2009
ANNUAL REPORT
OF
RESEARCH AND MONITORING
IN
TORNGAT MOUNTAINS NATIONAL PARK

Parks Canada Parcs Canada

Canada

Many people contributed to this report.
We wish to acknowledge them for their commitment to the project,
and their timely submission of reports.

ACKNOWLEDGEMENTS

Information about Parks Canada research and monitoring activities in Torngat Mountains National Park was provided by Parks Canada staff: Dr. Dave Cote, Dr. Jenneth Curtis, Alain Boudreau, Dr. Darroch Whitaker, Wanli Wu and Angus Simpson. Additional information on Parks Canada supported research was supplied by Pema Thinley of University of New Brunswick, Dr. Harvey Lemelin and Charlie Martina of Lakehead University, Carol Luttmer of Environmental Sciences Group, Royal Military College of Canada, Dr. Adrian Burke of Université de Montreal, Jamie Brake of Torngasok Cultural Centre, and Pierre Desrosiers of Avataq Cultural Institute

Reports on ArcticNet research were provided by: Dr. Trevor Bell, Dr. Sam Bentley and Mallory Carpenter of Memorial University of Newfoundland and Labrador; Sebastien Luque and Tanya Brown of Environmental Sciences Group, Royal Military College of Canada.

International Polar Year Research reports were provided by: Dr. Luise Hermanutz, Dr. John Jacobs, Laura Siegwart-Collier, Sarah Chan, Dan Myers, Peter Koncz of Memorial University of Newfoundland and Labrador; Dr. Alain Currier Jardin Bontanique de Montreal, Dr. Chantal Ouimet Parks Canada; Dr. Joseph Culp, Dr. Allen Curry, Andrea Chute and Allison Ritcey of University of New Brunswick.

Reporting on small mammal monitoring by the Newfoundland and Labrador Wildlife Division was provided by Frank Phillips.

Mandy Arnold provided the report on the kANGIDLUASUk student program

We would also like to extend a special thanks to the Student Interns who provided valuable assistance to many of the research and monitoring projects described in this document. They are Dorothy Angnatok, Elias Obed, Sheena Merkuratsuk, Anita Fells, Minnie OkKuatsiak Caitlyn Baikie, and Mike Ford of Nain, Sanak Unatweenuk and Sandy Emudluk of Kangiqsualujjuaq, Kelsey Hunter of Hopedale and Lily Anderson of Rocky Harbour. The student program is jointly supported and funded by Nasivvik, IPY, ArcticNet, Nunatsiavut Government, Environmental Sciences Group and Parks Canada.

This report was compiled by Bonnie Knott, and editorial review was provided by Darroch Whitaker, both from Parks Canada in the Western Newfoundland and Labrador Field Unit.

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Research camp below Minaret Glacier

INTRODUCTION

Research and monitoring are essential for managing protected heritage areas such as Canadian National Parks. Research activities are conducted to improve our basic understanding of cultural and ecological resources. Monitoring is conducted to document how these cultural-ecological systems change over time, especially in response to human activities and climate change. The information research and monitoring programs generate is vital for measuring the success of management actions and improving future activities, and also for allowing open and informative reporting on the state of the park.

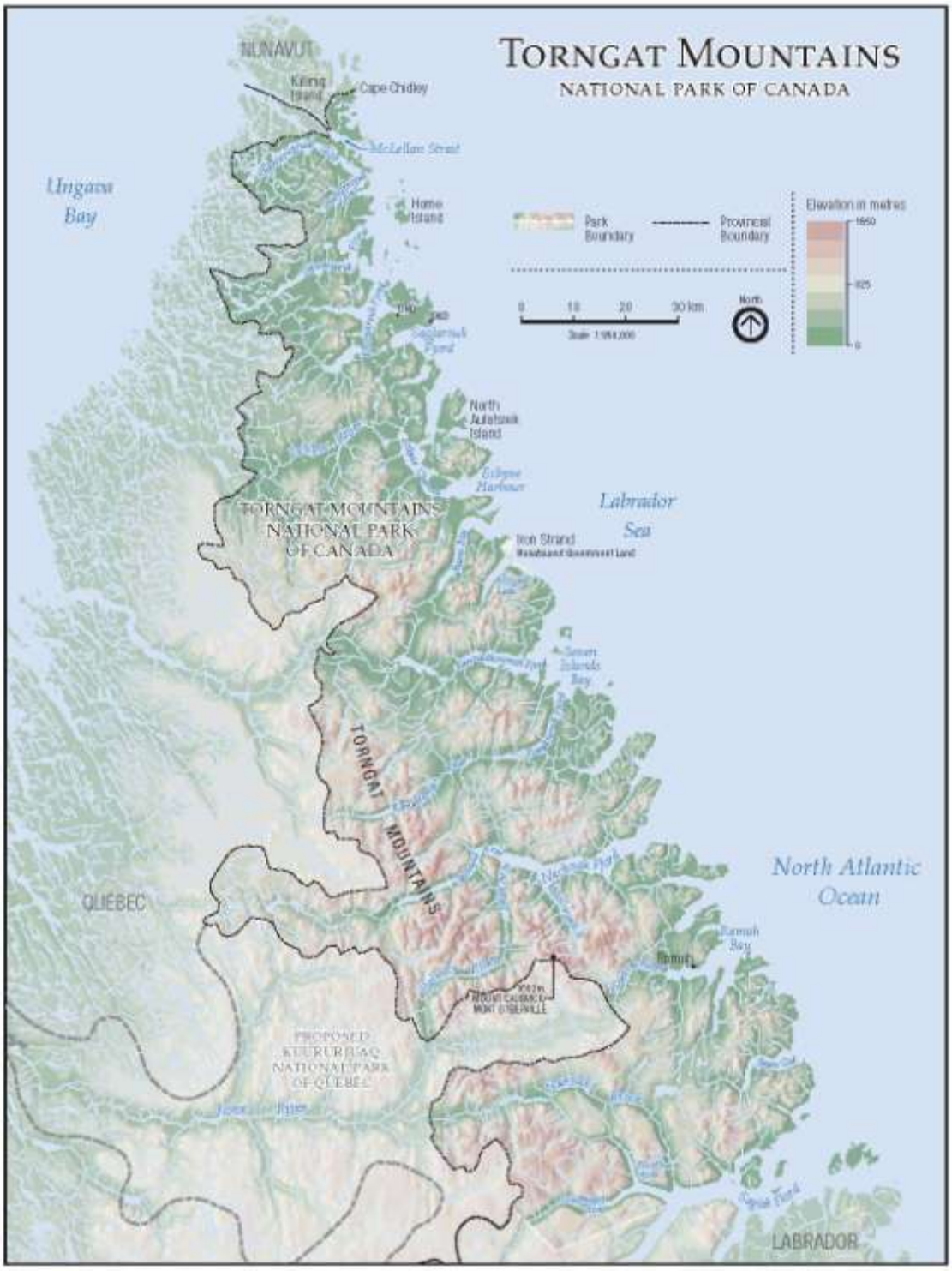
A major challenge to implementing an effective research and monitoring program is making the resulting information widely available and accessible to people outside the science program. Consequently, the purpose of this document is to present a summary of research projects and monitoring programs conducted in the park in 2009 to the Torngat Mountains National Park Cooperative Management Board, to other cooperative management organizations in Nunatsiavut and Nunavik, to government agencies, and to the general public and Parks Canada staff. All research and monitoring activities undertaken in 2009 are included in this document, and key findings and accomplishments are summarized.

This document is divided into two main sections: **Research** and **Monitoring**. Projects in the research section are divided into four categories based on the principal affiliation of the researchers as well as their primary source of funding. These four categories are:

- Parks Canada Research
- ArcticNet Research
- International Polar Year Research
- Newfoundland and Labrador Government - Wildlife Division

Projects in the monitoring section represent ongoing opportunistic programs such as the bird checklist and the wildlife cards, as well as focussed monitoring designed to support a long-term Ecological Monitoring Program. Many of the research projects (such as glacier and tundra vegetation research) highlighted in this report will provide valuable baseline information for developing future long-term monitoring programs. The opportunistic monitoring provides ongoing information important to park management and visitor experiences. These programs also provide an excellent opportunity for visitors to contribute to the collection of ecological information.

We hope that this report serves as an informative synopsis of the current research and monitoring program in Torngat Mountains National Park of Canada. We welcome any feedback, and encourage interested readers to contact us for further details on specific projects or to become involved in the research and monitoring program.



Torngat Mountains National Park in Northern Nunatsiavut, Labrador

REPORTING ON RESEARCH AND MONITORING

Torngat Mountains National Park of Canada is a new park that is still in the early stages of program development. It was established in 2005 through the signing of the Labrador Inuit Land Claims Agreement and is managed in partnership with Inuit through Park Impacts and Benefits Agreements (PIBA) signed with both Labrador and Nunavik Inuit. These agreements provide a blueprint for park management, and in particular call for the development of a research and monitoring program. Direction for establishing and supporting this program in Torngat Mountains National Park comes from a number of sources.

First and foremost, consultation and collaboration are central to developing an effective research and monitoring program for the park. Both the Labrador Inuit PIBA and Nunvik Inuit PIBA require consultation with a variety of research and land management organizations during the development of a research strategy. These institutions include:

- Torngat Mountains National Park Cooperative Management Board;
- Nunasiavut Government;
- Makivik Corporation and any Makivik Designated Organization;
- Torngat Wildlife and Plant Co-Management Board;
- Torngat Fisheries Co-Management Board;
- Torngasok Cultural Institute;
- Government of Newfoundland and Labrador;
- Other institutions the Field Unit Superintendent deems appropriate.

A research strategy will set out the methods that will be used to gather social, cultural and ecological information about the park and will include five components: a traditional knowledge component; an ecosystem component; an ecological monitoring component; a threat specific component; and a communications component. The research strategy will identify research priorities for the park, guide future research and monitoring, inform the State of the Park Reporting and Management Planning processes, and ensure consistency with regional research priorities in Nunatsiavut and Nunavik.

At the national level, the Canada National Parks Act identifies the “maintenance or restoration of ecological integrity through the protection of natural resources and natural processes, as the first priority when considering all aspects of the management of parks.” Accordingly, research is needed to provide a detailed understanding of the natural resources and processes of the park. National parks provide a unique opportunity for researchers to study in relatively natural landscapes free from intensive land use. As such, parks are valuable “laboratories” for learning and research and are ideal for supporting effective education and outreach programs.

Park staff must continuously monitor the state of park ecosystems in order to develop effective management programs and demonstrate that the agency is meeting the expectations of the Canada National Parks Act. Consequently Parks Canada Agency has developed comprehensive guidelines for Ecological Integrity (EI) monitoring in national parks and heritage areas. These EI monitoring programs are used to assess the condition of park ecosystems and the effectiveness of management actions, and are the primary source of information used to evaluate the state of the park’s ecological and cultural integrity. Research underway in Torngat Mountains National Park is integral to the ongoing development of an effective, informative, and scientifically credible monitoring program.

Future initiatives will include collaboration on research and monitoring programs with the newly created *parc national de la Kuururjuaq* in Nunavik, Quebec. This park, which encompasses the entire Koroc River watershed, shares a common boundary with Torngat Mountains National Park and strengthens and protects the cultural and ecological connections between Nunavik and Nunatsiavut.

STRUCTURE OF THE REPORT

This report covers all research and monitoring projects conducted in 2009, and also describes some projects that were initiated in previous years. Each project summary follows a common format that provides a brief overview of the project. Contact information for the principle investigator is included for readers seeking more information on particular projects.

Summaries for each project include:

Rationale

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

Objectives

A description of the main objectives of the project

Methods and Information Collected

A brief description of the study site or area, the methods used, and the information collected.

Years of Data

Lists the years for which data are available.

Partners

A list of organizations that were involved in the project.

Funding

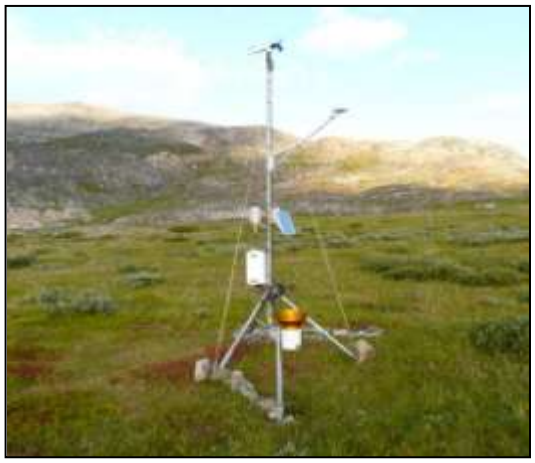
A list of organizations that provided funding for the project

Results

A summary of results available at the time this document was prepared (Winter 2009).

Contacts

Contact information for the principal researchers



RESEARCH

Research is the scientific search for facts to increase our understanding of the park's cultural or ecological systems. A broad range of research programs are being carried out in Torngat Mountains National Park. The resulting knowledge will contribute significantly to the development of effective monitoring, education, and management strategies.

RATIONALE

The kANGIDLUASUk Base Camp Student Intern Program has evolved over the past three years as part of an experiential education and outreach initiative of Parks Canada, the Environmental Sciences Group, and the Nunatsiavut Government. It provides opportunities for Inuit youth to experience the land and work with visiting scientists in the Torngat Mountain region. The students also become engaged with local elders, Inuit contractors, government members, Parks Canada staff, local artisans, and tourists.

kANGIDLUASUk STUDENT INTERN PROGRAM

OBJECTIVES

The vision of the kANGIDLUASUk Student Program is to provide experiential learning opportunities for Nunatsiavut and Nunavik youth. It will influence their own career or life paths through a multi-faceted and cross-cultural internship integrating Inuit culture, Arctic science, and outdoor adventure.

METHODS AND INFORMATION COLLECTED

This season, the students engaged in a variety of hands-on learning opportunities including:

- Working onboard Inuit owned long liners studying marine food web dynamics.
- Traveling to historic Inuit gravesites and family homelands.
- Electro-fishing to determine species composition in glacial, snowmelt, and lake-fed streams.
- Learning to clean seal skin with local elders.
- Assisting with fieldwork to determine growth patterns of tundra berries and vegetation related to climate trends.
- Harvesting arctic char, seal, duck and caribou to share with all at the base camp during the next meal
- Assessing suspected contaminated sites and developing clean-up strategies.
- Discovering near shore marine communities at kANGIDLUASUk while kayaking.
- Assisting with archaeological research at Sallikuluk and Ramah Bay.
- Hiking the Torngat Mountains and learning about the land and customs from local Inuit.
- Reflecting on experiences through music, art, discussions, and storytelling.

YEARS OF DATA

2007, 2008, 2009

2009 kANGIDLUASUk Student Interns.

Student Sanak Unatweenuk (centre) from Kangiqsualujjuak assists Memorial University graduate students Laura Siegwart and Dan Myers with tundra vegetation research

RESULTS

In its third season the 2009 program continued to build momentum, welcoming six new students and five returning 2008 students to share their leadership. The program engaged the participation of youth from Nunatsiavut, Nunavik, and a non-Inuit student volunteer from Newfoundland. It is expanding on a vision to create unique opportunities for cross-cultural exchange while promoting an awareness of Inuit culture and Arctic science. To meet the coordinating demands of the increased student number a full-time student program coordinator was hired in June 2009.

Student Dorothy Angnatok (Nain) taking the weight of a seal with marine biologist Tanya Brown and long liner owner and operator Joey Angnatok

NEXT STEPS

Based on the success of the student program and the momentum that has been built over the past three years, it is clear that the student program at the kANGIDLUASUk base camp has provided a unique and transformational experience for Inuit youth in Nunatsiavut and Nunavik. Over the next few months, the program coordinator will be working with new and current partners to develop the program, and to ensure its sustainability going forward.

PARTNERS

- Parks Canada – Torngat Mountains National Park
- Environmental Sciences Group, Kingston, ON.
- Nunatsiavut Government
- Nasivvik
- International Polar Year
- ArcticNet
- Inuit Tapiriit Kanatami
- Indian and Northern Affairs Canada
- Northern Contaminants Program

Student Anita Fells (Nain) assists archaeologist Jenneth Curtis

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RATIONALE

Sallikuluk is a focal point of the Inuit cultural landscape in Saglek Fjord. Numerous sod houses and graves are located on the island. In addition more than a dozen archaeological sites illustrate a human history of the island, and surrounding areas, that reaches back more than 5000 years. Visitors to the park often come to Sallikuluk to experience the history and the landscape. Due to the importance of Sallikuluk this project was begun in 2008 to document the archaeology and oral history related to the island. The project continued in 2009.

Parks Canada Research

SALLIKULUK ARCHAEOLOGY AND ORAL HISTORY PROJECT

OBJECTIVES

- Update the information we have about the archaeological sites on Sallikuluk.
- Evaluate the condition of cultural resources and identify threats.
- Document oral history related to Sallikuluk.

Interior of a sod house on Sallikuluk

METHODS AND INFORMATION COLLECTED

This project focused on the archaeology of Sallikuluk (Rose Island) in Saglek Fjord. Previous archaeological research documented thirteen archaeological sites on the island representing 5000 years of human history. Our goal for this project was to revisit each of these sites to:

- verify and correct existing information including site location, the number and kind of cultural features and the location of previous excavations;
- identify and map the site boundaries;
- assess the condition of the site and potential threats;
- map and record individual cultural features (eg. sod houses, graves);
- document Inuit oral history related to Sallikuluk.

YEARS OF DATA

- 1969-1971 Memorial University of Newfoundland projects led by James Tuck
- 2008-2009 Parks Canada

PARTNERS

- Torngâsok Cultural Centre, Nunatsiavut Government
- kANGIDLUASUk Student Program

Whale bone outside sod house.

FUNDING

- Parks Canada

RESULTS

- Visited four archaeological sites on Sallikuluk.
- Searched for a fifth site, but did not locate it.
- Updated information on a Palaeoeskimo (4000 to 700 years ago) site, stone artifacts were observed in exposed patches on a gravel terrace.
- Mapped an Inuit site including at least 14 sod houses of various sizes.
- Noted the location of several Inuit graves.

Students mapping sod house.

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RATIONALE

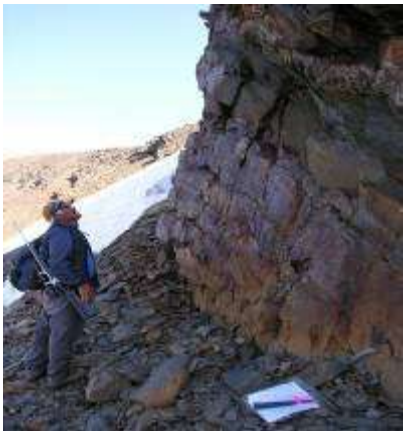
The Ramah Bay area is the source location for a unique variety of stone that was widely used by Aboriginal peoples over thousands of years. Artifacts made of Ramah chert have been found on archaeological sites as far south as New England and as far north as the Canadian Arctic. Ramah chert may have had a special symbolic significance related to its distinctive visual qualities – a translucent, ice-like appearance. As part of Parks Canada's New Commemorations Initiative this area has been identified as a potential nominee for national significance. The goal of this project is thus to collect information towards a nomination to the Historic Sites and Monuments Board of Canada.

Parks Canada Research

RAMAH BAY QUARRY ARCHAEOLOGICAL RESEARCH PROJECT

OBJECTIVES

- To verify known archaeological site locations and boundaries.
- To document the spatial and geological characteristics of the chert outcrops.
- To explore the characteristics of each archaeological site by identifying quarrying and manufacturing locations as well as associated habitation areas.



EliMerkeratsuk looking at chert outcrop (A. Burke)

METHODS AND INFORMATION COLLECTED

Our research focused on documenting chert outcrops and associated cultural materials in place. We used geological maps and known site coordinates to locate quarry sites, then used GPS units and a Total Station to map the geological and cultural features. We took photographs and recorded the characteristics of the artifacts we observed.

YEARS OF DATA

- Elmer Harp Jr. 1963
- Torngat Archaeology Project, Smithsonian Institution 1976-1978
- Parks Canada 2009

Recording an artefact of Ramah Chert (A. Burke)

PARTNERS

- Torngâsok Cultural Centre, Nunatsiavut
- Avataq Cultural Institute, Nunavik
- Université de Montréal
- kANGIDLUASUk Student Program

FUNDING

- Parks Canada
- Torngâsok Cultural Centre, Nunatsiavut
- Avataq Cultural Institute, Nunavik
- Université de Montréal

Research team (l-r) : Donna Dicker, Jenneth Curtis, Adrian Burke, Jamie Brake, Pierre Desrosiers.

RESULTS

- We re-visited five known archaeological sites and identified six new sites.
- These included at least three chert quarry sites and two workshop sites.
- At the quarry sites we mapped the extent of the chert outcrops along with the locations and characteristics of artifacts such as hammerstones, cores, preforms and flakes.
- We collected geological samples from several outcrops to document the range of variation within the raw material.

Hammerstone among slabs of Ramah chert (A. Burke)

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RATIONALE

The rationale for this study is to understand the relationship between TMNP and communities of Nain. TMNP in Northern Labrador, Canada is considered a blue print for park management. It was established and managed by taking into consideration the traditional rights of the people and involving the communities of Nunatsivut and Nunuvik as equal partners to help environmental preservation and enhance community livelihood. The findings from this study will become the basis for recommendations on the management of Jigme Singye Wangchcuk National Park in Bhutan, which was established without much consultation and involvement of *Monpas* (indigenous Aboriginal People) who have roamed the area and used the available resources for their sustenance for centuries. Such policies deprived these communities residing inside the park of their traditional rights over the land and the resources thereby making the people more vulnerable to poverty and hostile to conservation programs.

Parks Canada Research

EMPOWERING PEOPLE, ENHANCING LIVELIHOODS, AND CONSERVING NATURE: COMMUNITY BASED ECOTOURISM AS A SUSTAINABLE DEVELOPMENT OPTION IN *JIGME SINGYE WANGCHUCK NATIONAL PARK, BHUTAN AND TORNGAT MOUNTAINS NATIONAL PARK OF CANADA*.

OBJECTIVES

- Understand the relationship between the community of Nain and TMNP management;
- Understand the level and roles of community involvement in the management of the national park;
- Look at impacts and changes that the community of Nain is experiencing as a result of having a national park.

METHODS AND INFORMATION COLLECTED

- A combination of semi-structured interviews, unstructured interviews, and participant observation were used to gather information.
- Interviews were conducted to gather information on people's perception about TMNP, relationships between the communities of Nain and TMNP and the impacts of the park on the communities.
- Information on community viability, ecosystem viability, and community-based ecotourism were also collected.
- Field notes were also maintained from personal observations.

Interviewing elders from Nain

YEARS OF DATA

- 2009

PARTNERS

- Parks Canada
- Nunatsiavut Government

FUNDING

- Parks Canada, TMNP
- University of New Brunswick (Scholarship)
- Royal Government of Bhutan (Paid study leave)

PRELIMENARY RESULTS

- 20 semi-structured and over 10 unstructured interviews were completed.
- Interviews are transcribed and are being coded. The results will be available by April 2010.

The data available indicate that

- There is a strong relationship between the communities of Nain and TMNP.
- Communities of Nain are satisfied with the benefits that they derive from TMNP.
- Communities of Nain do not see any major negative impacts from having TMNP on their traditional land.

Group of cruise ship passengers in Nain, 2009

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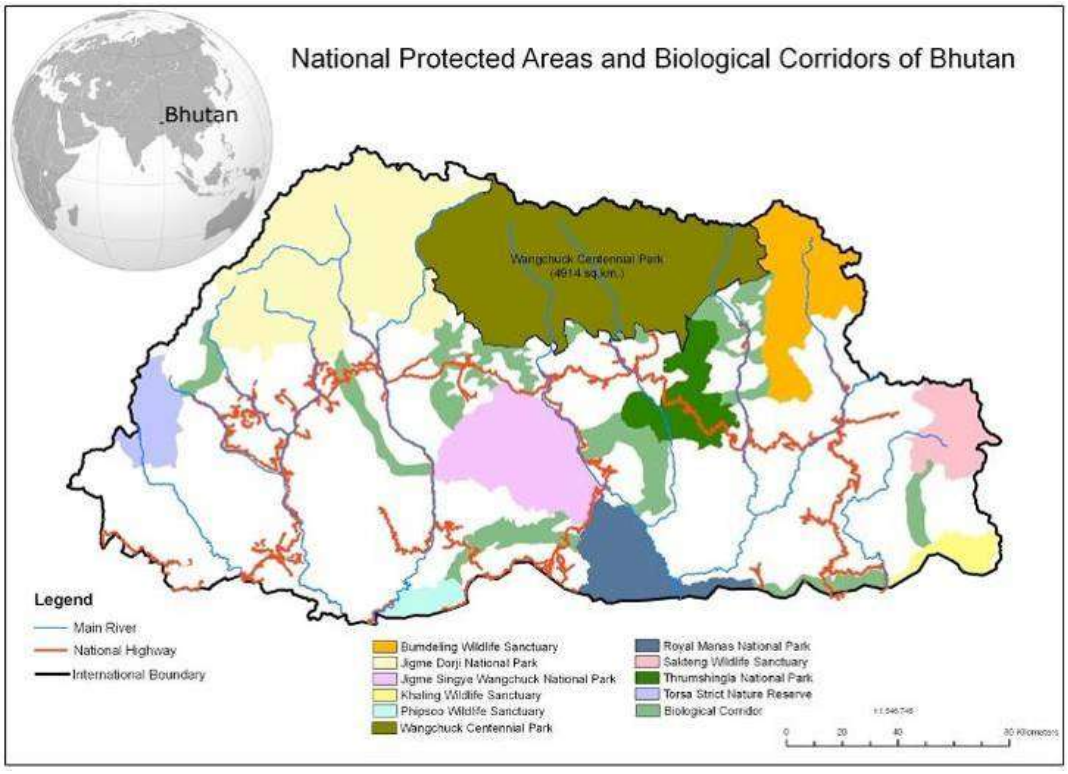

RATIONALE

Visitation to Torngat Mountains National Park is increasing. Developing tourism products that showcase the spectacular scenery, the rich cultural history and the abundant wildlife viewing opportunities is required. It is also important to ensure that these experiential opportunities are culturally appropriate and do not impair the ecological integrity of the site. To this end we are developing research instruments that compliment Parks Canada's Visitor Research Program and are designed to help us understand visitor expectations. Preliminary site inventories are being produced for selected sites in the park that are either actively used by visitors and tourism operators today, or are expected to be destinations in the future. These site inventories will assist park staff in actively promoting quality visitor experiences while ensuring that the physical site and rich natural and cultural resources are protected. Visitor brochures will be produced and distributed to tourism operators such as cruise ships, independent visitors and other tourism operators.

DEVELOPING SITE INVENTORIES OF TOURISM DESTINATIONS IN TORNGAT MOUNTAINS NATIONAL PARK

OBJECTIVES

- Conduct site inventories of various potential tourism destinations located within Saglek Bay Area.
- Produce standardized inventories of potential tourism.
- Develop information files for visitors.
- Develop a standardized code of conduct for kANGIDLUASUk and TMNP

Conducting a site inventory at North Arm, Saglek Bay

METHODS AND INFORMATION COLLECTED

Site inventories were developed by the research team in collaboration with the TMNP staff. Inventories of five separate sites were conducted in the 2009 field season. These include information about:

- Cultural resources (tent rings, food caches, graves, etc.)
- Natural resources (wildlife, flora, and physical features of note)
- Access requirements
- Site characteristics such as topography, soil and surface features, fresh water, trails and campsites etc.
- Potential activities(char fishing, hiking, wildlife viewing, camping)
- Photographic journal of the site
- Identification of Inutitut names

Draft visitor site guides were produced from these site inventories based on discussion with TMNP staff.

YEARS OF DATA

Summer of 2009

FUNDING

- Social Sciences and Humanities Research Council of Canada
- Parks Canada.

RESULTS

- Five site assessments including: North Arm, Rose Island, Hebron, Base Camp, Big Island were conducted for the 2009 field season.
- The assessments revealed that each of the sites contained:
    - A large amount of cultural and natural heritage.
    - Some sites like Hebron and Base camp are areas of high human disturbance.

Tent rings at Sallikuluk on Rose Island

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RATIONALE

In 2008, Parks Canada initiated a long term Visitor Research Program to understand who is visiting the Torngat Mountains National Park and what kind of experiences they are having. The program affords an opportunity to better understand visitors and visitor trends. It also and provides information the park can use to facilitate future experiences that are relevant and unique.

2009 VISITOR RESEARCH PROGRAM

OBJECTIVES

2009 Researcher Survey
Gather feedback from researchers to help us better meet their needs in future and gain a deeper understanding of the connections being made between Inuit and the scientific community.

2009 Visitor Survey
Gather feedback from visitors to help us better understand their expectations and the type of experiences visitors are having in the TMNP.

2009 Cruise Ship Visitor Survey
Obtain feedback from cruise ship passengers, who constitute the largest visitor group. The survey will provide insight into the type of shore-based experiences that are sought and enjoyed and help develop new ones for the future.

Glacier researchers at their remote camp in the Hidden Glacier Valley

METHODS AND INFORMATION COLLECTED

The original surveys were developed by TMNP staff in collaboration with social scientists from Parks Canada's Atlantic Service Center in 2008. Slight modifications were made to the surveys for 2009. Email addresses were collected by TMNP staff from all visitors, researchers and cruise ship passengers in 2009 and email invitations to complete the respective surveys were sent out to each group during the fall of 2009.

YEARS OF DATA

Both the Research Survey and Visitor Survey were administered for the second consecutive year. The Cruise Ship Visitor Survey was administered for the first time in 2009.

FUNDING

Parks Canada

Twin otter delivering visitors to Saglek

RESULTS

2009 Researcher Survey

- The individuals that came to TMNP to conduct research in 2009 were:
    - Predominantly from Atlantic Canada (67%).
    - 60% male / 40% female
    - A relatively young group, with close to 80% under 45 years of age.
    - 79% English-speaking / 12% French-speaking / 9% other languages
    - Highly educated, with 65% having obtained a Master's or Doctoral degree.
- While some were visiting TMNP for the first time, 61% had previously conducted research there.
- On average, researchers spent 16-17 days in the park.
- When asked "did your interaction with Inuit enhance your research in any way?" 95% researchers replied YES. Moreover, when asked to indicate their level of agreement with the statement "base camp enhances the opportunity for researchers to connect with Inuit", 76% of researchers "strongly agreed" while an additional 19% "somewhat agreed" with this statement.
- 88% of researchers observed black bears during their 2009 visit while 72% of saw or encountered polar bears.
- Overall, 67% of researchers surveyed indicated that they were "very satisfied" while an additional 28% were "satisfied" with their visit to TMNP.

2009 Visitor Survey

- 52 out of the 77 visitors (68%) that participated in this survey were visiting TMNP for the first time in 2009. On average they spent 5 or 6 days in the park and 77% visited kANGIDLUASUk base camp.
- 51% of visitors observed polar bears during their visit to the park, while 55% saw black bears.
- Many visitors relied on information provided to them by the Parks Canada staff to plan their trip to the park, as well as the base camp information package and previous experience traveling in remote locations. Visitors also used Internet resources such as the www.kangidluasuk.com website, the Parks Canada website, and TMNP Google Earth layer.
- On average, visitors‟ trips to TMNP, including travel, cost them > $5,100 per person.
- When asked to rate their overall visit to the Park, 96% of surveyed visitors were either "very satisfied" or "satisfied".

2009 Cruise Ship Visitor Survey

- Individuals that came visited the TMNP by cruise ship in 2009 were:
    - Predominantly from Canada (79%), particularly from Ontario (45%) and Québec (17%).
    - 58% male / 42% female.
    - A relatively older group, with over 80% ≥55 years old.
    - Well educated, with 90% having obtained a university degree.
- 93% of cruise ship visitors were visiting TMNP for the first time. On average they had been on 4 or 5 cruises in their lifetime.
- 65.5% of cruise ship visitors were aware of the existence of TMNP prior to the cruise.
- Almost all cruise ship visitors had the opportunity to go onshore. All of these individuals felt safe while on shore and 94.4% reported being accompanied by Inuit polar bear monitors at that time.
- All 55 surveyed visitors responded that overall they were "very satisfied" or "satisfied" with their visit to TMNP.

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RATIONALE

Past human activities in TMNP have resulted in various sites with anthropogenic debris such as fuel drums, cabin structures, fish weirs, net debris, and plane wrecks. The TMNP Co-Operative Management Board has identified the cleanup of these sites as a priority. Most of the sites were identified by local Inuit and park staff, who completed an inventory of sites in 2008. There is potential for some of the debris at these sites to contain hazardous materials (such as fuels). In 2009 the sites were assessed to determine if hazardous materials were present and if these materials had or could migrate into the surrounding environment. An appropriate cleanup is being developed.

Parks Canada Research

ASSESSMENT OF POTENTIALLY CONTAMINATED SITES IN TORNGAT MOUNTAINS NATIONAL PARK

OBJECTIVES

- Review and update the inventory of debris sites in TMNP.
- Complete initial site assessments.
- Determine if any of the sites are contaminated.
- Collect and analyze samples (surface soil and drum contents) for suspected contaminants.
- Develop detailed assessment and cleanup plans as necessary.

Radio beacon tower on Parmenter Island

METHODS AND INFORMATION COLLECTED

- Throughout the summer of 2009 all of the sites were visited and additional areas were scanned to ensure as much of the park as possible has been surveyed.
- Field work was mobilized out of the kANGIDLUASUk base camp where information could be gathered from locals, researchers, park staff, and pilots who have extensive experience in the park.
- Each site was assessed to determine the quantity and type of debris, presence of potential contaminants, pathways for contaminant migration, and environmental impacts

Soil sampling at Nachvak fuel cache

Assessing debris at the Ramah Mission Site

RESULTS

▪ The inventory of sites has been updated and additional debris has been identified including a fallen radio beacon tower and old propane canisters on Parmenter Island.

▪ Over 50 assessment samples were collected and analyzed for a variety of potential contaminants including inorganic elements, petroleum hydrocarbons, polycyclic aromatic hydrocarbons, benzene, toluene, ethyl benzene, xylenes and polychlorinated biphenyls (PCBs). Elevated levels of inorganic elements and petroleum hydrocarbons where found at some sites.

Next Steps

- Conduct phase III assessments (delineation) at sites where necessary.
- Prior to the removal of debris conduct archeological assessments at sites with potential cultural significance.
- Begin to implement removal of debris in 2010.

FUNDING

- Federal Contaminated Sites Action Plan
- Parks Canada

PARTNERS

- Parks Canada
- Environmental Sciences Group
- kANGIDLUASUk Student Program
- Cruise North Expeditions

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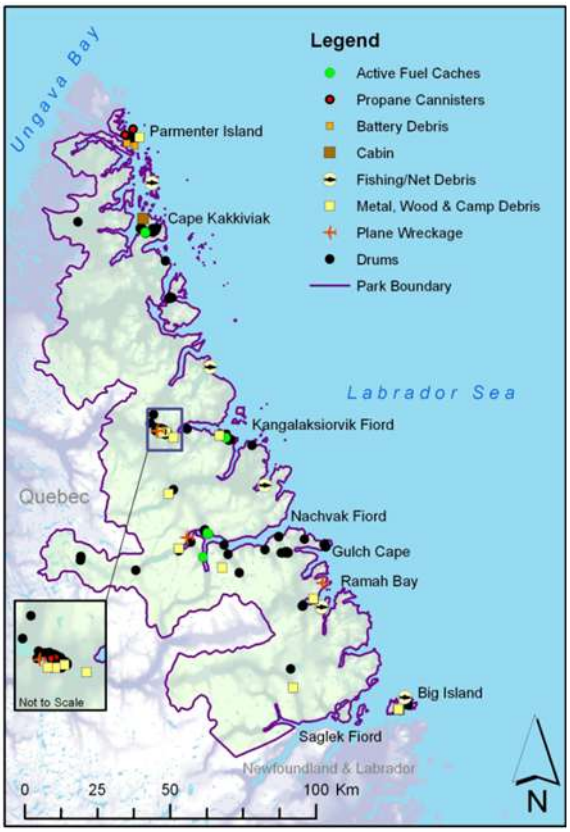

***Fig 1**. Location of debris in TMNP*

***Fig 2**. Location sites sampled in 2009*

RATIONALE

Cirque glaciers in the Torngat Mountains of northern Labrador are the only glaciers on mainland Canada east of the Rocky Mountains and represent the southernmost limit of glaciers in the eastern Arctic. Although relatively small in extent, these glaciers play an important role in local freshwater and marine ecosystems through meltwater inputs, related geomorphic processes and nutrient cycling. Changes in the mass balance of these glaciers will therefore directly impact local ecosystem dynamics and integrity. Apart from a brief monitoring period on four glaciers in the 1980s, there has been no attempt to gauge the impact of changing climate on the volume and extent of the Torngat Mountain glaciers.

ArcticNet Research

RECENT GLACIER CHANGE IN THE TORNGAT MOUNTAINS, NORTHERN LABRADOR – 2009 RESULTS

OBJECTIVES

- To re-survey ice-surface transects on Abraham, Hidden and Minaret glaciers
- To conduct ground penetrating radar survey and ice-surface transects on Superguksoak Glacier
- To install temperature sensors on Hidden and Minaret glaciers to measure local lapse rates
- To opportunistically survey other glaciers in region.

Temperature sensor installation on Hidden glacier

METHODS AND INFORMATION COLLECTED

- Differential Global Positioning System (DGPS) used to survey surface elevation, margins, and other geospatial features of glaciers
- Ground Penetrating Radar (GPR) used to measure ice thickness of glaciers
- Air temperature data loggers used to monitor climatic conditions around glaciers

YEARS OF DATA

- 1908 – Bryant & Forbes
- 1931 – Odell
- 1975 – McCoy
- 1981-83 – Rogerson
- 2008 – Bell & Sharp

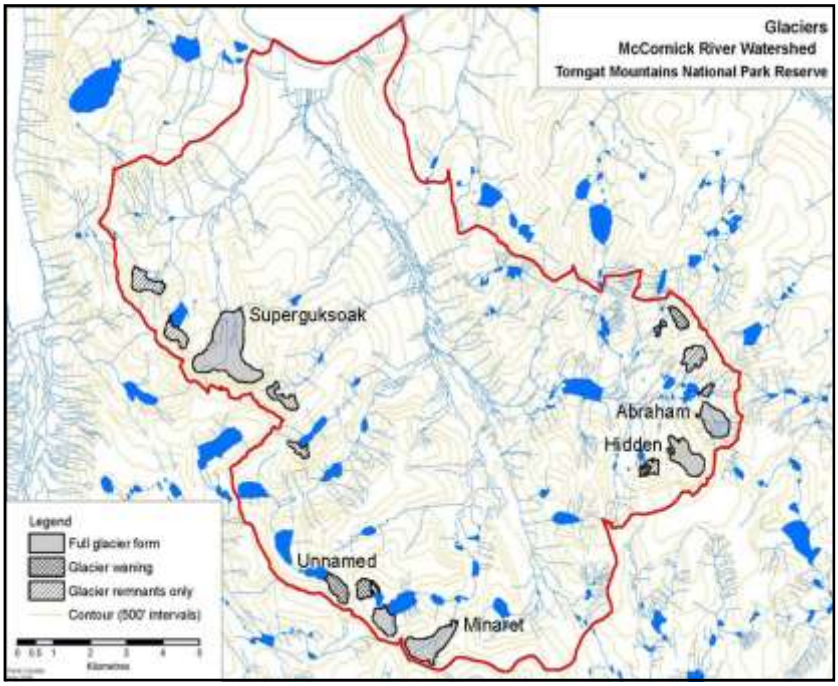

Figure 1: *Location of study glaciers in McCornick River watershed, Torngat Mountains National Park*

PARTNERS

- Memorial University
- University of Alberta
- ArcticNet
- Parks Canada

FUNDING

- ArcticNet

ACCOMPLISHMENTS

- Re-surveys of glacier surface elevation were carried out on Abraham, Hidden and Minaret glaciers using DGPS.
- The position of the ice front of Abraham, Hidden and Minaret glaciers were mapped using DGPS and re-surveyed relative to local datum.
- A first survey of ice surface elevation was carried out on Superguksoak and an unnamed glacier below Mount Caubvik using DGPS.
- A GPR line survey (~3 km long) was carried out on Superguksoak glacier to measure ice thickness.
- A precisely surveyed datum was established in Superguksoak valley to facilitate future DGPS.
- Eight air temperature sensors were established across two altitudinal transects on Hidden and Minaret glaciers.
- Located and re-measured four ice front boulder datums at Superguksoak glacier, installed by R.J. Rogerson, 1982.
- DGPS profile along R.J. Rogerson's medial moraine survey transect on Superguksoak glacier.
- DGPS profile along Superguksoak Little Ice Age terminal moraine ridge.
- Established glacier surface velocity markers at Hidden, unnamed and Superguksoak glaciers.
- Located field cache of R.J. Rogerson in Superguksoak valley (UTM E 454763, N 6536754).

Superguksoak glacier, August 2009

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RATIONALE

Fresh water and sediments from rivers play important roles in nutrient and other material transport to the coastal ocean (i.e., contaminants), thus influencing both terrestrial and marine ecosystems; human alteration of the landscape and/or water runoff can alter marine delivery of water and sediment; and fresh water (and probably sediment) delivery is known to be changing in northern Canada, probably in association with climate change. The basic purpose of this study is to gain a better understanding of patterns and variability of sediment and fresh water delivery from land to sea in the fjords of Nunatsiavut and Torngat Mountains National Park over time scales extending from seasons to approximately the past two centuries.

ArcticNet Research

MARINE RECORDS OF RIVERINE WATER AND SEDIMENT DISCHARGE, TORNGAT MOUNTAINS NATIONAL PARK

OBJECTVES

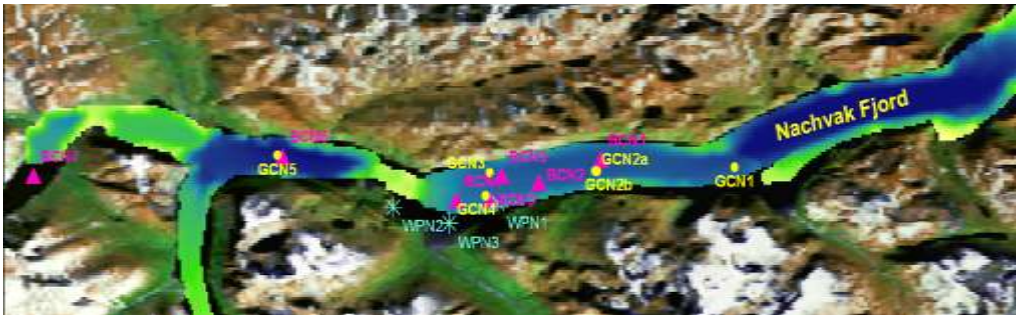
Specific field objectives for the 2009 field season were as follows:

- In stream water, recover and replace pressure sensors, deployed in 2008, from the beds of the McCornick River and Nachvak Brook to determine seasonal magnitude and variability of stream flow; and measure the current stream flow velocity;
- In fjord waters, measure concentrations of sediment, and ^{7}Be and ^{210}Pb to assess delivery of these materials from stream to ocean.

Elisabeth Kahlmeyer and Leo Angnatok collecting stream measurements in Nachvak Brook

METHODS AND INFORMATION COLLECTED

- Sample sites were located in Saglek Fiord and Nachvak Brook (unglaciated river, draining into Saglek Fjord), and in Nachvak Fiord and McCornick River (glaciated river, draining into Nachvak Fjord).
- Sample types include:
  - River Discharge- A SonTek Acoustic Doppler Velocimeter was used to measure stream velocity.



Nachvak Fjord with sample locations for Summer 2009 field work

- Water Samples- Sea water was pumped and filtered by passing through three cartridges, two of which have been impregnated with iron and manganese oxides, allowing collection of dissolved radioisotopes.
- Box Cores- seabed processes, characteristics and ages (up to 200 years) are studied through radioisotope analysis of sediments with focus on the particle-bound radioisotopes.
- Gravity Cores- Cores with lengths up to 3 meters have been collected from fjord basins to study seabed processes, characteristics and ages over timescales of several hundreds of years through radioisotope analysis and imaging analysis.

YEARS OF DATA

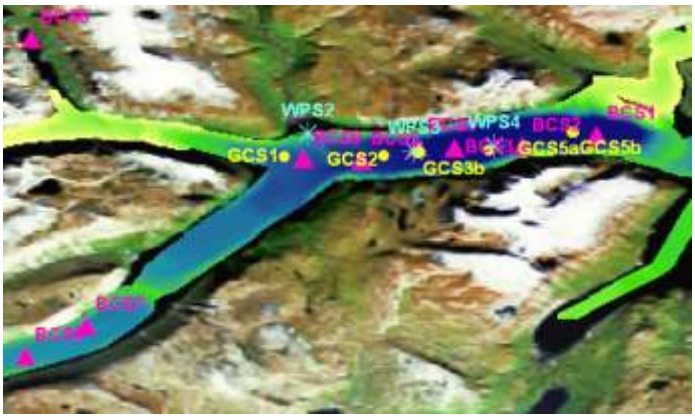
2008 & 2009

PARTNERS

- Nunatsiavut Government
- Parks Canada
- Environmental Sciences Group, Royal Military College, Kingston
- Memorial University of Newfoundland

FUNDING

- ArcticNet
- Parks Canada
- Environmental Sciences Group
- Memorial University Newfoundland.



Saglek Fjord with sample locations for Summer 2009 field work

RESULTS

Marine Record of Sediment Flux from Glaciated and Unglaciated Catchments

- Preliminary analysis suggest that the thickness of postglacial sediments in the marine basin for the McCornick (16km² area, 150-170 m deep) river is 5-10 m, and 10-20m in the basin off Nackvak Brook (20 km², 250m deep), implying that sediment volumes are proportional to catchment area.
- Sediments have been deposited in wedges that thicken towards the river mouth. X-radiographs of sediment cores show very faint layering. The presence of layering suggests that there was rapid sediment delivery (such as by gravity-driven mechanisms), rather than from water-column plumes.
- These layered sediments appear to be well preserved and therefore good indicators of river discharge in the recent past.

Recent Sediment Delivery and Accumulation in 3 Subarctic Fjords

- X-radiographs show that sediments cores have no obvious layering.
- Radioisotope analyses suggest that sediment accumulation rates vary among fjords from 0.3 cm/y in Nachvak Fjord to 0.35 cm/y in the Saglek Fjord.
- In these fjords, there is indication that the total sediment accumulation is modest, on the order of 16 X 10^6 kg/y. This presents a clear, stratigraphic record of fluvial sediment supply.

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RATIONALE

Ringed seals (*Phoca hispida*) are a valued country food for Inuit and consequently are also culturally important. They are also a key species in the arctic food web and are a primary food of polar bears. Ringed seal along the Labrador coast are exposed to stressors including contaminants, changing sea ice conditions, disease and industrial activity. They are especially vulnerable to elevated exposure to persistent organic pollutants as a result of their diet, moderate ability to metabolize contaminants, large fat reserves and long life. Consequently ringed seal is an excellent sentinel species for monitoring contaminant levels and potential effects on top predators including humans, arctic fox, and polar bears, and also to assess the status of the marine ecosystem.

ArcticNet Research

A MULTIDISCIPLINARY APPROACH TO ASSESSING ENVIRONMENTAL STRESSORS AND EFFECTS IN RINGED SEAL ALONG THE LABRADOR COAST: SATELLITE TELEMETRY, TROPHODYNAMICS (FOOD WEB) AND HEALTH.

OBJECTIVES

- To understand marine food web dynamics along the north coast of Labrador and determine how these are being affected by stressors such as climate change and industrial activities.
- To determine if there are differences in food web dynamics between northern (Nachvak and Saglek) and southern locations (Okak and Anaktalak).
- To describe ringed seal movement and diving behaviour to better understand ringed seal population dynamics and assess the impact of a local source of PCB contaminated sediments (Saglek Bay) on this species.
- Assess the overall health of ringed seal using physiological, biochemical and molecular measurements.
- Measure contaminant levels in ringed seal and report on relations between contaminant exposure and their health.

Tanya Brown and Dorthy Angatok taking blood from a ringed seal for health measurements, 2009.

- To develop risk models that link contaminant levels with biological effects on ringed seal. This will provide Inuit with health information regarding a valued component of their traditional diet.
- To provide an opportunity for the exchange of knowledge between Inuit and scientists.
- To allow Inuit students to build on their knowledge and skills while working alongside researchers.

METHODS AND INFORMATION COLLECTED

Food web (2008, 2009):

- Sampled four fiords (Nachvak, Saglek, Okak and Anaktalak) to model food web structure from north to south and contaminant and energy flow from the lower marine food web to top level predators such as ringed seal.
- Ringed seal, eight fish species and over 100 benthic invertebrate species were collected.

Telemetry (2008, 2009):

- Six ringed seals (4 juvenile males, 1 juvenile female, 1 adult male) were live-captured in Saglek Bay and fitted with satellite tags to record movement, diving, and foraging behaviours.

Health (2009):

- Ringed seals tissue samples were collected via harvesting and live-captures from Nachvak, Saglek, and Okak fiords. Blubber and blood samples were collected from harvested and live-captured animals. Liver, kidneys, heart, lungs, gonads, stomach, lower jaw, thyroid, thymus, left fore flipper, whiskers, and hair were collected from harvested animals.

Mike Ford, Minnie Okkuatsiak, and Sheena Merkuratsuk sampling fish for the food web study, 2009.

YEARS OF DATA

- 2008 & 2009

FUNDING:

- ArcticNet
- Parks Canada
- National Defense
- Northern Contaminants Program
- Fisheries and Oceans Canada
- Torngat Joint Fisheries Board
- Nunatsiavut Government
- Nasivvik and IPY funded the students

PRELIMINARY RESULTS

Foodweb

- Average blubber PCB concentrations in ringed seal captured from Saglek were higher than levels found in Anaktalak, Okak and Nachvak Fiords.
- Saglek ringed seal fatty acid signatures differed significantly from Nachvak and Anaktalak, while Okak ringed seal fatty acid signatures differed significantly from Nachvak and Anaktalak.
- $\delta^{13}C$ values from ringed seal harvested in Anaktalak Bay are lower relative to Okak, Saglek, and Nachvak, suggesting possible changes in the biology or feeding of the species (e.g. greater feeding in nearshore areas in the three northern fiords).
- $\delta^{15}N$ values in ringed seal are elevated in Anaktalak Bay relative to the three northern locations, which suggests that ringed seal from Anaktalak Bay are feeding at higher trophic levels than ringed seal captured from further north in Labrador.

Telemetry

- Movements differed greatly between the 6 tagged ringed seals.
- Blubber PCB concentrations in the 2008 tagged ringed seals were variable and showed no relation with age. Concentrations were surprisingly low in the adult male that remained in Saglek Bay. In contrast, the juvenile female used Saglek Bay, Bear Gut and Ramah Bay to similar extents and had concentrations that were 6 times higher.
- 2009 ringed seal blubber biopsies are currently being analyzed for contaminants.

Health

- Blubber and skin are being analyzed for vitamin levels, genomic toxicological and health endpoints, contaminants and fatty acids. Blood samples are being analyzed for hormone levels and parasites. Heart and lungs are being analyzed for parasites. Liver, muscle, whiskers, claws and hair are being analyzed for stable isotopes. Bone density measurements are being taken on the left fore flipper. Stomachs are being analyzed for parasites and content. Lower jaws are being used for aging. Gonads, thyroid, and thymus are being analyzed for cellular abnormalities.

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RATIONALE

Phytoplankton are the foundation of the marine food web and zooplankton are responsible for channelling energy from primary producers (i.e. phytoplankton) to fish and marine mammals at the higher trophic levels. Consequently phytoplankton and zooplankton are vital components of the Arctic marine food web and are excellent indicators of the state of a marine ecosystem. Very little information has been collected on zooplankton and phytoplankton species composition, productivity and oceanographic properties of Northern Labrador fiords.

ArcticNet Research

FIORD OCEANOGRAPHIC MONITORING AND ASSESSMENT IN NORTHERN LABRADOR: NACHVAK, SAGLEK, OKAK AND ANAKTALAK

OBJECTIVES

- To describe zooplankton and phytoplankton communities in four fiords and measure the environmental variables controlling their abundance, productivity, and species composition.
- To look at seasonal differences in phytoplankton and zooplankton in the four fiords;
- To assess impacts of climate change and human activities on fiord productivity, physical oceanic properties, and phytoplankton and zooplankton communities.

METHODS AND INFORMATION COLLECTED

Vertical Hydrobios and Monster nets and oblique Tucker Trawls were used to collect zooplankton (Figure 1, a-c). At each station, we measured vertical profiles of irradiance, temperature, salinity, transmissiometry, oxygen, and chlorophyll fluorescence, as well as nutrient and dissolved organic carbon concentrations, using a CTD-rosette system. During summer 2007 and winter 2009 surveys water samples were collected at 3 optical depths (50%, 15% and chlorophyll max) in the photic zone to obtain measurements of Chlorophyll *a* and to measure abundance and species composition. Zooplankton and phytoplankton were collected at each station for our marine food web study, a sub-project within ArcticNet Nunantsiavut Nuluak. Larval fish were collected using the rectangular mid-water trawl as part of our marine food web study (Figure 1d).

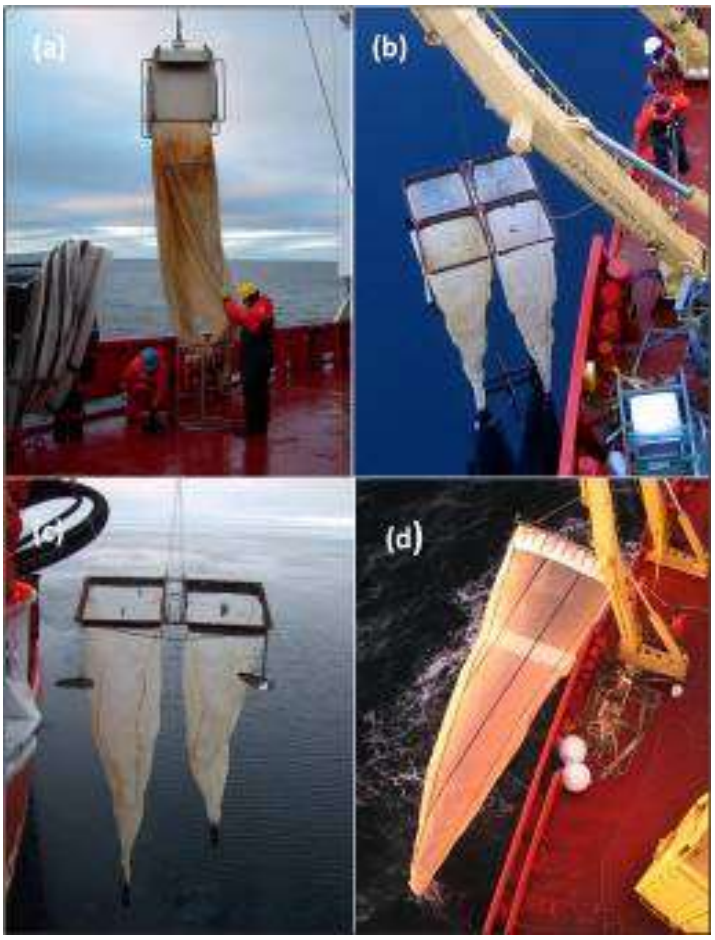

***Figure 1**. Zooplankton and fish sampling gear used during leg 4b: (a) Hydribios; (b) 4 x–m^2 Monster net; (c) 2 x–m^2 Tucker net; (d) Rectangular Midwater Trawl.*

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YEARS OF DATA

2006 (winter)
2007 (summer)
2009 (winter)

FUNDING

- ArcticNet
- Nunatsiavut Government
- National Defense
- VALE Inco.
- Nasivvik and Northern Contaminants Program funded the students

PRELIMINARY RESULTS FROM 2006 AND 2007 DATASETS

- Zooplankton species richness was significantly greater in Anaktalak and Saglek than Nachvak Fiord and in Nachvak Fiord there was greater diversity at the fiord entrance than at the fiord head.
- Species composition varied among seasons for the three fiords.
- Species composition in Anaktalak differed greatly from Nachvak. No difference was found between Nachvak and Saglek.
- Zooplankton communities for Nachvak, Saglek and Anaktalak fiords were dominated by Copopoda (*Calanus hyperboreus, Calanus glacialis, Pseudocalanus sp., Oithona similes*) and Chaetognatha (*Sagitta elegans*). The copepod *Metridia longa*, was found in the two most northern fjords (Saglek and Nachvak) and not in Anaktalak.
- There was high spatial and biological variability among Nachvak, Saglek and Anaktalak fiords.
- Primary production decreased from the northernmost to the southernmost fiord.
- Flagellates and diatoms were the dominant taxa for all three fiords.
- Algal abundance and chlorophyll biomass were generally dominated by small cells (<5 µm).
- The entrance of the fiords was extremely productive.

CCGS Amundsen in Saglek Fiord, November 2006. Photo Keith Levesque/ArcticNet

RATIONALE

Knowledge of coastal seafloor habitats is limited in the Arctic and very little information has been gathered on Labrador fiord ecosystems. This project seeks to better understand the nature and distribution of benthic habitats within northern Labrador fiords. Benthic habitat mapping is an accurate and efficient way to gather information about substrate type and associated biota. It is essential for development and implementation of resource management practices and conservation. This mapping study could be used to identify sensitive habitats as well as those important to fisheries, monitor habitats which may be affected by climate change, and provide background information for the creation of policies regulating the harvesting of marine resources.

ArcticNet Research

BENTHIC HABITAT MAPPING IN NACHVAK AND SAGLEK FIORDS

OBJECTIVES

- To gain a better understanding of the distribution and extent of marine habitats in Northern Labrador fiords.
- To fill in gaps from previous years (2007-08)
- To conduct ground-truth seabed sampling (boxcores and drop video) on shallow water environments of Nachvak and Saglek Fiords, as the deeper central basins were previously mapped.
- To ensure sampling stations cover a wide range of condtions.
- To provide an opportunity for the exchange of knowledge between Inuit and Scientists.
- To allow Inuit students to build on their knowledge and skills by working alongside researchers.

METHODS AND INFORMATION COLLECTED

Field sites: Nachvak (Torngat Mountains National Park) and Saglek Fiords (Southern boundary of the park) (Figure 1).

Fieldwork Dates: August 9-20, 2009.

FUNDING

- ArcticNet
- Parks Canada
- Torngat Joint Fisheries Board
- Nunatsiavut Government
- Nasivvik and IPY funded the students

***Figure 1**. Map of Northern Labrador showing the locations of Nachvak (Torngat Mountains National Park) and Saglek Fiords (Southern boundary of the park).*

YEARS OF DATA:
2007, 2008, 2009

ACCOMPLISHMENTS
- 105 sediment and biota samples were collected at 35 stations; 15 stations in Nachvak and 20 in Saglek (Figure 2 and 3).
- 18 sites were sampled with video transects.

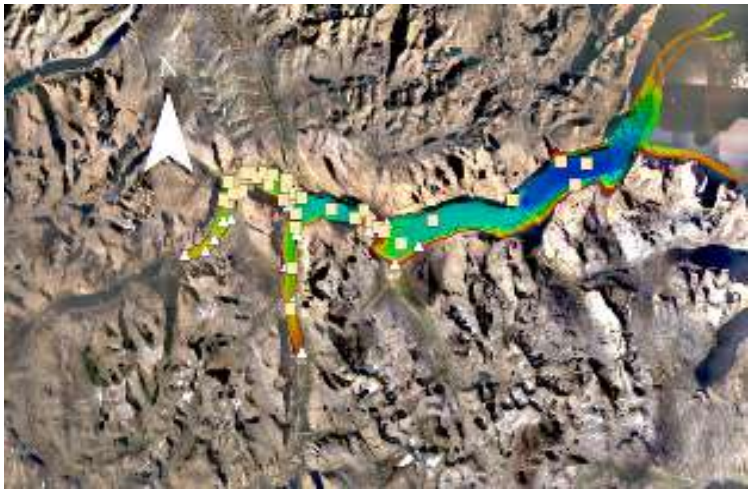

***Figure 2**. Location of grab sample/drop camera stations overlain on multibeam bathymetry in Nachvak Fiord.*

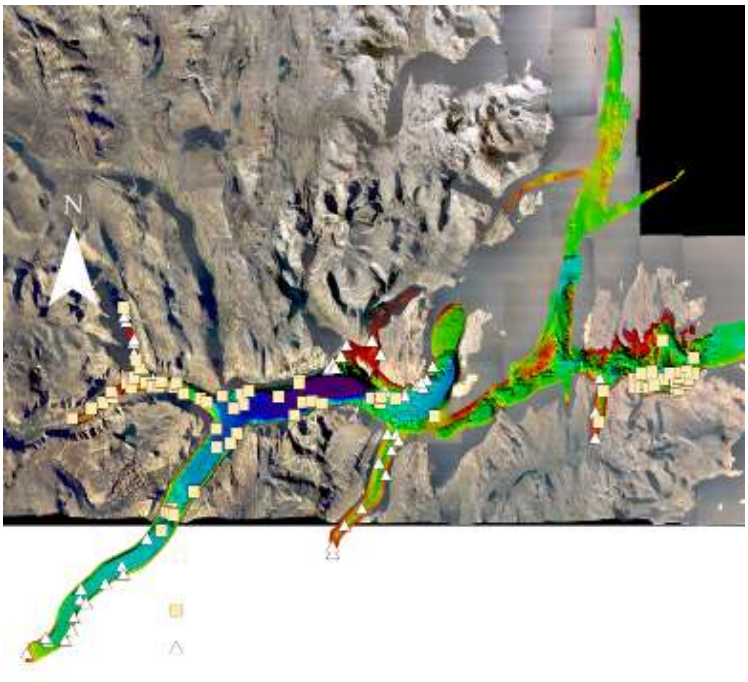

***Figure 3**. Location of grab sample/drop camera stations overlain on multibeam bathymetry in Saglek Fiord.*

Mallory Carpenter and Kelsey Hunter benthic invertebrate sampling

Joey Angnatok recording underwater video

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RATIONALE

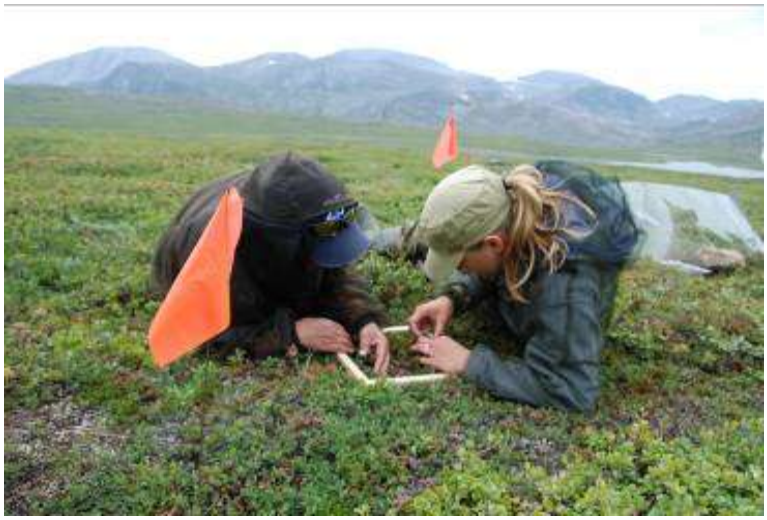
Across the Arctic tundra climate warming is increasing the abundance and height of shrubs like dwarf birch (*Betula glandulosa*) and upright willows (*Salix* spp.). The growth and expansion of tall-shrub tundra plant communities is predicted to affect berry producing plants such as bakeapple (*Rubus chamaemorus*), blueberry (*Vaccinium uliginosum*), redberry (*Vaccinium vitis-idaea*), alpine bearberry (*Arctous alpina*) and blackberry (*Empetrum nigrum*), as these plants are in most cases intolerant to shading. Inuit have observed changes in berries related to climate warming, such as berries appearing drier, smaller and less plentiful than in the past. This is a concern to northerners and scientists because of the importance of berries in tundra ecosystems to wildlife, human health and indigenous culture. Warming may also influence pollination of berry shrubs, but very little is known about the diversity of pollinating insects in northern Labrador. Understanding these processes and interactions is important to predict the impacts of climate warming on tundra berry shrub communities.

ArcticNet Research

ARE BERRIES A CHANGING RESOURCE IN NORTHERN LABRADOR?

OBJECTIVES

- Understand the local and regional effects of warming on tundra berry plant communities.
- Evaluate experimental warming effects on shrub growth, plant interactions and habitat conditions, and determine impacts on berry shrub growth and productivity.
- Identify and characterize important berry shrub pollinators.
- Understand the impact of climate warming on plant-pollinator interactions and berry productivity.
- Predict climate warming impacts on berry plant abundance, distribution, and traditional use.



Minnie OkKuatsiak and Laura Siegwart-Collier estimating berry productivity by counting stems and berries of bilberry, redberry, bearberry and crowberry and estimating their ripeness in a 25 x 25 cm area.

Bakeapple **Blueberry** **Red berry** **Bearberry** **Blackberry**

- Established 6 berry monitoring plots within 5km of kANGIDLUASUk base camp.
- Student interns harvested berries and collected soil nutrient probes from plots in late summer.
- Established 30 experimental warming greenhouses and 30 control plots along the Torr Bay valley to test the effect of warming on berry shrub growth and reproduction.
- In each plot, we measured cover of all vegetation, stem density, height and productivity of each berry species.
- We also measured soil temperature, nutrients and moisture and installed decomposition sticks.
- Installed 2 air temperature stations and many soil temperature loggers in Torr Bay valley.
- Set up pan traps filled with water and dish soap along 90 m transects to collect, identify and catalogue pollinating insects.

YEARS OF DATA

- 2009

PARTNERS

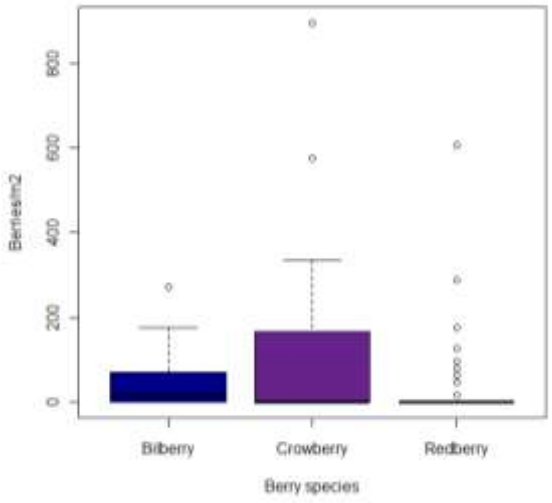
- Memorial University
- Nunatsiavut Government
- Parks Canada Agency
- CANPOLIN

FUNDING

- ArcticNet

PRELIMINARY RESULTS:

- Crowberry was most productive during the summer of 2009 (see graph below).
- Dwarf birch has a weak negative effect on the cover, height and productivity of most berry shrubs.



Top: *Berry plot setup in low-shrub tundra plant community near kANGIDLUASUk base camp.*
Bottom: *Example of experimental warming greenhouse in Torr Bay valley.*

Bee visiting a flowering lousewort amongst bilberry and crowberry shrubs.

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RATIONALE

Climate monitoring across polar regions has detected a general increase in average temperatures. Climate models predict that this warming trend will not be consistent across all arctic regions, instead predicting much slower warming in Labrador; however baseline climate data for northern Labrador are limited. Our goal is to track the magnitude of variation in climate warming across northern Labrador to fill that data gaps required for local and regional predictions of warming trends and impacts among northern communities.

International Polar Year Research

CONSTRUCTING CLIMATOLOGIES FOR TORNGAT MOUNTAINS NATIONAL PARK

OBJECTIVES

- To provide Parks Canada and other researchers with baseline climate information for Torngat Mountains National Park.
- Establish quantitative links to the long-term climate data available from other stations in the region.

Experimental greenhouse (left) and climate station (right) at the MUN Nakvak Fly Camp site.

METHODS AND INFORMATION COLLECTED

- Recovery of data was the main objective of the 2009 season.
- At the MUN Nakvak Fly camp, data recovery from the automatic climate station was unsuccessful; however data was collected from the back-up temperature and relative humidity logger.
- Ground temperature data was successfully recovered from the experimental greenhouse (open-top chamber) and control plots located in Nakvak Fly camp.
- Loggers installed in 2008 in the Ivitak (McCornick) Valley were retrieved; the data downloaded and re-installed for another season of recording.

Backup temperature and relative humidity data logger located across from the Nakvak climate station.

YEARS OF DATA

- 2007-2009

PARTNERS

- Memorial University (Depts. of Biology and Geography)
- Parks Canada, Torngat Mountains National Park
- IPY-CiCAT program

FUNDING

- International Polar Year - CiCAT
- Memorial University of NL
- Parks Canada
- ArcticNet

RESULTS

kANGIDLUASUk Base Camp:

The automatic climate station at the Parks Canada kANGIDLUASUk Base Camp was running from July 31st to August 15th, 2009, yielding climate data for that period (Table 1).

Table 1. Summary of data collected at kANGIDLUASUk Base Camp from July 31st to August 15th, 2009.

Average daily Total Solar Radiation (MJ/m2)	Average Wind Speed (max, km/hr)	Average daily Air Temp. (°C)	Max. Temp. (°C)	Min. Temp. (°C)	Average daily Relative Humidity (%)	Daily average Precipitation (mm)	Total Precipitation (mm)
9.91	25.7	8.20	20.13 (Aug. 5, 2009)	2.15 (Aug. 10, 2009)	88.27	5.5	88.7

Nakvak Brook MUN Fly Camp

A Hobo Pro V2 Temperature and Relative Humidity sensor acts as a backup to the main climate station at the, and it successfully recorded throughout the year (Table 2). For unknown reasons, the data retrieval from the main Nakvak climate auto station was unsuccessful in 2009.

Table 2. Summary of data collected at MUN Fly Camp from August 8, 2008 to July 23, 2009.

Period	Min Air Temp	Max. Air Temp.	Mean Air Temp.
8/8/2008 – 7/23-2009	-33.1	25.9	-6.5

Ivitak (McCornick) Valley

- Ground temperature, air temperature and relative humiditydata were collected at four sites established in summer 2008.
- A summary of the records' means is found in the individual report for vegetation and climate monitoring in the Ivitak (McCornick) River Valley.

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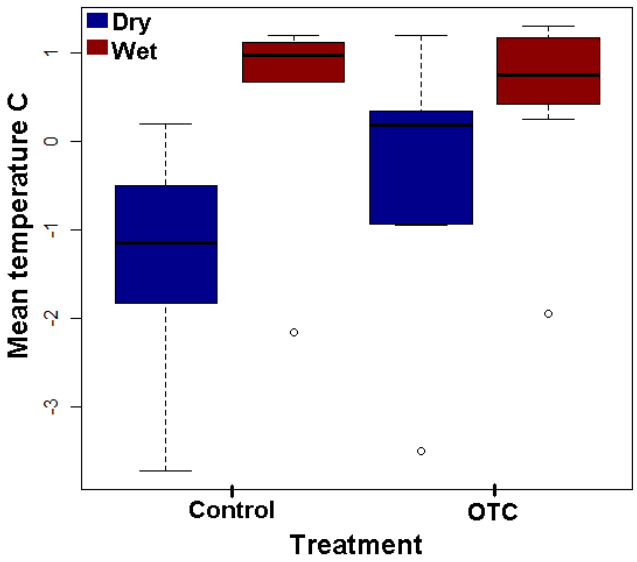

Mean soil temperature (°C) for control and OTC treatments in wet and dry habitat locations (July 2009).

RATIONALE

Many species of insects are highly mobile and have short life cycles, factors that may predispose them to respond quickly to climate change by colonizing new areas or disappearing from portions of their historic range. However, limited information is available on the distribution of most species of insects in northern Labrador. Butterflies are highly visible and readily identifiable, and also serve an important ecological role as plant pollinators, making them good candidates for biodiversity monitoring in areas experiencing climate change. This project was centered on cataloguing the species of butterflies found in and around Nakvak Brook, where the Labrador Highlands Research Group is investigating the influence of climate change on Tundra ecosystems.

International Polar Year Research

BUTTERFLY DIVERSITY AND SEASONALITY

OBJECTIVES:

- To catalogue butterfly species found in Torngat Mountains National Park.
- To assess flight times with respect to both flowering plants as well as weather patterns.
- To determine the most common butterfly species found on berry producing plants, as a means to assess the potential impacts of a disruption between the pollinating adult butterflies and flowering times.

METHODS AND INFORMATION COLLECTED:

- Over 50 samples were caught using a standard butterfly net.
- Through a comparison to known food plants as well as voucher specimens, host plant phenology and larval host plants were undertaken.
- Although a three week stretch of poor weather may have impacted flight times and therefore delayed mating and oviposition.

YEARS OF DATA:

- 2008
- 2009

PARTNERS

- Nunatsiavut Government
- Parks Canada Agency
- Memorial University

FUNDING

- ArcticNet and IPY-CiCAT
- Parks Canada Agency
- NSTP
- Memorial University

*White-veined Artic (*Oeneis bore*) on Carex*

RESULTS

Using the guide *"The Butterflies of Canada"* (Layberry, Hall, Lafontaine 1998) and comparisons to voucher specimen, several species were identified over a three week sampling period in August 2009:

1. The Pink-edged Sulphur (*Colias interior,* a forest dweller*)*
   - The pink-edged Sulphur is a boreal zone species and our specimen is the *furthest north record*
   - The larvae of this Sulphur species feed and over-winter on blueberry (*Vaccinium spp.*)
2. The Freija Fritillary (*Boloria freija; a* willow-bog species)
   - The Freija Fritillary is found all across Canada, confirmed as far north as Baffin Island
   - The larvae also feeding on blueberry (*Vaccinium spp.*) as well as bearberry (*Arctostaphylos uva-ursi*).
3. The White-veined Arctic (*Oeneis bore*) was found on artic tundra in great abundance during the 2009 field season.
   - While thought to be widely distributed in the North, this is a confirmation of its presence in Northern Labrador.
   - Its larvae feeding mainly on sedges (such as *Carex spp.)*

In addition, many Arctic Fritillary butterflies, numerous Sulphurs (Labradors, and subspecies Thula sulphurs) were observed and photographed. This species is found in open habitats throughout most of Canada and has been recorded as far north as Ellesmere Island.

By observations throughout the field season, we have determined that while flight times may begin early in the season (late July, early August), they are strongly affected by weather. Breeding pairs were still observed while eggs and larvae were absent from plant species as late as mid-August.

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*A Frieja Fritillary (*Boloria freija*) near Parks Canada base camp on Labrador Tea*

RATIONALE

Information on how climate change will affect terrestrial ecosystems of northern Labrador is limited, and systematic baseline data on the terrestrial ecosystems in Torngat Mountains National Park are needed to asses any potential impacts. This project will yield baseline data on two types of tundra moss communities and also complement work being done on vascular plant communities in this same study area. Mosses contribute 30% to the vegetation cover of the tundra and they play an important role in the biogeochemistry processes of the boreal and arctic ecosystems through carbon and nitrogen fixation, soil production, and habitat services for animals and vascular plants. This study will extend our knowledge of park biodiversity and by documenting variation in communities among habitats it will yield information on potential effects of and responses of vegetation to climate change.

International Polar Year Research

DETERMINING THE IMPACTS OF CLIMATE CHANGE ON TUNDRA VEGETATION: BASELINE STUDIES ON MOSSES

OBJECTIVES

- To describe moss community composition in adjacent wet and dry habitats in a low-arctic tundra study site that will be used for long-term monitoring of plant vegetation.
- To quantify the mosses to provide a baseline data base that can, in the future, be used to assess the consequence of climate change on the tundra.

Peter Koncz studying mosses

METHODS AND INFORMATION COLLECTED

- A spatial data base was created for the present mosses in order to detect any changes to the community structure after five, or more, years of warming experiments using the IPY-CiCAT protocol.
- At the site, 10 dry and 10 wet plots were selected in a mid elevational (400m) flat area (N58 38.402 W63 21.150). There were always 2 adjacent plots; one with an OTC and one as a control. Vegetation at the wet area dominated by mosses and grasses and the dry habitats by lichens and mosses.
- Species richness and abundance was measured using a point framing method. At each warming plot and its matched control plot a 1×1 meter frame was placed approx. 15 cm over the surface. The frame was divided with strings into 100 evenly space cross points each 10 cm apart. At each point a pin was dropped and the species and coordinates (based on the scale on the frame) were recorded.
- Warming is simulated by the open top chambers placed above the warming plots.

YEARS OF DATA

- 2008

PARTNERS

- Memorial University (Dept. of Biology)
- Torngat Mountains National Park
- IPY-CiCAT program

Open Top Chamber to simulate climate warming on wet site – mosses were studied in these mini-greenhouses

RESULTS

- 17 species were identified with significant differences between assemblages associated with wet and dry sites. For two additional genera species identification was not possible due to an absence of sporophytes. Species diversity was higher in the wet habitat and only one species was unique to dry habitat. Most of the wet sites were dominated with *Sphagnum spp.* and most of the dry sites were typified by *Polytrichum juniperinum.* All species were recorded from Labrador and the species richness and diversity relative to the study area are similar to those found in other alpine tundra areas.

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Tundra vegetation with the moss Polytrichum juniperinum

RATIONALE

Numerous plants reproduce through both sexual, like seeds, and asexual, like layering, mechanisms. However, the evolutional and ecological factors influencing allocation among the two reproductive strategies are little understood. Information on how allocation between sexual and asexual reproduction varies along elevational and moisture gradients will provide insight as to how plant reproductive strategies may change along environmental stress gradients. The moss *Polytrichum juniperinum*, covers 20% of the ground cover in open mesic areas of the Torngat Mountains National Park and can reproduce through both sexual and asexual propagules. Understanding how reproductive strategies of this moss may or may not change as a function of environmental stress will increase our ability to better understand how changing climates may affect plant community composition in Torngat Mountains National Park.

International Polar Year Research

INVESTIGATING THE REPRODUCTIVE STRATEGIES OF THE MOSS *POLYTRICHUM JUNIPERINUM*

OBJECTIVES

- To characterize the sexual and asexual reproductive allocation of *P. juniperinum* populations along elevational and moisture gradients.

Rodney Gear and Peter Koncz in the Nakvak Brook while collecting moss specimens for reproduction ecology studies

METHODS AND INFORMATION COLLECTED

- Sampling sites were established in the low elevation valley, along a mid elevation slope (wet, mesic, dry sites), and near a high elevation exposed summit.
- Within each site population structure of *P. juniperinum* were characterized (density, sex ratio, reproduction effort,and diaspore bank).
- Population genetic composition and mating system was described at each site by examining molecular genetic markers (allozymes) of approx 15 cushions per site, leading a total of 100 female, 100 male and 100 sporophytes per sites (sites were 10×10 meter, and cushions were 5×5cm)

YEARS OF DATA

- 2008
- 2009

PARTNERS

- Memorial University (Dept. of Biology)
- Torngat Mountains National Park
- IPY-CiCAT program

Females and sporophytes of the moss Polytrichum juniperinum

RESULTS

- Data analysis of the genetic structure and related reproduction behavior is ongoing.
- All populations appeared to consist of large patches with low genotypic diversity, suggesting asexual reproduction via clonal growth; however, all populations also showed evidence of sexual reproduction.
- Among the populations of the elevational gradient the sexual reproduction was intense at the mid elevation and lower at the high and low elevational populations.
- Among the populations of the moisture gradient the sexual reproduction was intense at the mesic and less at the wet and dry populations.
- Therefore the reproduction strategies were not affected by the environmental gradients, suggesting high plasticity in the reproduction behavior of the moss *Polytrichum juniperinum*.

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RATIONALE

The Ivitak (McCornick) watershed is a natural unit of the park that represents the area drained by the Ivitak (McCornick) River. The vegetation in this watershed is characterized by elevation, aspect, topography and drainage, resulting in distinct plant communities ranging from alpine to low-shrub tundra. Our goal is to monitor climate and vegetation changes in these plant communities and use this information to make long-term predictions about the impacts of climate warming among similar plant communities around the Park. To monitor these changes effectively, we must first understand the limitations of field sampling in each plant community, and investigate the best method of tracking vegetation change through time.

International Polar Year Research

DEVELOPING A VEGETATION MONITORING PROTOCOL FOR THE IVITAK (McCORNICK) RIVER VALLEY

OBJECTIVES

- Determine the best methods for detecting changes in climate, plant cover and plant diversity by comparing sampling techniques across plant communities in the Ivitak (McCornick) River Valley.
- Develop a preliminary monitoring protocol for each plant community based on our 2009 field sampling trials.

Alpine tundra

- Mountain hopped via helicopter to take digital images of plants in $1m^2$ quadrats.

Riparian-shrub tundra

- Sampled low and tall shrubs in $1m^2$ and $4m^2$ quadrats.
- Estimated time to measure cover class, height and density along two, 50 x 2m transects.

Low-shrub Tundra

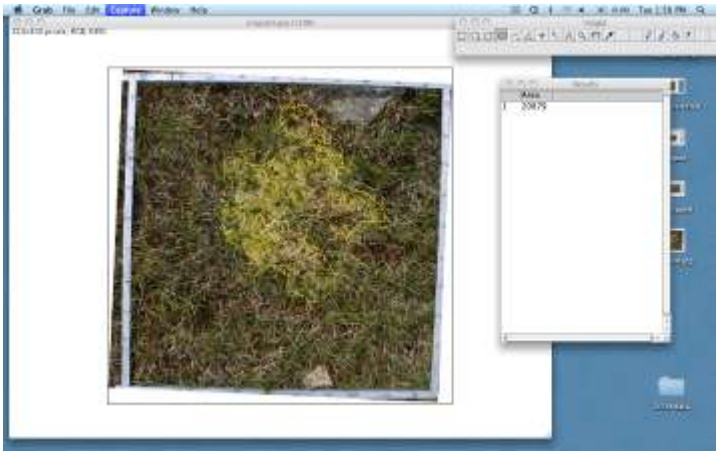
- Sampled $1m^2$ quadrats in 10 x 10 m plots.
- Took digital photos of plants.
- Estimated presence/absence of plants.
- Estimated plant cover into classes (e.g. <5%, 5-10%....100%).

Tall-shrub tundra:

- Methods similar to low-shrub tundra, but all cover estimates were based on cover classes.
- Measured the height and density of tall shrubs >50cm.

METHODS AND INFORMATION COLLECTED

- Tested sampling techniques in four plant community types (alpine, low, tall, and riparian shrub tundra) from 12 locations around the Ivitak (McCornick) River Valley.
- Ground truthed selected vegetation ecotypes mapped by Donald McLennan's team in 2008.
- Downloaded soil and air temperature data loggers from tall shrub, glacier and freshwater habitats and visited the Ivitak (McCornick) weather station, which was established in 2008.



Use of Image J software to estimate plant cover and diversity from digital images taken from alpine and low-shrub vegetation communities.

RESULTS AND NEXT STEPS

- All digital images from 2008 and 2009 have been archived.
- We are now developing a protocol for image analysis using the free software "ImageJ".
- The software works well when species are easily differentiated.
- Plant lists should be collected for each monitoring site to accompany digital photos.
- This should allow for easier species identification in future sampling years.
- Based on the plant diversity data collected in 2009, we are compiling a comprehensive list of plant species for each site.

Summary of climate records from summer 2008 to winter 2009.

	Tall shrub	Glacier	Freshwater	Weather Station
UTMs (Easting/Northing)	459445 6538656	460559 6535332	461709 6531394	479750 6498514
Mean Air Temp. (°C)	-4.87	-6.17	-5.54	-0.23
Mean (Median) RH (%)	74.32 (76.74)	78.27 (81.23)	78.87 (85.10)	84.56 (92.72)
Mean Ground Temp. (°C)	2.43	1.22	0.77	NA
Snow Free 2009 Ground Temp.	10.92	7.88	8.51	NA

Offloading and resetting data loggers that monitor daily soil temperature (left), air temperature and relative humidity (right) throughout the year.

YEARS OF DATA

2008-2009

PARTNERS

- Memorial University (Depts. of Biology)
- Parks Canada, Torngat Mountains National Park
- IPY-CiCAT program

FUNDING

- IPY-CiCAT program
- IPY-ArcticNet program
- Memorial University of Newfoundland

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RATIONALE

Monitoring ecosystem health and change in a large and remote area such as Torngat Mountains National Park presents a major challenge. One solution is to monitor a landscape unit that can serve as a reference of the Park's ecosystems. Watersheds are natural sub-divisions of landscapes that represent the area drained by a single river. Research and monitoring within a selected watershed serves as a pilot study and early step in the development of the park's ecological integrity monitoring program. Monitoring different systems such as glaciers, tundra, freshwater, and fiord sediments within one watershed can lead to a better understanding of ecosystems, their interconnections, and changes affecting their health. The watershed approach integrates different perspectives, experience and expertise and the information gathered can be used to understand and monitor other park areas and the overall park.

International Polar Year Research

INTEGRATING MONITORING FROM SEA TO SKY WITHIN THE IVITAK (McCORNICK) VALLEY

OBJECTIVES

- Bring together, share and integrate different sources of knowledge and expertise to better understand the ecosystems of a watershed as a functioning unit.
- Develop integrated monitoring programs to measure ecosystem health and change.
- Develop and test monitoring methodologies adapted to Northern context.
- Determine the number and types of samples needed to obtain an effective monitoring design at different spatial scales and for different ecosystems.
- Collect local climate/weather information.

Alpine lake environment in the upper Ivitak watershed

METHODS AND INFORMATION COLLECTED

- Permafrost sampling was initiated: Active layer depth was sampled over a 1 hectare grid using a soil probe (see page 64)
- Arctic BIONET researchers conducted stream surveys and tested monitoring methods at 12 locations within the watershed. (see page 50).
- The MUN Labrador Highlands Research Group conducted two main research projects as part of this integrated research and monitoring project (see pages 46 and 38)
  - vegetation sampling method testing – quick tundra vegetation assessment, shrub sampling
  - portable climate station weather data and individual loggers provided information on one or more of the following measures: air temperature and humidity, solar irradiance, wind speed, precipitation, and soil temperature.
- The Torngat Glacier Project conducted surveys on three glaciers within the Ivitak (McCornick) watershed (see page 26)
- Sam Bentley's team measured stream characteristics and sediment discharge from the McCornick River (see page 28).
- The terrestrial inventory and mapping team refined their terrestrial ecosystem map of the Ivitak (McCornick) Valley (see page 49 of the 2008 Annual Report of Research and Monitoring in Torngat mountains National Park)

PARTNERS

- Memorial University (Depts. of Biology, Earth Science, Geography)
- University of New Brunswick, Canadian Rivers Institute
- Parks Canada, Torngat Mountains National Park

Hidden Glacier, one of many that feed the Ivitak River

YEARS OF DATA:

2008, 2009

FUNDING

- International Polar Year: CiCAT and BIONET projects
- ArcticNet
- Parks Canada
- Memorial University of Newfoundland and Labrador

RESULTS

- Costs of sampling in the Ivitak Valley.
- Partial monitoring protocols.
- See individual project summaries in this report and also the 2008 report for a detailed summary of each project.

Sampling vegetation with a 1 m quadrat

Future Research

- Consult with Inuit to document existing knowledge about the land.
- Include social sciences: connection to the land, archaeology, history.
- Include other fields of knowledge: ex., hydrology (underground water flow), berry production.
- Develop measures and indicators of change within the watershed based on Inuit and scientific knowledge.
- Assess the interconnectedness of all the monitored components of the watershed.
- Develop a strategy for climate/weather sampling in the valley.

Upper middle slopes of the Ivitak Valley

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RATIONALE

Climate change is predicted to alter important processes in Arctic stream ecosystems and is expected to alter biodiversity and food web dynamics in aquatic communities. Rivers of the Torngat Mountains National Park (TMNP) are predicted to be vulnerable to these climate-induced ecological changes in the next several decades. Potential negative consequences to Arctic charr populations are expected. To date, the ecology of these important charr ecosystems is relatively unknown and must be studied in order to begin long-term biomonitoring and, ultimately, predict specific climate-driven ecological changes.

International Polar Year Research

FOOD WEB STRUCTURE AND FUNCTION OF NORTHERN LABRADOR STREAMS (ARCTIC BIONET IPY PROJECT: STREAMS COMPONENT)

OBJECTIVES

- Investigate the rates of two key stream processes (algal biomass production, organic matter decomposition) within and adjacent to TMNP and to investigate how these processes relate to food chain length, complexity and diversity;
- Assess potential ecological and physical-chemical differences that may exist between glacial, snowmelt and lake-fed streams;
- Identify the role of young-of-year and juvenile Arctic charr in the Torr Bay Brook watershed using stable isotope analysis; and
- Provide information needed for the establishment of long-term monitoring sites that will contribute to an effective and comprehensive bio-monitoring program for the TMNP.

Allison Ritcey and Andrea Chute electrofishing for young Arctic charr in Torr Bay Brook.

METHODS AND INFORMATION COLLECTED

The field programs were conducted between July and August in 2008 and 2009. Research was focused on three watersheds: Ivitak (McCornick), Nakvak and Torr Bay brooks. Stream surveys were conducted on 12 sites in the McCornick Brook, 8 sites in the Nakvak Brook and 6 sites in the Torr Bay Brook watersheds.

The field program for all sites included:

- Collection of benthic invertebrates for species composition (biodiversity), stable isotope (food web) analysis and growth rate determination;
- Collection of algae for biodiversity, biomass and stable isotope analysis;
- Collection of water samples for chemical analysis (nutrients, trace metals, stable isotope analysis of fine particulate organic matter);
- Collection of stream-side vegetation for stable isotope analysis;
- Determine dissolved oxygen concentration, conductivity, temperature and pH at stream sites;
- Deployment of small cotton strips to investigate decomposition rates by measuring 1) the amount of mass loss and 2) the loss in tensile strength of the fabric;
    - Deployment of 'artificial substrates' as a media for growth of algae;
    - Estimation of algal taxonomy and biomass on stream substrate;
    - Deployment and retrieval of temperature and pressure loggers; and

- Stream particle-size surveys.

Within the Torr Bay watershed, the research program also included:

- Electrofishing surveys and minnow trapping; and
- Deployment of nutrient diffusing substrates (NDS).
- Deployment of data sondes at 4 locations to collect water parameter information

YEARS OF DATA

2007, 2008 and 2009

FUNDING

- International Polar Year
- Parks Canada

PARTNERS

- Parks Canada
- Environment Canada
- Canadian Rivers Institute

Figure 1. *Map of the Torr Bay watershed displaying 6 sampling sites and the waterfall that may be a barrier to the movement of Arctic charr (Salvelinus alpinus).*

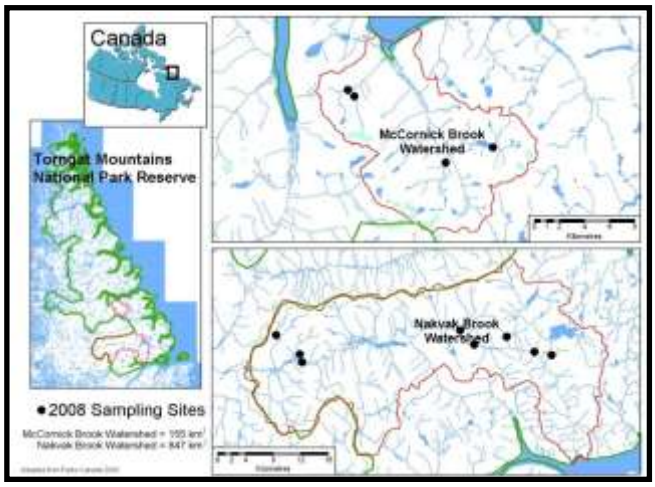

Figure 2. *Sample locations in McCornick Brook and Nakvak Brook watersheds.*

PRELIMINARY RESULTS

- Water quality data suggest that these streams have very low phosphorus and nitrogen nutrient concentrations.
- Decomposition rates in these streams are very low – more than 60% lower than decomposition rates recorded in temperate streams in Italy and Switzerland; such low rates of decomposition are probably the result of low temperatures and low nutrient concentrations.
- After 4 weeks in the streams, cotton strips lost only 7% of their initial mass and 13% of their initial tensile strength (Figures 7 and 8).
- Artificial substrate samples remain to be processed and analyzed
- All 6 Torr Bay Brook sites contained Arctic charr and most contained three spine sticklebacks. Approximately 5 young-of-year charr (20-65 mm) were lethally sampled at each site, and fin tissue samples from juvenile fish of two size classes (66-110 mm, and 110+ mm) were taken before fish were released. All fish caught were measured (length and weight).
- Preliminary results indicate that more fish were caught at all sites in 2008 than 2009 (Figure 9).
- Overall, the Torr Bay Brook and the fish in it appear to be in good health. Productivity levels at each site appear to be dependent on upstream and downstream effects (i.e. lakes and the marine environment).

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RATIONALE

As part of the annual pan-Labrador small mammal monitoring program, Saglek was added to the network in 2009. Previous to this the most northerly small mammal monitoring site was near Nain. The network is a series of standardized small mammal permanent sampling sites where small mammal abundance and species presence are monitored through trapping. It is a way of tracking the population cycles of mice, lemmings, voles and shrews upon which so many other animals depend e.g. foxes, marten, weasels and hawks and owls. It is also a way of determining distribution and ecology of the lesser known species such as rock voles. The survey and other related recent work have confirmed the presence of 10 of the previously reported 12 species in the province.

NL Government Wildlife Division Research

SMALL MAMMAL SURVEY, SAGLEK 2009

OBJECTIVES

- Identify species presence and distribution across the province
- Develop population trend data that is useful for managing predator species. The data is valuable to groups such as trappers
- Track changes in species distribution
- Establish a reference collection of species in the province
- Monitor disease and provide for early detection
- Develop a database for general status information, tracking of invasive species, and as an aid to associated research and management projects

Sanak Unatweenuk collecting a sample from the trap

METHODS AND INFORMATION COLLECTED

- 240 traps are set in a 140 x 140 meters grid for 3 nights and checked daily.
- Captures are recorded, saved and later examined to determine species.
- Monitoring is conducted the same location each year across Labrador. Over a period of years population cycles and distribution can be closely documented across Labrador.

YEARS OF DATA

- 2009

PARTNERS

- Newfoundland and Labrador Dept. Environment and Conservation
- Nunatsiavut Government
- Parks Canada
- kANGIDLUASUk Student Program

FUNDING

- Torngat Wildlife and Plants Co-Management Board
- Provincial Dept. of Natural Resources.

Frank Phillips teaching students Sheena Merkuratsuk and Sanak Unatweenuk how to conduct the small mammal survey, as Kenny Dicker Jr. looks on.

RESULTS

The Saglek trap grid was run from Aug. 12-14. Only 5 captures were made - 2 Ungava lemmings (avingak, mountain mice), 2 deer mice (longtails) and one meadow vole. Some random traps were set outside the study area in areas different from the trap grid. Two deer mice and a meadow vole were captured. Results were consistent with our other 9 trap grids in areas throughout Labrador indicating that populations of small mammals are at a very low point in their cycles.

This monitoring site will be visited annually and the ongoing monitoring will be conducted by students participating in the kANGIDLUASUk student program.

Study area is in the middle left of the picture near Torbay pond.

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MONITORING

Monitoring programs will document how the cultural and ecological systems in Torngat Mountains National Park are changing over time. This information will be vital for measuring the success of management programs and reporting on the health of the park (State of the Park Report) every five years.

RATIONALE

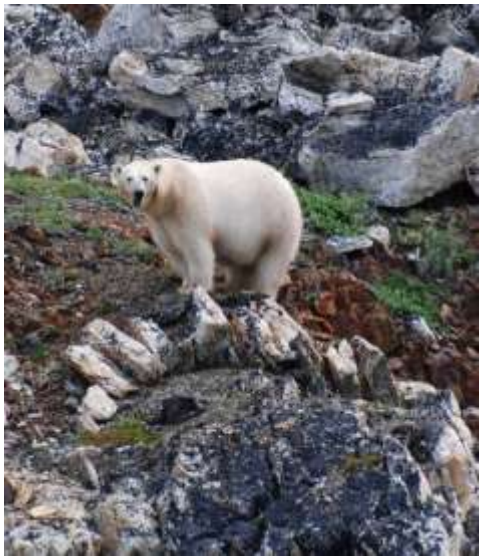
Recording incidental wildlife observations is an inexpensive and effective method to compile information about long-term trends in the abundance and distribution of wildlife. It is also an activity that park visitors can participate in and thereby contribute to monitoring of park EI. Observations of wildlife in Torngat Mountains National Park, and surrounding areas, are recorded on wildlife cards and the information is stored in a Microsoft Access database. Special attention is paid to observations of Species at Risk such as peregrine falcon, wolverine, polar bear, harlequin duck, barrow's goldeneye, ivory gull, and short-eared owl. Observations of black bear, wolves and marine mammals are also recorded, as they are good indicators of environmental health.

Parks Canada Monitoring

WILDLIFE CARDS

OBJECTIVES

- To collect basic information (presence, distribution, breeding and relative abundance) about wildlife populations in TMNP and surrounding areas.



Polar bear in Saglek Bay

METHODS AND INFORMATION COLLECTED

- Parks Canada staff, base camp guests, contractors and 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.
- All information from the wildlife cards is entered into a master database.
- Summaries of incidental observations and maps of these observations can then be produced.

Torngat Mountains caribou in Saglek Bay area

YEARS OF DATA

- 2005- 2009

FUNDING

- Parks Canada

RESULTS

- There are currently 358 records in the wildlife cards database. This includes 123 records of polar bear observations, 74 records of black bear observations, 16 records of wolf observations and 27 records of caribou observations.
- In future years all visitors will receive wildlife cards as part of their pre-trip information package.
- All Researchers are asked to record wildlife observations during their time in the park. This is a condition of their research permit.
- In 2009 there were two observations of note. One was the discovery of a short eared owl feather in the Ramah Bay area. The other was a sighting of a short-eared owl near the kANGIDLUASUk Base Camp in Saglek Bay. Short eared owls are listed as a Species of Special Concern under the Species at Risk Act and this is the first confirmation of the owl's presence in the park since it was established.

Peregrine Falcon

Short-eared owl

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RATIONALE

Torngat Mountains National Park spans the transition between low Arctic and northern boreal ecosystems, and includes a diverse range of coastal, estuarine, taiga, tundra, and montane habitats. Consequently a broad range of bird species reach their northern or southernmost range limits in the park, while others use the park as a migration route and staging area. Accessibility has hindered bird surveys in past and relatively little is known about the distribution and status of many species in the region. Indeed for many species it is not even clear whether or not they occur in the park. Consequently a bird checklist has been prepared in order to encourage persons visiting the park to pay closer attention to the birds they see and provide an easy means to report their observations in a standardised manner. The program was initiated in 2008 as a compliment to the wildlife cards program and will improve our understanding of the status and distribution of birds in the park.

BIRDS OF TORNGAT MOUNTAINS NATIONAL PARK CHECKLIST

OBJECTIVES

- To encourage people visiting and working in Torngat Mountains National Park to observe and enjoy birds.
- To build a database of incidental bird observations.
- To increase knowledge on the diversity, status and distribution of birds in the park.
- To document long term changes in park bird communities.

METHODS AND INFORMATION COLLECTED

- In 2008 a checklist of birds potentially occurring in Torngat Mountains National Park was prepared based on published accounts, observations by Parks Canada staff, and local knowledge. The checklist included:
  - A list of all 94 bird species known or expected to occur in the park, including information on their abundance and status.
  - Check boxes to record descriptive information to go with observations (location, habitat, weather).
  - A mailing address and request that visitors return a copy of their completed list to the park.
- The checklist is being distributed to individuals visiting or working in the park, and park staff are encouraging them to report their observations to the park office.


Bird Checklist

Kutsitak / White-crowned Sparrow

Torngat Mountains National Park of Canada

This checklist has been prepared based on best available information on the status and distribution of birds in Torngat Mountains National Park of Canada. However the remoteness of this landscape means that much remains to be learned about bird populations in the area. Consequently we hope that you use this form to keep a personal record of any birds you see during your visit, and also ask that you return a copy to the park so that we can use your observations to help us better understand the park ecosystem and monitor its ecological integrity. With this in mind we ask that you please follow the instructions provided on the following page. Also, please complete the checklist summary on the reverse, as information on the locations, habitats, and environmental conditions that apply to your observations will help maximize the knowledge we can derive from your completed checklist. Enjoy your visit! (updated August 2008)

Parks Canada Parcs Canada Canada

YEARS OF DATA

- 2008 and 2009

PARTNERS

- Anyone visiting or working in Torngat Mountains National Park

FUNDING

- Parks Canada

Spotted Sandpiper, McCornick River

RESULTS

- Copies of the checklist were made available to numerous individuals visiting the park during 2008 and 2009, including park visitors, tour group leaders, researchers and park staff.
- 177 new records were collected and reported in 2009, improving our knowledge of the status, abundance and distribution of many bird species.
- New observations from 2009 clarified several uncertainties regarding regional avifauna:
    - two species not previously known to occur in the park were observed – **palm warbler** and **bald eagle**
    - **Spotted sandpiper**, a species not previously known to breed north of Okak on the Labrador coast, was observed with fledglings near kANGIDLUASUk, confirming breeding in the area. Another pair was observed at North Arm, and an agitated individual was encountered along the McCornick River, suggesting that a population breeds in the park.
    - Further distributional observations and evidence of breeding was documented for several species first confirmed as nesting in the area in 2008. These included **Common loon**, **blackpoll warbler, American robin**, **Wilson's warbler**, **American tree sparrow** and **fox sparrow**.
    - **Gray-cheeked thrush** and **yellow-rumped warbler**, whose presence in the park was first documented in 2008, were both seen again in 2009.
    - **Short-eared owl**, a federally listed species at risk, was documented at both Ramah Bay and near kANGIDLUASUk.
- New information from 2009 was used to revise the checklist for future use.

Wilson's Warbler, North Arm

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RATIONALE

Since park establishment in 2005, the number of visitors to TMNP has steadily increased. Visitors are broadly defined as anyone who spends time in the park, including researchers, contractors and other user groups. Understanding the type of activities people participate in while in the park is valuable for long-term park management. Knowing the interests and needs of visitors helps park managers develop unique, safe and memorable experiences. It also helps to ensure that activities in the park do not affect ecosystem health or come into conflict with wildlife. Increasing visitation to Canada's national parks is a key objective of Parks Canada Agency.

Parks Canada Monitoring

HUMAN USE MONITORING IN TORNGAT MOUNTAINS NATIONAL PARK

OBJECTIVES:

- To document the number of people visiting the park and record the type of activities they engage in and the locations they visit.
- To generate information necessary to adapt park planning and programs to best serve park visitors while maintaining park ecological integrity and meeting park management goals.

Hiker in the Palmer River Valley

METHODS AND INFORMATION COLLECTED:

- All visitors entering the park must register with the park administration office.
- The number of people in the park, the dates of their visit and the activities that they conduct are recorded.
- Visitors are categorized as: recreational boaters, cruise ship passengers, guided and non-guided recreational visitors, researchers, contractors, park staff, and other base camp guests (everyone not included in the above categories).
- Inuit who are associated with park programs are included in the researchers, contractors, park staff, and base camp guests categories.
- An online visitor survey was conducted with researchers, cruise ship passengers and non-cruise ship visitors (see separate report in the research section of this document).
- Inuit who visit the park for personal reasons are also recorded, but are not required to register.

Cruise ship passengers returning from a shore

YEARS OF DATA:

- 2006, 2007 2008 and 2009

Table 1: *Visitor statistics for years 2006-2009, categorized by major activity groups.*

Activity	2006	2007	2008	2009
Recreational boating/sailing visitors	4	4	21	3
Cruise ships passengers	150	275	364	295
Guided and non-guided visitors	12	49	27	76
Researchers	31	58	51	55
Contractors	19	24	29	59
Park Staff	9	11	15	22
Base Camp guests	47	63	58	62
Inuit not affiliated with park programs				57
Total	272	484	565	629

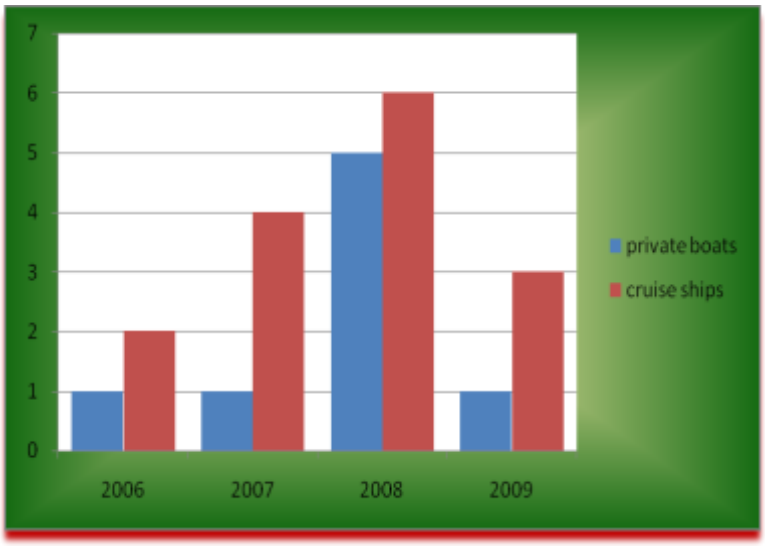
RESULTS

- Most types of park visitation have increased since 2006 (Table 1).
- Number of cruise ship visits declined in 2009 (Figure 1).
- The number of private yacht visits also declined in 2009.
- Guided and non-guided visitors increased sharply in 2009 and are expected to continue to rise.
- Parks Canada has operated a base camp (kANGIDLUASUK) at the southern boundary of the park since 2006. This camp facilitates access to the park for Parks Canada staff, researchers, Inuit and other visitors. It also serves as an orientation, reception and access point for visitors. The number of participants at kANGIDLUASUK has increased steadily since 2006 (Table 2).

Table 2*: Number of participants at kANGIDLUASUK each year*

Year	# people	Total person days
2006	63	600
2007	146	1381
2008	165	2033
2009	232	2783

Figure 1*: Number of private recreational boats and cruise ships visiting TMNP between 2006-2009*



Hikers camped above the Palmer River Valley over looking Nachvak Fiord

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RATIONALE

Benthic invertebrates are used as indicators of water quality in many parts of the world and offer a promising approach to monitoring ecological change in northern parks. However, northern ecosystems differ considerably from those where these tools were developed. As such, research is required to better understand the characteristics of "healthy" invertebrate communities in northern ecosystems and to assess the value of this approach as a biomonitoring tool in the north.

Parks Canada Monitoring

ASSESSMENT OF WATER QUALITY AND BASELINE INVENTORY OF BENTHIC INVERTEBRATES IN SAGLEK AND NACHVAK FIORDS

OBJECTIVES

- To continue to sample macro-invertebrate communities, water chemistry and primary production in streams in Torngat Mountains National Park. This information will contribute to describing "reference conditions" for healthy areas in northern Labrador.
- To assess the feasibility of collecting and using benthic invertebrates for park monitoring. Sampling the same sites over multiple years will provide information on our ability to detect change in the North's unique ecosystems.
- To integrate local Inuit into this element of the monitoring program.

Nachvak Fjord freshwater monitoring field crew, Naksaluk Cove, Nachvak Fiord

METHODS AND INFORMATION COLLECTED

This sampling program relies on a standard set of field protocols developed by the Canadian Aquatic Biomonitoring Network, which have previously been used at several temperate field sites in Canada to characterize stream habitat and benthic macroinvertebrate community structure. At each site several habitat variables are measured, water samples are collected, benthic invertebrates are collected with a 3-minute kick-net sample, and periphyton (algae) is scraped from a sample of rocks.

Field activities:

- Our 4th year of sampling occurred in Saglek and Nachvak Fiords (dataset now runs from 2006 to 2009).
- Six Inuit (3 of which trained this year) were integral contributors to the field collections.
- Eighteen sites in riffle-run habitats were re-sampled; 9 in each of Nachvak and Saglek fjords.
- A 3-minute kick-net sample of benthic invertebrates was collected.
- Water samples were collected at each site.
- Contributed wildlife sightings of polar bear, black bear, wolves, caribou and whales.

Laboratory activities:
• Invertebrate samples (2007, 2008, 2009) to be sorted, subsampled and processed according to the CABIN protocol.
• Invertebrates will be identified to the lowest feasible level for 2007-2009. Samples from 2006 will be reprocessed to the same level of identification.
• Invertebrate data will be entered into the Environment Canada CABIN database.
• Water chemistry is being analyzed by Environment Canada (results pending).
• Chlorophyll A levels will be measured in periphyton samples.

Scraping periphyton from stream rocks, Tallek Arm, Nachvak Fjord

RESULTS

Preliminary Results from 2006:

• Mean of 10.2 families of benthic invertebrates per site (range: 6-15). For comparison, this is lower than is typical in insular Newfoundland.
• Statistical analyses suggest the habitats we sampled in the Torngats support a total of 35-60 families of benthic invertebrates.
• Estimated number of invertebrates ranged from 138-2925 per site (mean = 898).
• Invertebrate communities in Saglek and Nachvak were similar despite Nachvak's more northerly location.
• The sample taken below the PCB containment facility at the Saglek radar base (SRC0106) was similar to samples from uncontaminated sites.

PARTNERS

- Environment Canada
- Nunatsiavut Government
- University of New Brunswick

Proposed activities for 2010/2011:

• Re-sampling of coastal sites in Nachvak and Saglek Fiords. This final year of sampling (5 in total) should provide sufficient data to understand annual variation in benthic communities. This information will be critical for assessing our ability to detect ecosystem change with this monitoring measure.

Proposed data uses:

• Develop a "reference condition" to be used when assessing stream community health in Northern Labrador (planned data sharing with Environment Canada/UNB will improve this product).
• Contribute to "Sea to Sky" sampling conducted by Environment Canada/UNB
• Assess statistical power of benthic invertebrate monitoring given the community structure observed in northern streams (ongoing this winter)
• Combine with similar data sets from other national parks to describe variation in benthic invertebrate communities along the Atlantic coast from Nova Scotia through the high Arctic. Again, collaboration with Environment Canada/UNB is planned.

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RATIONALE

Permafrost is soil or rock that remains below 0°C throughout a year, and forms when the ground cools sufficiently during winter to produce a frozen layer that persists through the summer. An active layer refers to a zone of annual freezing and thawing between the ground surface and top of the permafrost. Permafrost plays an important role in ecological processes of cold region ecosystems such as tundra, shrub thickets, wetlands, and coastal zones. For example, permafrost has a strong influence on development of vegetation communities through its influence on rooting depth, soil temperature, soil drainage, and hydrology. Permafrost also influences numerous other factors, including soil stability and erosion and the preservation of archaeological remains. Torngat Mountains National Park lies near the southern limit of the continuous permafrost zone in Canada, and may experience changes to permafrost resulting from climate change, including reduced permafrost extent and increased active layer depth. Consequently monitoring permafrost will provide important information on the state of the park.

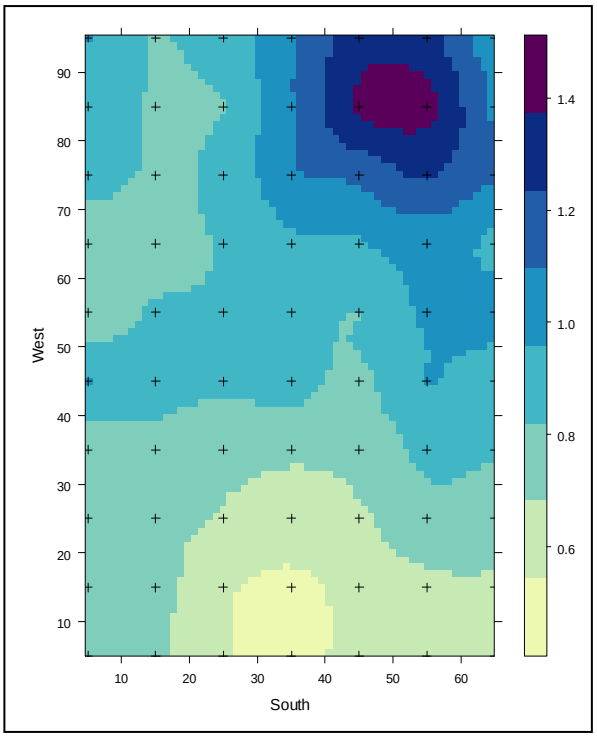
PERMAFROST AND ACTIVE LAYER MONITORING

OBJECTIVES

- To identify sites for permafrost monitoring.
- Establish at least one 1 ha active layer monitoring grid, preferably in the focal McCornick River watershed, and collect baseline data for 2009.
- Introduce Inuit students to permafrost monitoring.

METHODS AND INFORMATION COLLECTED

- We began by searching for sites having rock-free soil, typically marine sediment. Initially we reviewed maps of surficial geology then carried out site visits.
- Initially we focussed on the Ivitak (McCornick) River watershed, with later consideration being given to coastal sites from Nachvak to Saglek that had marine soil deposits.
- A soil probe was used to test for the presence and depth of permafrost. Using a slide hammer we wereable to probe to 250 cm depth, even in soils having a moderate amount of gravel.
- Once a suitable site was identified, a 1-ha active layer probing grid was set up based on the Circumpolar Active Layer Monitoring (CALM) protocol. Wooden stakes were used as semi-permanent grid markers.



Map of the active layer depth (i.e. depth to permafrost) at Ramah Bay permafrost monitoring site, August 14, 2009. The depths to permafrost were assessed using standardized set of measurement points, located within the 10 m by 10 m grid cells marked on the map.

Permafrost monitoring site at Ramah Bay. The site measures 100 m by 100 m (1 hectare) and its boundary has been drawn into the photo for reference; see people standing along the boundary for scale.

YEARS OF DATA

- 2009

PARTNERS

- We are partnering with the Geological Survey of Canada with the goal of installing permanent monitoring equipment (thaw tubes and boreholes instrumented with thermistors) in 2010.

FUNDING

- Parks Canada

Students probing for permafrost at theIvitak (McCornick) River Valley site.

RESULTS

- Two monitoring sites were established – one on a low terrace along the Ivitak (McCornick) River and a second on a high terrace at Ramah Bay. At each we delineated and sampled a 1 ha CALM probing grid and installed a soil temperature logger.
- Observed mean active layer thickness at the Ivitak (McCornick) River site on August 12, 2009 was 68 cm (range: 21-151 cm), while at the Ramah Bay site on August 14, 2009 mean active layer thickness was 85 cm (range: 37-168 cm).

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RATIONALE

Ten known Species At Risk (SAR) occur in Torngat Mountains National Park. They include 2 subspecies of peregrine falcon (*tundrius* and *anatum*), harlequin duck, Barrow's goldeneye, short-eared owl, polar bear, eastern wolverine, Atlantic walrus, ivory gull and red knot. Another species, Eskimo curlew, is still listed as endangered but sadly is almost certainly extinct. Some of these species breed in the park and others use the park during migration. Parks Canada is one of three federal agencies with responsibility for managing SAR. In 2005 when the park was established, little was known about the SAR that resided in the park. Since 2005 we have been focused on determining the population density and distribution of these species in order to build a foundation of knowledge that can contribute to future monitoring, protection and if necessary, recovery efforts.

Parks Canada Monitoring

MONITORING SPECIES AT RISK IN TORNGAT MOUNTAINS NATIONAL PARK

OBJECTIVES

- Complete inventories of each species as funding becomes available.
- Continue to record opportunistic observations of SAR
- Promote the participation of visitors and others who spend time in the park to record sightings.
- Learn about the traditional importance of SAR to Inuit, and incorporate this knowledge into future research and monitoring.
- Build awareness of the importance of SAR among Inuit youth through the kANGIDLUASUk student program.

Harlequin ducks- special concern

Photo/image: Dr. Gordon Court
Peregrine falcon- special concern

Species	SARA status
Peregrine Falcon (*Anatum* subspecies)	Threatened
Peregrine Falcon (*Tundrius* subspecies)	Special Concern
Short-eared Owl	Special Concern
Harlequin Duck – eastern population	Special Concern
Barrow's Goldeneye	Special Concern
Ivory Gull	Special Concern
Wolverine – eastern population	Endangered
Eskimo Curlew	Endangered
Polar Bear	Under assessment
Atlantic Walrus – NW Atlantic population	Extirpated
Red Knot (*rufa* subspecies)	Endangered

YEARS OF DATA

2005-2009

FUNDING

Parks Canada

RESULTS

Wolverine- endangered

- Surveys of peregrine falcon nest sites occur every 5 years. Seven nests are found within the park and 1 more site is located along the southern boundary. Incidental observations of peregrine falcons are also collected annually. See the 2007 and 2008 Annual Research and Monitoring Reports for details.
- A harlequin duck survey was conducted on rivers in the southern portion of the park in 2007 and recorded 58 adults and 16 broods. See the 2007 Annual Research and Monitoring Report for details.
- A survey of Barrow's goldeneye coastal moulting sites in the southern half of the park was completed in 2007. See the 2007 Annual Research and Monitoring Report for details.
- No surveys have been conducted for short-eared owl; however 2 sightings in 2009 confirm their presence in the park and set the stage for future monitoring.
- A comprehensive polar bear Mark-Recapture survey was conducted in the park over a 3 year period (2005-2007). Results showed that the Davis Strait population, which includes Labrador, numbers approximately 2200 animals. Estimates of numbers in the park in 2007 exceed 150.
- Occasional sightings of Atlantic walrus are recorded along the coast as far south as Cartwright. However, no permanent concentrations of walrus have been recorded in the park in recent years.
- No sightings of eastern wolverine have been confirmed in the park for many years; however probable tracks were discovered in Hebron fiord in April 2008. Hebron is 50 km south of the park.
- Very little is known about ivory gull and red knot use of the park, though both species likely use the park as migratory staging or stopover sites at the end of the breeding season.

FUTURE WORK

- Sightings of SAR in the park will continue to be recorded by park staff, visitors and others and entered into the wildlife card and bird checklist databases.
- Complete the harlequin duck and Barrow's goldeneye inventory in the northern half of the park.
- We will seek funding through SAR funds to help complete a thorough inventory of each species.
- Continue to participate in the North American peregrine falcon survey, which is scheduled to be repeated in 2010.
- Develop a learning module for the kANGIDLUASUk student program that will teach students about SAR and provide the skills to assist with the completion of inventories in the park.

Atlantic wlarus

Ivory gull- Special Concern

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2009

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Torngat Mountains

National Park