ASSESSMENT OF CLIMATE CHANGE IMPACTS ON THE CARIBOU, THE LAND, AND THE NASKAPI NATION, AND IDENTIFICATION OF PRIORITY ADAPTATION STRATEGIES

AUTHORS:

John Mameamskum (Naskapi Nation of Kawawachikamach)
Georges Guanish (Naskapi Nation of Kawawachikamach)
Natalie D'Astous (Biologist Advisor)
Thora Herrmann (Université de Montréal)
Willie Johnny Swappie (Naskapi Nation of Kawawachikamach)
Darren Einish (Naskapi Nation of Kawawachikamach)
Steve Einish (Naskapi Nation of Kawawachikamach)
Amanda Di Maio (Atmacinta)

Table des matières

1. Introduction

The Canadian Subarctic is undergoing climatic and socio-environmental changes, which are leading to wide-ranging implications for wildlife, ecosystems and Aboriginal communities living in these regions. An ecologically and socially important northern terrestrial species that may be impacted by climatic and socio-environmental change is the caribou, *Rangifer tarandus* (Sharma et al. 2009; Festa-Bianchet et al. 2011; Taillon et al. 2012). Recent surveys have indicated that the George River caribou herd in northern Québec has suffered a dramatic decline from about 800,000 heads in 1993 to 24,000 for the 2012 fall, based on mortality and recruitment rate (Porter 2011; MRN 2012). Modifications in the distribution of the caribou and its habitat due to altered temperature and precipitation regimes and effects such as food availability, predator's density and human disturbance that also correlate with climate change have social, cultural and economic implications for the Naskapi First Nation of Kawawachikamach who are dependent on the caribou for their livelihood and cultural identity. The increasing recognition of the process of climate change has led to a growing interest in the ways Aboriginal communities in northern regions observe and monitor climate conditions and its impacts on species through their indigenous knowledge systems. Scientists are now urged to incorporate data and observations from northern communities into scientific models of climate change. Such local observations and monitoring practices are increasingly recognized as a valuable data source which enhances studies on environmental change in northern regions. This project contributed to and is one concrete example of the active engagement of northern communities to science and research.

PROJECT TEAM

This project is a joint initiative of the Naskapi Nation of Kawawachikamach, Natalie D'Astous, Atmacinta and the Université de Montréal. The research team consisted of:

- John Mameamskum (Project Leader, Naskapi Nation of Kawawachikamach)
- Georges Guanish (Project Co-researcher and Translator, Naskapi Nation of Kawawachikamach)
- Natalie D'Astous (Project Co-researcher, Biologist Advisor)
- Thora Herrmann (Project Co-researcher, Université de Montréal)
- Willie Johnny Swappie (Research Assitant, Naskapi Nation of Kawawachikamach)
- Darren Einish (Research Assitant, Naskapi Nation of Kawawachikamach)
- Steve Einish (Research Assitant, Naskapi Nation of Kawawachikamach)
- Amanda Di Maio (Coordinator and Budget manager, Atmacinta)

In the project realization, several persons / organizations joined the project to assist in field activities:

- Le Groupe Hémisphère and TaTa Steel (New Millennium Iron Corp. "NML") agreed to undertake the caribou survey with the Naskapi assistants.
- Richard Sandy (NML, and member of the Naskapi Nation of Kawawachikamach) trained Local Research Assistants
- Guillaume Larocque (GIS technician, Quebec Centre of Biodiversity Science) assisted in the design of the CyberTraper Interface
- Oliver Sonnentag (Climatologist, Université de Montréal) joined the project for the trend analysis of precipitation, temperature and snow data of the meteorological stations Fermont and Kuujjuaq and Schefferville.
- Marie-Jeanne Royer (Health Geographer, Université de Montréal) joined the project for the climate change and nutritional health assessment.

The purpose of this project was to assess the consequences of climate change on the caribou, its habitat and Naskapi society (hunters and trappers and other Naskapi community members) to find possible avenues to mitigate and adapt to these impacts.

2. Project goals and objectives

The project's goals and objectives are closely aligned with the Naskapi Nation's own mission of preventing further damage to a Naskapi way of life grounded on a close relation to the caribou and the land. The project aimed to document the information collected and understanding on climate change and its effects on caribou and community wellbeing in the Naskapi Territory in such a way that it can evolve constantly and emerge as an new adaptive planning instrument and decision-making tool for the Naskapi Nation. This project aimed to offer an approach that could be used by other communities that face similar challenges. The Naskapi Nation are the central repositories for all project related information and knowledge, and will share it with other communities, governments, organizations, academics etc. as required and permitted. This proposed project is contributing to and drawing upon actual Naskapi involvement in caribou monitoring, e.g. CircumArctic Rangifer Monitoring and Assessment (CARMA), Institute for Environmental Monitoring and Research, Labrador.

The main objectives of this joint project are:

- to gain a thorough understanding of the health and patterns of migration of the George River caribou herd affected by climate change drawing both on local Naskapi and Western science perspectives;

- to gain a thorough understanding of the human impacts of climate change for the Naskapi society, with a specific focus of the impacts on Naskapi hunters and trappers, Naskapi resource and land use patterns (hunting, subsistence harvesting), and assessing how impacts identified by the Nations in previous studies (e.g. Tremblay et al. 2006) have been evolved over the last years;

- to identify the vulnerabilities of Naskapi land and society to climate change, as well as the priority strategies for mitigation of, and adaptation to its impacts; and,

- to enhance awareness among Naskapi of the implications of climate change on caribou in their territory, and encourage Naskapi youth participation in mitigation and adaptation measures; to promote discussions about the possible consequences that observed trends may have on specific aspects of the caribou/Naskapi relationship.

For these overall goals, the following specific objectives were defined:

- *identify locally observed climatic impacts* on the George River herd caribou and in Naskapi territory, and define local concerns to gain a deep understanding of:
  - What do the Naskapi members and communities know about climate change?
  - What do they observe (e.g. changes in caribou activity around the communities; appearance of new species, changes in plant patterns (caribou habitat, i.e. lichens etc.)?
  - How are Naskapi resources (i.e. Caribou and its habitat) and land use patterns (i.e. hunting, trapping) affected by climate change, and what is expected in the future?
  - What is the present status (health, behavior, and disposition) of the George River caribou herd according to Naskapi knowledge perspective?

- examine *several specific issues* of concern including:
  - What are seasonal and climatic changes in the territory (collect data on weather conditions using, for example, weather stations, cameras, ice probes)?
  - How travel for caribou hunting is and will be affected: for example, how are the times of year and routes upon which it is safe to travel changing (monitor the main caribou hunting routes)? How in the last years the Naskapi Nation has adapted to climate change impacts identified by them in previous studies (adaptation evolution monitoring) (Tremblay et al. 2006; climatechance.krg.ca) and what are ongoing/future challenges?.
  - How do the potential impacts of climate change on caribou and the land affect food security in Naskapi society due to its consequences on subsistence harvesting?

- enable *co-production of knowledge* based on Naskapi and Non-indigenous perspectives;

- develop *tools and guidance documents* that will help mitigate the impacts of climate change on the caribou, the land and resource use in the Naskapi territory while remaining appropriate to the Naskapi context;

- identify *vulnerabilities and priority adaptation strategies* for the Naskapi Nation;

- establish *closer on-going working links* on climate change activities between the partner organizations, and other climate change research and adaptation initiatives taking place in the Nunavik Region (e.g. Caribou-Ungava project, Institute for Environmental Monitoring and Research organization based in Happy Valley/Goose Bay);

- examine the *future needs for monitoring* related to climate change and its impact on the caribou, the land and Naskapi society; and

- contribute to *capacity building* in the Naskapi Nation in project research design, implementation and interpretation through strengthening the participating communities with respect to:
  - understanding and adapting to climate change;
  - providing training opportunities and employment; and
  - fostering an interest in young Naskapi in multiple approaches to land use and local wildlife management (‘traditional’ and Western science-based).

3. Literature Review

Climate Change in the Canadian Arctic and Subarctic

There is a broad consensus that the climate is changing and Aboriginal societies are among the first to face the direct impacts of these changes as their traditional way of life is dependent on climate-sensitive biodiversity resources (e.g., harvesting fish and wildlife) (Krupnik & Jolly 2002; Furgal & Prowse 2008; Cavaliere 2009; Downing & Cuerrier 2011). Arctic and subarctic regions are predicted to be at the forefront of climate change with temperatures rising by more than 4–5°C by 2090 (Costello et al. 2009). The temperature increase observed in the Arctic is also detectable in northern Québec, where warmer summers lead to growth and favoured range expansion of trees and shrubs, as well as to greater snowfall and deeper snow cover. Recent scientific evidence shows that the climate is changing throughout Québec (e.g., increase in low-intensity precipitation, decrease in snow cover, increase in mean air

temperature [Tair_mean]); for example, between 1960 and 2005 daily Tair_mean increased in southern Québec by 0.2 to 0.4°C/ decade (Yagouti et al. 2008; Brown 2010). By the year 2050 winter temperatures are expected to increase by 4.5°C to 6.5°C and summer temperature by 1.6°C and 2.8°C in northern Quebec where the Naskapi territory is located (DesJarlais et al., 2010). Winter precipitation is predicted to increase from 16.8% to 29.4%. It is projected that this increased winter precipitation would lead to an increase in snow accumulation on the ground. In the summer, precipitation in the North could increase by 3.0% to 12.1%.

Studies have demonstrated the intimate link between air temperature, precipitation and snow and ice conditions and indigenous communities in the Canadian and circumpolar Arctic (Krupnik & Jolly 2002; Laidler 2009; Ford 2009; Weatherhead et al. 2010). The success, safety, and ability to hunt, trap, and fish depend on the availability and health of animals and their ecosystem, as well as on ice and snow conditions. Shifts in species distributions and habitats, in migratory patterns, or in animal health can have implications for harvesting practices and for the availability and quality of traditional food resources (Chan et al. 2006; Peloquin & Berkes 2009). Animals and traditional wildlife harvesting practices play a prominent role in Aboriginal culture; hence, the alteration of species and their ecosystems is identified as a fundamental factor eroding and dismantling the traditional way of life of aboriginal communities living in these regions (Masty 1991). Subarctic regions with high climatic variability are also at substantial risk; however, literature on the Canadian Subarctic is still scarce (Turner et al. 2009; Moser 2010).

The George River Caribou Herd in a Precarious State

Recent surveys have indicated that the George River caribou herd in northern Québec has suffered a dramatic decline from about 800,000 heads in 1993 to 74,000 in 2010, and to 15,000 for the 2013 fall, based on mortality and recruitment rate (Porter 2011; MRN 2012, 2013).

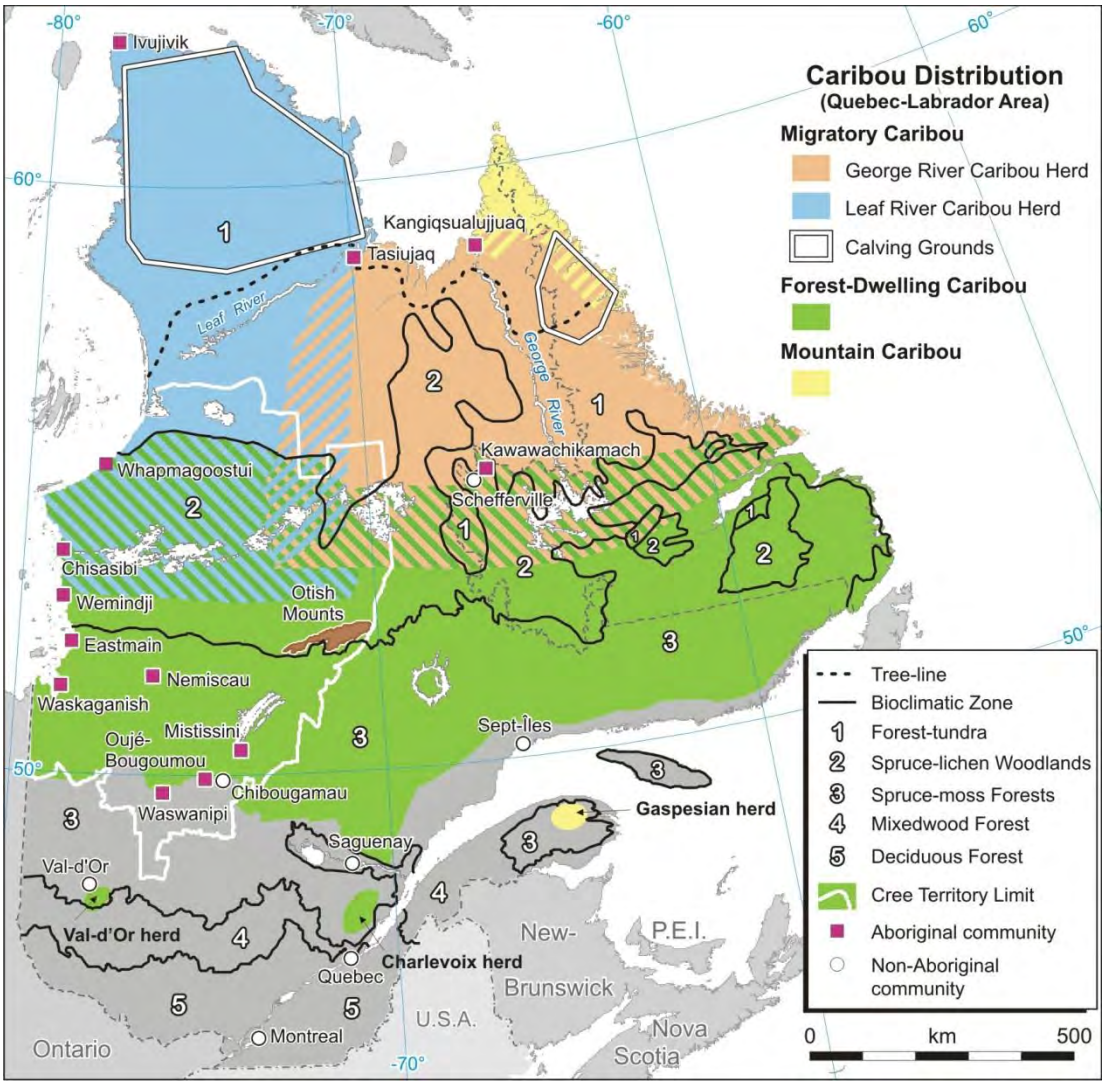


Figure 1: The caribou herds of northern Quebec
Cartography: Marc Girard, 2012

Climate change can have direct and indirect impacts on caribou: 1) delayed access for caribou to green vegetation in spring or due to alterations in lichen distribution (Laing et al 2002), 2) increased energy cost to obtain forage in deep snow during winters, 3) delayed or earlier melting of snow on calving grounds that modified the time to raise calves or complicated movement enroute to calving ground, 4) destruction of winter habitat due to high frequency of forest fires as a result of higher temperatures (Crête et al. 1990, Crête & Huot 1993, Overland & Wang 2005, Couturier et al. 2006); forest fires affect lichens and according to Crête et al (1996:28): "After forest fires, lichen species important to caribou feeding in the Québec-Labrador peninsula take ≈30-40 years to recolonize the ground and to become large enough to be edible"; and 5) extension to the north of the range of predators (e.g. wolf) and animals that are carrying parasites that affect caribou. This in turn hinders caribou from completing their annual cycle in some parts of their actual range. Based on future climate projections by 2040–2069, winter, spring, and summer George River caribou occurrences will tend to be restricted to Northern Quebec and Labrador and under a climate change scenario,

with the exception of fall, this migratory caribou herd is predicted to undergo significant range contractions for each season (Sharma et al. 2009).

Diverse effects such as food availability, predator's density and human disturbance correlate with climate change impacts on caribou. According to Crête et al (1990:163): "Overgrazing, habitat destruction, overhunting, predation, disease, and climatic changes all constitute possible explanations for the decline of caribou observed in northern Québec during the first half of this century. Of all, climatic changes possess the greatest potential of affecting equally all animals over vast areas".

The Role of the Caribou for Naskapi Livelihood and Culture

Modifications to the distribution of George River caribou herd attributed to global climatic change have biological implications for the northern ecosystem, but also social, cultural and economic implications for the Naskapi First Nation.

The Naskapi are one of the ten First Nations of Québec. The majority of the 1028 people of the Naskapi Nation live in the village of Kawawachikamach, which is located close to Schefferville in north-eastern Québec. Naskapi is the principal language and is spoken by all of the residents, including at the school. The Naskapi still practice many aspects of their traditional way of life and culture. Like many northern communities, they rely on subsistence hunting, fishing, and trapping for a large part of their food supply and for many raw materials.

Among the many animal species that inhabit the tundra, the caribou has a very special status for the Naskapi culture. Since time immemorial, the caribou is strongly linked to the cultural identity of the Naskapi, and contribute to their social and economic well-being, and this relationship continues to the present day. (Cartwright 1911; Speck 1935, Barbeux et al. 2008). Caribou hunting is of great importance to the Naskapi. Providing food, clothing, tools, and being an important source of spiritual power (Mameamskum et al. 2010), caribou migration patterns and behavior have structured the way of life of the Naskapi in their territory.

The knowledge that the Naskapi have built about the caribou is extremely rich and accurate, including of the animal's eating habits, behavior in different contexts (such as rut or injury), physiological characteristics, diseases that affect it, location, and migration routes. The Naskapi use every part of the caribou for many different purposes (see Box 1).

It is feared that climate change will negatively affect the land, the caribou, its behaviour and migration patterns, which in turn impacts

Box 1: A Naskapi elder's description of traditional uses of caribou

"When we shot down a caribou, we used all parts of his body. Even the bones were crushed and boiled into bone fat and broth that we drank. The marrow was eaten raw. We also used the powder of the burned bones to whiten tanned hides, which we rubbed with this powder. Then, we expanded the skins for the surplus powder to be blown by the wind. The skins of the caribou were used to make tents. We also made sinew with skin – thin strips that were used for fishing nets or fishing rods. These strips were also used to connect the different parts of sleds. The sinew was used to do many other things; for example, we tied our luggage when we wanted to travel. We also made rackets. We dried the meat and reduced it to very fine powder. We also used the shoes and made necklaces with the teeth and also games. When we made a drum, we used a lot of parts of the caribou. We also made toys for children with certain parts of the caribou. We respected this animal a lot because it allowed us to live and it was always present among us."

[The authors' translation from the original text in French in Babeux et al. (2003)]

the Naskapi ability to use the land (e.g. change of hunting routes) , to maintain traditional subsistence activities and ultimately the community wellbeing (e.g. poorer health produced by the change in traditional food species). Such effects of, and concerns over, climate change for the caribou, Naskapi land and community wellbeing have been regular themes in various community meetings over the last few years. These observations are largely consistent with similar ones reported elsewhere in the North (Krupnik & Jolly 2002; Ford 2009; Henry et al. 2010).

4. Methods and Materias

4.1. Community Workshop "Learning from our Elders" and Participatory Mapping

The community workshop was held on February 27-28, 2012 in Kawawachikamach, at the Naskapi Community Center. A total of 45 elders and participants from the community were present and shared their knowledge and observations on changes in the climate and caribou.

This workshop was structured around three activities:

1) ***Presentation*** on the current state of knowledge on the George River caribou herd and climate trends in Naskapi territory by Thora Herrmann (Université de Montréal)

2) ***Group discussion : Observations on climatic and environmental changes***
   - Have you noticed changes in the weather, changes on the land (thawing and freezing of rivers/lakes), the ice and the snow? Extreme events?
   - Have you observed changes in behavior, health status, and population trends of caribou?
   - Have you noticed changes in vegetation?

Photo1: Kawawachikamach, community workshop, February 27, 2012
Photo credit: Thora Herrmann, 2012

The following checklist was used to guide the discussions

Table 1: Theme Checklist	
Theme	**Sub-theme**
General Weather	
Seasons	Hotter / Colder or Wetter / Drier Seasons; Length of Seasons;
Temperature	
Rain	
Snow	Dates of First / Last Snow; Quality and Quantity
Wind	Direction; Strength
Extreme Events	Frequency and Intensity of Storms
Lake and River Ice	Thickness
Caribou	Distribution; Migration Patterns; Abundance; Population Trends; Calf Mortality; Behavior; Health
Predators	Wolf; Bear;
Big Game	Moose
Small Mammals	Fox; Marten, Mink
Fish	White Fish; Trout
Birds	Ptarmigan; Geese; Duck;
Insects	New; Abundance of Mosquitoes and Black Flies
New Species	
Vegetation	Berries; Trees; New plant
Transport	Roads; Ski-Doo Trails;
Land	Landscape; soil
Mining	

A map of the Northern Quebec was used for the workshop so that information on caribou habitats, range, distribution, movement patterns, and human use of the land could be recorded and presented in visual form.

3) ***Patterns mapped*** :
   - Changes in migration routes, and areas of occurrence of caribou
   - Areas where caribou has been seen in winter, summer and when calving: has there been a change over time?
   - Areas of danger / disturbance to caribou
   - Any areas most important to protect for caribou
   - Changes in Vegetation

Photo 2: Community elders are mapping the changes in caribou population and migration in Naskapi territory.

4) ***Group discussion***: ***Impacts of changes on caribou and the Naskapi society***
    - Is climate change affecting you and your activities on the land (positive or negative or neutral effects)?
    - What are future challenges?

5) ***Group discussion***: ***Adaptation strategies***
    - Looking at the effects, what can be done at the household or individual level to adapt or take advantage of future changes and effects?
    - Looking at the community, what can or should organizations do in response to these changes and their impact in the communities?

Based on the workshop, a summary of the findings was prepared and published in a brochures and distributed (please see Annexe A).

4.2. Questionnaires and Interviews

Individual Interviews
Perspectives on climate and environmental change on caribou were gathered using in-person, semi-structured individual interviews with Elders, active hunters and trappers, women, youth, in Spring 2012. We selected key themes for these interviews but there was no fixed set of questions to allow for greater flexibility (Laidler 2009). This allowed for the recording of information on a variety of topics, while giving participants the freedom to deviate from these topics as they saw correspond. Topics covered during the interviews included aspects of caribou ecology such as habitat, range, distribution, population trends, and movement patterns; caribou health; human relationships with and use(s) of caribou; hunting practices; future use and management of the George River caribou herd; and overall weather conditions, summer and winter air temperatures, dates and quantity of snowfall, ice thickness, lakes / rivers / sea ice freeze-up and break-up dates.

In addition, members of the project team met with the community's senior administrators (e.g., the Local Environment, Hunting and Trapping Administrator, Justice Administrator, Health Administrator).

Questionnaire 1: Climate Change and Caribou (please see Annexe B)
The questionnaire asked respondents closed-ended questions according to a gradient to obtain basic information on observed changes of weather conditions. For example, participants were asked to compare the current situation with the one when they were 16 years of age (e.g., summers have gotten: colder/stayed the same/warmer) to give them a specific point in time to compare to the current situation. Also, memories from the age of 16 are more precise than those from childhood and are often associated with key life events (e.g., driver's licence, end of high school) (Czernochowski et al. 2005; Ghetti & Angelini 2008). The respondents were divided into age groups and their answers then compared qualitatively to reveal any differences between age groups. Selected open-ended questions allowed the respondents to explain their answers to previous closed-ended questions.

The questionnaire was divided into six large sections: 1) personal information, 2) weather observation, 3) observation linked to caribou population trends, 4) observation linked to threats, 5) current and past hunting habits, 6) observations about climate impacts on caribou-related subsistence activities, and perceptions on intergenerational subsistence activities knowledge.

All questionnaires were in English and in Naskapi could be answered in written or oral form and were hand-distributed by the local Research Assistants and members of the project team. If the respondents decided to complete the questionnaires at a later date, a drop-off place at the Naskapi Nation Office was identified to return the questionnaire.

The respondents were selected using an accidental sample (n=100) and had an acceptable return rate (35%, n=35/100).

Questionnaire 2: Assessment of Nutritional Health Changes for the Naskapi Nation
(please see Annexe C)
At the community workshop many people repeatedly mentioned health, nutritional health and climatic and environmental as an issue of concern. To respond to this need, a short questionnaire was designed to assess nutritional health changes for the Naskapi Nation as a result of climate change. The questionnaire asked: 1) personal information, 2) observation of changes regarding personal hunting/fishing/trapping and eating habits pertaining to traditional food species (e.g., Caribou, ptarmigan, geese), 3) Perceptions of the younger generations' habits, 4) physical activity, 5) self-reported health assessment.

The questionnaire was mainly composed of closed-ended questions, asking the respondent to identify their observations according to a gradient. It also included selected open-ended questions to allow the respondents to explain their choices.

All questionnaires were in English and in Naskapi could be answered in written or oral form and were hand-distributed during summer 2012 by the local Research Assistants and the translator of the NNK. The questionnaires (n=30) which were distributed among the population had a good return (n=24/30).

4.3. Meteorological data & statistical analysis

Using trend analysis of precipitation, temperature and snow data, similarities and/or discrepancies between Naskapi's perceptions of changes in meteorological conditions and long-term measurements are examined. Monthly estimates of mean-maximum, mean and mean-minimum air temperature
[Tair_max, Tair_mean, Tair_min, respectively; ºC], total rain [mm], total precipitation [total rain plus snow water equivalent; mm] and snow depth [cm] for two locations within the Naskapi's territory and available as standardized data sets through the National Climate and Information Archive maintained by Environment Canada (http://climate.weatheroffice.gc.ca/): Fermont (52°47′ N; 67°05′ W), Kuujjuaq A (58°06' N; 68°25' W). The time series for the two locations varies slightly in terms of length and completeness (i.e., Fermont: 1976-2004; Kuujjuaq A: 1947-2005).

Using the monthly estimates, seasonal and annual time series of all six meteorological variables for the two locations are calculated based on the standard climatological seasons (winter: December-February; spring: March-May; summer: June-August; autumn: September-November) following Gagnon & Gough (2005). The non-parametric Mann-Kendall test (Kendall & Gibbons 1990) in combination with the non-parametric Theil-Sen approach (Hirsch et al. 1982) is used to identify significant trends and their magnitudes in the seasonal and annual time series of Tair_max, Tair_mean, Tair_min, total rain, total precipitation, and snow depth over the above 25-year periods.

To account for serial autocorrelation present in some of the annual and seasonal time series (data not shown), the Mann-Kendall test and Theil-Sen approach is applied following Yue et al. (2002) and Gagnon & Gough (2005). The significance level is fixed at 0.05. The trend analysis is performed in the R computing environment (v2.10.0; R Development Core Team 2009) using the 'zyp' package (Bronaugh & Werner 2009).

The analysis is currently in progress and carried out by the team of. Oliver Sonnentag (Université de Montréal). Results will be available in early summer 2014.

4.4. Combining Naskapi' observations & meteorological data

A three-step analytical framework is used to combine Naskapis' observations with meteorological data. First, data obtained from questionnaires, interviews and meteorological stations are separately analyzed. Questionnaire and interview data are cross-tabulated by age group to allow for variations based on these parameters. Second, the questionnaire data, the interview data is then combined among key themes. Third, the combined climate observation (e.g., questionnaire and interview data) is then qualitatively compared to the meteorological data to show divergences and similarities to offer new perspectives on the effects of climate change on the Naskapi.

Step 1 is finished. Step 2 is currently being carried out. Step 3 (Naskapi observations and meteorological data) will be combined with the observations on climatic changes of the Inuit (cooperation with Alain Cuerrier, UdeM).This analysis is currently in progress. Final results are expected in summer 2014 (paper in prep).

4.5. Development of a geospatial data tool for community caribou survey using CyberTracker

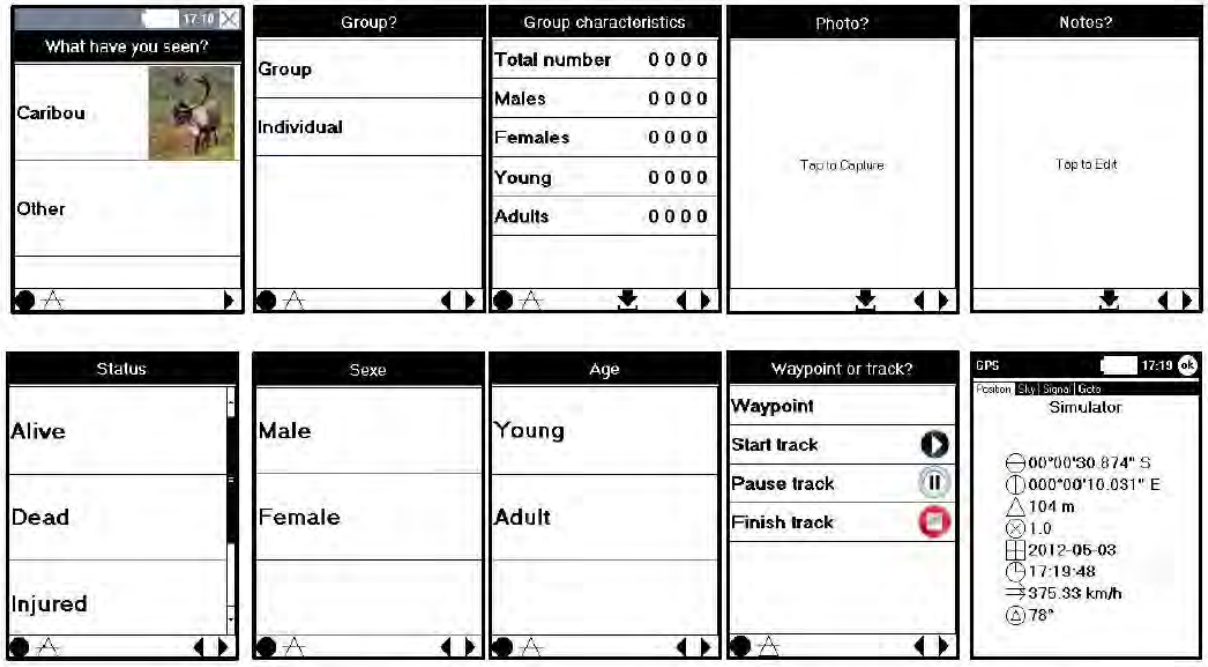
A combination of rugged GPS-equipped electronic devices with CyberTracker software (CyberTracker Software Ltd, http://www.cybertracker.org) designed to simplify field data collection, enabling rapid and accurate recording of observations was used to identify and include geographic location information on caribou or caribou tracks sighted during the survey. CyberTracker is a GPS with a customizable touch screen interface. CyberTracker allows customizing an interface to the needs of the caribou monitoring and the future Naskapi users. Selecting particular icons will lead to additional screens with new icons to collect more information. These series of screens will eventually lead back to the original once all the data requirements are fulfilled and a GPS point will be recorded. It allows collecting systematic, geo-referenced data that can be downloaded to a central database and represented in map formats and environmental reports. A Trimble Nomads was provided by the Quebec Centre of Biodiversity Science (QCBS) and loaded with CyberTracker software.

The development of geospatial data tool for community-based caribou monitoring was structured around three activities (please see Annexe D):

1) ***Presentation:*** An introduction to CyberTracker and its data functions has been given by Thora Herrmann. She presented examples of the use of CyberTracker in community-based environmental monitoring by other First Nations in Canada (Inuit, Anicinapek, Cree, Gwich'in) and elsewhere (San Bushman, Aboriginals in Australia).

2) ***Design of the CyberTracker interface for the caribou survey*:** During February and March 2012, project members and Local Research Assistants identified the parameters for the CyberTracker interface to be used for caribou survey in Kawawachikamach:
   - Number of caribous sighted
   - Groups or individuals sighted
   - Age of caribou sighted
   - Sex of caribou sighted
   - Caribou health status
   - Caribou tracks
   - Photographs
   - Additional notes on caribou sighted and/or habitat

Based on these parameters, the interface was designed, and installed on the CyberTracker in collaboration with Guillaume Larocque (QCBS). The CyberTracker was tested in the field (April, 2012) several times prior to the caribou survey.



Screenshots of the icon-based touch screen CyberTracker interface for community-based caribou survey and monitoring by NNK.

4.6. Community Caribou Survey

Capacity building in caribou survey methodology and techniques: training in caribou survey methodology and survey techniques has been provided by Natalie D'Astous (April, 2012). She explained the differences in between doing census for migratory and sedentary caribou. In this case, the main objectives were not to count individuals but to verify the presence of caribou in the vicinity of the area covered by DSO project (including a radius of 20 km). The **caribou survey** was carried out on April 18, 2012.

4.7. Local Naskapi Researcher Training

Three Local Research Assistants (LRA) - Willie Johnny Swappie; Darren Einish; Steve Einish - were provided with training in February, 2012 in Kawawachikamach by George Guanish and Thora Herrmann in facilitation and participatory research methods, climate change issues and qualitative data collection. LRA's were trained in April 2012 by Nathalie D'Astous in caribou monitoring methodology and caribou survey techniques. Training in the use of CyberTracker and in the design of CyberTracker interface for community-based caribou survey was provided to LRAs by Thora Herrmann in March and April 2012. Richard Sandy provided training in the use and data collection with GPS to the LRAs in April 2012. Direct supervision by George Guanish in Kawawachikamach were used to assist the LRAs in carrying out interviews during summer 2012. Phone and email contacts by members of the project team throughout the project realization, in addition to direct supervision helped LRAs.

5. Results

5.1. What Changes the Naskapi have observed

This section presents a summary of the observations, impacts and solutions that were collected during the workshops and the interviews with Elders, hunter and trappers and other members of the Naskapi society. A total of 249 observations were recorded on climate changes and the impacts that these changes in weather patterns have on the caribou, land use and Naskapi society.

Photo 4: Kawawachikamach, Group discussion, 2012

Table 2: Changes in the local weather conditions observed by the Naskapi	
Observation / Changes	Examples
General weather patterns	• The weather has gotten warmer (overall).
– *"Weather changes suddenly nowadays. It is more unpredictable than in the past."* – *"It is more difficult to predict the weather now. People feel less comfortable to read the weather."*	
Temperature	• Very cold days are less frequent than they used to be in winter. • Warmer (overall). • Cold is not as severe as in the past.
– *"There used to be more extreme cold 10 years ago. The cold is not as severe as in the past."*	
Precipitation	• More rain. • Wetter summer.
– *"There is more rain in summer, especially since the last two years."*	
Seasons	• Longer, warmer Summer. • Shorter, warmer Winter. • Spring has warmed up. • Less snow in winter. • Spring and winter changed the most.
– *"The cold weather comes later in fall."* – *"January used to be very cold, but not anymore."* – *"Winter is two months shorter."*	
Snow	• Less snow (esp. in December). • First snowfall arrives two months later (in Oct./Nov.). • The type of snow changed (snow is softer). • The number of snowstorms decreased.
– *"Before the condition of the climate was really good, but now, everything on the land has changed and nothing is the same anymore. Characteristics of snow have changed."* – *"There is no big snowfall in March as used to be."*	
Ice quality and quantity on the lakes and rivers	• Spring ice is less thick. • The lakes and rivers freeze over later (late November). • Rivers do not freeze through. • Thinner lake ice. • Lake ice thaws sooner and faster (in May). • Holes on the ice are causing water on the ice.
– *"Since the last three years some lakes around Kawawa do not freeze at all."* – *"When we used to go to Lake John to camp, the ice used to be very thick and there were piles of snow. Today, when you go with a ski-doo on the lake you can hear the ice cracking."* – *"Small streams are no longer frozen, there is snow on top but it's not frozen under the snow."* – *"There used to be 3-4 feet of ice on the lakes, now it is around 2 feet."*	

Table 3: Changes in caribou ecology observed by the Naskapi	
Observation / Changes	Examples
Distribution	• Shifts in distribution.
– *"Caribou tends now to stay in Labrador area throughout the year."* – *"The caribou used to roam the streets of Kawawachikamach, now it stays only at the George River in the North."* – *"Between Kawawa and Kujjuaq are many outfitting camps. The caribou avoids the camps and roam more in the North."* – *"Maybe they stay now more in the Torngat Mountains."*	
Migration	• Changes in timing. • Changes in migration routes.
– *"Since 6 years we do not see caribou anymore around Kawawachikamach."* – *"In the past, caribou used to travel in one big herd. Now you see small little groups of 30 or 40, scattered over the land."* – *"The caribou are coming later. Sometimes they don't come. They change routes."*	
Abundance	• Fluctuation of caribou population. • The caribou are less abundant. • Impact of mining.
– *"Long ago, when there was lots of caribou, the hills where covered, it looked like if the hills were moving."* – *"Lots of caribou [in the 1990s]; the soil was vibrating. You could hear the noise they make when they are coming."* – *"Well, caribou has gone up and down over the years. Some years there are many them and some years you hardly see them. It depends on the food, and the snow and ice, the hunting, the mining."* – *"There is too much noise and shaking of the ground because of the mines. This is affecting the caribou. You don't see them anymore. "* – *"The caribou stopped coming around Kawawa a couple of years ago, it is about the same time the drilling started."*	
Herd size	• Large herds noted in the 1970s, 1980s; today decrease in herd size.
– *"In the past, caribou used to travel in one big herd. Now you see small little groups of 30 or 40, scattered over the land."* – *"In the past, they used to travel in one big bunch. Now they just travel in groups."* – *"30 years ago there used to be one big herd - 100,000, 200,000. Now there are small groups - 200, sometimes 250.Mauybe because of the mining or the outfitters. Maybe they get no food anymore."* – *"There was lots of caribou in the past [1980s]; there used to be thousands and thousands of caribou in one big herd. Now a big group is hundred or something."*	
Population and behavior	• Higher calf mortality.
Caribou health	• Reduced body weight. • Less healthy. • Smaller size. • Changes in fur quality. • Parasites.
– *"We used to measure the fat of the caribou by fingers. In the past it was tick like 4*	

fingers, but now it is about 2 o 3 fingers. The body condition of the caribou changed."

- *"People used to boil the bones of caribou, now there are abnormalities in bones."*
- *"The fur of caribou has become thinner."*
- *"Caribous have been observed to be infected with parasites."*

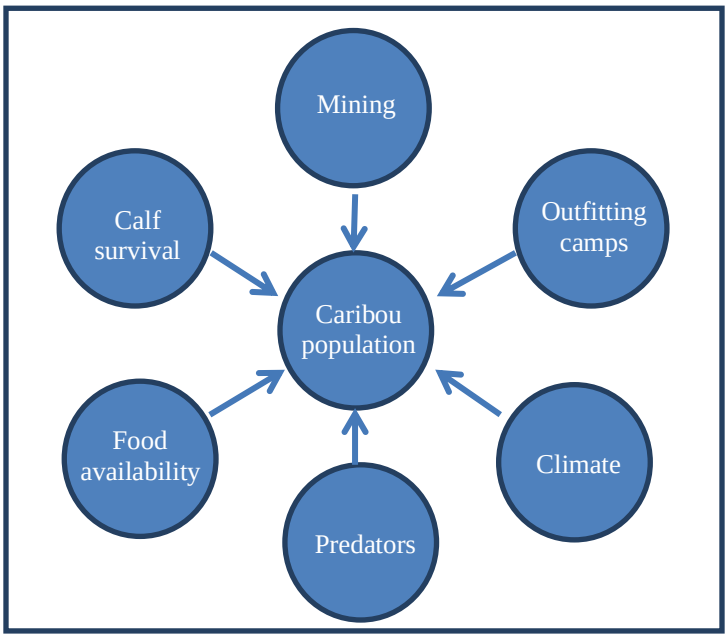
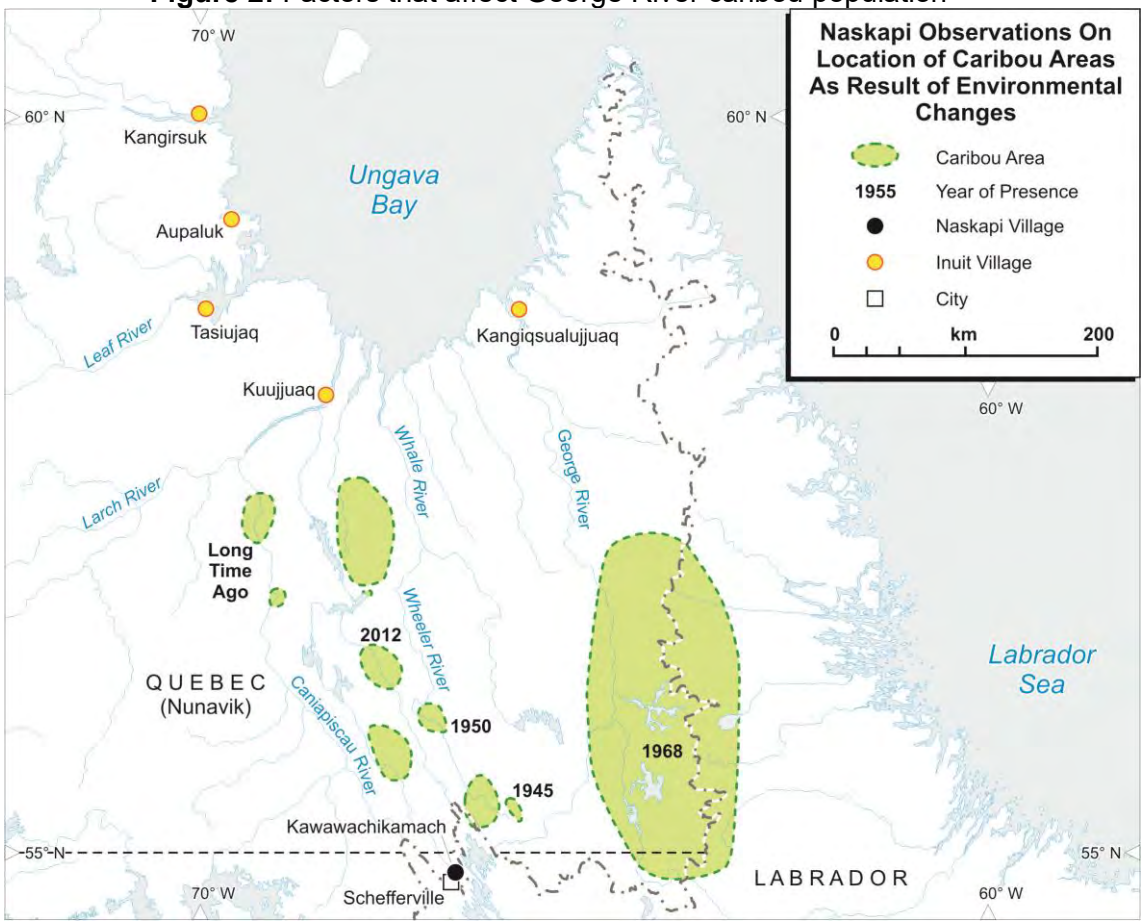


Figure 2: Factors that affect George River caribou population



Catography: Marc Girard, 2012

Photo 5: Community elders are mapping the changes in caribou population and migration in Naskapi territory.

Table 4: Changes in wildlife and vegetation observed by the Naskapi	
Observation / Changes	Examples
Predators	• There are more bears in summer than before. • Increase in wolves.
New species to the area	• Moose is new to the area.
– *"There was no moose in the area 30 years ago. They are moving in to this region."*	
Fox	• Increase in Fox population. • Changes in fox behavior.
– *"There are a lot more foxes (red fox) since five years in and around Kawawa and Schefferville."* – *"Foxes are not scared. There come close to houses."*	
Small mammals	• There is an increase of marten in the area. • Minks are more abundant. • Small mammals are less in the area.
Birds	• Less geese. • Fewer ducks. • Decrease in Ptarmigans. • Less birds in Summer. • More bold eagle.
– *"In February, there used to be plenty of Ptarmigans in Kawawa. This year there are not seen anymore."* – *"In summer specific birds eat insects, now these birds are gone."*	
Fish	• Less trout. • The fish are smaller.
Insects	• Flies and mosquitos that were commonly observed in the region are now seen less often.

Trees	• Trees and plants change when the weather changes. • Plants used to be healthier near Kawawa. • Changes in Tamarack and Spruce morphology. • Increase in forest fires. • There is less vegetation growing in general near Kawawa. • Plants do not bloom as well as they used to in the past.
– *"Growth of tamarack is strange nowadays."* – *"Tamaracks do not have the color that there used to have in the past."* – *"The needles of the spruce changed."*	
Berries	• Less berries. • Changes in berry distribution. • Berries are much drier today. • Berries are of not good quality. • Berries are smaller.
– *"The coloration of berries changes from red to orange/yellow."* – *"Berries are not growing anymore near the airport."*	

Table 5: Changes in the landscape observed by the Naskapi	
Observation / Changes	Examples
Land	• The entire landscape changes. • Trees are brown from dust in summer. • Drier land conditions. • Land freezes later.
– *"Before the condition of the climate was really good, but now, everything on the land has changed and nothing is the same anymore."*	
Environmental pollution	• Increasing levels of environmental pollution and contaminants. • Fish is affected by pollution. • Numerous outfitting camps in the central part between Schefferville and Kujjuaq, where people are leaving their garbage on site.
– *"Pollution gets disseminated to others fishes through the food chain, and ultimately to humans."* – *"Outfitting camps are impacting caribou due to pollution, noise. Caribou changes routes to avoid the camps."*	
Mining	• Noise • Animals leave their natural habitat
– *"Noise and shaking of the ground due to the mines is affecting the caribou."* – *"The caribou stopped coming around Kawawa a couple of years ago, it is about the same time the drilling started."*	

5.2. What are the main impacts of climate and environmental change on the Naskapi

During the community workshop and interviews, and in the questionnaires, members of the Naskapi Nation confirmed that climate and environmental changes have had multiple direct and indirect impacts on Naskapi-caribou-relationship, land-based activities, on food security, transmission of knowledge, on culture, and health and well-being of the Naskapi Nation. This section illustrates these multiple impacts.

IMPACTS ON LAND-BASED ACTIVITIES

Thinner ice across Naskapi territory, earlier and faster ice break-up, later freeze-up, unsafe ice, pose challenges to the Naskapi rendering traveling on the land, lakes, and rivers hazardous, especially in winter and spring. People are adapting by using helicopters to access the land. Changes in snow and ice conditions of travel routes make usual trails unusable. Weather indicators today confuse experienced hunters who have been able to predict the weather in the past. Unpredictable weather causes problems for people traveling on the land and some people have cancelled their travel plans out of concern for unpredictable weather conditions. People are bringing abundant equipment now when traveling out on the land to ensure that people are safe if sudden change in weather conditions leave people with only a short amount of time to reach shelter.

- *"More equipment is needed now when traveling on the land to guarantee that hunters are safe if weather changes suddenly."*
- *"Planning for travel on the land is more difficult because of increased unpredictability of weather conditions."*
- *"Some trails can't be used anymore."*
- *"Less snow in spring makes travel on the land more difficult."*
- *"Certain travel routes along the shore of lakes are no longer accessible because of changes in snow conditions."*
- *"We have to wait longer to go out on the lake."*
- *"Trails in spring and winter are affected."*
- *"We need to adjust travel routes depending on where safe areas are."*
- *"The conditions of the ice are different, more difficult to pass. One cannot travel along the shore of lakes by ski-doo anymore."*

IMPACTS ON HUNTING, TRAPPING, FISHING

The instability and variation in ice thickness generate challenges to the Naskapi hunters making hunting more hazardous and shortening the seasons for hunting, trapping and fishing. Naskapi hunters use frozen lakes and rivers for hunting but with the travel routes being impacted, they have to be very careful or abandon regular routes to avoid falling through thin ice. Ice travel-related accidents have increased among both experienced and young Naskapi hunters. The hunting seasons and times have needed to be adjusted in response to the increasingly unpredictable weather conditions. Naskapi hunters have to be now more selective in choosing hunting locations because of weather difficulties out on the land. People are adjusting hunting practices/methods to better match the changing migration patterns and other changes in wildlife. They are also adjusting fishing seasons in a way to maximize the harvest.

- *"It takes longer to hunt caribou; fewer caribou are killed in the community."*
- *"People have to use bush planes now for caribou hunting."*

- *"Hunting time, season needs to be adapted."*
- *"Traveling on the land is more dangerous; this impacts on hunting."*
- *"Changes in ice and temperature on lakes make it harder to practice ice fishing in winter."*
- *"When travelling on the land, using unsafe trails is dangerous for younger people and less experienced hunters. That is why we are teaching hunting safety in school now."*
- *"In the past thick ice made access to wildlife easy, now it becomes difficult."*
- *"Less geese means a negative impact on goose hunting."*

IMPACTS ON FOOD SECURITY

For the Naskapi, access to and availability country food is a central element of food security and are critical for Naskapi well-being. However, climate change makes it increasingly difficult and expensive to travel on the land rendering access to food increasingly difficult. Modifications of species' distribution and habitat, of animal health, have implications for access to the traditional food harvest, as well as the availability and quality of certain foods. Participants in workshops and interviews also mentioned that they have noticed a degradation of the animals body conditions (e.g., less fat, more parasites) which affect the quality of game and impact the food security of the Naskapi. For members of the Naskapi Nation this has meant that people are relying increasingly on store-bought for food and they have been eating less traditional food.

- *"There has been a decrease in the amount of caribou being consumed, as caribou migration patterns have changed."*
- *"People used to boil the bones of caribou, now there are abnormalities in bones."*
- *"The caribou meat tastes different. It used to taste better before. People have to be more careful about the meat they are eating."*
- *"Ducks taste different."*
- *"Less fish affects Naskapi food security."*
- *"Animals feed on berries; less berries has an impact on their food availability. "*
- *"Change of the diet of animals has implications on the health of the people."*
- *"More difficult travel out on the land means that people have been eating less game/country food."*

IMPACTS ON HEALTH

Concerns were expressed by the Naskapi about the increase in the number of abnormalities and unhealthy characteristics in animals, in particular in caribou and subsequent impacts on human health. Adapting to this change, participants of the workshop and interviews stressed that they have to be more selective of the meat they are consuming (e.g., they have to choose not to eat and discard more animals than in the past). Participants expressed concerns about the impact of environmental pollution (i.e., mining) on human health. Many participants mentioned the higher risk of injury due to reduced personal safety during travel out on the land (see also land-based activities). Changes in medicinal plants have health impacts.

- *"Decreasing caribou hunt means that people are relying more on store-bought food today. It affects human health."*
- *"Abnormalities in wildlife have impact on human health."*
- *"More foxes. Dangerous for spread of diseases, i.e. rabies. "*
- *"Fox can transmit rabies to dogs. Dangerous for human health."*

- *"Mining activities causes animals to leave their natural habitats and start coming closer to human spaces."*
- *"Pollution gets disseminated to others fishes through the food chain, and ultimately to humans."*
- *"There are more accidents on ice (people have fallen through the ice)."*
- *I am thinking about the country food we used to eat long ago. Today there is diabetes. When we moved here, there was only one case with diabetes. There is social change. It impacts on the health of people.*

IMPACTS ON CULTURE AND LEARNING

Participants also noticed that climate change creates additional cultural impacts because land based activities play an important role in the transmission of skills and traditional knowledge. These skills are at the heart of Naskapi culture and society and activities on the land are an important time where Naskapi values are practiced and passed on. Participants at workshops and in interviews denoted that changing environmental conditions can hinder people to participate in traditional subsistence activities, which could affect other ways of traditional life (e.g., values, oral history, and language). As local climate conditions changes, culture, skills and traditional knowledge need to be preserved to help the community to adapt to changes.

- *"It was nice and cold in our winter camps, now it is not anymore."*
- *"We need to go back to understand our land."*

5.3. Caribou Survey

Le Groupe Hémisphère and TaTa Steel (New Millennium Iron Corp. "NML") agreed to undertake the caribou survey with the Naskapi assistants. This survey is part of the caribou monitoring program required by Newfoundland and Labrador government in relation of the development of DSO (mine project). The survey was carried out on April 18, 2012 (with an airplane) from 1.30 pm- 4.30 pm. Caribou aerial survey around the Schefferville demonstrated a quasi-absence of forest-dwelling caribou tracks around the mining sites and the transportation corridors. The detailed report of the caribou survey was prepared by Le Groupe Hémisphère.

Photo 6: Willie Johnny Swappie, Darren Einish, Steve Einish together with Richard Sandy (NML) are studying the flight route of the airplane prior to the survey.

Photo 7: Willie Johnny Swappie, Richard Sandy, Darren Einish, Steve Einish in front of the airplane before the start of the caribou survey.

6. Identified Priority Actions for Adaptation

6.1. Establish a Naskapi climate change working group

The creation of a Naskapi specific working group to address climate change issues was a key action identified by the community with the project team.

The main tasks of this Naskapi Climate Change Working Group could be to:

- *Determine local priorities and opportunities for adaptive actions* to help minimize the impacts of climate change on the community;
- *Monitor* the adaptive actions identified and implemented;
- *Identify funding sources* and *secure funding* to implement community-based climate and environmental change monitoring
- Provide *annual reporting* back to the community of monitoring results;
- Hold an *annual community consultation meeting* on the state of the local environment to engage the community and seek input regarding the changes being seen by the community members on the land;
- Find the means to *increase community awareness of the climate change issue* and capacity to take advantage of existing programs;
- *Build Community Resilience leadership, skills and capacity*
- *Network* with other Indigenous peoples who are facing the same challenges regarding climate change;
- Link Naskapi priorities on climate and environmental change to influence research at various levels including the Caribou—Ungava program and ArcticNet program

The potential members of this working Group could include Elders, members of the Hunter Support Committee, the members of the community who are currently enrolled in the Naskapi Rangers Program, the Naskapi Development Corporation, the Environment Administrator, the Naskapi Education Committee, the Health Administrator, and others.

The importance to create a job for a monitoring and environmental officer has been stressed by the community.

6.2. Monitor Climate Change and Caribou in Naskapi Territory

The community and the project team proposed the development and implementation of monitoring programs in order to better understand and keep close track of the changes that are occurring in caribou ecology and on Naskapi territory as a result of climate and environmental changes. These monitoring programs could be conducted in partnership with research centers. A framework and strategic work plan must be set for these monitoring programs with concrete objectives (what), clearly defined methods (how), timelines (when), and responsibilities (who).

Climate change indicators that need to be monitored include:

- freeze-up and break-up of ice on lakes and rivers
- Trails
- Changes in snow quantity / quality, and snow depth
- Changes in caribou behavior, health, migration patterns
- Changes in predators (e.g., wolf, bear)

- Foxes, Ptarmigans, Geese, Animals new in the area
- Berries, plants and trees, medicinal plants

Examples of task these monitoring programs could undertake include:

- *Monitor snow and general weather pattern* to support and expand security and safety programs (e.g., hunting travel). Existing programs from Nunavik (e.g., Real-time Monitoring for Travel Safety and Food Security in Salluit, Nunavik [2010-2011]) could serve as an example.
- *Systematic ice monitoring* (i.e., monitor the main ice routes, monitor lake/river ice) similar to already existing initiatives in Nunatsiavut (e.g., Establishment of Inuit Community Based Ice Monitoring and Surveillance Programs for Human Safety and Security Nain & Hopedale, NL [2008-2009]), and develop a local surveillance and travel hazards warning system through the radio, community website, etc.;
- *Monitor caribou* distribution, migration patterns, abundance, behavior, health in the Naskapi territory using GPS collars (telemetry) similar to already existing community-led initiatives (e.g., the Gwich'in and Inuvialuit of the Arctic Borderlands region of Alaska, Yukon and the Northwest Territories monitor caribou health (Gordon et al. 2008); the Chipewyan Dene of Lutsel K'e used hunter's observations to monitor caribou movements, NWT (Parlee & Manseau 2005));
- *Habitat/wildlife monitoring* that would increase focus on the protection and conservation of key species that are important to the Naskapi Nation (e.g., lichen/caribou monitoring, traditional food species);
- *Monitor shifts in phenology, distribution and productivity of berries, and other plants of interest to the Naskapi* (e.g., aromatic and medicinal plants). Existing programs (e.g., Impacts of Vegetation Change in the Canadian Arctic: Local and Regional Assessments [2011-2014]) could serve as an example.
- *Climate and environmental change vulnerability assessment of species* of concern, or of particular interest to the Naskapi (e.g., caribou, geese, ptarmigan);
- *Monitor contaminants* and environmental pollution and mining in around Kawawachikamach;
- Monitor locations, arrival date for certain *migratory birds* important to the nation (e.g., geese).

The process of community-based climate/environmental change monitoring could start with the identification of several climate-sensitive indicators. These indicators should be easily observable and documentable (without needing special technical equipment), for example, date of first/last snow fall, lake and river freeze-up and break-up (timing) at particular locations, arrival date for caribou, etc.. These indicators could form the basis for individual monitoring.

The involvement of Naskapi youth in the monitoring to learn how to collect data and analyze it as Community Researchers is crucial. Provide annual reporting back to the communities of the monitoring results.

ROLE OF THE CYBERTRACKER

The CyberTracker could be used as tool in the monitoring programs to gather large quantities of geo-referenced data for field observations. With its easy and adaptable interface using pictograms, CyberTracker allows to customize the interface to the needs of the specific monitoring program (e.g., animal species) and its potential users. Data could be transmitted to

central database in the NNK office. This tool can also being used as a public awareness tool, as georeferenced data collected by CyberTracker can be represented in map formats to use them in environmental reports.

Potential partners to support these monitoring programs are:

- Environment Canada (EC) Funding
- Ouranos (Consortium on Regional Climatology and Adaptation to Climate Change)
- ArcticNet has a program on climate change monitoring
- Centre d'Études Nrodique (Caribou-Ungava Program)

6.3. Raise Awareness on Climate Change and Caribou

ELABORATION OF EDUCATIONAL MATERIAL ON CARIBOU AND CLIMATE / ENVIRONMENTAL CHANGE

The community elaborated educational material thanks to which by using the caribou as the focus, for students will learn about the natural stressors and the cumulative impacts of human activities affecting this species, as well as the complex processes of caribou and land/resource management and decision-making.

Pedagogical resources have been designed for primary and secondary school level to be used at the Jimmy Sandy Memorial School, and in a way that they can be easily adapted for other uses. Such community-developed education resource will advance the goal of promoting informed and responsible decision-making for caribou, and land/ resource management in the territory. Existing teaching resource developed by other northern communities (e.g., 2-disc DVD package "Caribou and People: A Shared Future" of the Government of the Northwest Territories Department of Environment and Natural Resources, and Cranberry Consulting [2009]) served as an example.

Learning content to be covered by the educational material:

- Learning Unit 1) Introduce students to caribou management, and to understand what climate change is and how it occurs;
- Unit 2) Students will understand the different caribou herds and the value of caribou to Naskapi culture and community and northern communities ;
- Unit 3) Stressors = Students will learn how environmental, climatic and human development influence behaviour, migration, and health of caribou throughout their seasonal life cycle;
- Unit 4) Impacts = Understand climate and environmental change impacts on land, hunting & lifestyles; local stories, knowledge, and observations;
- Unit 5) Research = Students will gain an understating of the work conservation biologists do throughout their annual cycle, Traditional Knowledge and Caribou Management;
- Unit 6) What I can do? = Contribution at home, at school, in our communities to solutions for climate change and caribou conservation.

The final educational product will consist of **two parts**, one aimed at **primary school children** and the other for **high school students**.

For each of these two parts, the pedagogical resource will comprise two components:
- A trigger to generate students' interest in the theme
- Additional activities for reflective thinking, for acquiring knowledge and developing skills in relation to the topic (e.g., maps, videos such as "Voices of the Caribou People" in which members of the Naskapi Nations speak, PowerPoint slide shows, activities, songs and stories, lesson plans, student handouts and teacher answer keys).

Primary school children level

The educational component aims to trigger interest in pupils at primary level is a story based on a traditional Naskapi legend on the caribou and adapted to include current issues on the impacts of climate change and the cumulative impacts of human activities affecting this species. This story will be illustrated by a local artist and published electronically or/and in book form.

This story will be accompanied by additional activities: e.g., songs, group activities, videos such as "Voices of the Caribou People" in which members of the Naskapi Nations speak, student handouts.

Secondary school level

The educational component aims to trigger interest in high school students will be a short film documentary (camera, sound) made by Naskapi youth who were trained by the Wapikoni Mobile in summer 2012. Wapikoni Mobile staff could assist in the post-production of this film. Young Naskapi filmmakers will interview Elders and hunters and other community members about the importance of the caribou in Naskapi culture and their observations regarding the impacts of climate change and human disturbances on caribou/habitat. They will also interview biologists about their research and conservation work. This short film will not only provide an overall picture of the climate change issues and the precarious state of the caribou, and generate student interest in the topic, but it will also to serve the entire community as archive document.

This short film is accompanied by complementary activities: e.g., interactive maps, PowerPoint slide shows, activities, lesson plans, student handouts and teacher answer keys.

Potential partners to support these activities are:

- Wapikoni-Mobile
- Centre de recherche en éducation et formation relatives à l'environnement et à l'écocitoyenneté (UQAM)

ESTABLISH CLIMATE CHANGE AND HEALTH PROGRAMS: SECURITY / SAFETY TRAINING FOR HUNTING AND TRAVEL, FOOD SECURITY PROGRAM

Health issues (i.e., hunting and traveling safety, food security) were important concerns raised at the workshops and interviews; and community members suggested the implementation of climate change and health programs.

Main tasks in a climate change and health program to be carried out include:

- Implement specific *security/safety and awareness programs*:
- Organize *outdoor land camps for youth to learn traditional skills* and self-rescue from community elders and experienced community members;
- *Emergency response plans* for winter travel and/or provide additional safety equipment, for example, GPS tracking systems;

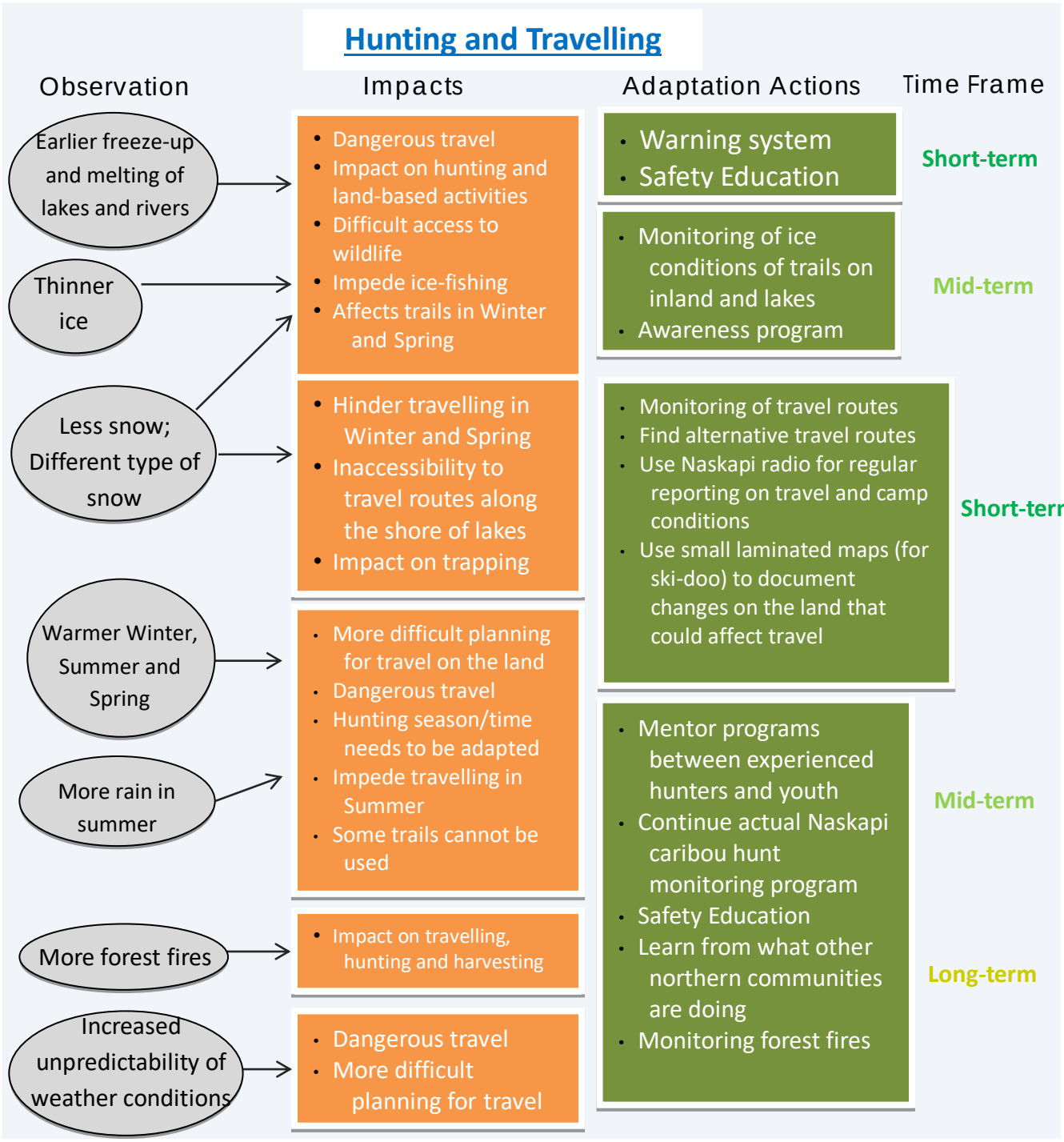
- Implement *preventative human health protection measures* in Naskapi territory related to climate and environmental change impacts (e.g., early warning systems in Kawawachikamach for extreme weather events, human-induced disasters)
- *Develop and implement food security programs,* and monitor traditional food species (e.g., ptarmigan who is not seen anymore in the community, geese); changes in aromatic and medicinal plants. Similar already existing projects (Multi-disciplinary Investigation of Climate Change Impacts on Yukon River Traditional Foods and the Implications for Health and Tr'ondëk Hwëch'in River Culture and Lifestyle [2009-2011]) might serve as example;
- *Awareness programs concerning diseases* (i.e., in winter 2012 detection of foxes with rabies around Kawawachikamach and Schefferville).

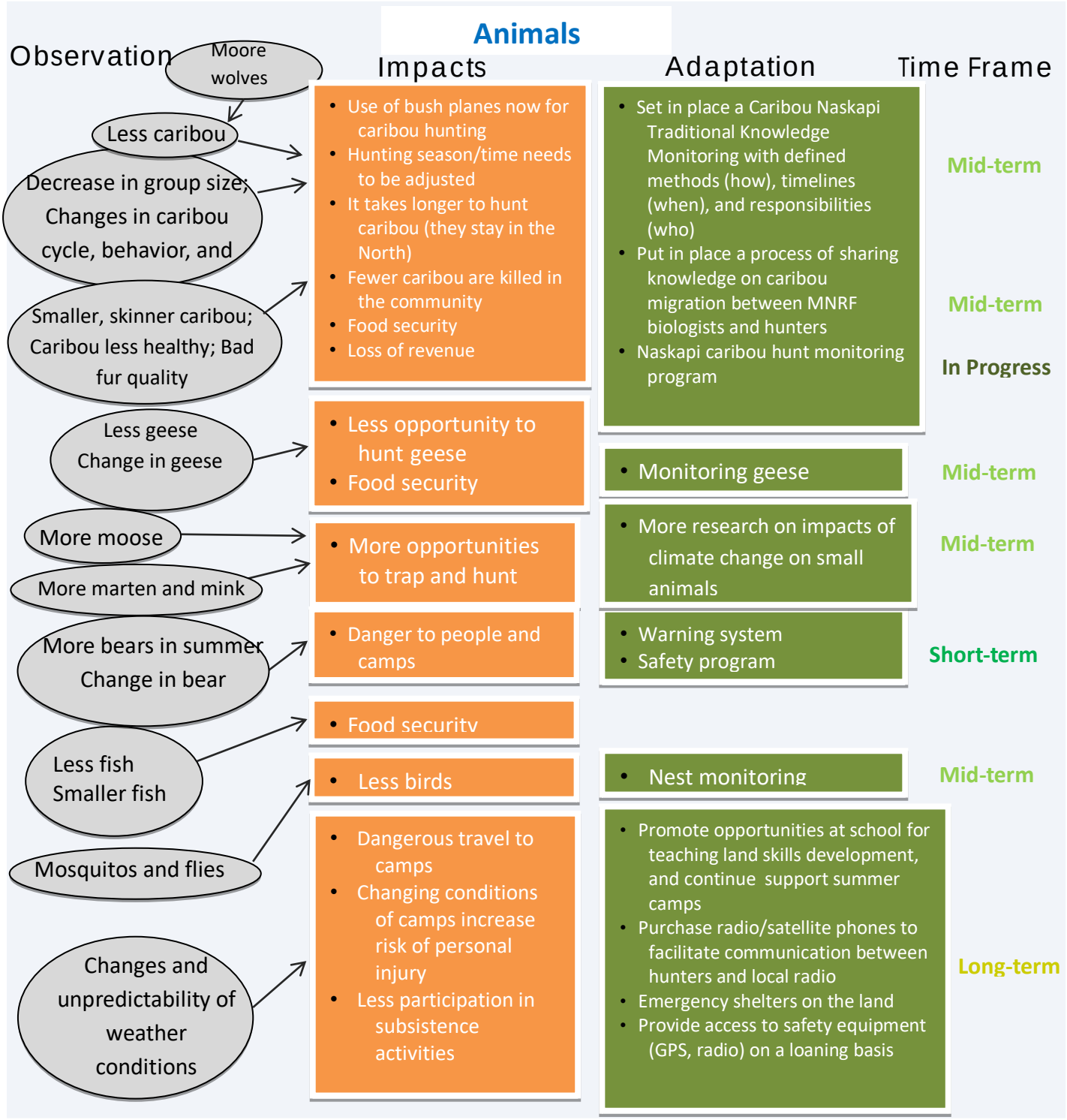
Potential partners to support these activities are:

- Health Canada
- CLSC Kawawachikamach

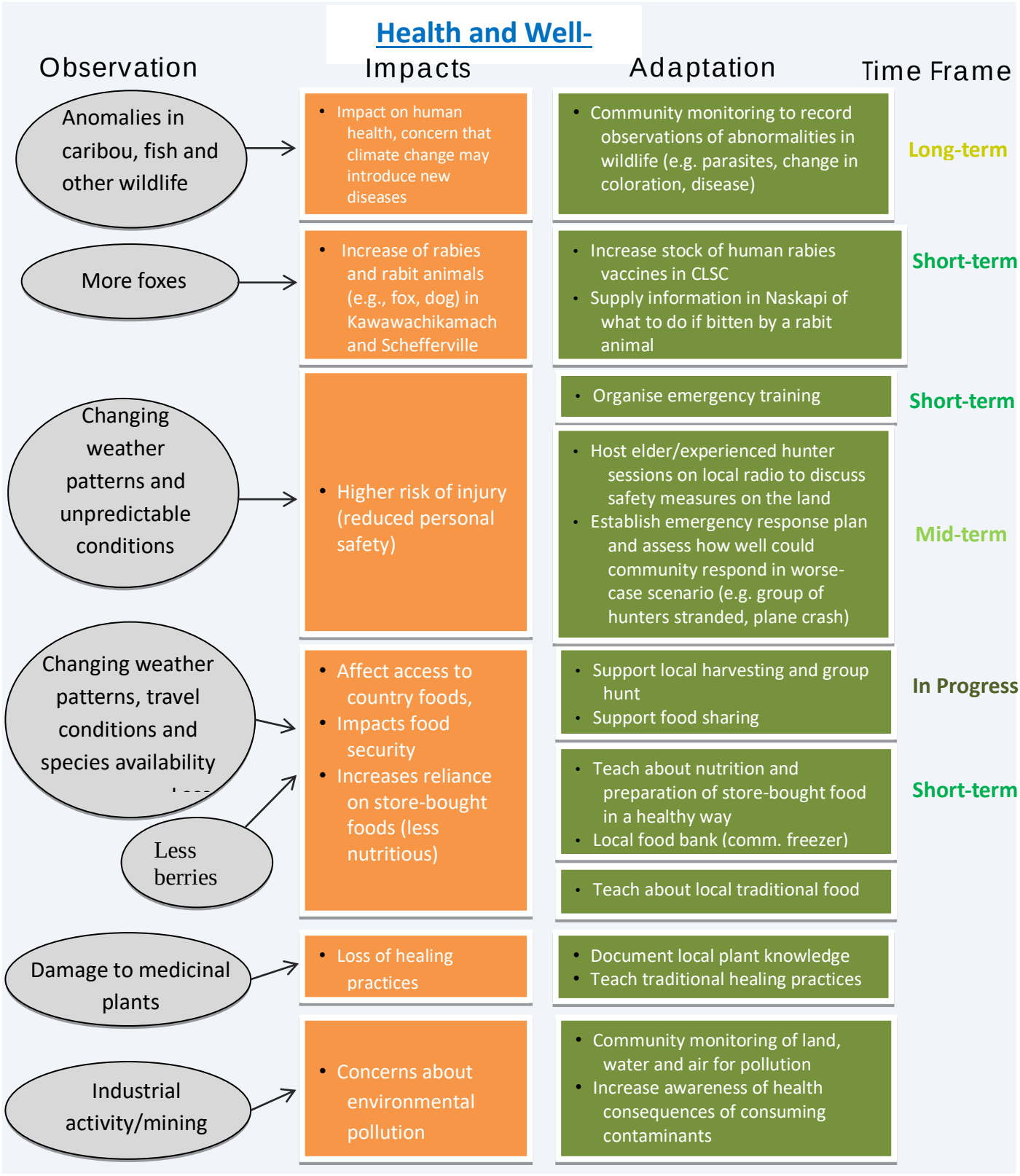
6.4. Naskapi Climate Change Adaptation Action Plan

The community identified adaptation actions and the time frame of actions for a Naskapi Climate Change Adaptation Action Plan that applies across four sectors: animals, hunting and travelling on the land, health and well-being, culture and learning. This Action Plan will be used a living document that looks out to long-term needs, and will be constantly modified and updated to reflect changing conditions and new information and knowledge of adaptation.

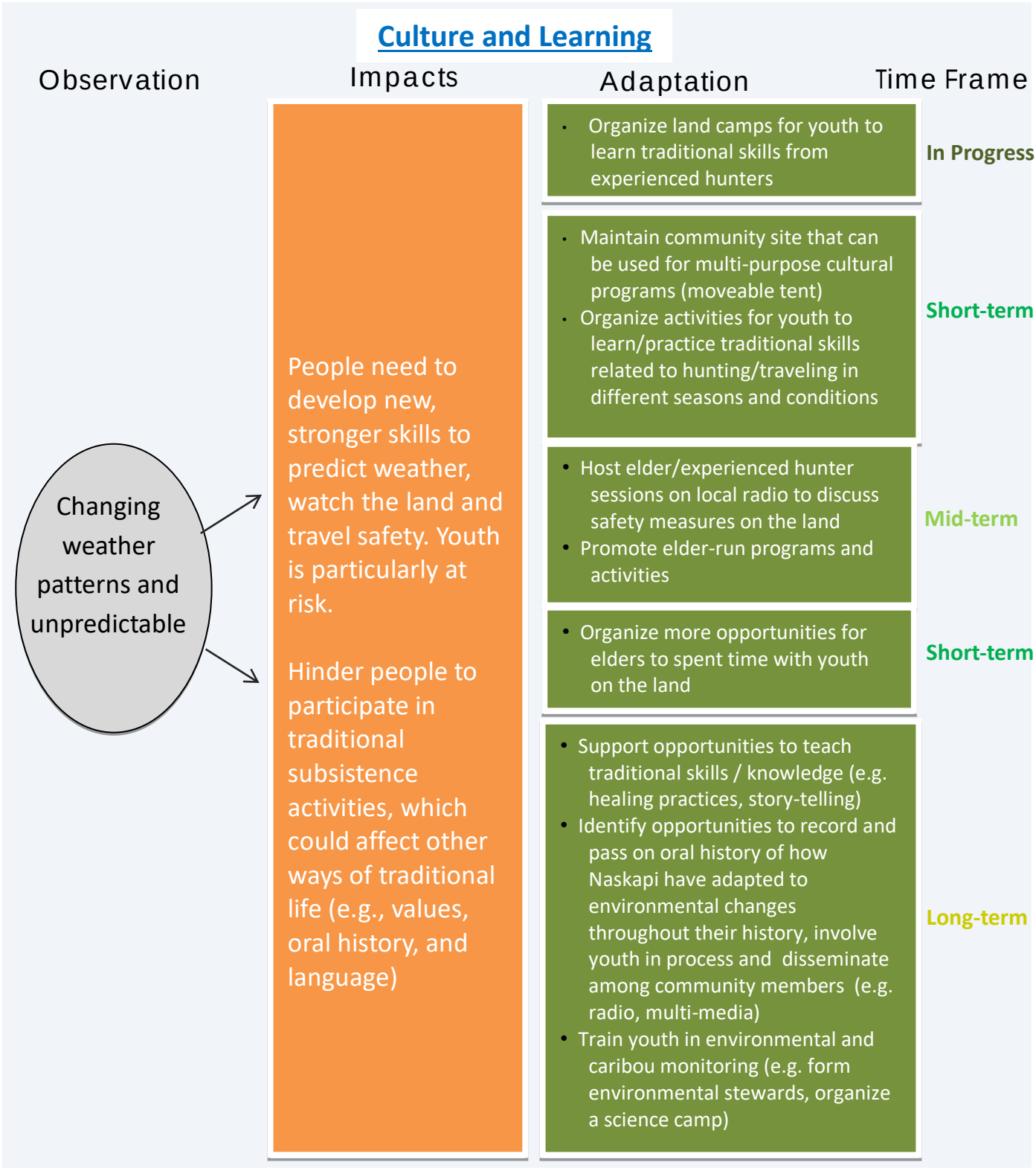



Animals
Observation
Impacts
Adaptation
Time Frame
Moore wolves
Less caribou
Decrease in group size; Changes in caribou cycle, behavior, and
Smaller, skinner caribou; Caribou less healthy; Bad fur quality
• Use of bush planes now for caribou hunting
• Hunting season/time needs to be adjusted
• It takes longer to hunt caribou (they stay in the North)
• Fewer caribou are killed in the community
• Food security
• Loss of revenue
• Set in place a Caribou Naskapi Traditional Knowledge Monitoring with defined methods (how), timelines (when), and responsibilities (who)
• Put in place a process of sharing knowledge on caribou migration between MNRF biologists and hunters
• Naskapi caribou hunt monitoring program
Mid-term
Mid-term
In Progress
Less geese
Change in geese
• Less opportunity to hunt geese
• Food security
• Monitoring geese
Mid-term
More moose
More marten and mink
• More opportunities to trap and hunt
• More research on impacts of climate change on small animals
Mid-term
More bears in summer
Change in bear
• Danger to people and camps
• Warning system
• Safety program
Short-term
Less fish
Smaller fish
• Food security
• Less birds
• Nest monitoring
Mid-term
Mosquitos and flies
Changes and unpredictability of weather conditions
• Dangerous travel to camps
• Changing conditions of camps increase risk of personal injury
• Less participation in subsistence activities
• Promote opportunities at school for teaching land skills development, and continue support summer camps
• Purchase radio/satellite phones to facilitate communication between hunters and local radio
• Emergency shelters on the land
• Provide access to safety equipment (GPS, radio) on a loaning basis
Long-term

Health and Well-



Culture and Learning



7. Cooperation Activities

7.1. Exchange between Naskapi and Sámi reindeer herders in Finland

Naskapi and Sámi share a traditional livelihood and identity based on the same species *Rangifer tarandus* – caribou / reindeer -, and face similar major environmental and economic changes due to global warming, human development (e.g., mining). Facing these challenges, both nations have similar concerns; sustain their traditional subsistence activities, generate new jobs for youth, preserve the knowledge of the elders.

The Naskapi initiated exchange and cooperation with Sámi reindeer herders in northern Finland to pool the risk factors and success factors of both nations sharing a way of life and culture based on the caribou and reindeer. Reindeer husbandry is of crucial importance to Sami traditional livelihood activities and cultural identity. The Sámi are very active in monitoring of the reindeer populations and climate change. A second main objective of this exchange was to learn how other northern indigenous communities are preparing for and adapting to the impacts resulting from climate/environmental change, and to find together ways to address *common concerns* and challenges faced by both nations.

The follow exchange activities were realized and two detailed reports (in French) have been produced (Report 1: "Visit of the Sámi delegation to Naskapi and Innu Nations in Quebec"; Report 2 "Visit of the Innu-Naskapi delegation to the Sámi in Finland"). Both detailed reports are annexed to this project report (see Annexes E and F).

Visit of Sámi delegation to Kawawachikamach (May 2013)

A delegation of 3 Sámi reindeer herders (member of the Sámi Reindeer Herders Association of Finland) and members of the Sámi Educational Institute SEI), in Inari (Finland) came to Kawawachikamach in May, 2013. During their stay they gave presentations about the reindeer monitoring, about Sámi culture, language and brought Sámi artcrafts.
The SEI manages the BEBO Network that brings together northern communities in the circumpolar region whose culture is strongly linked to the caribou / reindeer: http://www.beboedu.fi
The Naskapi Nation was officially invited to become member of this network.

A detailed report of their visit is enclosed in Annexe E.

Visit of Naskapi delegation to Inari, Finland (September 2013)

A delegation of the Naskapi Nation (George Guanish, Noat Einish, Marc-Shennon Shecanapish) went to Finland, to Inari where they were welcomed by the Sámi Educational Institute in September 2013. The Sámi Education Institute (SEI) provides education mainly for the needs of the Sámi Area, to maintain and develop Sámi culture, language and livelihoods. Activities of the SEI including the studies, education, culture, traditional livelihoods and research (reindeer/habitat monitoring) that covers the Sámi area, but extends beyond it, into the world of indigenous peoples of the North.

In Finland, the Naskapi delegation visited the Sámi Educational Institute and gave presentations to the students of the SEI in Inari. They traveled to Sámi communities in finish

Lapland and met with Sámi Reindeer Herders Association, with the Sámi Parliament, the Sámi radio, the Sámi Cultural Centre.
They also traveled to Kautokeino, the capital of the Sámi in Norway, and met and exchanged with staff of the Reindeer Research Centre, and the Sámi University.

They participated at the international Conference "Protection of Arctic Sacred Sites of Indigenous peoples" that was co-organised by the Arctic centre, the Univerity of the Artic, the Université de Montréal in Rovaniemi.

A detailed report of their visit and all activities carried out is enclosed in Annexe F.

Opportunity to Naskapi Youth
The Sami Education Institute is open to Naskapi youth who would like to stay for a semester up to a year at the Sami Educational Institute for training in reindeer herding, monitoring, meat and skin processing, Sámi arts and culture. The Institute also offers courses to young adults.

7.2. Next Steps

The next steps that will need to be taken in order to implement the key actions are outlined in the table below.

Table 6: Next Steps

Activity	Responsable	Time frame
Develop partnerships with research centres to support systematic Ice Monitoring and Safety Programs	The Research Team, Naskapi Climate Change Working Group	Short/Mid-term
Find funding opportunities to support the Naskapi Climate Change Working Group and to finance monitoring programs	NNK	Short/Mid-term
Find funding opportunities for Climate Change and Health (safety, food security) programs	NNK, the project team, and other partners	Short/Mid-term
Develop awareness and safety programs that could be used in the school	The Project Team, Naskapi Climate Change Working Group, Naskapi Education Committee, and Naskapi partners	Short/Mid-term
Integrate youth training and capacity building into all proposed project activities.	NNK	ongoing

8. References

Babeux D, Einish P, Geoffroy D, Lévesque C, Nabinacaboo S, Polèse G, Paradelle M, Robinson R, 2008. *Les Savoirs Écologiques des Naskapis: caractérisation, utilisation, transmission* – Poster du projet de mobilisation des connaissances - Initiative des Écosystèmes du Nord, Environnement Canada, 2004-2008. INRS Montréal.

Berkes F, Jolly D. 2002: Adapting to climate change: social–ecological resilience in a Canadian western Arctic community. *Conservation Ecology* 5 (2), article no. 18.

Bronaugh D, Werner A (2009) zyp: Zhang + Yue-Pilon trends package. R package version 0.9-1. http://www.r-project.org

Brown RD, 2010: Analysis of snow cover variability and change in Quebec, 1948-2005. *Hydrological Processes* 24(4): 1929–1954

Cartwright, George (Sir), 1911. *Captain Cartwright and His Labrador Journal*, reprinted in 2009, edited by C. W. Townsend. Dana Estes: Boston.

Cavaliere C, 2009: The effects of climate change on medicinal and aromatic plants. *Herbal Gram* 81: 44-57

Chan HM, Fediuk K, Hamilton S, Rostas L, Caughey A, Kuhnlein HV, Egeland G, Loring E, 2006: Food security in Nunavut, Canada: Barriers and recommendations. *International Journal of Circumpolar Health* 65 (5): 416–431.

Costello A, Abbas M, Allen A, Ball S, Bell S, Bellamy R, et al. 2009: Managing the health effects of climate change. *The Lancet* 373: 1693–1733

Couturier S, Côté SD, Otto R, Weladji RB, Huot J. 2006. *Masse des faons du caribou migrateur: effets de l'habitat, du climat, des déplacements et de la taille des troupeaux*. Ministère des Ressources naturelles et de la Faune, Direction de la recherche sur la faune et Direction de l'aménagement de la faune du Nord-du-Québec. Québec. 31 p.

Crête M, Payette S, 1990: Climatic changes and caribou abundance in northern Québec over the last century. *Rangifer* 3: 159-165.

Crête M, Huot J. 1993: Regulation of a large herd of migratory caribou: summer nutrition affects calf growth and body reserves of dams. *Canadian Journal of Zoology* 71: 2291–2296.

Czernochowski D, Mecklinger A, Johansson M, Brinkmann M, 2005: Age-related differences in familiarity and recollection: ERP evidence from a recognition memory study in children and young adults. *Cognitive, Affective & Behavioral Neuroscience* 5(4): 417-433

DesJarlais C., M. Allard, D. Bélanger, A. Blondlot, A. Bouffard, A. Bourque, D. Chaumont, P. Gosselin, D. Houle, et al.2010. *Savoir s'adapter aux changements climatiques*.Ouranos.128 p.

Downing A, Cuerrier A, 2011: A synthesis of the impacts of climate change on the First Nations and Inuit of Canada. *Indian Journal of Traditional Knowledge* 10 (1): 57-70

Festa-Bianchet M, Ray JC, Boutin S, Côté SD, Gunn A. 2011. Caribou conservation in Canada: an uncertain future. *Canadian Journal of Zoology* 89:419-434.

Ford JD, 2009: Vulnerability of Inuit food systems to food security as a consequence of climate change: a case study from Igloolik, Nunavut. *Regional Environmental Change* 9(2): 83–100

Furgal C, Prowse T, 2008: Northern Canada. In: Lemmen DS, Warren FJ, Lacroix J, Bush E (eds) *From impacts to adaptation: Canada in a Changing Climate 2007*. Government of Canada, Ottawa, pp.57-118

Gagnon AS, Gough WA, 2005: Trends in the dates of ice freeze-up and break-up over Hudson Bay, *Canada. Arctic* 58: 370-382.

Ghetti S, Angelini L, 2008: The development of recollection and familiarity in childhood and adolescence: evidence from the dual-process signal detection model. *Child Development* 79(2): 339-358

Gordon AB, Andre M, Kaglik B, Cockney S, Allen M, Tetlichi R, Buckle R, Firth A, Andre J, Gilber M, Iglangasak B, Rexford F, 2008: Arctic Borderlands Ecological Knowledge Co-op Community Reports 2006-07. Arctic Borderlands Ecological Knowledge Society, Whitehorse, Yukon.

Hirsch RM, Slack JR, Smith RA,1982: Techniques of trend analysis for monthly water quality data. *Water Resources Research* 18:107–121.

Kendall MG, Gibbons JD, 1990: *Rank correlation methods*. London: E. Arnold.

Krupnik I, Jolly D. (Eds). 2002. *The Earth is Faster Now: Indigenous Observations of Arctic Environmental Change*. Fairbanks AK: Arctic Research Consortium of the United States.

Laidler GJ, Ford JD, Gough WA, Ikummaq T, Gagnon AS, Kowal S, Qrunnut K, Irngaut C, 2009: Travelling and hunting in a changing Arctic: assessing Inuit vulnerability to sea ice change in Igloolik, Nunavut. *Climatic Change* 94:363-397

Mameamskum J, Herrmann TM, Füleki B, 2010: The "Caribou Heaven": Recognizing a Sacred Site and Integrating Naskapi Ecological Knowledge in the Management of the Proposed Kuururjuaq National Park (Nunavik, Canada). *Policy Matters* 17 (Special Issue 'Rights-based Approaches to Biodiversity Conservation'): 120-126

Masty D, 1991: Traditional use of fish and other resources of the Great Whale River region. *Northeast Indian Quarterly* 8(4) : 1214.

MRN – Ministère des Ressources naturelles du Québec, 2012 : *Caribous du troupeau de la rivière George - les résultats de l'inventaire*. Communiqué du 16 August 2012. [online] http://www.mrn.gouv.qc.ca/presse/communiques-detail.jsp?id=9880 (accessed on 01 Novembre 2012)

Moser SC, 2010: Now more than ever: the need for more societally relevant research on vulnerability and adaptation to climate change. *Applied Geography* 30:464-474

Overland JE, Wang M, 2005. The Arctic climate paradox: the recent decrease of the Arctic oscillation. Geophysical Research Letters 37:

Parlee, B., Manseau, M., Lutsël K'é Dene First Nation. 2005. Using traditional knowledge to adapt to ecological change: Denésoliné monitoring of caribou movements. *Arctic* 58(1):26–37.

Peloquin C, Berkes F, 2010: Local knowledge and changing subsistence strategies in James Bay, Canada. In: Bates D.G., Tucker J (eds) *Human ecology: contemporary research and practice*, Springer, New York

Porter I. 2011: Mystère dans la toundra. *Québec-Science* (Mars 2011): 26-30.

Sharma S, Couturier S, Côté SD. 2009: Impacts of climate change on the seasonal distribution of migratory caribou. *Global Change Biology* 15:2549-2562.

Speck FG, 1935. *Naskapi, The Savage Hunters of the Labrador Peninsula*. University of Oklahoma Press: Norman.

Taillon J, Festa-Bianchet M, Côté SD, 2012: Shifting targets in the tundra: Protection of migratory caribou calving grounds must account for spatial changes over time. *Biological Conservation* 147 (2012) 163–173.

Turner N, Clifton H, 2009: It's so different today: climate change and indigenous lifeways in British Columbia, Canada. *Global Environmental Change* 19: 180–190

Weatherhead E, Gearheard S, Barry RG, 2010: Changes in weather persistence: insights from Inuit knowledge. *Global Enviornmental Change* 20: 523–528

Yagouti A, Boulet G, Vincent LA, Vescovi L, Mekis É, 2008: Observed changes in daily temperature and precipitation indices for Southern Quebec, 1960-2005. *Atmosphere-Ocean* 46(2):243-256

Yue S, Pilon P, Phinney B, Cavadias G, 2002. The influence of autocorrelation on the ability to detect trend in hydrological series. *Hydrological Processes* 16:1807–1829.

9. Annexes

Annexe A: Report - Naskapi Community Workshop
Annexe B: Questionnaire Naskapi Climate Change Adaptation and Caribou Project
Annexe C: Questionnaire Assessment of Nutritional Health Changes for the Naskapi Nation
Annexe D: Report - Training of Naskapi Environmental Monitors, and Caribou Survey in Schefferville/Kawawachikamach
Annexe E: Rapport Volet 1 Projet Echange Innu-Naskapi-Sami : Visite Samis chez les Innus-Naskapis (Mai2013)
Annexe F: Rapport Volet 2 Projet Echange Innu-Naskapi-Sami :Visite Innus Naskapis chez les Samis (Sept2013)