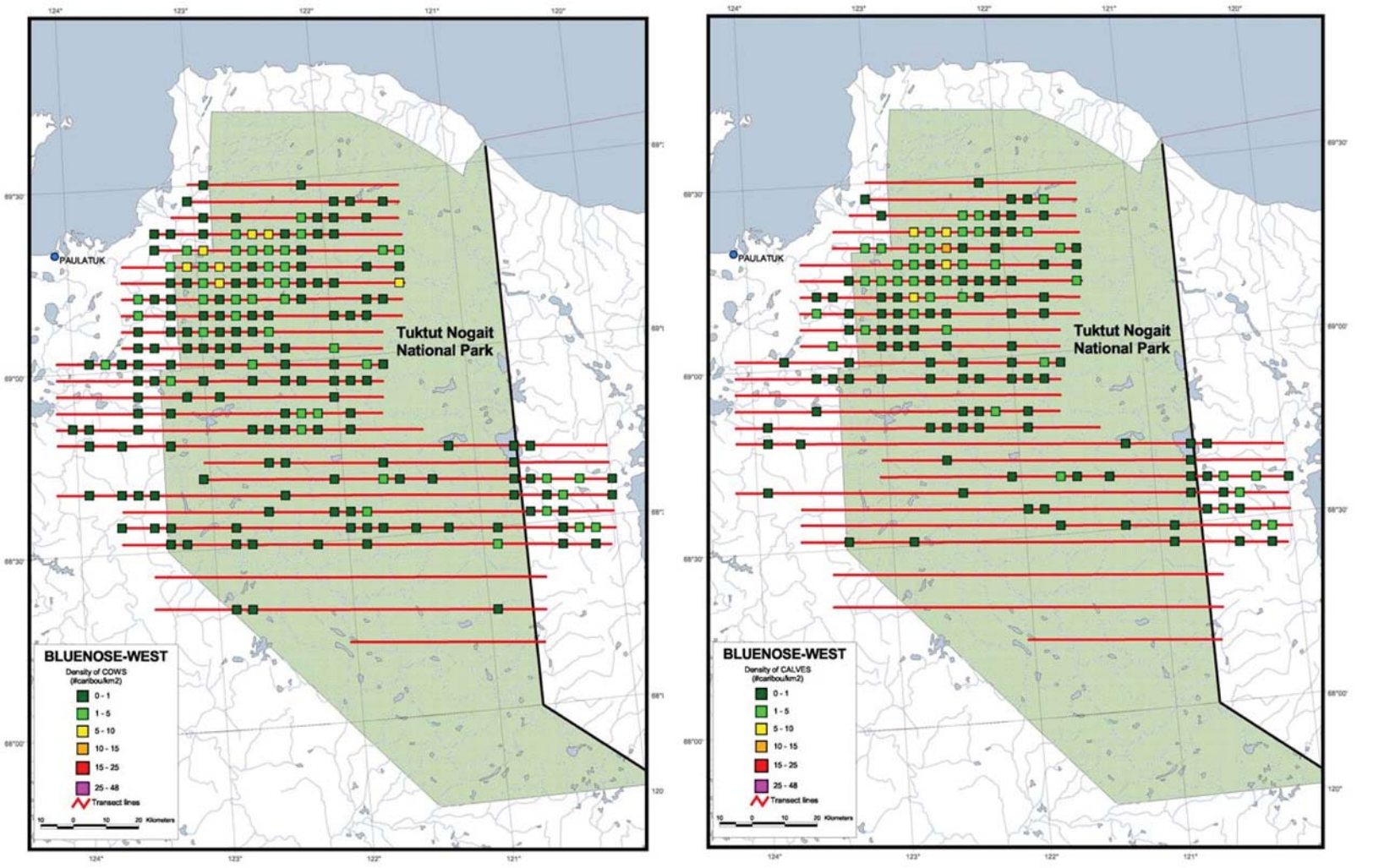

FIGURE 1. Observations of barren-ground caribou cows (left) and calves (right) on the Bluenose-West caribou herd's calving area, June 2007

Partners

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

Funding

- Government of the Northwest Territories
- WMAC (NWT)
- Gwich'in Renewable Resource Board
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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 been delayed or cancelled in recent years due to weather resulting in failure of the herd to aggregate on the coast plain or forest fire smoke preventing flights. However, annual population monitoring indicators such as birth rate and adult female survival estimates suggest the herd is declining at a rate that requires attention. 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 the 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.

PORCUPINE CARIBOU HERD MONITORING

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

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 Ivvavik National Park PHOTO: J. LUCAS

Update/Results

- A photocensus was initiated in July 2007, but was unsuccessful at providing a population estimate. The herd did not aggregate on the coastal plain before they moved into the mountains. Weather warmed considerably and biologists attempted the census while the caribou were loosely aggregated in the mountains. As it turned

Update/Results (continued)

out, shadows from the mountains on the photographs hid a significant portion of caribou pictured and herd size could not be estimated. This is the 5th year in a row that the photocensus failed. Technical staff are currently investigating alternate methods to estimate herd size.

- The 2007 calving survey indicated that due to delayed melting of the snow pack in the Arctic National Wildlife Refuge of Alaska, the Porcupine herd calved west of the Firth River in Ivvavik National Park. Seventy-nine radiocollared cows ages 2 years and older were observed during flights. The parturition rate (percent of cows that were pregnant or had given birth) was 88%. The June calf survival rate was 83% and the post-calving (July) calf survival rate was 90%.
- Estimates of calf production and survival during June 2007 were among the highest recorded for this herd. Several factors may have helped increase productivity this year. For example, the herd wintered farther north than in recent years, and range conditions may have been better than in areas used previously. Also, the winter range was closer to the coastal plain, so spring migration was shorter and caribou arrived in the calving area sooner than in many years. Most calves were born several days earlier than usual, and so had additional time for growth before the herd moved west into Alaska.
- A study to estimate adult female survival concluded in 2006. The annual survival rate for 2003/04 to 2005/06 was calculated at 0.826, similar to an estimate made in the early 1990's, just after the herd started to decline, and lower than when the herd was increasing. Consequently, biologists will continue to estimate over-winter survival of adult females annually with 2007 being the first year of this monitoring.
- Information about the movements and distribution of the Porcupine Caribou Herd can be found at www.taiga.net\satellite\index.html.

Years of Data

- Population estimates have been conducted since 1972; the last successful photocensus was completed in 2001.
- Parturition rates, calf survival, and calf:cow ratios have been documented since 1983.
- Three point estimates of adult female survival have been recorded (1982, 1991, 2006). Annual monitoring started in 2007.
- Seasonal range use has been documented since 1970.

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

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Funding

- 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

Rationale

Some environmental changes are best understood by looking at entire landscapes. Parks Canada monitors changes in plant productivity using normalized difference vegetation index (NDVI), which is acquired from Advanced Very High Resolution Radiometer (AVHRR) satellite imagery. This Satellite Monitoring of Northern Ecosystems project involves 9 national parks, including Aulavik, Ivvavik, and Tuktut Nogait National Parks, in the Canadian north.

Habitat

SATELLITE MONITORING OF NORTHERN ECOSYSTEMS

Objectives

- To monitor large-scale variation in plant productivity in Aulavik, Ivvavik, and Tuktut Nogait national parks.

Methods and Information Collected

- 10-day AVHRR composite images are taken 1 April to 31 October 1985-2007.
- NDVI is used as a measure of plant productivity.
- Analysis of AVHRR composite images is conducted by the Parks Canada Western and Northern Canada Service Centre in Winnipeg.
- Ecodistricts are used as sampling units in order to best integrate the satellite data with available landscape and biological data.
- Wavelet analysis is 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 plant productivity is 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.
- The annual NDVI values, as well as growing-season temperature, tended to increase in all Canadian ecozones.
- In general, increases in NDVI typically occurred when El Niño brought a favorable climate (warm) for plant growth, while decreases in NDVI when La Niña engendered a less favorable climate (cold).

Years of Data

- 1985 - present

Partners

- Parks Canada - Western and Northern Canada Service Centre (Winnipeg)

Funding

- Parks Canada

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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. Further, in the summer of 2007, a fire damaged much of the vegetation on the southwest side of Ibyuk Pingo, the world's second-tallest pingo. There is concern that 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. These changes may degrade the value of the PCL as an area that represents unique permafrost landforms and as a visitor attraction. The Pingo Working Group is a management advisory body for PCL. This board is comprised of the Inuvialuit Land Administration, Hamlet of Tuktoyaktuk, Tuktoyaktuk Hunters and Trappers Committee, Tuktoyaktuk Community Corporation, and Parks Canada.

PINGO MONITORING

Objectives

- To monitor changes in the height and shape of Ibyuk and Split pingos.
- To monitor damage caused by recreational vehicles to the vegetation of Ibyuk and Split pingos and surrounding areas.
- Determine rate of revegetation in the burned areas of Ibyuk Pingo.

Methods and Information Collected

- In cooperation with the Pingo Working Group, Parks Canada is developing a monitoring program for the Pingo Canadian Landmark.
- Vegetation surveys were conducted to determine the rate of revegetation in the burn, and to compare vegetation composition and density to unburned sites.
- Active layer depth measurements were taken within the burn area and also in control areas in order to monitor changes in active layer depth as a result of the fire.

Aerial photo of the burned area on Ibyuk Pingo in 2007. The area is being monitoring to determine the rate of revegetation and to compare the plant communities in burned and unburned area. PHOTO: : ROSS MACKAY

Methods and Information Collected (continued)

- Pictures were taken at designated photopoints around Ibyuk and Split pingos in order to monitor changes in vegetation cover and pingo shape.

Update/Results

- Photopoint photos and pingo measurements were taken for the fourth year in a row. Preliminary assessment of the photos reveals no change in vegetative cover on Split pingo. However, significant surface damage occurred on Ibyuk as a result of a fire in June 2007. Photos also reveal fire pits at the base of both pingos, the continued presence of heavy ATV traffic around the base of Ibyuk, and snowmobile tracks on both pingos.
- Analysis of the burn site on Ibyuk indicates that vegetation is regenerating and that most of the damage was confined to the vegetative layer and little damage reached mineral soil. Active layer measurements do not indicate increased thaw associated with the burn. Future measurements will continue to monitor the active layer and vegetation regeneration.

Years of Data

- 2002 - present

Partners

- Geological Survey of Canada (Atlantic)
- Hamlet of Tuktoyaktuk
- Inuvialuit Land Administration
- Tuktoyaktuk Hunters and Trappers Committee
- Tuktoyaktuk Community Corporation
- RCMP – Tuktoyaktuk Detachment

Funding

- Parks Canada

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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.

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

- 35 campsites, at maximum, are monitored along the Firth River between Margaret Lake and Nunaluk Spit.
- Campsite monitoring is conducted in the fall every year.
- 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. Daubermire squares are used to measure plant cover and are used to record data in areas with the largest impact.

Campsite monitoring on the Firth River in Ivvavik national park PHOTO: M. JOE

Methods and Information Collected (continued)

- A campsite 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 2007, campsite monitoring was conducted at 35 sites that were assessed for human use impacts. 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. Monitoring may be discontinued at sites that have little to no use.
- 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.

Funding

- Parks Canada

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Rationale

Understanding the 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, law enforcement, 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 of their visit, and the activities they conduct are recorded.

Update/Results

- In 2007, a total of 254 people, including researchers, students and volunteers visited the parks of the western Arctic (Table 1). Visitation to Aulavik and Tuktut Nogait national parks remained relatively low, while visitation to Ivvavik was substantially higher, 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.

TABLE 1 Number of visitors to each of the western Arctic national parks in 2007

Park	Number of Visitors
Aulavik	12
Ivvavik	226
Tuktut Nogait	16
Total	**254**

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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 national parks in the western Arctic, and to understand how these changes will affect the environment of the western Arctic.

Climate Change

WEATHER MONITORING

Objectives

- To monitor weather in Aulavik, Ivvavik, and Tuktut Nogait national parks.

Methods and Information Collected

- Aulavik, Ivvavik and Tuktut Nogait national parks each have two weather stations.
- All of the weather stations record the following:
  - precipitation
  - wind speed and direction
  - air temperature
  - incoming short-wave radiation
  - relative humidity
  - dew point
  - snowfall and snow depth
  - barometric and vapour pressure
  - UV-B radiation is recorded at one station in each park.
- All measurements, except for snow depth, and barometric pressure are recorded automatically by the weather stations every 5 seconds. Snow depth, and barometric pressure, are measured every 5 seconds during the last 10 minutes of the hour.

Weather station at Green Cabin in Aulavik National Park PHOTO: J.F. BISAILLON

Update/Results

- Information collected from the weather stations is available from the Environment Canada web site at http://www.climate.weatheroffice.ec.gc.ca/climateData/canada_e.html. To find the appropriate weather station, select "Customized Search" and then use the station names listed under "Web search name" in the table below in the "Search by Station Name" feature of the web site.

Years of Data

- The weather stations operated by the Western Arctic Field Unit were installed between 1995 and 1999.

Partners

- Environment Canada, Meteorological Service of Canada

Funding

- Parks Canada
- Environment Canada

Contacts

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Rationale

Changes in the amount of water flowing in Arctic rivers, and the timing of peak and low water levels, may be affected by climate change. 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. On the Hornaday River, river flow information is also used to look at relationships between river water flow, fish habitat, and fish productivity. River water flow information is also useful for visitors and park staff when canoeing, rafting, or kayaking the Hornaday or Firth rivers.

Climate Change

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 examine the relationship between river water flow, fish habitat, and fish productivity in the Hornaday River.
- 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 2007.
- 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.

Years of Data

- Firth River station from 1972-1994 and since 1997
- Hornaday River station since 1998

Partners

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

Funding

- Parks Canada
- Environment Canada, Water Survey Branch
- Fisheries and Oceans Canada
- Fisheries Joint Management Committee
- Polar Continental Shelf Project

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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. The clean-up involved demolishing buildings, excavating contaminated soil, soil remediation of a fuel spill area, collecting debris, and excavation of three landfills and closure of a fourth. A 25 year landfill monitoring program has been developed for the site at Komakuk Beach by the Department of National Defence in co-operation with the Inuvialuit Regional Corporation and Parks Canada. The environmental monitoring program has been designed to track possible environmental/geotechnical issues that may arise at the landfill and/or fuel spill area. IEG Consultants Ltd have been contracted by Defence Construction Canada to conduct environmental and geotechnical monitoring at the landfill and former fuel spill area since 2003.

KOMAKUK BEACH CLEAN-UP MONITORING

Department of National Defence

Objectives

- To monitor the condition of the remediated fuel spill and landfills at Komakuk Beach.

Methods and Information Collected

- The first phase of the 25 year monitoring program began in 2001 and ended in 2006. Phase II landfill monitoring consists of 4 monitoring events; the first one conducted on summer 2007 i.e. year 7, the remaining three events will be carried on 2010, 2015 and 2025.
- Visual assessments of the landfill and fuel spill area are conducted by a Professional Engineer to record changes in vegetation, settlement, erosion, discoloration, odours, and other features of note. Features are recorded using a survey grade GPS and compared to data collected from previous years.
- Shallow soil samples are collected up-gradient and down-gradient of the landfill and analysed for concentrations of hydrocarbons, PCBs and selected metals.
- Approximately 120 groundwater monitoring wells in the fuel spill area are examined and water samples are collected from 10 of the monitoring wells and tested for concentrations of hydrocarbons and BTEX.
- Ground temperature data is uploaded from dataloggers which collect vertical temperature data from six onsite thermistors located on the fuel spill area. Temperature readings are collected twice a day, 365 days a year.

Taking samples at Komakuk Beach
PHOTO: PARKS CANADA AGENCY

Update/Results

- Field crew visited the site via charter aircraft from Inuvik, August 21 – 24, 2007.
- Groundwater samples from 10 wells from the former fuel spill area were collected and shipped to an analytical laboratory for analysis of hydrocarbons and BTEX.
- Soil samples from four locations down-gradient of the fuel spill area were collected and shipped to an analytical laboratory for analysis of hydrocarbons.
- One upgradient and three downgradient soil samples were collected adjacent to the station area landfill. Soil samples were shipped to an analytical laboratory for analysis of hydrocarbons, PCBs and select metals.
- In 2007 thermal data was downloaded from four of the six onsite thermistors.
- Two of the thermistors were damaged and did not collect data.
- Final 2007 BAR-1 monitoring reports were submitted to the Defence Construction Canada in December 2007.

Years of Data

- The initial clean-up was conducted in 1999 and 2000
- Phase One of the monitoring program began in 2001
- Phase Two of the monitoring program began in 2007

Partners

- Department of National Defence - Defence Construction Canada (project lead)

Funding

- Department of National Defence

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Rationale

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 (POPs), heavy metals and radionuclides are a concern because they can have negative effects on Arctic ecosystems and human health. Water quality monitoring is conducted on the Thomsen River in Aulavik National Park, the Firth River in Ivvavik National Park and the Hornaday River in Tuktut Nogait National Park. Water quality information for these rivers is used to determine current water quality conditions and to monitor changes in water quality over time.

Long Range Transport of Pesticides

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 in these rivers changes 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 May or June, just after the ice breaks up on the river. The second set of samples is usually taken in late June or July and the third set of samples is taken in September.
- One or two sets of water samples are taken from the Thomsen River each summer. Samples are typically taken in June and 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 at the site.
- Water quality samples are analysed for physicals, nutrients, major cations, major anions, trace metals and organics.

Taking water samples at the Thomsen River in Aulavik National Park
PHOTO: PARKS CANADA

Methods and Information Collected (continued)

- Sediment samples are taken once at both sites on the Hornaday River and analysed for nutrients, metals, pesticides and hydrocarbons.

Update/Results

- The following samples were taken in 2007:
  - Thomsen River was sampled in early July;
  - Firth River was sampled in early June, late June, and September;
  - Hornaday River was sampled in early June, late June and September.
- Results from the Thomsen, Firth and Hornaday rivers indicate that all three rivers have excellent water quality.
- Minute traces of lindane, an agricultural pesticide used outside the Canadian Arctic, have been found in the Thomsen and Hornaday rivers. This is an example of the long-range transport of pollutants to the Arctic.

Years of Data

- Aulavik and Tuktut Nogait: since 1999
- Ivvavik: since 2000

Partners

- Environment Canada

Funding

- Parks Canada

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