VULNERABILITY TO CHANGES IN WINTER TRAILS AND TRAVELLING: A CASE STUDY FROM NUNATSIAVUT

by

© Rudolf Riedlsperger

A thesis submitted to the
School of Graduate Studies of
Memorial University
in partial fulfillment of the
requirements for the degree of

Master of Arts

Department of Geography/Faculty of Arts

Memorial University of Newfoundland

May 2014

St. John's Newfoundland and Labrador

ABSTRACT

This thesis explores the vulnerability of Nunatsiavut residents to changes in winter trails and travelling on land based and sea ice trails, brought about by weather and climate stresses in combination with livelihood changes. Data were collected using map biography interviews with 28 community members of Makkovik and Postville between January and March 2012. Participant observation and regional climate data were utilized to gain contextual understanding of the data collected during map biography interviews. Accessible winter trails are critical to the livelihoods of the communities. They provide access to the land and ice and facilitate subsistence activities such as hunting and collecting firewood. Winter trails also permit overland travel between communities that are not connected by conventional roads. Residents are currently affected by changes related to winter trails and travelling considered outside the range of previously experienced variability. Physical changes in winter trails are brought about mainly by a deterioration of snow and ice conditions, as well as changes in wildlife availability. Sea ice routes are more affected than land based routes. Interview participants reported changes in the act and experience of travelling due to a compromised sense of safety while being on winter trails, and due to changes in trail use activities away from subsistence participation towards recreational and sports activities in combination with technological changes. These changes have immediate, tangible effects on community and individual livelihoods, including negative economic implications for households and threats to livelihood security, health and safety for individuals. There are also intangible dimensions of change as unimpeded access to the land and ice is further linked to a sense of place, identity, purpose, and stewardship for community members. Currently, ad-hoc coping mechanisms outweigh planned adaptation strategies. Communities and individuals respond to changes in winter trails and travelling through adaptation of trail routes and improved trail maintenance and equipment, adaptation of subsistence activities, proactive mobilization of traditional knowledge and skills, as well as collaboration and sharing among individuals and communities. Barriers to adaptation include livelihood changes undermining subsistence participation, constraints in financial and human resources, and bureaucratic stipulations such as mandatory hunting and trapping permits, restrictions in hunting and trapping areas, and liability questions. Potential resource development projects and initiatives to boost adventure tourism in the winter pose both future vulnerabilities in terms of additional disruption of travel routes and subsistence activities, as well as chances to enhance adaptive capacity through economic growth and the capitalization on traditional knowledge and skills. Accessible winter trails will remain critical for the continuity of traditional knowledge and skills, livelihood security, health, and subjective wellbeing of individuals and communities.

ACKNOWLEDGEMENTS

I would like to thank my supervisors Trevor Bell and Johanna Wolf, my parents, my research assistants Marilyn Winters and Jessica Sheppard, my local mentors in Makkovik and Postville Joan Anderson and Cora Edmunds, the people of Makkovik and Postville, and my friends who have followed me along my journey from Salzburg, Austria to St. John's, Newfoundland by way of Salem, Oregon and Fairbanks, Alaska.

I would also like to thank Scott Hatcher, Robert Way, and Andy Flood for their invaluable help with data collection and analysis, and the faculty and staff of the Department of Geography at Memorial University. I would like to thank Charles Conway, who provided me with beautiful maps, and Cheryl Tetford, Pamela Murphy, and Harriet Taylor who have helped me with many things, including the administration of travel claims.

I am very grateful for the graduate fellowship from Memorial University and the generous financial contributions of ArcticNet and the Provincial Government of Newfoundland and Labrador (Department of Environment and Conservation). Their funding made this research project possible.

TABLE OF CONTENTS

ABSTRACT……...ii
ACKNOWLEDGEMENTS……..iii
TABLE OF CONTENTS……..iv
LIST OF TABLES……..vii
LIST OF FIGURES…….viii
LIST OF APPENDICES……x
LIST OF ACRONYMS…….xi

CHAPTER 1. INTRODUCTION…….. 1
1.1. Introduction……1
1.2. Aims and objectives……5
1.3. Setting and research context……....6
1.3.1.On cross-cultural research and positionality……9
1.4. Thesis structure…….. 10

CHAPTER 2. CONCEPTUAL FRAMEWORK……...11
2.1. Conceptual framework……... 11
2.2. A values-based vulnerability approach to changes in winter trails and travelling…… 11

CHAPTER 3. METHODOLOGY AND METHODS……... 18
3.1. Methodology and methods……. 18
3.2. Methodology…….. 18
3.3. Methods……. 20
3.3.1. The map biography method……. 20
3.3.2. Participant observation…… 24
3.3.3. Instrumental data……. 25

3.4. Data collection and data analysis ……. 26

CHAPTER 4. STUDY AREA: THE INUIT SETTLEMENT REGION OF NUNATSIAVUT ……..33

4.1. Study area: The Inuit Settlement Region of Nunatsiavut……... 33

4.1.1. Makkovik……38

4.1.2. Postville……... 40

4.2. Characteristics of winter trails and travelling in the study region…….. 41

4.2.1. Winter trails……. 41

4.2.2. Winter trail travelling…….. 46

4.2.2.1. Subsistence activities dependent on winter trails……. 47

4.2.2.2. Travelling between communities….……49

4.2.2.3. Recreational trail use….……49

4.2.2.4. Economic trail use…..…….. 50

4.3. Climate variability and change in Nunatsiavut ……. 51

4.3.1. Observed change in Nunatsiavut……. 52

4.3.2. Projected change in Nunatsiavut……. 57

CHAPTER 5. RESULTS: VULNERABILITY TO CHANGES IN WINTER TRAILS AND TRAVELLING……..... 61

5.1. Vulnerability to changes in winter trails and travelling……..61

5.2. Physical changes in winter trail routes and winter trail conditions…… 61

5.3. Changes in the act and experience of travelling……. 72

5.3.1. Travel hazards are perceived to be increasing……. 73

5.3.2. Trail use activities are changing…….. 77

5.4. What do these changes mean to community members?..... 85

5.4.1. Sense of security with respect to satisfying basic human needs……. 85

5.4.2. Sense of identity, purpose, and stewardship…… 87

5.4.3. Sense of space and independence…… 90

5.5. Current adaptive capacity to changes in winter trails and travelling…….. 92

5.5.1. Adaptation of trail routes and improved trail maintenance……..93
5.5.2. Adaptation of subsistence activities…… 99
5.5.3. Adaptation through proactive mobilization of traditional knowledge and skills……..101
5.5.4. Adaptation through collaboration…… 103
5.6. Current barriers to adaptation……. 105
5.6.1. Physical limitations of trail route adaptation……... 105
5.6.2. Resource limitations…… 108
5.6.3. Regulatory constraints…….…… 110
5.7. Future vulnerability to changes in winter trails and travelling…….. 111
5.7.1. Tourism and its effects on winter trails and travelling…… 111
5.7.2. Resource development and its effects on winter trails and travelling..113

CHAPTER 6. DISCUSSION…….117
6.1. Discussion……... 117
6.1.1 Winter trails as an important factor to life quality……..……..117
6.1.2. Opportunities for dissemination and mobilization of traditional knowledge and skills relevant for winter travelling……...120
6.1.2.1 Outdoor workshops……121
6.1.2.2. Policy discussion forums…….. 122
6.1.2.3. Teaching curricula development or improvement:……... 123
6.1.2.4. Online knowledge transfer taking the form of communication and collaboration……..124
6.1.2.5. Plain language publications…….. 124
6.1.3. Opportunities and challenges of tourism and resource development.. 125

CHAPTER 7. CONCLUSION…….. 132
7.1. Conclusion…….. 132
References……..139
Appendices…….155

LIST OF TABLES

Table 3-1. Topics covered in the semi-structured interview component of the map biography session……..…….....30

Table 3-2. Themes and sub-categories for data analysis……32

Table 4-1. Summary of projected changes in climate variables for the Nunatsiavut communities (Nain to Rigolet) to 2050……. 60

LIST OF FIGURES

Figure 1-1. Presenting the proposed research to the Inuit Community Governments (ICGs). …… 8

Figure 2-1. Elements of the vulnerability assessments framework……... 14

Figure 2-2. Elements of double-exposure……..15

Figure 3-1. Key considerations for community involvement in Northern research.. 19

Figure 3-2. The four autonomous Inuit regions of Canada……22

Figure 3-3. Map biography setting…… 28

Figure 4-1. Map of Labrador including Nunatsiavut …… 35

Figure 4-2. Winter trails in Nunatsiavut.……... 42

Figure 4-3. The groomed trail network in Labrador……. 44

Figure 4-4. Different examples of trail use in Makkovik and Postville……..... 50

Figure 4-5. Mean annual air temperatures in Labrador……. 53

Figure 4-6. Northern Labrador winter temperature change based on NCEP reanalysis data R1…..……..... 54

Figure 4-7. Average winter temperatures of heavy precipitation in Makkovik and Postville…..…… 55

Figure 4-8. Projected change in mean annual temperature and precipitation in Nunatsiavut…… 59

Figure 5-1. Current travel routes used by residents of Makkovik and Postville….. 63

Figure 5-2. Differences in ice characteristics on the marked trail from Postville to Makkovik……... 64

Figure 5-3. Current subsistence areas used by residents of Makkovik and Postville……..66

Figure 5-4. Caribou hunting sites accessed by residents of Makkovik and Postville……..……..... 67

Figure 5-5. Dangerous travel areas identified by residents of Makkovik and Postville ……..…….. 70

Figure 5-6. A resident of Makkovik showing a seal net (A) and a snowshoe (B) he made from scratch.……..…….. 89

Figure 5-7. Trapper in front of a typical cabin near Postville……91

Figure 5-8. Differences in length between actual and imaginative winter trails…... 95

Figure 5-9. Newly cut groomed trail……..98

Figure 5-10. Ship's track pontoon crossing in Voisey's Bay, Nunatsiavut……... 107

Figure 5-11. Uranium mining claims near Makkovik and Postville……..114

Figure 5-12. Tentative winter outfitting areas for Makkovik and Postville…….. 115

LIST OF APPENDICES

Appendix A. Nunatsiavut government research permit…… 155

Appendix B. Data collection manual including consent forms…….. 157

Appendix C. Research awareness flyer……...…….. 207

Appendix D. Academic poster on research methodology and methods…… 208

LIST OF ACRONYMS

ATV: all terrain vehicle

CBR: community based research

CVC: climate variability and change

ICG: Inuit Community Government

FAO: Food and Agriculture Organization of the United Nations

GCM: General Circulation Model

LAO: Labrador Affairs Office

LIA: Labrador Inuit Association

LILCA: Labrador Inuit Land Claims Agreement

LISA: Labrador Inuit Settlement Area

NAO: North Atlantic oscillation

NCEP: National Centers for Environmental Prediction

NCDC: National Climatic Data Center

NOAA: National Oceanic and Atmospheric Administration

RA: research assistant

RCM: Regional Climate Model

CHAPTER 1: INTRODUCTION, SETTING AND RESEARCH CONTEXT, AND THESIS STRUCTURE

1.1. Introduction

The regional focus of this research project is in Nunatsiavut, Labrador. Since Nunatsiavut became an autonomous Inuit region in 2005 its government has strived to facilitate "vibrant self-sufficient Labrador Inuit practicing their unique culture and traditions throughout Canada and in healthy Nunatsiavut communities in sustainable environments" (Nunatsiavut Government 2012a, 2). In a region where the majority of people hunts and gathers many of the resources required to satisfy their needs (Felt et al. 2012), this vision is inextricably linked to unimpeded access to the land and ice.

Winter trails in good condition, accessible and functional winter trails for subsistence activities, and opportunities to travel safely and efficiently are among the foundations for individual and community livelihoods and well being in remote Northern communities. Inhabitants of Canada's North have utilized the Arctic and Subarctic efficiently for generations through the use of winter trails and the characteristics and importance of winter trails and winter travel in that respect are well documented (see, for example Aporta 2004; 2009). The importance of favorable snow and ice conditions for winter travelling has been thoroughly examined too (e.g. Riewe 1991; Laidler 2007; Laidler and Ikummaq 2008; Aporta 2011; Aporta and MacDonald 2011). Sea ice has even been likened to "glue that binds … northern communities together" (Wilkinson et al. 2011, 1). As part of the Canadian Arctic and Subarctic, winter trails

are the key that provides access to the land and ice for most parts of the year in Nunatsiavut. Appropriately, many *Nunatsiavummiut* ("people of Nunatsiavut") also refer to themselves as *Sikumiut,* or "people of the sea ice". *Sikumiut* have traditionally travelled on the ice to harvest seals, polar bears, walrus, whales, migratory birds, and white fox (Natcher et al. 2012). Subsistence areas inland are equally as important. Nunatsiavummiut *"*go off" on the land in the winter to collect firewood and harvest species such as caribou, partridges, and hare (Ames 1977; Schwartz 1977). Commonly, these subsistence activities are based from *aullasimavet*, a term that refers to land areas where people have cabins and camping or tenting sites outside of the communities (Rowell and Metcalfe, 2005; LISA Draft Land Use Plan 2010). In order to access *aullasimavet* and subsistence sites, Nunatsiavummiut utilize an elaborate network of winter trails.

It is important to distinguish between winter trails on the one hand, and winter trail travelling on the snow and ice on the other. Winter trails refer to the physical manifestation of travel routes. Winter trails can be groomed, marked, or semi-permanent features on the landscape, leading over snow, freshwater ice including rivers and lakes, and sea ice. While land based winter trail routes depend on stable snow, lake, and river ice conditions, sea ice routes are most dependent on favorable sea ice and wind conditions. As a rule of thumb, about 15 cm of snowcover are required for acceptable travelling on land based trails (McBoyle et al. 2007). For routes based on freshwater and sea ice, the ice thickness required for save travelling varies. Travelers may test sea ice conditions with tools (such as harpoons) and rely on their

judgment on whether or not the ice is thick enough to travel on (Laidler et al. 2009). Because many routes utilize both land and sea ice, trails are not usefully distinguished by their terrains. Among the main characteristics of winter trails is their establishment around a function or use: (i) they ensure access to critical resources, (ii) they permit overland travel between communities that are not connected by conventional paved or gravel road networks, and (iii) they allow for recreational activities such as backcountry and freestyle snowmobiling. Importantly, (iv) winter trails also make it possible to access sites that have value for spiritual or ancestral reasons. Examples in Nunatsiavut include the former communities of Ramah, Okak, Nutak, and Hebron, which were home to many Inuit before the provincial government ordered them to resettle in the 1950s and 1960s (Ben-Dor 1966; Brice-Bennet 1977).

Winter trail travelling (henceforth simply referred to as "travelling") alludes to the act and experience of travelling over snow and ice. To do so requires considerable knowledge and skills, including a thorough understanding of the region's geography, weather, snow and ice conditions, wildlife location or availability and behavior, and further skills required for subsistence activities. The knowledge and skills associated with travelling are part of *Inuit Qaujimajatuqangit,* the collective body of knowledge held by Labrador Inuit. Knowledge about how to navigate on snow and ice is passed on to younger generations through actual use and practical teaching (Rowel and Metcalfe 2005). In addition to the intellectual component of winter travel, the physical demands of negotiating over snow and ice are not to be underestimated.

Evidence is mounting that winter trails and winter travelling are increasingly subject to the negative impacts of climate variability and change (CVC) in Northern Canada[1]. Examples include biophysical impacts of changes in temperatures and precipitation that have led to compromised travel routes and increasing travel risks (Laidler et al. 2009; Pierce et al. 2009; Wolf et al. 2012; Fleming et al. 2012). Residents of communities throughout Labrador have already voiced their concern about the negative impacts of CVC on travel and infrastructure safety (Bell et al. 2008; 2009). At the same time, it is known that socioeconomic factors are influencing or exacerbating environmental stresses, and therefore need to be examined as well (O'Brien and Leichenko 2000; Ford et al. 2004; O'Brien and Wolf 2010; Wolf et al. 2012).

Using the example of two Nunatsiavut communities, this thesis provides a structured analysis of the extent to which CVC in combination with socioeconomic factors affect winter trails and travelling on the north coast of Labrador. Changes were identified through adapted land use and occupancy mapping of the region. Employing the map biography method for data collection allowed documentation of land use and occupancy, specifically current winter trails and current winter trail use, and changes therein. 'Occupancy' in the context of this research refers to the terrain that people utilize for winter travel. An understanding of where people travel led to distinguished exposure sensitivities to CVC by area and trail network. Documented changes were

[1] Throughout this thesis "Northern Canada" is defined as the three Canadian territories in addition to the northern parts of Canada's provinces, specifically Labrador with a focus on Nunatsiavut.

examined for their implications on individual and community livelihoods. In the process, the adaptive capacity of individuals and communities to existing and future vulnerabilities were identified and described. This study also comprehensively carved out the meaning that residents in Makkovik and Postville associate with changes in trails and travelling. This is largely a new observation from the perspective of CVC impacts and adaptation. Finally, I present knowledge mobilization options to provide regional decision makers with information on effective adaptation strategies that are in line with achieving a vibrant and self-sufficient Nunatsiavut. Targeted end-uses for this research are stakeholders including community members, local officials and policy makers within and outside of Nunatsiavut.

1.2. Aims and objectives

The primary aim of this research project is to understand how changes related to winter trails and travelling are affecting individual and community livelihoods in the communities of Makkovik and Postville, Nunatsiavut. The main objectives of the research project are to:

i. describe the nature and the significance for individual and community livelihoods and well-being of winter trails and travelling in Makkovik and Postville, Nunatsiavut.

ii: determine current and future vulnerabilities as a function of exposure sensitivity and adaptive capacity to changes in winter trails and travelling, and the implications of vulnerabilities for individual and community livelihoods.

iii: determine current and future barriers to adaptation, and factors that might enhance the adaptive capacity of the study communities.

iv: present knowledge mobilization options to provide regional decision makers with information on effective adaptation strategies that are in line with achieving a vibrant and self-sufficient Nunatsiavut.

1.3. Setting and research context

During the conference *Climate Change and Renewable Resources in Labrador: Looking toward 2050,* held in the Labrador community of North West River in 2008, participants identified travel and infrastructure safety as an important challenge when dealing with the negative impacts of CVC (Bell et al. 2008; 2009)[2]. Wolf et al. (2010) further identified winter travel in Labrador as an area requiring in-depth research in order to explore anticipatory mechanisms to mitigate negative impacts of CVC.

After supervisors Trevor Bell and Johanna Wolf and myself decided to pursue the research topic, the next step was to select study communities in Nunatsiavut. Potential research communities were based on the following factors: community interest, community characteristics and location, and the kind of research previously undertaken in the region. The coastal location of the Nunatsiavut communities was deemed beneficial for a comprehensive evaluation of change related to both inland and

[2] I did not attend this conference, however, supervisor Dr. Trevor Bell was a lead organizer.

sea ice trails and travelling. After corresponding with the *AngajukKâks* (community leaders or mayors) and town managers of the communities of Makkovik, Postville, and Hopedale, a pre-research field trip to Nunatsiavut was arranged for June 2011. Through personal communication and observations, it became clear during the visits that unimpeded access to the land and ice was very important for people in Makkovik and Postville, both from economic and cultural points of view. This impression was confirmed when the Inuit Community Governments (ICGs) of both communities lent their support to the research after a presentation of the research proposal (Figure 1-1). Though the research problem was already defined, it was with the help of the ICGs and community members that research questions were refined and the map biography approach deemed an appropriate research tool (see Chapter 3: Methodology and Methods). Though no formal interviews were conducted at the time, the preliminary research trip also helped to obtain an initial overview of potential research participants. Additional information about the research project was shared through flyers, announcements on the local radio stations, and personal conversations.

Consequently, Makkovik and Postville were chosen as appropriate communities for this research project and research permits and ethics clearances were obtained from the Nunatsiavut Government and Memorial University, respectively (see Appendix A). The ICGs were helpful in finding affordable accommodation and providing workspace, and with the hiring of one research assistant (RA) each for Makkovik and Postville. RAs Marilyn Winters (Makkovik) and Jessica Sheppard (Postville) were an integral part of the research project. Their being involved with local organizations,

such as the Makkovik Historical Society, indicated that they were well connected and respected within the communities. The RAs helped identify and contact potential interview participants, they were knowledgeable about community customs, and they were present during the map biography interviews taking notes of place names, community events, and other information that might be difficult to grasp for outsiders to the region.

Figure 1-1. Presenting the proposed research to the Inuit Community Governments (ICGs). Presentations took place in Makkovik (A) and Postville (B) in June 2011. Photo A by Makkovik ICG. Photo B by R. Riedlsperger.

With the help of a data collection manual (see Appendix B), the RAs became familiar with the research project to the extent that they were able to address basic questions and inquiries from the community. All participants opted to conduct their interviews in English. Funding for this research was provided in part by the Government of Newfoundland and Labrador (Department of Environment and Conservation), the Networks of Centres of Excellence of Canada through ArcticNet, and Memorial University (Department of Geography).

1.2.1 On cross-cultural research and positionality

Cross cultural research takes place when those involved in a research project share different cultural heritages, backgrounds, or practices (Skelton 2001). A researcher's positionality refers to how their identity may influence the relationship with their interview participants (or subjects of study in general), making necessary to acknowledge that different power relationships may exist (Valentine 1997). The lead-researcher of the project was myself (Rudy Riedlsperger). I am a male Geographer in training growing up in the Austrian Alps. Since 2005 I have been living in North America, including places such as Salem, Oregon, Fairbanks, Alaska, and St. John's, Newfoundland and Labrador. Over the course of three years, in Alaska I got introduced to Northern cultures through extensive travelling and interactions with different Native and First Nation communities from the United States and Canada through meetings, workshops, and conferences. Among the most important realizations was the immense diversity of Aboriginal groups throughout Alaska and Canada. It therefore did not surprise me that in Nunatsiavut in many ways my

ethnicity, education, or philosophical outlooks on various issues did not differ greatly from those of my interview participants. Still, as a non-Inuit 'outsider' to not only Nunatsiavut but Canada in general, I tried to maintain a neutral role in some of the issues that affect Aboriginal communities (some of which will be treated in the discussion chapter of this thesis), and I believe this approach was well respected and appreciated among community members.

1.4. Thesis structure

Chapter 1 introduces the thesis subject, its structure, setting and context. Chapter 2 explains the conceptual framework. Chapter 3 discusses methodology and methods. Chapter 4 focuses on the field work region, specifically the communities of Makkovik and Postville, and presents a review of the existing winter trail system and its characteristics. In addition, the climate of the study area is discussed. Chapter 5 presents results from field work in the winter and spring of 2012. Chapter 6 provides a discussion on how this research can potentially inform adaptation strategies that may contribute to healthy Nunatsiavut communities and sustainable environments. Chapter 7 concludes the thesis with a discussion on project limitations and future steps. The thesis contains four appendices. Appendix A is the research permit issued by the Nunatsiavut Government. Appendix B consists of the data collection manual including consent forms. Appendix C displays a flyer distributed in the communities. Appendix D includes an academic poster on the employed research methodology presented at the 2012 International Polar Year conference in Montreal.

CHAPTER 2. CONCEPTUAL FRAMEWORK

2.1. Conceptual framework

This chapter gives an overview of the conceptual framework employed to fulfill the aims and objectives of the research project. This research is in large part influenced by the body of literature on climate change vulnerability and adaptation that analyzes both environmental and socioeconomic change. Within the vulnerability and adaptation framework special emphasis was placed on the concept of double exposure (Leichenko and O'Brien, 2008), and the integration of personal values, perceptions, and preferences into the assessment of vulnerability and adaptive capacity (O'Brien and Wolf, 2010).

2.2. A values-based vulnerability approach to changes in winter trails and travelling

To fulfill the aims and objectives outlined in section 1.2., a values-based vulnerability approach to changes in winter trails and travelling was employed. On a basic level, vulnerability based research on the human dimensions of climate change aims to understand the exposure of individuals and communities to climatic stresses, how sensitive they are to these stresses, and what their current and future adaptive capacity is (Ford and Smit 2004). In doing so, the approach proactively seeks to reduce vulnerability by helping communities and regions to adapt to the negative effects of climate change and take advantage of new opportunities. This may happen through the

presentation of adaptation options provided in the form of recommendations, strategies, or policies.

The vulnerability approach draws some of its main influences from natural hazards literature, with pioneer scholars already focusing on cultural and personal variables in the perception of natural hazards and management thereof (Hewitt and Burton 1971; Burton 1972; UNDRO 1979). Further influences stem from the fields of physical geography, human geography, and political ecology, focusing on climate change impacts, livelihoods, and food security (Timmerman 1979; Sen 1981; Bohle et al. 1994; Adger and Kelly 1999; Dilly and Boudreou 2001), and literature on resilience within social ecological systems (Berkes et al. 2000; Walker et al. 2002; Gallopin 2006, Miller et al. 2010).

The vulnerability approach evolved from a more theoretical line of thinking, employed to understand the negative impacts of climate change (see for example Kelly and Adger 2000; O'Brien and Leichenko 2000; O'Brien et al. 2004; 2007; Ford and Smit 2004; Adger 2006; Ford et al. 2006; Smit and Wandel 2006; Füssel and Klein 2006; Smit et al. 2008). Pre-vulnerability (or standard) approaches focused on climate change scenarios and on modeling the impacts of the changing climate variables (Adger 2006). The common practice then was to assume various adaptation options to see how well they would moderate the proposed adverse impacts if they were implemented (Ford and Smit 2004). A main critique of pre-vulnerability approaches stemmed from their apparent neglect of actual community conditions. This led to a search for new

social science paradigms in community change research. Duerden (2004, 210) stated that "a systematic investigation of current conditions in communities across the North is needed with some expediency." Doing so would allow comparative assessments of community vulnerability to the negative effects of climate change and to inform decision making on how to respond to these vulnerabilities. Out of these needs an analytical research framework to empirically assess vulnerability was established by Ford and Smit (2004). The specific framework adopted for this thesis was further expanded by Ford et al. (2006) and Smit et al. (2010), among others. The main elements of the framework are depicted in Figure 2-1 and include: "Vulnerability", which is understood as a function of exposure sensitivity and adaptive capacity, "exposure", which refers to the nature and degree to which a system experiences environmental or socioeconomic stress, "sensitivity", which describes the degree to which a system is affected by disturbances, and finally "adaptive capacity", which is understood as the "the ability or potential of a system to respond successfully to climate variability and change" (Adger et al. 2007, 727). Individuals or communities with sufficient adaptive capacity are more likely to be able to cope with stress because their capacity to adapt offsets some of their exposure. Individuals or communities with low adaptive capacity are therefore more vulnerable (Warren and Egginton 2008).

Vulnerability of individuals and communities to impacts of CVC has been largely assessed through case studies and similar methods (Ford et al. 2010). The temporal scale of vulnerability assessments is usually divided into current conditions and future trends and dynamics. A comparison of the increasing number of case studies

throughout the Arctic and Subarctic has aided the development of adaptation strategies to address the impacts of CVC (Smit et al. 2008).

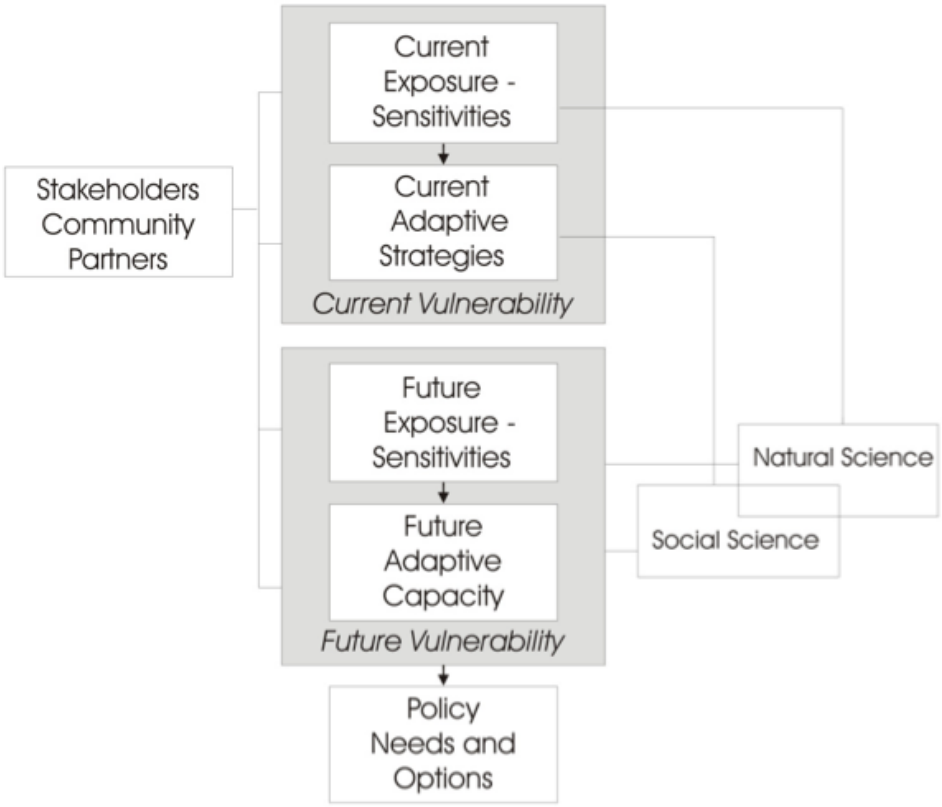


Figure 2-1. The vulnerability assessments framework. Source: Smit, B., Hovelsrud, G., Wandel, J., and Andrachuk, M. 2010. Introduction to the CAVIAR project and framework. In: Hovelsrud, G. and Smit, B. eds. Community adaptation and vulnerability in Arctic Regions. Springer. 1-22.

Incorporated in vulnerability and adaptation frameworks is the idea that climate change is not the only factor contributing to change. O'Brien and Leichenko (2000) provided the concept of double exposure to better understand the interactions of the different kinds of stresses contributing to climate change vulnerability. Figure 2-2

provides an illustration of the main components of double exposure. The concept holds that climate related stresses interact with socioeconomic factors, thereby altering or increasing existing vulnerabilities to climate change for individuals and communities:

> Pathways to increased vulnerability (or enhanced resilience) are multidirectional, so that socioeconomic conditions may mediate the impacts of environmental change, but changing environmental conditions may also alter socioeconomic capacities to maintain particular livelihood strategies (Silva et al. 2010, 9).

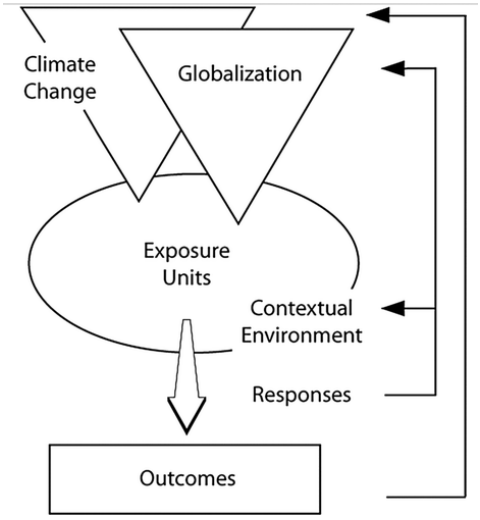


Figure 2-2. Elements of double-exposure. Source: Leichenko, R., O'Brien, K., and Solecki, W. 2010. Climate change and the global financial crisis: A case of double exposure. Annals of the Association of American Geographers, 100(4). 963-972.

Focusing on double exposure is important because of the significant livelihood changes that have occurred in recent decades throughout the Canadian North. These changes have largely not been related to CVC, but rather to socioeconomic (or political) factors such as the ordered resettlement of semi-nomadic aboriginal peoples, and new circumstances caused by economic resource development (Bone 2009). In addition to the interdependency of climatic and socioeconomic factors, vulnerability

and is also influenced by the scale of assessment: local, regional, and national scales may experience different vulnerabilities in terms of nature and extent (O'Brien et al. 2003). The main focus of this research is on the local scale.

Besides the significance of socioeconomic factors, there is also an important experiential dimension to climate change vulnerability and adaptation. O'Brien and Wolf's (2010) values-based approach provides a better understanding of what climate related changes mean to individuals and communities. Their qualitative and interpretive approach "recognizes and makes explicit that there are subjective, qualitative dimensions to climate change that are of importance to individuals and cultures" (O'Brien and Wolf 2010, 235). Rather than focusing solely on the tangible aspects of vulnerability and adaptation, such as economic costs of implementing certain adaptation strategies, this approach emphasizes how the effects of climate change influence people's cultural identity, their way of life, their sense of place, and their visions for the future (Ibid.). Because this project has been conducted in an Inuit setting, it is important to point out that research has shown that imperialism and colonialism have caused tremendous distress in Aboriginal regions in Canada (see, for example Richmond and Ross 2009; Kral et al. 2011; Crawford 2013). Importantly, therefore, the values-based component allows the inclusion of Inuit worldviews, also with respect to colonialism and Aboriginal rights. It has to be noted, however, that this research did not explicitly distinguish between Inuit and non-Inuit interview participants. In other words, interview participants were chosen regardless of their ethnicity.

To summarize, the conceptual framework employed in this project provides comprehensive guidance to determine and analyze existing and future vulnerabilities to both tangible and intangible impacts of CVC in combination with socioeconomic factors. Furthermore, the framework permits analysis of the adaptive capacity of both individuals and communities in this respect.

CHAPTER 3: METHODOLOGY AND METHODS

3.1. Methodology and methods

The methodology employed in this study has been influenced by the conceptual framework employed (see Chapter 2), taking specific inspiration from community based research (CBR). Main methods employed include map biography, participant observation, and utilization of instrumental data.

3.2. Methodology

CBR is "rooted in alternative research methods designed to overcome various forms of oppression (or omission)" (Markey et al. 2010, 159)[3]. Through training and skills transfer, CBR aims at enabling community members to assume control of the research, "thus instilling a sense of project ownership that can empower and mobilize local initiatives in order to further their own self-defined development" (Natcher 2001, 118). While this research project does not lay claim to political empowerment of Inuit communities, the principle of having the voices of community members (regardless of their being Inuit or non-Inuit) heard through active participation in the research process is fundamental.

[3] With the exception of the above statement, which refers to all people of indigenous descent in the United States and Canada, "Aboriginal" in the context of this thesis is used as an encompassing term describing First Nations, Inuit, Innu, and Inuit-Métis in Canada. "Alaska Native" refers to Aleut, Athabaskan, Eyak, Haida, Inupiaq, Tlingit, Tsimishian, and Yupik cultures.

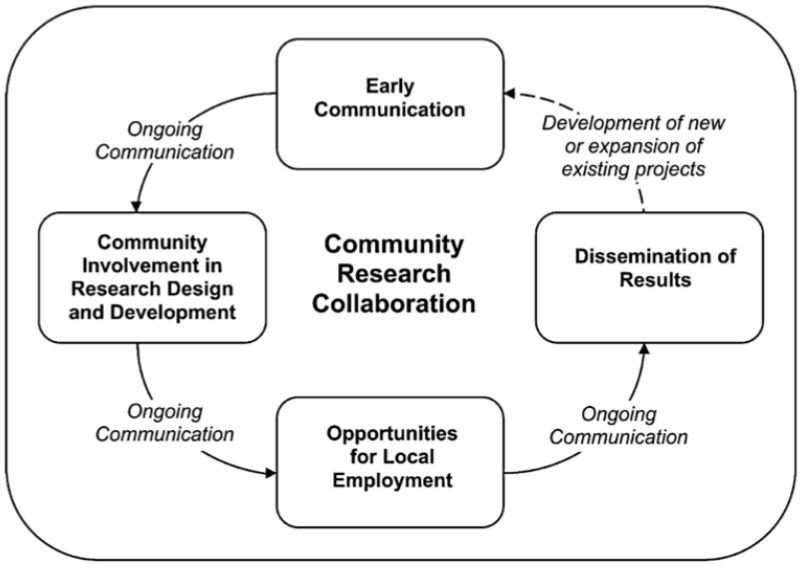


Figure 3-1. Key considerations for community involvement in Northern research. Source: Pearce, T., Ford, J., Laidler, G., Smit, B., Duerden, F., Allarut, M., and Andrachuk, M. 2009. Community collaboration and climate change research in the Canadian Arctic. Polar Research 28/1.10-27.

Important considerations informing the research methodology are outlined in Figure 3-1. Key components of CBR include communication, community involvement in research design and development, opportunities for local employment or engagement, and dissemination of results accessible for non-experts. A crucial aspect of CBR is the development of long-lasting relationships, which in the ideal case exceed the time frame of a completed research project (Pearce et al. 2009). This project strived to find respectful ways to involve community members, and to help ensure that direct community benefits flow from the research process. It is important to note, however, that due to resource and time constraints large parts of research planning, data collection, and data analysis were carried out outside of Nunatsiavut. It is therefore appropriate to refer to the project as being "community informed" rather than

"community based". The ICGs and community members were actively involved in the planning phase of the research project, and regularly involved in the implementation phase of the research.

3.3. Methods

Two main data collection tools were chosen to accommodate the research methodology: the map biography method and participant observation. Information retrieved through these methods was complemented by climate data available for the region. The following is an in-depth explanation of the data collection methods.

3.3.1. The map biography method

The map biography method is fundamental for this research project. A map biography is an account of a person's experience on the land, sea, or ice, as recorded on maps and through face-to-face semi-structured interviews (Tobias 2009). The mapping and interview components are interdependent and conducted simultaneously. The former makes possible the visualization of the extent and significance of land use, and shows any changes that might have occurred throughout the living memory of interview participants. The latter retrieves qualitative information with the intent to complement and enhance what is being mapped.

The map biography has its roots in the late 19th century, when the ethnographer Franz Boas engaged Inuit with translating local knowledge on maps (Aporta 2004). Pioneer projects employing techniques resembling map biographies can also be identified in

Alaska in the 1950s and 1960s, where studies on land use and resource conflict were conducted in the Inupiat region of the North Slope (Chapin et al. 2005). The dominant social paradigm of the time perceived nature as something to be conquered or tamed (McBeath and Rosenberg 2006). In the eyes of many, Aboriginal and Alaska Native subsistence lifestyles were not compatible with that paradigm, thus it was concluded that these peoples were not making use of the land (Chapin et al. 2005). Due to a combination of a variety of factors, including the rise of the civil rights and environmental movements, economic development projects conducted in Northern regions increasingly triggered protests from Aboriginals and Alaska Native against the federal governments of both Canada and the United States (O'Neill 1995; Chapin et al. 2005; McBeath and Rosenberg 2006). In this context, the map biography played an important role in counterbalancing the neglect of minority viewpoints in conflicts with governments, and to provide a means of political empowerment. Map biography projects became inextricably linked to the protection of the rights of Aboriginal and Native communities, with the overarching purpose of increasing their wellbeing (Freeman et al. 1976; Brice-Bennet 1977; Charest 2003; Tobias 2009). Geographers have been on the forefront of these developments, with Canada taking a prominent role since the late 1960s (Chapin et al. 2005).

Figure 3-2. The four autonomous Inuit regions of Canada. Communities in Inuvialuit, Nunavut, Nunavik, and Nunatsiavut are marked by red dots. Source: Guèvremont, A., and Kohen, D. 2007. Inuit in Canada: Findings from the Aboriginal Peoples Survey - Survey of Living Conditions in the Arctic. Statistics Canada. Social and Aboriginal Statistics Division. Ottawa.

The first important Canadian map biography project with respect to Aboriginal rights was the Inuit Land Use and Occupancy Project, published in 1976, which emerged in the political and judicial context of Native land claims. The council of Canada's autonomous regions, today known as Inuit Tapiriit Kanatami, pushed forward Inuit land use and occupancy research in the Northwest Territories. Figure 3-2 depicts the four autonomous Inuit regions of Canada today. Similar pioneer projects were conducted in other parts of Canada, including a study titled 'Our Footprints are Everywhere' conducted in Labrador (Brice-Bennet 1977). Map biographies, or more specifically the maps they produced, were crucial pieces of evidence in federal courts,

which required a demonstration of a traditional interest in land by showing the extent of use and occupancy on maps (Tobias 2009). Map biography projects have also been employed outside the context of land claims, focusing on economic planning, natural resource management, and the documentation of history and culture, without primarily serving political or judicial purposes (Sirait et al. 1994; Robinson and Ross 1997; Usher 2002; Armitage and Stopp 2003).

More recently, map biographies have entered the climate change realm. The *Igliniit* project (Inuktitut for "trails") introduced a longitudinal component to the method, as it equipped land users with GPS devices that mapped their movements, activities, and observations as they happened, thereby continuously providing up-to-date information (Gearheard et al. 2011).

Besides its obvious advantages, it is important to also point out potential shortcomings of the method. The participatory nature of map biographies has sometimes been overstressed, with little value being added to the communities once the lead researchers leave (Gearheard et al. 2011). It has also been argued that the method fosters cultural misinterpretation through the exclusion of women (the typical map biography participants are middle aged men) and the presentation of dynamic relationships on static maps (Sletto 2009; Gearheard et al. 2011). While projects such as *Igliniit* addressed these criticisms to a certain extent, they do require technology and software that is sometimes expensive and difficult to learn. Whether community

participation and technology are compatible has been contested in the past (Chapin et al. 2005).

This research project aimed to address these criticisms from the outset. Proactive efforts were made to include perspectives from women, even though these efforts have not proved entirely successful (see Chapter 3.4 for a breakdown of male and female participants). Funding was secured for return trips to the communities to disseminate research results. In addition, the Makkovik and Postville ICGs and community members were involved in adjusting the research design, including choosing map biography as the main data collection method. To ensure cost efficiency and inclusiveness, the use of technology during data collection was kept to a minimum. For example, paper maps rather than tablet computers were employed during the interviews.

3.3.2. Participant observation

Participant observation is a data collection method whereby the researcher becomes part of the events being observed and an active member of community life (Bennet 2002). As Laidler (2009) notes, there is a fundamental advantage to asking questions in context, with elders, hunters, and others being able to discuss observations and opinions on site rather than in potentially unfamiliar settings. Observations were therefore guided by the research questions and ethical considerations, but not restricted to noting prescribed phenomena (Kearns 2010). The researcher travelled winter trails inland and on sea ice, joined community members in collecting firewood, visited an

ice-fishing camp, and followed trappers to check on their trap lines in the Makkovik and Postville regions. In addition, attending community events, including a Nunatsiavut Government open house function and an information session for proposed uranium mining development, helped to gain a better understanding of specific customs and life in general in the communities, and to make sense of the information that interview participants shared in map biography interviews. The field trips also provided complementary evidence on changes in winter trails and travelling. The researcher relied on detailed note taking based on recollection, and no other recording tools with the exception of a camera were utilized for this data collection method.

3.3.3. Instrumental climate data

Instrumental data were utilized with the intent to complement interview participants' accounts of changes in the environment. Climate data for Labrador communities including Makkovik and Postville were retrieved from the National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC). A Java program was used to put daily observational data in a script compatible with the Fortran program STARDEX (Statistical and Regional dynamical Downscaling of Extremes for European regions; STARDEX 2005). All data were obtained from climate stations and no reanalysis data were used. Climate summary statistics utilized for Makkovik and Postville include mean daily temperatures, number of annual frost days, and days of heavy precipitation (>10 mm). The data record for Makkovik spans 1977 to 2010 and for Postville 1980 to 2010. The data were assembled in St. John's before field work took place.

3.4. Data collection and analysis

Data collection took place between January 15 and March 8, 2012. Interview participants were chosen based on their interest in the research project and their experience on the land and ice. Potential interview participants ideally had spent significant time on the land and ice in the Makkovik and Postville regions, engaging in one or more of the following activities in the winter: hunting, ice fishing, collecting firewood, travelling on winter trails (also if 'just' for fun) by snowmobile, dog team, skis, or snow shoes, or engaging in other activities that depend on being out on the land and ice in the winter. A minimum number of days spent on the land and ice to be considered for interviews was not set. Initial lists of potential interview participants were compiled during a pre-data collection visit to the communities in June 2011, with RA Marilyn Winters and a local historian in Makkovik, Joan Andersen, in January 2012 and with RA Jessica Sheppard and the Postville Community Development Officer Cora Edmunds in Postville in February 2012. Potential interview participants were then contacted in person and kindly asked to self-identify whether they fit the interview participant characterization. The snowball approach was employed to identify further interview participants. The local radio stations in Makkovik and Postville also provided a good opportunity to reach out to the community for interview participants and create awareness of the project. In addition, flyers were put up on announcement boards in the communities (see Appendix C). A pilot interview conducted with RA Marilyn Winters was arranged to help ensure the flawless conduct of the interviews. No data from the pilot interview was used for analysis.

In total 28 individuals were interviewed in map biography sessions. Interview participants ranged in age from 21 to 88 years old. The majority of interview participants were employed full time for at least parts of the year. Employment in the public sector was prevalent (Makkovik and Postville Inuit Community Governments, Nunatsiavut Government Department of Nunatsiavut Affairs, Nunatsiavut Government Department of Lands and Natural Resources, Nunatsiavut Government Department of Finance, Human Resources and Information Technology, crown corporations, and education), followed by private industry (mining and exploration, retail, and maintenance). Five interview participants had already entered retirement, and one interview participant was an undergraduate student at the time of the interview. The profession of one interview participant remained unknown. Considering the occupation profile, it is likely that community members affected by long term and/or seasonal unemployment are underrepresented in this research. In addition, and despite proactive efforts to avoid this situation, women are underrepresented as well. Makkovik's population of residents between the ages of 20 and 85 and older is 261, divided into 131 male and 130 female residents (female percentage: almost 50 percent; Statistics Canada 2012). Postville's population between 20 and 85 or older is 145, divided into 70 male and 75 female (female percentage: 52 percent; Statistics Canada 2012). In contrast, of the 28 interview participants, only 7 were female (female percentage: 25 percent).

Virtually all interview participants were involved in activities that depend on accessible winter trails throughout their lives. Twenty interview participants reported

hunting different species on a regular basis (at least several times throughout the winter). Eight interview participants reported a recreational approach to hunting throughout the winter. Especially older interview participants reported not being involved any longer in hunting big game on a regular basis, but still enjoyed hunting small game and birds on an occasional basis. All interview participants were involved in collecting firewood and travelling on winter trails to visit other communities.

Figure 3-3. Map biography setting. (A) The community hall in Makkovik provided a conveniently located, well-lit and well equipped venue to conduct map biography interviews; (B) interview participant pointing out travel routes; (C) interview participants playing traditional Labrador songs after the interview; (D) interview set-up at an office in Postville. Photos A, C, and D by R. Riedlsperger. Photo B by Marilyn Winters.

The Makkovik and Postville ICGs offered generous in-kind contributions that allowed the utilization of community halls and council chambers for the interviews. Figure 3-3

shows the workspace in the Makkovik community hall and the interview set-up at an office in Postville. In some cases, interview participants preferred being interviewed in their homes. The map biography sessions did not exceed 90 minutes. It also has to be noted that all photographs of interview participants included in this thesis have been taken with the interview participants' permission.

Map biography participants were asked to indicate places where they have personally travelled on the land and ice, using 1:250,000 - scale topographic paper maps. The regional scale was chosen because of the relatively far reaching extent of local travel routes. Interview participants could also indicate places they have not personally travelled, but for which they had knowledge, for example from parents or elders. The information was drawn and written on transparent map overlays, which were subsequently scanned, orthorectified, and digitized using ArcGIS 10 software. Consistent with pioneer map biographies, the individual semi-structured interviews were conducted as informal and open-ended as possible (see Freeman et al. 1976). The interviews were divided into four parts (see Table 3-1). The purpose of interview topic 1 was to map travel routes that interview participants were using (or for which they had knowledge), and the reasons for why the interview participants were using these routes (for example: hunting, recreation, or travelling to visit other communities). Interview topic 2 focused on vulnerability to changes in winter trails and travelling. The purpose was to learn about travel conditions and travel hazards that participants had encountered on the mapped routes, or travel hazards they knew about in routes they were not using themselves. Interview participants were also asked to indicate

areas that were considered more dangerous to travel than others, and the reasons for why they thought this was the case.

Table 3-1. Topics covered in the semi-structured interview component of the map biography session

Part	Topic
1	TRAVEL ROUTES – what routes are being travelled and why
2	TRAIL/TRAVEL CONDITIONS AND HAZARDS – what is the condition of the mapped trails and what are the travel dangers
3	CONSEQUENCES OF CHANGES IN TRAILS AND TRAVELLING – on livelihood and wellbeing during the lifetime of participant
4	BIOGRAPHICAL INFORMATION – about participant

Interview topic 3 covered the double-exposure and values-based components of the research framework by focusing on the significance of trails and travelling with respect to the personal lives and values of participants. Interview participants were encouraged to reflect upon the consequences that changes in winter trails and the act and experience of travelling might have on their livelihoods. They were also encouraged to reflect how influences unrelated to CVC might affect their use of winter trails. While interview topic 4 was added with the intention to gather basic biographical information from the interview participant, this information was retrieved throughout the interview instead of employing a separate block of questions. In addition to open-ended questions, some answers were sought in regard to pre-determined categories that could be transcribed onto the maps with a code of colors and symbols. Examples include active or abandoned trails, travel hazards, and specific

purposes of subsistence areas. A single participant's indication of a certain feature was sufficient to mark it on the map. For example, trails were marked as 'abandoned' if at least one interview participant pointed out that he or she stopped using the travel route due to poor snow and ice conditions and/or disproportionate travel hazards, even though other individuals might still have indicated their use of that particular trail or travel in its vicinity. The complete set of questions and codes can be found in the data collection manual (Appendix B).

A coding system inspired by Grounded Theory (GT) was used to sort and retrieve data from the interviews, employing NVivo 9 qualitative data analysis software. GT combines "empirical observation, concrete analysis, and abstraction in an ongoing dialogue" with each other (Barnett 2009, 751). Data were analyzed and coded, as ideas and insights began to develop. This involved putting hypotheses aside if their importance failed to materialize (Heath and Cowley 2004). Preliminary data analysis and coding took place immediately after interviews were conducted. To enhance dialogue and reflexivity, the principal researcher debriefed with the research assistants and local mentors (Joan Anderson and Cora Edmunds) after the interviews to elaborate on themes and patterns. Upon conclusion of field-work all map biography interviews were transcribed and subject to content analysis, which involved further identification of themes and sub-categories (Dunn 2010). This was done in accordance with the conceptual framework and interview guides. The main codes employed to analyze the data are shown in Table 3-2. The five main themes consisted of: environmental conditions (to address climate change related vulnerability); socioeconomic conditions

(to address double exposure); subsistence activities; winter trails, travelling, and trail use; values (to address the values-based approach); and one catch-all category for themes that did not fit the aforementioned categories.

Table 3-2. Themes and sub-categories for data analysis

Categories⇓/Subcategories⇒	Perceived seasonal and long term changes	Perceived causes and implications	Coping mechanisms and adaptation strategies
Environmental conditions	√	√	√
Socioeconomic conditions	√	√	√
Subsistence activities	√	√	√
Winter trails, travelling, and trail use	√	√	√
Values	√	√	√

The responses of interview participants were allocated accordingly, and each theme was analyzed for perceived seasonal and long term changes, the perceived causes and implications of these changes, and coping mechanisms and adaptation strategies with respect to these changes.

CHAPTER 4. STUDY AREA: THE INUIT SETTLEMENT REGION OF NUNATSIAVUT

4.1. Study area: The Inuit Settlement Region of Nunatsiavut

Located within the province of Newfoundland and Labrador, Nunatsiavut is part of the *Inuit Nunangat* (Inuit homeland) and represents one of the four autonomous Inuit regions in Canada (see Figure 3-1). Prehistoric cultures have occupied the region for thousands of years. Modern Inuit descended from Thule Inuit migrating from Alaska in the 1400s (Wenzel 2009; Rankin et al. 2012). Settlers first arrived in Labrador in the early 19th century as professional trappers, fishermen, and seal-hunters who did not live in organized communities, but instead set up houses along the bays and inlets of the Labrador Coast. The Moravian church began installing missions around the same time (Ben Dor 1966). Before the establishment of Nunatsiavut, the two main governing bodies in the region were the Moravian church and the Governments of Newfoundland, which include the separate Dominion of Newfoundland until 1927, the British controlled commission government of Newfoundland from 1927 to 1949, and the Province of Newfoundland and Labrador from 1949 to 2005 (Anderson 2007). Nunatsiavut achieved the right to self-government through the Labrador Inuit Land Claims Agreement (LILCA) in 2005. Thirty years of negotiations between the Labrador Inuit Association (LIA) and the federal and provincial governments preceded this outcome (Nunatsiavut Government 2012b).

Nunatsiavut maintains two levels of government. The Nunatsiavut Government (NG) is the regional Inuit consensus-based democratic government. In addition, municipalities or ICGs were established for each of the five Nunatsiavut communities: Nain (the administrative capital), Hopedale (the legislative capital), Postville, Makkovik, and Rigolet. These communities have a total population of about 2500, most of them beneficiaries to LILCA (Statistics Canada 2012a; b; c; d; e). This includes all residents of Inuit descent and the *Kablunangajuit*[4] of Nunatsiavut. The latter term is an Innuttitut word meaning "resembling a white person" and includes immigrants to the region formerly referred to as settlers (Natcher et al. 2012). It is also used as an encompassing term for all beneficiaries, including those who reside outside of Nunatsiavut. The total number of beneficiaries is about 8000. They form the electorate of Nunatsiavut (Felt 2011).

The settlement area totals approximately 72,500 sq. km of land from the North Coast of Labrador extending to the Quebec border, including 15,800 sq. km of Inuit-owned land, and an adjacent ocean zone of 48,690 sq. km (Figure 4-1). Labrador Inuit own about one fifth of the land within the settlement area and have co-management rights in the remaining area. The Torngat Mountains National Park and portions of the Mealy Mountains National Park are also part of Nunatsiavut. The region excludes the Voisey's Bay area, which the provincial government deemed not negotiable due to its immense mineral deposit. The site of the coastal Innu community Natuashish is also

[4] *Kablunangajuit* are beneficiaries if they or their families have settled in what today is Nunatsiavut before 1940.

Figure 4-1. Map of Labrador including Nunatsiavut. As the crow flies, Makkovik and Postville are less than 45 km apart. The two study sites are located within Nunatsiavut, Labrador, which is indicated by the shaded regions on this map and comprises Labrador Inuit Settlement Areas (medium gray) and Labrador Inuit Lands (dark gray). Map produced by Charles Conway, Department of Geography, Memorial University, 2012.

excluded from Nunatsiavut (Natcher et al. 2012). Financial ties continue to exist between Nunatsiavut and the federal and provincial governments. A fiscal financing agreement ensures that funding is provided to the Nunatsiavut Government for the provision of programs and services to beneficiaries at levels comparable to non-Inuit communities of similar size throughout Labrador (Nunatsiavut Government 2005). Consequently, in return for receiving such payments Labrador Inuit are still subject to federal and provincial taxes (Nunatsiavut Government 2012b). In the context of winter trails and travelling, the Provincial Government provides grooming subsidies to Labrador communities through its Labrador Affairs Office (LAO). As the name implies, these subsidies are used for maintaining and grooming winter trails. In Nunatsiavut, the ICGs are responsible for managing these subsidies. Other examples of transfer payments beneficial to Nunatsiavut communities include the Air Foodlift Subsidy Program (also administered through LAO), which has the intent to provide affordable, nutritious food items available for purchase at the stores. This subsidy is noteworthy in the context of food security. Nunatsiavut households spend more on food and shelter than other Canadian households (IHSN 2008), and as in most remote Canadian communities, grocery store items are especially expensive. In addition, the communities have access to federal and provincial gas tax funds, which is ensured through implementation of Integrated Community Sustainability Plans (Municipal Affairs 2009; Labrador Affairs Office 2012). The aforementioned subsidies contribute to keeping travelling on the land and ice affordable for community members.

Subsistence activities are fundamental for individual and community livelihoods in Nunatsiavut, fulfilling important economic, nutritional, social and ceremonial needs (Natcher et al. 2006; Natcher et al. 2012). *Nunatsiavummiut* produce many of the goods required to meet their basic needs through hunting, fishing, and gathering on the land, water, and ice. Throughout times of significant social change, these activities have remained important in the region both nutritionally and culturally (Natcher et al. 2012). Reflecting the reliance on a dual economy, the subsistence lifestyle is complemented by free market capitalism. Wage labor provides residents with disposable income, even though all Nunatsiavut communities struggle with high levels (>30 percent) of unemployment. (Newfoundland & Labrador Statistics Agency 2009a; Statistics Canada 2007a; b; c; d). Especially seasonal unemployment affects many community members (Newfoundland & Labrador Statistics Agency 2009a; b).

Many *Nunatsiavummiut* are in favor of economic development, especially resource development such as mining, as a means to support individual and community livelihoods. This mindset is reflected in the lifting of a uranium mining ban by the Nunatsiavut Assembly in 2011. At the same time Nunatsiavut actively strives to promote its culture and traditions, not least from standpoints of environmental sustainability and mental and physical health (Nunatsiavut Government 2012a). Bridging this gap will remain a challenge in the evolution of the still young government.

4.1.1 Makkovik

The community of Makkovik (59° 11′ W, 55° 5′ N) is situated within the Inuit Settlement Region of Nunatsiavut on the northeastern coast of Labrador. It lies nested in Makkovik Harbour within Makkovik Bay (Figure 4-1). Makkovik has a population of 361, the majority (close to 90 percent) of whom identify as Inuit (Statistics Canada 2007b; 2012a). Even though today it embodies both Inuit and *Kablunangajuit* influences, Makkovik started as a settler community. In 1860 Norwegian born Torsten Anderson and his wife Mary Ann Thomas established a trading post at the site where Makkovik is located today (they called it "Flounder's Bight"), prompting other settlers in the region to frequent the area to purchase supplies. In 1896 the Moravian Church built a mission station and later a boarding school, arguably finalizing the transition from the Flounder's Bight trading post to the organized community of Makkovik. The introduction of mandatory schooling for children brought about by Newfoundland and Labrador joining Canada in 1949 was an additional incentive for settlers to permanently stay in Makkovik in order to send their children to school (Ben-Dor 1966). According to Tanner (1947) not a single person of aboriginal descent lived in Makkovik at the beginning of the 20th century, and probably very few did until around 1950. That changed when the Provincial Government ordered over 150 Inuit from Hebron and Nutak, farther north on the Labrador Coast, to resettle in Makkovik. Unlike Nutak, Hebron was a former Moravian mission station, which might have influenced the relocation to the Moravian community of Makkovik. As Kennedy (1982, 129) observed, the arrival of Inuit "*en masse*, primarily during the summer of 1959, was a dramatic event that posed real problems for the small community of

English-speaking Settlers". Makkovik became what Ben Dor (1966, 9) described as "the most southerly Eskimo community in the world."

The initial hostility between Inuit and settlers in Makkovik has been discussed elsewhere (Ben-Dor 1966; Zimmerly 1975; Kennedy 1982). From a perspective of winter trails and travelling it is crucial to point out one of the undisputed similarities between *Kablunangajuit* and Inuit, namely the significance for both groups of living off the land and ice. Most, if not all, community members engage in subsistence activities such as hunting, fishing, trapping, berry picking, and collecting firewood. In addition, some community members (regardless of heritage) still upkeep traditional skills such as crafting snow shoes, Inuit drums or seal boots. Yet, Makkovik historically has relied on a robust wage economy as well. Makkovik was known for commercial fur trapping, and it has also been an important commercial fishing community where people (mostly non-Inuit) moved from other parts of the province to make a living (Zimmerly 1975; Schwartz 1977). This changed with the collapse of the cod and salmon populations in the 1990s, even though today the fish and crab plants still are among the biggest employers in town despite an operation limited to a few months every summer.

Makkovik is not connected to other communities through conventional (paved or gravel) roads. Snowmobiles provide the main mode of transportation in the winter. In addition, the community is serviced year round by weather-dependent airplanes and ferries in the summer, both of which carry passengers and freight.

4.1.2. Postville

The community of Postville (59° 48′ 8″ W, 54° 54′ 37″ N) is located within Kaipokok Bay, where the freshwater of the Kaipokok River runs into the Atlantic Ocean (Figure 4-1). Postville has a population of 206 (Statistics Canada 2012b) and is dominantly Inuit (90 percent, Statistics Canada 2007a). Similar to Makkovik, Postville started as a small trading post (hence the name), established by Quebec merchant D. R. Stewart. The trading post was taken over by the Hudson's Bay Company in 1837 (Ames 1977). Year-round settlement of Postville did not occur until 1941 when the construction of the Pentecostal Church was completed (Natcher et al. 2012). Similar to Makkovik's history, the religious institution in combination with a school provided a good reason for settlers to permanently move to Postville. Unlike Makkovik, however, Postville was not subject to significant Inuit relocation in the late 1950s.

Postville also relies on a mixed economy, with subsistence activities supplementing wage labor and vice versa. The former is very popular: based on a recent study, over 90 percent of community members in Postville are active on the land, sea, and ice to hunt and gather (Natcher et al. 2012). Wage labor in Postville has traditionally been of cyclical nature, even more so than in Makkovik. Employment in the past has been provided, sometimes to greater or lesser extent, by logging operations and lumber mills, small scale shipyards, commercial fishing, hunting, trapping, and quarry sites. Community members hope that future mining developments in the Michelin Lake region will provide long-term, permanent jobs. An Australian mining and exploration

company owns the uranium assets in the region and has already set up exploration camps (Aurora 2012).

Similar to Makkovik, the snowmobile provides the main mode of transportation for Postville residents in the winter. There are no conventional roads connecting Postville to other communities. Instead, Postville is serviced by airplanes dependent on weather, and ferries in the summer, both of which carry passengers and freight.

4.2. Characteristics of winter trails and travelling in the study region

4.2.1. Winter trails

Winter trails are part of Labrador's built environment. They are considered 'soft infrastructure' and can be divided into three broad categories: Groomed trails, marked trails, and non-marked trails (Figure 4-2). The differences between the three trail types are sometimes subtle, but very significant in practice, as each trail type accommodates different skill levels in terms of traditional knowledge and travel skills. The trails connect to other communities, cabins, *aullâsimavet* (seasonal camping and tenting sites), and subsistence areas. Even though the Nunatsiavut Government has set the official dates for the winter travel season between December 1st and May 15th of the following year, the period when *Nunatsiavummiut* actually use the trails is completely dependent on snow and ice conditions (LISA Draft Land Use Plan 2010).

Figure 4-2. Winter trails in Nunatsiavut. (A) Example of a groomed trail, (B) a sea ice trail marked by cut treetops, and (C) an ad-hoc trail that is a semi-permanent feature in the landscape. Photos by R. Riedlsperger.

The groomed winter trail network (Figure 4-2, A) in its current form has been established since the winter of 2000/01. The network connects Labrador City and

Wabush in the west with the communities on the southeastern Labrador coast. The Nunatsiavut portion of the network is relatively small (Figure 4-3).

The Nunatsiavut portion of the network is maintained by the ICGs through the Labrador Transportation Grooming Subsidy, which is administered by the LAO. A total of CAD 70 000 is allocated annually to the communities of Makkovik and Postville (LAO 2012; personal communication with Community Development Officer of Postville). The subsidy is used to hire two groomer operators per community and to purchase and maintain equipment, including grooming machines. Once snow cover and ice thickness are sufficient, the grooming machines leave the communities to follow the broad, cut out trails leading south towards Goose Bay and Rigolet. To minimize the impact of groomed trails on the environment, the width of cleared trails is not allowed to exceed six meters, and setbacks and buffers around topographical features such as watercourses, wetlands, lakes, and ponds have to be taken into consideration while grooming the trails (LISA Draft Land Use Plan 2010). Likened to "highways" by residents, the main purpose of the groomed trail network is to allow for safe and fast travel. Even without thorough geographical knowledge or without skills to interpret snow and ice conditions, travelers are able to follow the groomed trails with relative ease - if the weather conditions are favorable. A groomed trail link between Makkovik and Postville exists, and the two communities are also accessible via the groomed trail from Goose Bay.

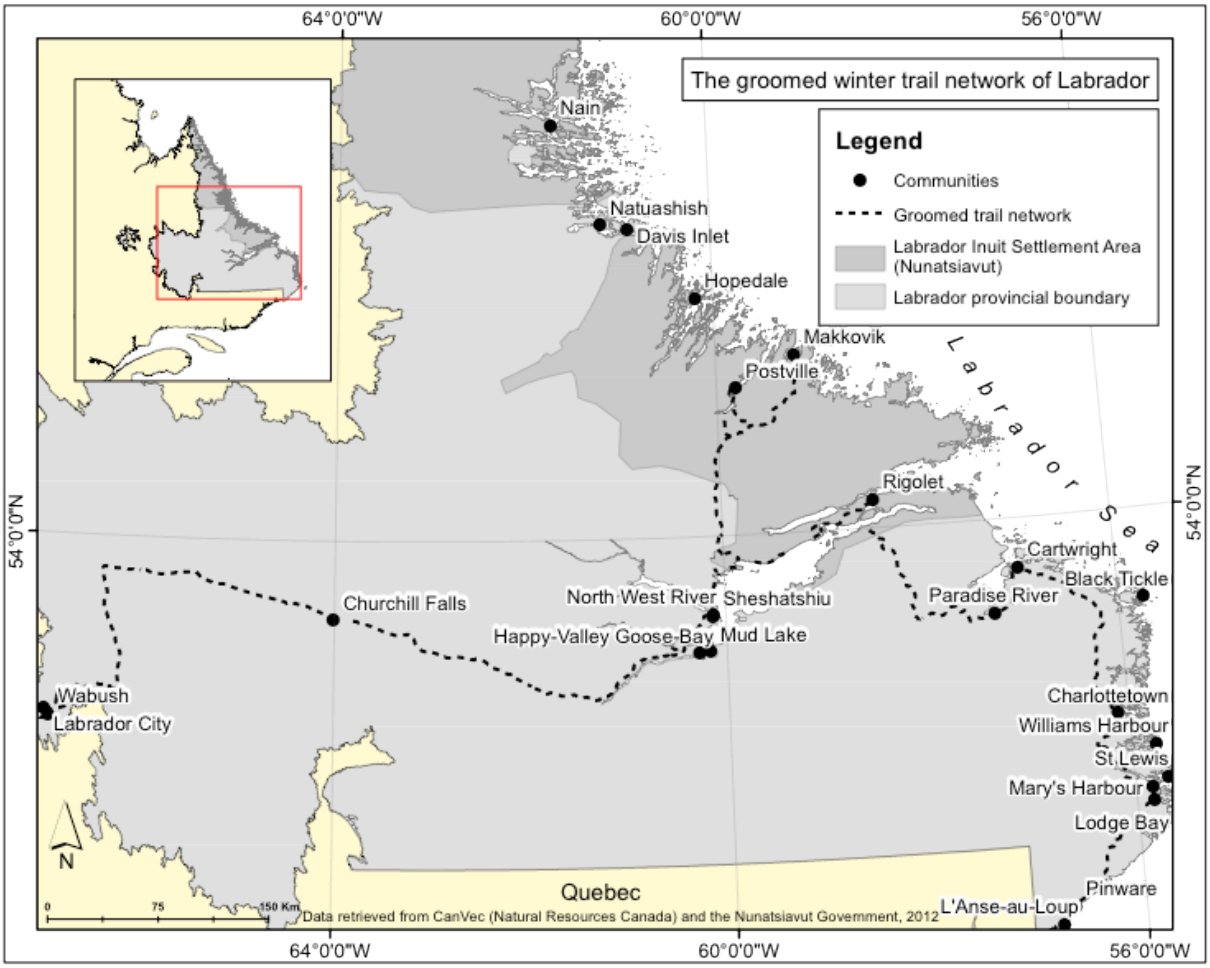


Figure 4-3. The groomed trail network in Labrador. In Nunatsiavut, only the communities of Postville, Makkovik, and Rigolet are linked to the groomed trail network. Map produced by R. Riedlsperger.

Where no groomed trails exist, travelers rely primarily on marked trails (Figure 4-2, B). This is especially relevant in the vicinity of the Nunatsiavut communities of Nain and Hopedale (and the Innu community of Natuashish, which is located between Nain and Hopedale but not part of Nunatsiavut), because these communities have no direct connection to the groomed trail network. Marked trails utilize cut treetops, signposts, and reflectors to mark routes, increase travel safety, and improve orientation. Unlike

groomed trails, marked trails often lead over sea ice if conditions allow. This requires considerable skills in terms of interpreting snow and ice conditions on the traveler's part. Marked trails are also narrower and less smooth than groomed trails, hence travelers have to proceed at lower speeds.

Finally, the majority of winter trails are semi-permanent tracks in the landscape. The routing of these trails, which are mainly utilized to access cabins, *aullâsimavet* (camping sites), and subsistence areas, depends not only on snow and ice conditions, but also on changing factors such as the availability of wildlife. It would therefore not be feasible to mark these trails. Snowstorms often erase the trails throughout the winter and the routes have to be memorized. Travelling on semi-permanent trails requires sophisticated way-finding skills in addition to being able to read the environment, especially weather patterns and snow and ice conditions. Permanent features in the landscape such as hills, rocks, or cabins allow for orientation while travelling these routes.

It should be noted here that a variety of other trails exist in the Makkovik and Postville region that are not considered for the purpose of this research project. For example, Makkovik maintains historic and interpretive trails in the Moravian Woods, a protected area within the community. Likewise, Postville currently extends its walking trail network to make historically and culturally important sites more accessible to community members. These trails are easily accessible and play an important role in educating community members and visitors about the region's natural and cultural

environments, and in some cases are also utilized for subsistence activities such as berry picking. Nevertheless, this research project simply focuses on trails that extend the immediate borders of the communities.

4.2.2. Winter trail travelling

Winter trail travelling refers to the act and experience of travelling. The latter focuses on non-physical factors, such as time spent travelling, or the perceived sense of safety while being out on the land and ice. The former includes the variety of activities for which people go out on the land and ice. In other words, trails are built around a function and use (Figure 4-4). The most important activities that require unimpeded access to the land and ice in the winter are hauling firewood (also referred to as "wooding"), hunting, accessing trap lines, and travelling between communities. Winter trails are therefore significant for community and individual livelihoods: The ability to "go off" (as locals refer to the activity) in the winter heats homes, feeds families, connects communities, and allows for recreation. Winter trail travelling is associated with significant local and traditional knowledge (Aporta 2004; Aporta and Macdonald 2011). Local knowledge is knowledge reflecting understanding of local phenomena or knowledge that involves some level of expertise of a local site or issue (including ecological aspects, such as freeze up and break up dates of lake and sea ice). The term is used to make a distinction between the knowledge of external experts, who might have technical or theoretical expertise but lack appreciation of the local nuances (Raymond et al. 2010). "Local" also differs from "traditional" knowledge in the sense that the former has been derived from more recent human environment interactions

(e.g., a few generations) rather than being embedded in deeper cultural practices (Ibid.).

4.2.2.1 Subsistence activities dependent on winter trails

Though many homes are equipped with both woodstove and oil furnace, firewood is the heating fuel of choice for most households. Both Makkovik and Postville are located south of the latitudinal tree line (Payette 1993). Even though unprotected areas adjacent to the communities are already cut out, firewood is still available within close proximity[5]. Two kinds of wood are collected: Green wood and burnt wood. Green wood is cut in the winter and spring and stored until it is dry enough to be burned during the next winter. Burnt wood can be found in areas that have previously been subject to forest fires. Despite its name the wood is not entirely burnt, but very dry and can be used as firewood as soon as it is hauled back to the communities. Having firewood that close to home is a financial relief for households in the region, as relatively small amounts of gasoline are required to haul wood. Time is a factor as well: a komatik (wooden trailer hauled behind snowmobile) holding 20 to 25 logs can be filled within less than two hours. It takes about 200 to 250 logs of firewood to heat a home in the winter, which requires a minimum of ten trips to firewood sites per household per season.

[5] Some forests are considered community assets and therefore protected. For example, within the town of Makkovik the wooded area referred to as the Moravian Woods is a protected area where cutting firewood is not allowed (JW Consulting Associates 2009).

Hunting is one of the most important subsistence activities for people in Makkovik and Postville in general. Species hunted in the winter include caribou, moose, partridges, ptarmigan, porcupine, and hare. Hunting season dates are set by the Provincial Government of Newfoundland and Labrador through the Department of Environment and Conservation. While certain species, such as partridges, can be harvested very close to the communities, caribou hunting trips especially can last up to several weeks, requiring diligent preparation. In addition to hunting on the land, people in Labrador also fish in the winter (smelts are a popular species), and go out on the ice to hunt seals.

Trapping is a popular activity among Nunatsiavut residents. Trapping can be divided into commercial trapping, subsistence trapping, and recreational trapping. Large scale commercial trapping was an important factor in the settlement of Labrador, but only plays a negligible role today. However, small scale commercial and/or subsistence trapping is still an important part of life for many people in Labrador. Most animals are trapped for their fur, which is then sold on the market (reflecting the commercial component of trapping) or used to craft clothing such as boots and mittens (reflecting the subsistence component of trapping). While certain trap lines are used for trapping exclusively, many trap lines also function as winter trails and vice versa, as traps are set along groomed or marked winter trails. It is difficult to determine the number of people engaging in this activity. Nunatsiavut beneficiaries do not require licenses to engage in subsistence or recreational trapping, even if furs are sold on the market.

4.2.2.2. Travelling between communities

Winter trails allow travelling back and forth between the communities and therefore offer an attractive alternative to expensive travel by airplane[6]. Groomed trails connect Postville and Makkovik with Goose Bay, which as the second largest city is one of the main hubs of Labrador. In addition to the groomed trails, the marked trails connecting the communities are used extensively as soon as snow and ice conditions allow.

4.2.2.3. Recreational trail use

There are a variety of recreational activities that depend on the winter trails. Many people enjoy going off on the land and ice simply to enjoy being in the outdoors, without the purpose of hunting or collecting firewood. Younger people especially take their snowmobiles on recreational trips around the community. As a pastime, families set up ice-fishing camps for a day on the weekend. Although there is a subsistence component to ice-fishing, the main focus of such outings is on spending time with family and friends. Dog mushing has transformed from being the main mode of winter transportation to a pastime and sport. Only a handful of families still have dog teams in Makkovik and Postville. The dogs are kept mainly for recreational trips and the traditional annual dog team races in the region.

[6] In the winter of 2012, a round-trip air ticket from Postville to Goose Bay cost approximately $600/person. Purchasing enough gasoline to travel from Postville to Goose Bay and back on the groomed snowmobile trails cost approximately $200.

Figure 4-4: Different examples of trail use in Makkovik and Postville. (A) Travelling between the communities; (B) ice-fishing; (C) hauling firewood; (D) caribou hunting. Photos A – C by R. Riedlsperger. Photo D by B. Jacque

4.2.2.4. Economic trail use

Trails also fulfill direct and indirect economic purposes. Indirect economic purposes include the generation of subsistence revenues such as firewood or country foods. In addition, trails allow people to transport and exchange goods and services between communities. Direct economic purposes of winter trails in the region include snowmobile racing and outfitting. The Cain's Quest snowmobile race is among Canada's biggest snowmobile races. Start and finish are in Labrador City, but checkpoints of the stage race include Makkovik and Postville. It brings race managers,

volunteers, and racing teams (including the race drivers and their personnel) to the communities, contributing to the number of overnight stays and goods purchased in the region. Such events may also have a wider economic impact, as they expose Nunatsiavut to an audience of North Americans and Europeans interested in the outdoors in general and snowmobiling specifically. For these reasons, the Provincial and Federal governments supported the race with over CAD 600 000 in 2011. (ACOA 2011). Popular tourist activities in addition to snowmobiling for race or recreational purposes include fishing and hunting, cultural touring, and outdoor exploring/eco-tourism. Many of these activities depend on accessible winter trails. Today, Labrador's tourist activities take place mainly outside of Nunatsiavut, which can be attributed to its remoteness. For example, over fifty outfitters provide hunting and fishing tours throughout Labrador, but none of these are located in one of the five Nunatsiavut communities (Destination Labrador 2012). Despite the current situation, the intent of Nunatsiavut communities to boost winter tourism offers potential for utilizing local winter trials for outfitting and eco-tourism purposes (JW Consulting Associates 2009).

4.3. Climate variability and change in Nunatsiavut

Case studies showing a link between climate change and travelling on snow and ice have been conducted throughout the Arctic and Subarctic, including Savoonga and Gambell, Alaska; Ulukhaktok, Northwest Territories; Kuujjuaq, Nunavik; Cape Dorset, Igloolik, and Pangnirtung, Nunavut; Nain, Nunatsiavut; and Quequertaq, Greenland (Furgal et al. 2002; Pearce et al. 2009; Laidler et al. 2009; Kapsch et al. 2010, Taverniers, 2010; Krupnik et al. 2010; Laidler et al. 2010). Several weather and

climate parameters are especially relevant in the context of winter trails and travelling, including temperature and precipitation, snow and ice characteristics, wind patterns, and fauna and flora important for local subsistence activities.

Near surface warming in the Arctic and Subarctic has been almost twice as large as the global average over recent decades. This is partly due to feedback loops, which contribute to accelerate change (Huntington and Weller 2005; Greene and Pershing 2007; IPCC 2007; Furgal and Prowse 2008; Graversen et al. 2008; Serreze and Barry 2011; Tivy et al. 2011). As a consequence, snow cover throughout the Arctic and Subarctic is currently decreasing, with further decrease expected in the near future (Prowse et al. 2008; Brown and Mote 2009; McCabe and Wollock 2010; Callaghan et al. 2012). The decline of sea ice, which is one of the most notable consequences of climate change, is also linked to changes in air and sea temperatures (Markus et al. 2009; Stroeve et al. 2008; Stroeve et al. 2012). While natural variability plays an important role in climate and weather patterns, evidence suggests a significant anthropogenic component to these changes (e.g. Overland and Serreze 2012).

4.3.1. Observed change in Nunatsiavut

Mean annual air temperature in the study region are between -1 and -2C (Figure 4-5).

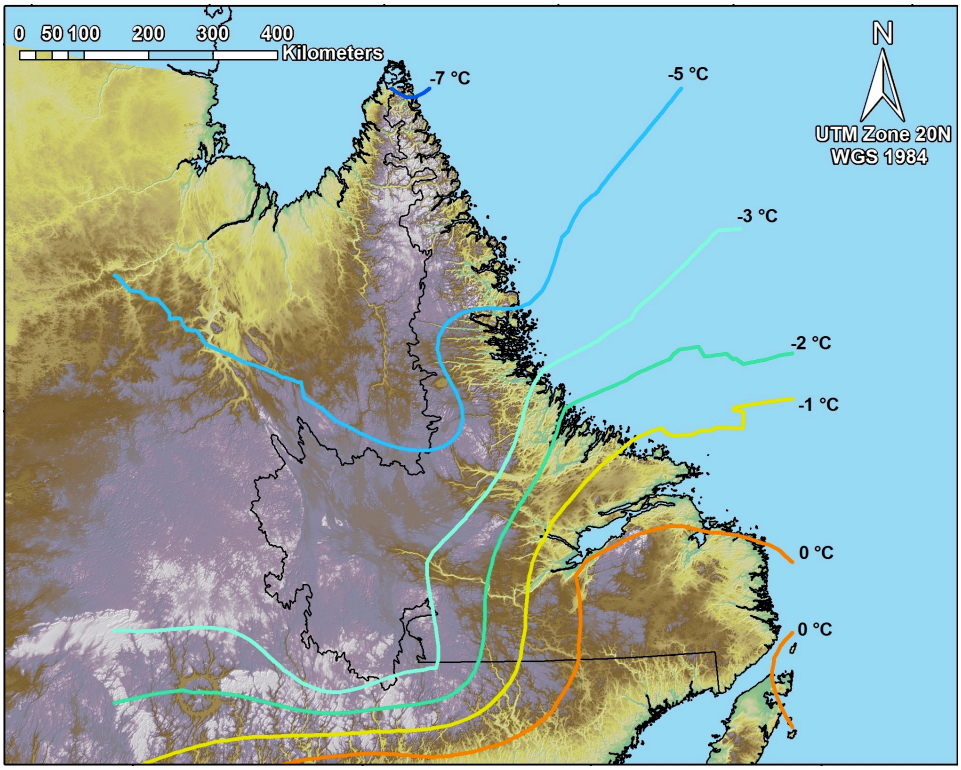


Figure 4-5. Mean annual air temperatures in Labrador. Graph produced by Robert Way, 2010.

Climate data from Labrador suggests that around 1995 a shift took place from no trend to an increase in average winter temperatures (Figure 4-6; Kistler et al. 2001). In Makkovik and Postville, mean temperatures from December to May increased by more than 2°C, and the number of days with heavy precipitation (>10 mm per day) more than doubled (Figure 4-7).

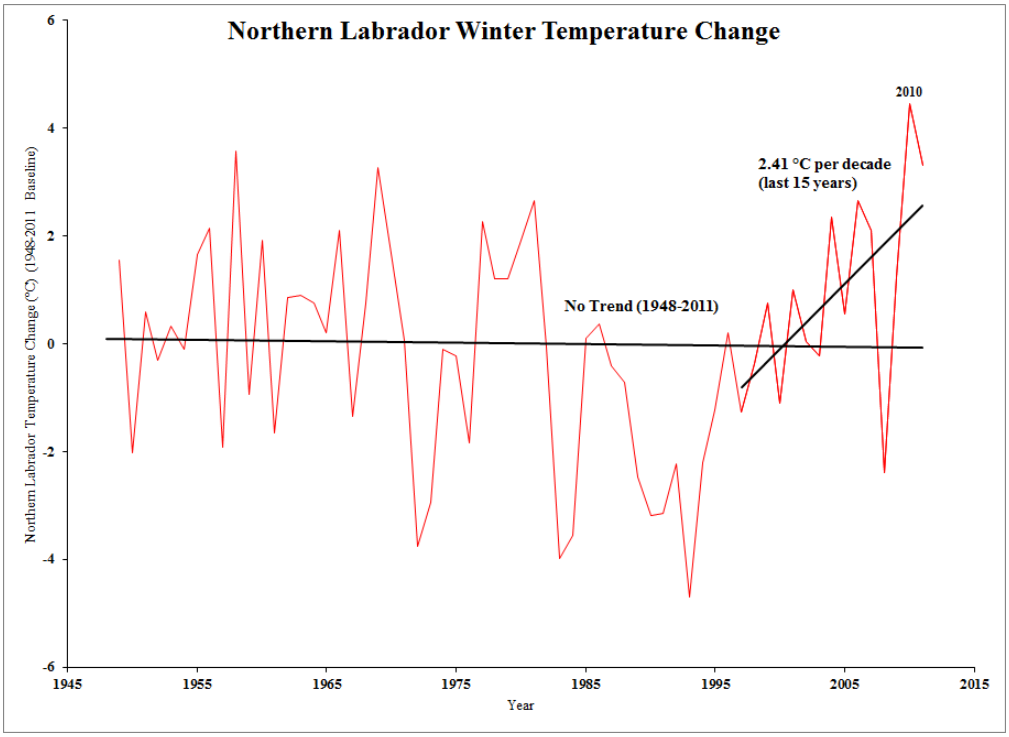


Figure 4-6. Northern Labrador Winter Temperature Change based on NCEP reanalysis data R1. Included are the months November-March, all of which have an average temperature colder than -3. Source: Kistler, R., Kalnay, W., Collins, S., Saha, G., White, J., Woollen, M., Chelliah, W., Ebisuzaki, M., Kanamitsu, V., Kousky, H., van den Dool, R., and M. Fiorino, 2001: The NCEP-NCAR 50-Year Reanalysis: Monthly Means CD-ROM and Documentation. Bull. Amer. Meteor. Soc. 82. 247-268
Graph produced by Robert Way, 2012.

Specific data for snow cover and sea ice change in the Labrador Sea are sparse. However, an analysis of trends in snow cover duration during the 1966–2007 period from NOAA data showed that snow cover in Labrador is responding negatively to increasing temperatures, albeit to a lesser extent than other parts of Canada (Brown and Mote 2009). In addition, the significant annual variability of sea ice extent in Labrador is relatively well documented, with heavy ice years correlating with positive NAO phases (Prinsenberg et al. 1997; Deser et al. 2002; Johnston et al. 2002; Strong and Magnusdottir 2010). Despite variability, and consistent with local observations,

the average annual sea ice extent of the Labrador Sea has been decreasing (Furgal et al. 2002; Parkinson and Cavalieri 2008). From 1968 to 2010 Nunatsiavut experienced the largest percentage loss of sea ice in all of Arctic Canada (Statistics Canada 2011).

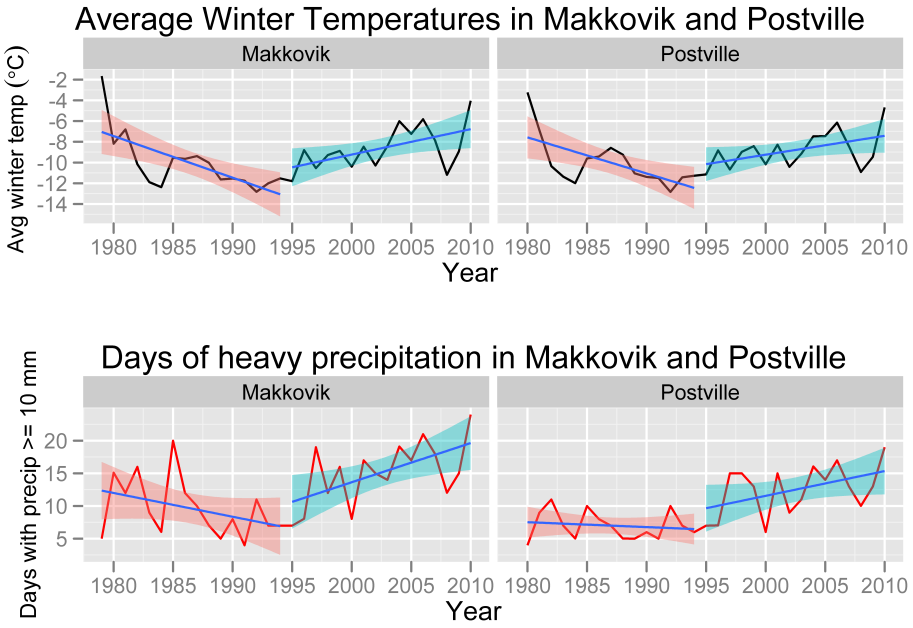


Figure 4-7. Average winter temperatures and days of heavy precipitation in Makkovik and Postville, Nunatsiavut. Source: NOAA National Climatic Data Center. Data retrieved by Andrew Flood. Graph produced by Scott Hatcher, 2012.

CVC may also negatively affect fauna and flora relevant for winter trail use and subsistence activities. Impacts are already evident on caribou (*Rangifer tarandus*), which are a main source of country food for people in Nunatsiavut (Natcher et al. 2009). Even though recent estimates suggest that some migratory caribou herds are stable or in recovery, most caribou populations in North America have been declining in recent decades (Russell and Gunn 2011). Besides anthropogenic disturbances, changes in temperature and precipitation have been known to affect caribou negatively, as they reduce the natural habitat of the animals and create critical food

stresses (Wittmer et al. 2007; Sharma et al. 2009; Faille et al. 2010; Kofinas et al. 2010; Taillon et al. 2012). In the context of Labrador, the George River caribou herd is very important for cultural and economic reasons for residents of Nunatsiavut. It consisted of 385,000 animals in 2001, and within less than a decade declined to 74,000 based on a 2010 post-calving photo-census (Russell and Gunn 2011). In August 2012 the herd consisted of only 27 000 animals. Researchers involved with the Caribou Ungava project, which studies population and migration dynamics of caribou in Quebec and Labrador, called for a reduction if not an immediate stop of all hunting activities on the George River caribou herd (CBC 2012). Other herds in the region, such as the Mealy Mountain caribou herd, are in decline as well (Popp et al. 2011). During the 2012 caribou hunting season a total allowable harvest approach was put in place, allowing Nunatsiavut residents to only hunt two caribou per household (NL Department of Environment and Conservation 2012).

Two other species that have historically been important in Nunatsiavut for subsistence activities are harp seals (*Pagophilus groenlandicus*) and ringed seals (*Pusa hispida*). Ecological factors such as lack of snow accumulation, thin and soft ice, warm temperatures, rain events, and intense storms have negatively affected seals in the last decade in Labrador and elsewhere in Canada, leading to a decrease in available animals. In addition, harvested animals in Labrador were reported to be undernourished (Furgal et al. 2002; Ferguson et al. 2005; Sjare 2008; Johnston et al. 2012).

With respect to accessing firewood, changes in forest cover and the tree line are of interest. Outside of Labrador it has been observed that CVC cause upslope and north ward forest advance. Research in Labrador suggests that warming will enhance tree seedling growth in Labrador in the future. Denser forest growth and slow northbound tree line movement are expected, even though there are more factors at play (such as seed availability) than simply temperature increase. While trees might become more plentiful, there is evidence that accessing them is already becoming more difficult (Hermanutz 2008; Munier et al. 2010; Wolf et al. 2012).

4.3.2. Projected change in Nunatsiavut

Throughout the northern regions climate change is projected to have continuing impacts (ACIA 2005). If produced at useful spatial resolutions, such projections are important for planning and decision-making in communities. Two studies, one conducted by ArcticNet and another prepared by J. Finnis (Memorial University) produced climate projections at a spatial resolution of 45-50 km, which is appropriate for developing regional to local climate change scenarios (see Brown et al. 2012; Finnis 2013). Both the ArcticNet and Finnis studies employed local climate station records and Regional Climate Models (RCM) nested within General Circulation Models (GCM) to compare current conditions with projected mid 21st century conditions under the same future scenario of greenhouse gas emissions. The two studies differ in their choices of GCM and RCM and their selection of projected climate variables, with the ArcticNet study focusing more on Arctic-relevant indices

and the Finnis study on more temperate indices, appropriate for a province-wide analysis.

Between these two studies, where there is overlap in the climate variables generated (e.g., seasonal temperature), there is good agreement in the projections, which are roughly centered on 2050. For example, for Nunatsiavut the average winter season temperature in both studies is projected to be 3-4°C warmer, about double what is expected during the summer. This wintertime temperature increase drives change in other climate indices; for instance, there is projected to be 25-50% more thawing-degree days, a shorter frost season by as much as 19 days per year, a three-week shorter period of continuous snow cover and a three-week longer summer season. Projected changes in precipitation, although typically spatially variable, show consistency in trend and general magnitude. Generally, projections suggest an increase in precipitation by <10-15%, with a larger fraction of annual precipitation falling as rainfall, leading to a thinner mean annual snowpack (up to 15% thinner), and an increase in intensity of extreme rainfall events, especially in spring and summer months. Figure 4-8, retrieved from the ArcticNet study, shows that projected temperature changes typically exhibits a North-South gradient over Nunatsiavut with the largest changes (~3°C) in the Torngat Mountains and the smallest changes (~2.5°C) around Lake Melville (although this pattern can be inverted depending on the variable selected).

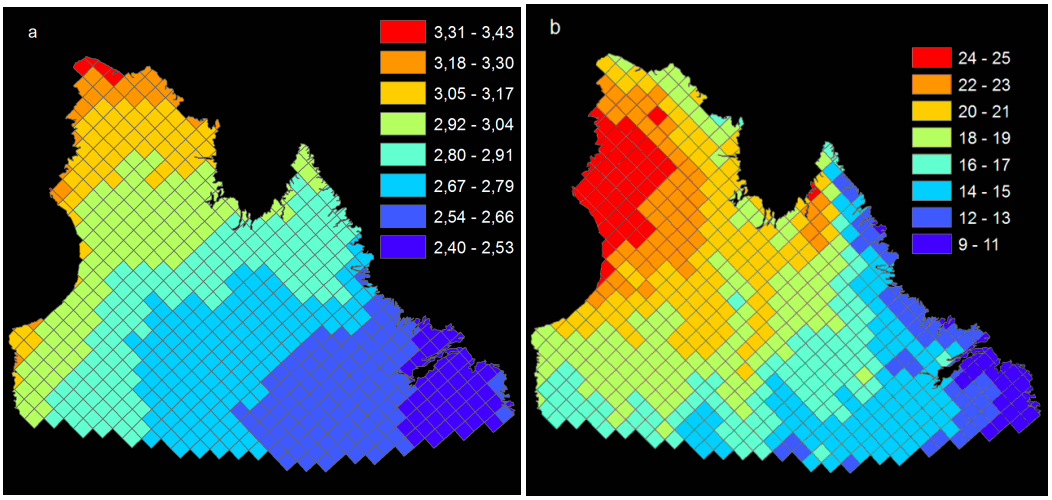


Figure 4-8. Projected change in mean annual temperature and precipitation in Nunatsiavut. (A) shows temperature (°C) and (B) shows total precipitation (%) for 2050 period in Nunavik and Nunatsiavut from six CRCM runs. Source: Brown, B., Lemay, M., Allard, M., Barrand, N., Barrette, C., Begin, Y., (contributing authors) Bell, T., Bernier, M., Bleau, S., Chaumont, D., Dibike, Y., Frigon, A., Leblanc, P., Paquin, D., Sharp, M.J. and Way, R., 2012. Climate variability and change in the Canadian Eastern Subarctic IRIS region (Nunavut and Nunatsiavut). In Allard, M. and Lemay, M., Nunavik and Nunatsiavut: From science to policy. An Integrated Regional Impact Study (IRIS) of climate change and modernization. ArcticNet Inc., Quebec City, Canada, 57-93.

Second, the spatial pattern of projected increases in mean annual precipitation has a strong coastal gradient, increasing from 12-13% at the Labrador coast to 14-15% inland and 16-17% at the Labrador-Quebec border. Third, the largest changes are projected to occur in the winter season with about double the warming and up to one-third more precipitation during the winter. Table 4-1 provides a summary of projected changes in climate variables by Brown et al. (2012) for the five Nunatsiavut communities.

Table 4-1. Summary of projected changes in climate variables for the Nunatsiavut communities (Nain to Rigolet) to 2050

Projected change in climate variables for 2050s	Nunatsiavut Communities
Mean annual air temperature (Δ°C)	**2.4−2.8** (±0.4)
Mean winter (Oct-Apr) air temperature (Δ°C)	**2.7−3.5** (±0.4-0.5)
Mean thawing degree days (ΔTDD)	**213−296** (±15-27)
As percent of current mean TDD (%)	**28−48** (±3-9)
Total annual precipitation (%)	**12−15** (±2.3-5.7)
Total annual solid precipitation (%)	**-3.0−4.5** (±4.5-7.2)
Decrease in mean annual snow depth (%)	**3.6−14.4** (±3.6-7.1)
Rain-on-snow events (days)	**0-2**
Annual maximum snow depth (%)	**-3.6−2.7** (±4.1-6.9)
Later start date of continuous snow cover (days)	**9.4−13.3** (±0.5-6.0)
Earlier end date of continuous snow cover (days)	**5.7−9.9** (±0.6-2.2)

In summary, the projected climatic changes of relevance for winter trails and travelling in Nunatsiavut communities include: a three-week shorter period of continuous snow cover, on average winter season temperatures higher by about 3°C compared to only half of this warming in summer, 25-50% more thawing-degree days, and an increase in precipitation by 12-15% with a larger fraction of annual precipitation falling as rainfall, leading to a thinner mean annual snowpack (up to 15% thinner).

CHAPTER 5. RESULTS: VULNERABILITY TO CHANGES IN WINTER TRAILS AND TRAVELLING

5.1. Vulnerability to changes in winter trails and travelling

This chapter presents the results of the 28 map biography interviews conducted in Makkovik and Postville between January and March 2012. It describes the physical changes that have occurred in the winter trail network during the lifetime of interview participants, and the factors contributing to trail route change according to them. It then explores changes in the act and experience of travelling before discussing the experiential dimensions of change for interview participants. Coping and adaptation measures are discussed, and barriers to adaptation identified. Possible cultural or socioeconomic differences between Makkovik and Postville seem not to be reflected in perceptions on winter trails and travelling. Hence, the findings of both communities are presented together rather than separate.

5.2. Physical changes in winter trail routes and winter trail conditions

Makkovik and Postville residents utilize an elaborate network of winter trails. The routes identified by interview participants are shown in Figure 5-1. The northernmost extent of regular winter travelling for residents of Makkovik and Postville as indicated by interview participants is approximately 400 km north of Postville (linear distance) near Hebron. Hebron is a former Inuit community and Moravian mission station. Today, travelling in this area mainly serves the purpose of caribou hunting in March and April. The easternmost extent of regular winter travelling is Jeanette Bay, which

lies 80 km south-east of Makkovik (linear distance). Besides recreational activities, this region is a hub for subsistence participation, including hunting small game, waterfowl, and seal, and collecting firewood. Less travelled due to the establishment of the groomed trail network, but still in use, is the long route to Rigolet via Alliuk Bight and Groswater Bay.

To the west, Harp Lake provides an important destination for regular travelling (located 135 km west of Postville linear distance, actual travel route closer to 240 km one way). The region is mainly utilized for caribou hunting, with additional subsistence activities occurring along the way. To the south, the groomed trail to Goose Bay (approximately 190 km one way) provides access to one of the main hubs of Labrador. Apart from the groomed trail network, the Nipishish Lake area was the furthest subsistence area that interview participants pointed out in the south-west direction (110 km linear distance from Postville).

Only a small portion of travel routes is groomed, and therefore well maintained. (Figure 5-1). The majority of trails are marked, unmarked, and semi-permanent, which means that they frequently change their appearance depending on environmental conditions and wildlife availability (Figure 5-1). Most of the winter travel routes pointed out by map biography participants are hybrids of land based and ice based routes, with the majority of travelling taking place on freshwater ice and sea ice surfaces. The travel routes avoid coastal landforms such as barrier islands, spits, or even shorelines. Ice conditions near such features tend to be very rough, with

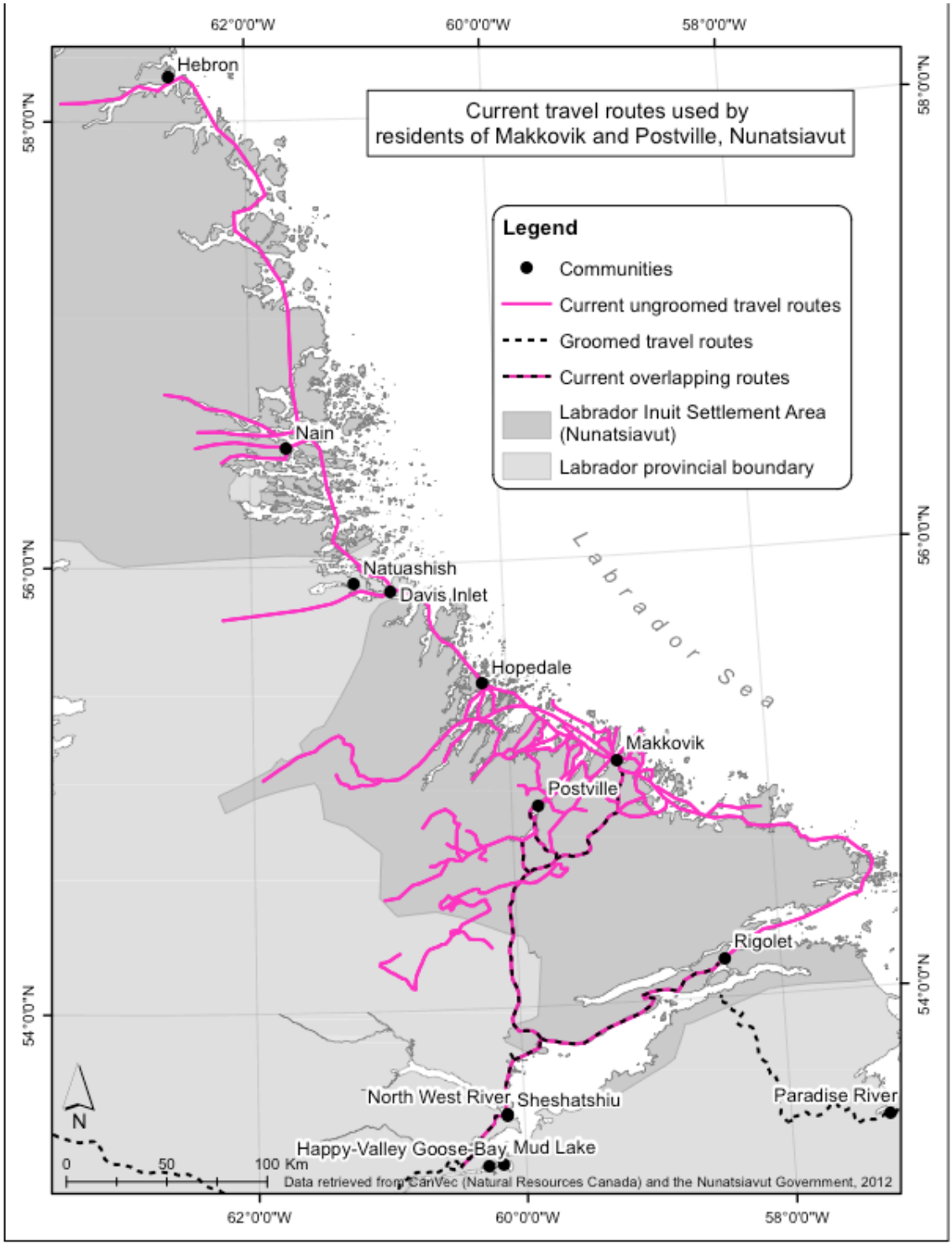


Figure 5-1. Current travel routes used by residents of Makkovik and Postville, Nunatsiavut. Map produced by R. Riedlsperger.

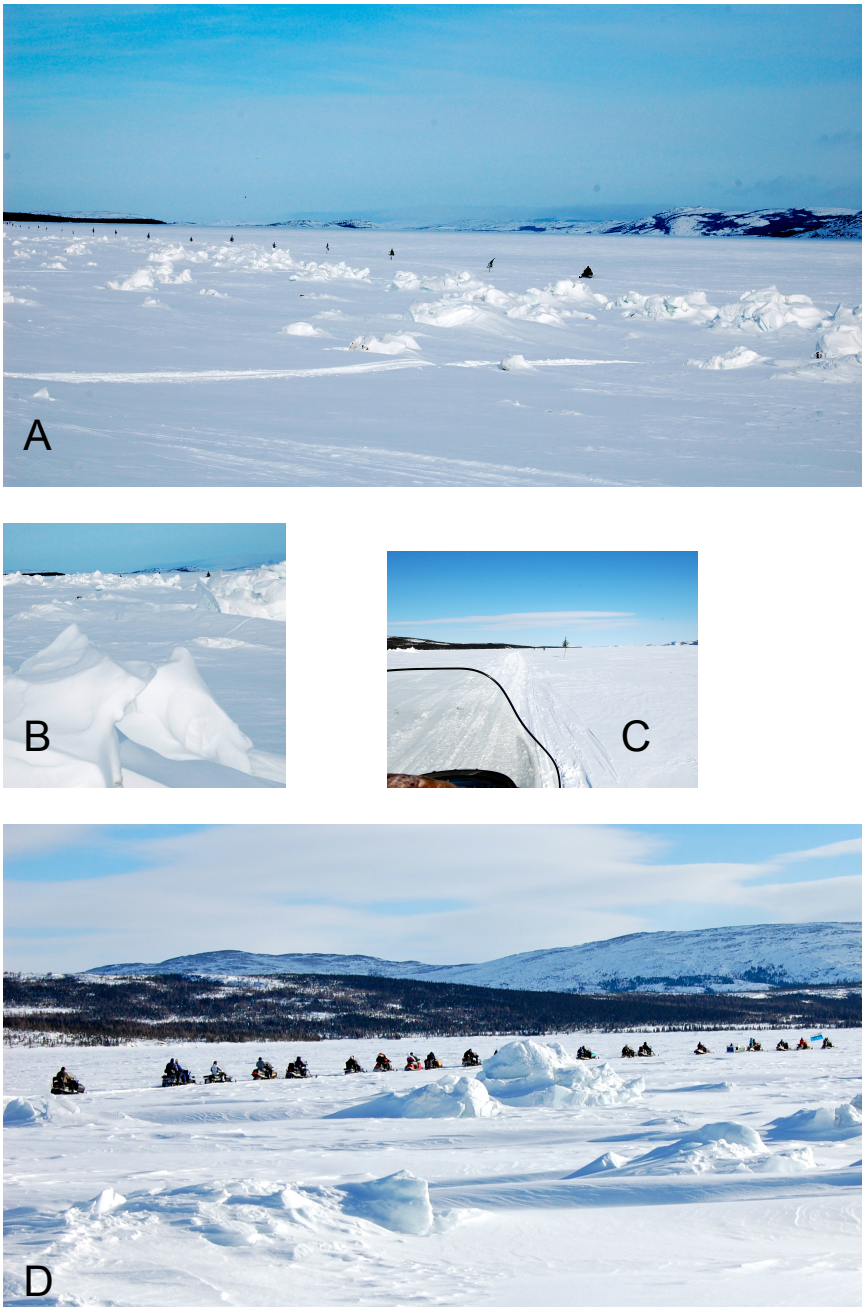


Figure 5-2. Differences in ice characteristics on the marked trail from Postville to Makkovik. The darker spots in the picture are trees that mark the easiest route, whereas closer to the shoreline (to the left of the tree markers) the sea ice surface is visibly deformed (A); a close up image of sea ice buckling near the shoreline (B); smooth sea ice travelling conditions from the point of view of a snowmobile driver (C); a group of snowmobiles travelling on smooth ice next to buckled sea ice (D). Photos by R. Riedlsperger.

buckling of ice causing surface features to occasionally exceed two meters in height (Figure 5-2).

Trail use to a large extent centers around subsistence activities. Figure 5-3 shows the subsistence areas that interview participants accessed via winter trails. These areas are divided into hunting areas on land (green), hunting areas on sea ice (pink), firewood sites (brown), and trap lines (orange). Most of the immediate surroundings of both Makkovik and Postville (a radius of 20 km) are intensively utilized for subsistence activities, especially so for small game hunting and firewood collection. Community members can access subsistence sites in relatively short trips (< 1 hour). The high geographical accessibility of these sites distinguishes the study area from the Nunatsiavut communities of Nain and Hopedale, where people have to travel further to access subsistence sites (Fleming et al. 2012). Caribou hunting is a significant exception in terms of accessibility, however. The activity takes place in areas that can typically only be reached in multi-day trips (Figure 5-4). With the exception of caribou, both communities utilize different geographic areas for subsistence activities. While Makkovik residents access the land south to south-east of the community, residents of Postville mainly utilize southern and south-western areas. Though the communities are close, no conflicts over travel routes and subsistence areas were mentioned by interview participants.

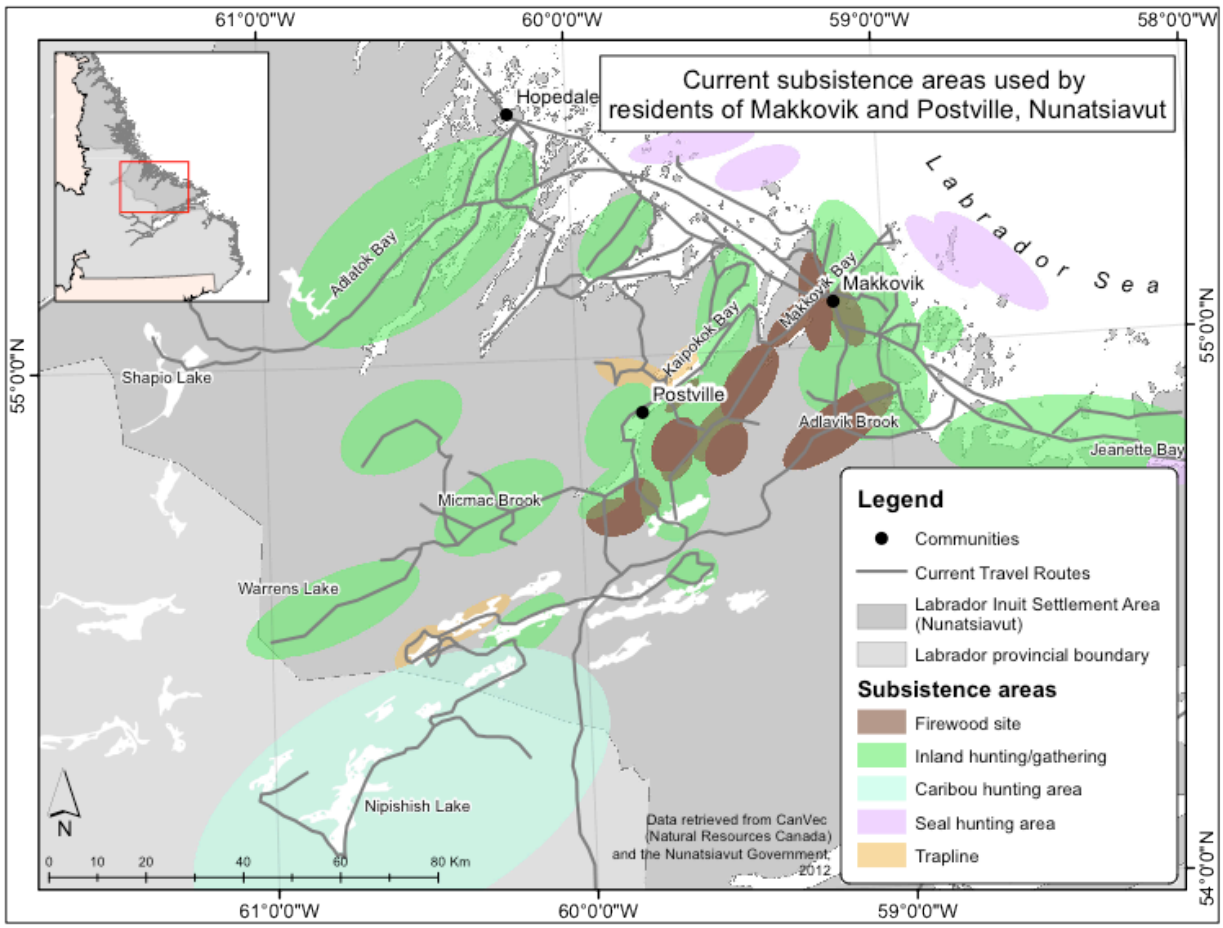


Figure 5-3: Subsistence areas identified by residents of Makkovik and Postville, Nunatsiavut. Map produced by R. Riedlsperger.

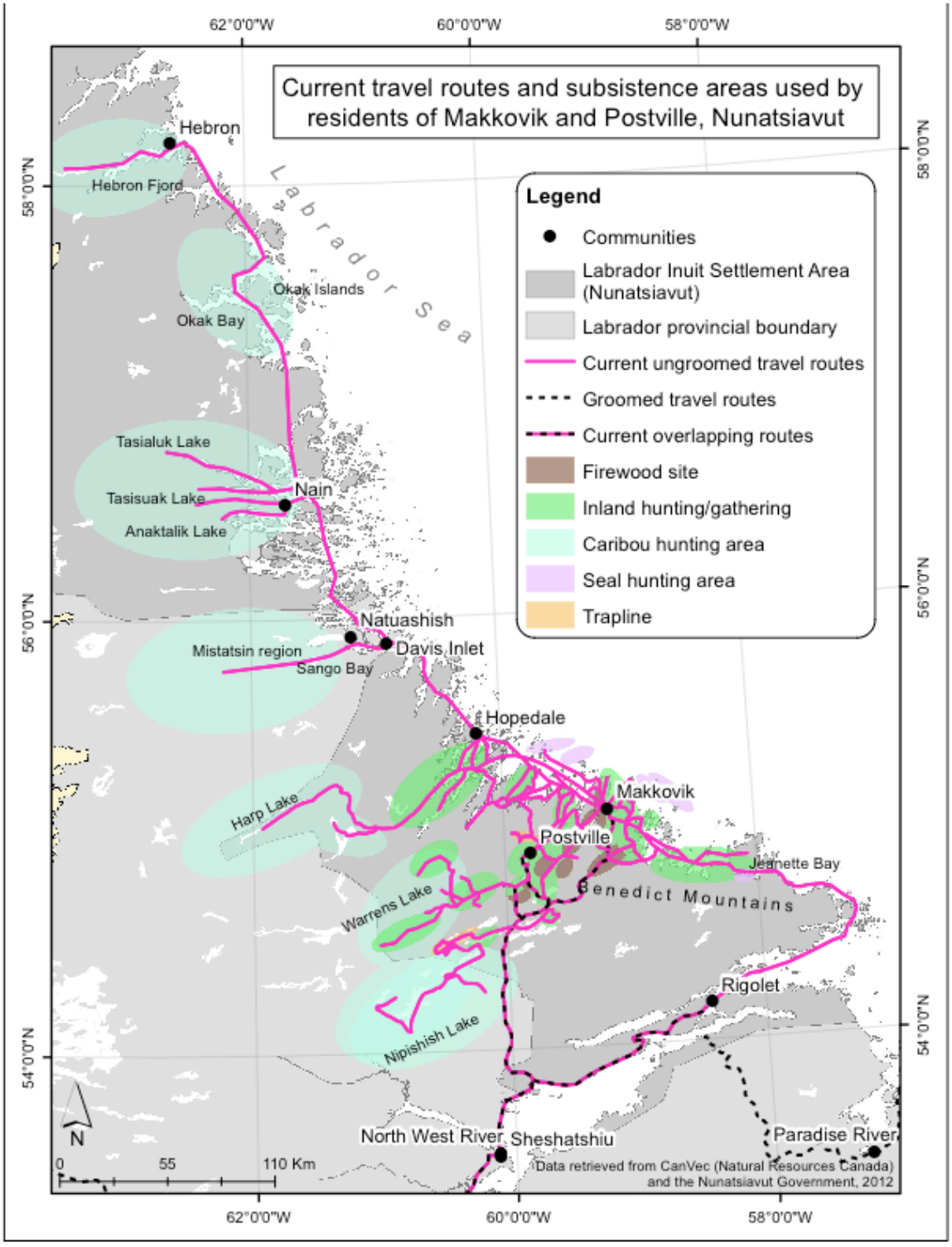


Figure 5-4: Caribou hunting sites accessed by residents of Makkovik and Postville, Nunatsiavut. Map produced by R. Riedlsperger.

Interview participants noted a gradual physical deterioration of winter trails occurring throughout their lifetime. Poor physical conditions in winter trails have historically been more pronounced during the shoulder seasons (the days and weeks leading up to a solid freeze-up when bay and landfast sea ice has become strong enough to support individuals venturing on it) and, conversely, the days and weeks before the break-up of the ice occurs (when bay and landfast sea ice is no longer strong enough to support travelers). However poor physical conditions of winter trails have increasingly become noticeable during the months of January, February, March, and April. These changes were especially pronounced in the winters of 2008/09, 2009/10, and 2010/11. Areas most affected by these changes are shown as shaded red polygons in Figure 5-5. Of particular note are the coastal areas around Turnavik Islands, Hares Islands, and Kingitok Islands towards Hopedale to the north-west, and the areas near the Benedict Mountains towards Jeanette Bay to the east (for location of these places see Figure 5-4). In addition to coastal areas, bays are also affected, albeit to a lesser extent. In extreme cases, interview participants reported no longer travelling in some of these places. Such abandoned travel routes are marked solid red in Figure 5-5. They concentrate around Cape Makkovik and Cape Strawberry, both of which are within close proximity of Makkovik.

Participants noted these changes in their interviews, highlighting that sea ice conditions have deteriorated throughout their lifetime to the extent that individuals are unable to travel in certain areas:

Ice thickness and extent of the ice in the last ten years has been different. Usually in the spring time we could drive all the way here and up to the Adlavik Islands, but you can't do that now these days, it's all broken up in this area right here, obviously. We travelled by snowmobile from Makkovik out around here to these islands in the past, 80s and 90s, but now you can't do that anymore, not safely.

Former seal hunter, M, Makkovik[7]

I don't think that you could make that kind of turn [around Cape Harrison], *for the past ten years. And before that, it was just normal, you'd just take off. … And now when I tell my children about* [travelling around the capes]*: "How did you ever do it?" But it was normal.*

Hunter, M, Makkovik

For the last 10 to 15 years it has been gradually gone [worse], *you could not get on a ski-doo and go around the cape.*

Hunter, M, Makkovik

It's different in everything, even the ice. One time we could go over to the cabin, my mother used to go up in the spring. Used to go out around the cape, out on the ice and go over to the cabin, and stay over there for the spring for break up. Get seals and fish and everything else. But you can't go out over there now; it's all open water.

Hunter and crafts maker, F, Makkovik

[7] The descriptive info of interview participants consists of their (self-identified) main activities related to travelling on the land and ice OR their occupation, their gender, and their home community. Other info, such as age, were only added if it contributed to the meaning of the quote.

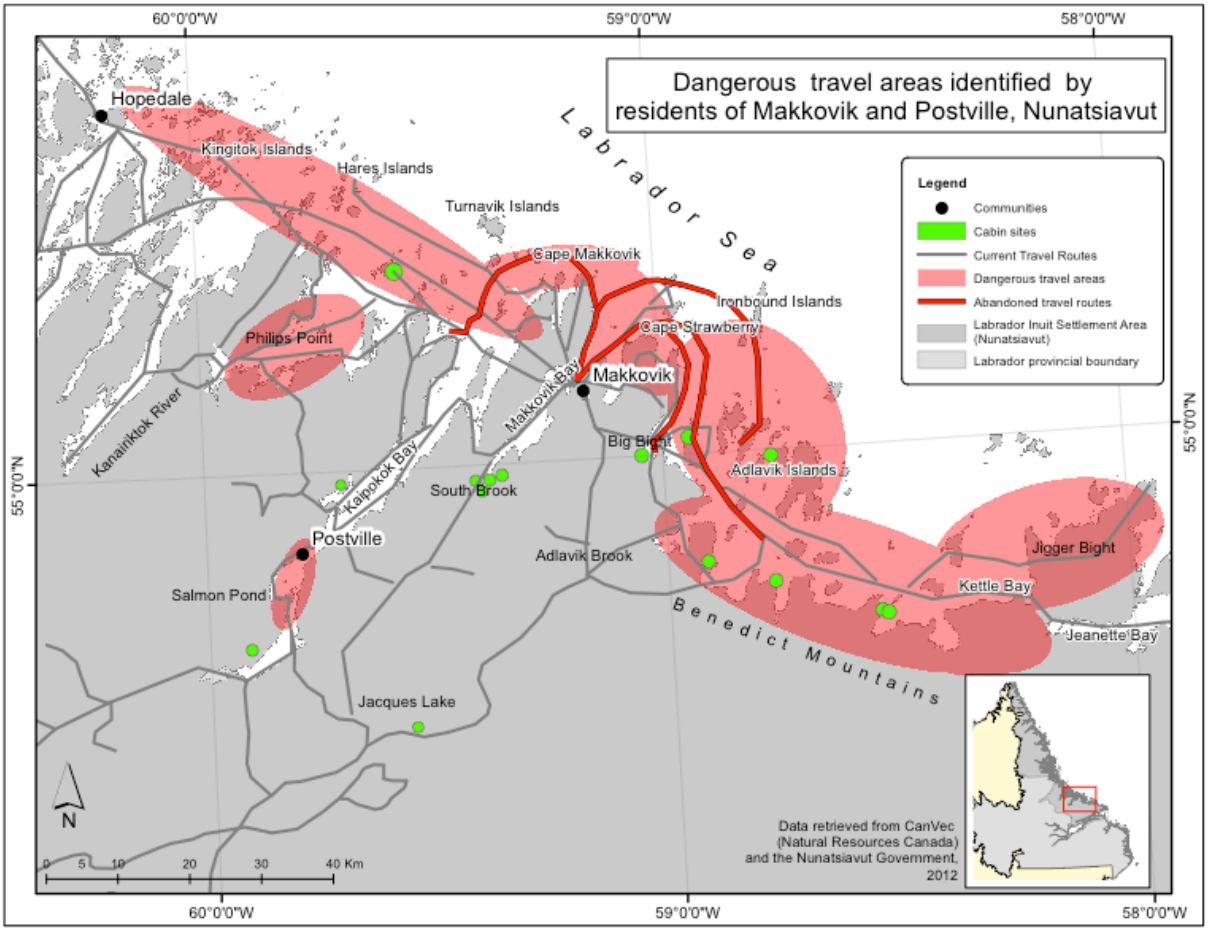


Figure 5-5: Dangerous travel areas identified by residents of Makkovik and Postville, Nunatsiavut. Map produced by R. Riedlsperger.

Interview participants identified mild winters with above average temperatures and changes in precipitation patterns as the main causes contributing to winter trail route change. Shifts in the timing of freeze-up and break-up dates are one manifestation. Freeze-up dates throughout the interview participants' memory ranged from December 15 to January 29, with interview participants indicating a gradual shift towards the later dates. Break-up dates ranged from early April to mid June, with interview participants indicating a gradual shift towards earlier dates. Interview participants

noted the winter of 2009/10 as an extreme example. Community members could only spend approximately one month on the land and ice, which severely impacted their ability to travel.

> *Three or four years out of the last ten were really, really bad for travelling, like really mild. Late, very late freezing and it opened up early. Like no cold weather after mid-April, just really warm.*
>
> Hunter, M, Postville

> *Sometimes it would be middle of June before you had to give up going on the ice. Now, by the middle of May, you better stay off it.*
>
> Caribou hunter, M, Makkovik

Even in winters with less extreme shifts in freeze-up and break-up dates, interview participants commented on deteriorating ice quality throughout the winter, noting an increasing slushiness of sea ice due to unusually extensive salt water inundation. As a consequence, sea ice thickness was changing rapidly from any given spot to the next, making it difficult to properly assess the ice conditions.

Warm temperatures also had effects on snow cover on inland routes. Interview participants commented on poor snow quality being more common while travelling on land based routes.

> *The snow conditions, it seems like the snow is not the same as it used to be. … You go farther inland and have less snow.*
>
> Hunter/RCMP, M, Makkovik

> *The last three or four years it's completely changed. … The biggest* [change is] *that we don't get snow early in the fall. … We had lots of snow, you know, and now people try to go and the temperatures are milder, there's not much snow, the travelling conditions are just terrible.*
>
> Hunter, M, Makkovik

Instead of snowfall, interview participants noted an increase in rain and freezing rain events throughout the winter, most unexpectedly so during the months of January and February. These months are usually associated with very cold temperatures. Rain is known to be detrimental to winter trail conditions due to the severe damage it causes to existing layers of snow and ice. On sea ice routes, rain events can lead to open water spots and thin ice conditions. Inland, brooks are easily washed out, acting as potential barriers to travel routes. Rocks and other material on the ground are exposed, making travelling difficult and dangerous. Winter trail deterioration due to rain events was reported to be more common in the Makkovik area than in Postville, which might partly explain the concentration of abandoned travel routes in the area around Cape Makkovik and Cape Strawberry (Figure 5-5). Besides an increase in rain events, interview participants noted persistent southern winds, bringing unusually warm air to the region.

5.3. Changes in the act and experience of travelling

The communities of Makkovik and Postville are affected by the physical deterioration of travel conditions in different ways. Interview participants first and foremost noted a perceived increase in travel hazards, in combination with changes in trail use activities. Stresses brought about by CVC are exacerbated by other factors, such as wildlife availability and socioeconomic changes.

5.3.1. Travel hazards are perceived to be increasing

Virtually all of the 28 interview participants have been involved in dangerous travel situations throughout their lifetime. Incidents range from snowmobiles running out of gas close to home, to breaking through sea ice with snowmobiles while travelling alone hours away from the next community. There is an acceptance among community members that travelling on the land and ice in Labrador is dangerous, sometimes fatally so. Accidents are not stigmatized, but getting oneself in danger recklessly is very much frowned upon in the communities. A hunter who broke through the ice on his snowmobile while out on a trip was embarrassed upon his (unharmed) return to the community:

> *I spoke to some guys older than myself, and I told them, I hope you don't think that I am being reckless or careless, and my friends said, "No way, we would never think that."*
>
> Caribou hunter, M, Makkovik

Interview participants emphasized that while travelling on the land and ice has always been dangerous, consistent cold temperatures have contributed to keeping travel risks acceptable or manageable in the past. Community members could assume that travel conditions were excellent during certain times of the year. Interview participants noted that in cold and clear conditions knowledgeable travelers were even able to rely on celestial bodies to derive potential changes in the weather, and how they would affect travel conditions for days ahead. This helped them to inform decisions of when and where to travel, providing a sense of relative travel safety. Therefore, travelers often

felt comfortable travelling at night and in diffuse light conditions (the latter even being referred to as "blind driving").

Partly as a result of the physical deterioration of winter trails, travel safety is increasingly shifting outside of the acceptable range of risk. Interview participants noted a perceived increase in travel hazards, especially in the areas shaded red in Figure 5-5. Travel hazards occurring within these areas included rough ice, thin ice, open water spots (sometimes covered with snow), rattles (areas of open water occurring in bays and rivers), slob[8], and ice fissures or larger broken up sections of sea ice. In such conditions participants noted that they find it more difficult to rely on traditional knowledge about travel conditions.

> *The traditional knowledge of the probably three or four nights* [of cold enough temperatures so that ice would be able to form] *was safe to go on, it is not really holding true anymore.*
>
> Hunter, M, Postville

The winters of 2008/09, 2009/10, and 2010/11 especially compromised people's sense of security. This made travelling on the land and ice more stressful for them.

[8] Slob is a Labrador term for heavy, slushy, densely packed mass of ice fragments, snow and freezing water, often occurring on the surface of the sea. Source: Heritage Newfoundland 2012. Available online at: www.heritage.nf.ca/dictionary/azindex/pages/4332.html, last accessed on January 12, 2013.

Nighttime travelling and travelling in unfavorable light conditions are perceived as especially dangerous.

> *People are nervous on the ice, like I'm nervous on the ice, and as soon as it starts getting not good for travelling, then I don't go anywhere.*
>
> Recreational trail user, F, Postville

> *But it was not safe to travel during night … fifteen, twenty years ago we used to travel during the night to go to Nain, now everything has changed. … I have enough skills to read ice conditions, but you don't know. You don't physically see it, the area is not all safe anymore, these last couple years you go there and the head of the bay and you could chop down, two foot* [of sea ice]*, and the next place you go there, five, six inches. It leaves holes, and a lot of people don't travel at night anymore. Us older guys, we are not that old, fifty-five, sixty years old, we've talked about it and noticed the differences.*
>
> Caribou hunter, M, Postville

The perceived increase in travel hazards caused by the physical deterioration in winter trails is exacerbated by increased travel radius and travel speed. Technological advancements allow people to travel much faster on the land and ice than was the norm when dog teams were the main mode of travelling.

> *As one elder said, the ski-doos they got nowadays, you go on a hunt, you can almost meet yourself coming home. You are so quick.*
>
> Hunter, M, Postville

Interview participants explained that it is possible to cover the distance from Makkovik to Hopedale on snowmobile in two hours, whereas it would take more than eight hours by dog team. Travelling from Makkovik to Nain on a snowmobile takes about twenty hours, whereas travelling the same route with dogs would take approximately two weeks according to interview participants. As a consequence, the

high pace of travelling makes it more difficult to notice landscapes, changes in weather conditions, and travel hazards. One older interview participant explained that even though travelling with dog teams was fatiguing because mushers often ran next to the sled and helped push it through difficult terrain, the relatively slow and steady pace allowed travelers to take note of their surroundings, environmental conditions, and potential travel hazards. Sled dogs were able to distinguish ice conditions and could therefore help navigate over precarious lake and sea ice, for example. Even in poor visibility dog teams were able to bring the mushers to the desired destinations. With snowmobiles this is not possible.

> *If you were on a dog team, when we had dogs back then, if you were travelling over sea ice and it was starting to get not as strong as it should be, you'd see the dogs all starting to spread out, then you knew the ice was bad,* [you had to] *turn around and go back. And today you have to rely on your own self, stop every now and then, and test [the ice conditions].*
>
> Hunter, M, Makkovik

Interview participants explained that self-reliance while travelling by snowmobile was a substantial problem for inexperienced travelers and youth, as they would sometimes be overly confident in their ability to travel in less than ideal conditions and consequently were more at risk of encountering dangerous situations. Participants suggested this was because youth and otherwise inexperienced travelers are disconnected from traditional ways of traveling. Experienced community members were exposed to traveling on the trails by dog team first hand to a greater or lesser degree, depending on their age. They can still apply these traditional skills, such as assessing snow and ice conditions, even when travelling by snowmobile. Experienced

travelers also worry about younger people relying too much on electronic devices while out on the land and ice. GPS (global positioning system) technology has become ubiquitous since the 1990s and often makes it possible for travelers to navigate through less than ideal conditions. Interview participants fear that reliance on technology can help conceal a lack of skills and even contribute to the erosion of them.

> *Once they make a GPS track across these necks of land, they don't need elders so much anymore. They think they don't. Because they can follow the track, right? For me, I had to go several times across these places, because it was by memory. It was by my own brain and by people, you know, telling me what to look for. What landmarks, certain rocks, certain things. I would rather use my own senses, to put it simply, you know. Because the* [GPS device] *can go off, or it doesn't tell you in really bad weather where steep inclines are.*
>
> Hunter, M, Makkovik

The consensus among interview participants is that being technology savvy is very important, but learning about the land and ice by spending significant amounts of time travelling and being involved in subsistence activities is essential. They therefore see technology as a supplement to, not a substitute for experience, as it may give travelers a false sense of security while being away from the community, further increasing their risk of being exposed to travel hazards.

5.3.2. Trail use activities are changing

Besides causing a perceived increase in travel hazards, physical deterioration of winter trails impedes trail use activities, including access to subsistence areas (hunting, trapping, and hauling firewood), travelling between the communities, and recreational travelling.

Caribou hunting provides the most prominent example of a subsistence activity that is of concern to many in the community, and this is in part due to deteriorating travel conditions. The caribou hunting grounds around Michinape Lake, Witch Doctor Lake, Harp Lake, and Hebron (Figure 5-4) have all been subject to poor travel conditions in recent years. In certain cases, hunters had to return because the winter trails were unfit for travel, leaving households without caribou for the winter.

> *I think there's one party* [that] *went up from Nain last year, I think they were the only people who got caribou in the Hebron area, and other than that nobody went up because there just was not enough snow on the land for travelling, that was last year* [2011].
>
> Caribou hunter, M, Makkovik

> *A few years ago we only had tags to hunt caribou at Harp Lake. We could not even get there because the river was not frozen. We had to return.*
>
> Caribou hunter, M, Makkovik

Wildlife availability adds to the problem of accessibility, as the declining number of caribou causes community members to reconsider whether or not it is worth engaging in hunts at all.

> *Eighty, ninety percent of what's eaten in my household is caribou, and it's really having an effect this winter, because, when I was hunting last year I only brought home two caribou for myself, I had two for my father in law, and I ran out long ago and, you know, when I travel way into Nipishish for one caribou, it's not very, it does not make much sense.*
>
> Hunter, M, Makkovik

Besides caribou hunting grounds, popular seal, goose and partridge hunting sites have also been impacted, as these species are abundant in the areas shaded in red in Figure 5-5.

> [Seal hunting] *would not be as good now because, I don't know, it seems like it can't freeze up winter time, like, we used to go to the outside of the islands to hunt seals on the ice, but now it usually is broken up, pretty much all winter.*
>
> Former seal hunter, M, Makkovik

> *The first time I did not get up to do any goose hunting at all* [near Jeanette Bay in 2010], *not even once, you could not go, there's no ice.*
>
> Hunter, M, Makkovik

Seal hunting offers an example of how a variety of factors affect subsistence activities. CVC causes reduced access to seal hunting sites. In addition, however, the demand for sealskins on the national and international markets has plummeted due to protests by environmental groups and activists calling for a ban on seal hunting. Bans have been implemented in important former markets such as the European Union[9], for example. In addition, the marine mammals have also become less attractive for personal use as well. Very few people have dog teams nowadays (there are less than five dog teams each in Makkovik and Postville). This further reduces the incentive to get seal meat, which is a staple food in the diet of sled dogs. Furthermore, interview participants expressed worry about the safety of seal meat for personal consumption, as hundreds of dead harp seals were washed ashore between Hopedale and Makkovik in the winter

[9] The Federal Government of Canada (with the support of the Inuit) unsuccessfully urged the World Trade Organization to challenge the European Union's ban on seal products (www.theglobeandmail.com, retrieved on August 23, 2012; www.nunatsiaqonline.ca, retrieved on August 23, 2012; http://europa.eu/, retrieved on August 23, 2012).

of 2011[10]. It is a combination of these four factors that has caused seal hunting to become a less common activity for Makkovik and Postville residents.

Trapping activities fare better. According to interview participants, the activity is generally thriving because furbearers yield good prices at auctions. However, trap lines often serve as inland travel routes and vice versa and are therefore equally as affected by changes in temperatures and precipitation as other winter trails. Some trappers in Makkovik could not access their trap lines regularly in recent years due to the physical deterioration of travel routes. As a consequence trapped animals decayed and could not be sold:

> *We had lots of snow and ice, like I never had no trouble going over* [to the traps] *and then just, within a week it was almost just raining and warm weather, all snow was gone, and ice and brooks was open and it was almost a whole month to get back* [to the trap line], *like before it froze over again and snowed.*
>
> Trapper, M, Makkovik

Activities not associated with hunting and trapping have been affected, too. Collecting firewood is the most prominent example. The traditional time to start "wooding", as locals refer to it, is from late February to early March. This allows travelers to take advantage of longer daylight hours and slightly warmer temperatures than in mid winter. In the winters of 2008/09, 2009/10, and 2010/11 temperatures were too mild, however, making it difficult for locals to find enough good travel days to complete hauling enough firewood for the following winter.

[10] Coverage from the Canadian Broadcasting Company can be found here: http://www.cbc.ca/news/technology/story/2011/01/17/nl-dead-seals-117.html, retrieved on May 8, 2013.

> *In March I went in and cut my last load, but I did not know that was going to be my last load because the next day the brook had broken up so I could not get across. I had to turn around and come back. It was just so warm that night and that day that the brook opened up.*
>
> Hunter, M, Makkovik

Some firewood sites are more exposed to the changing conditions than others. One of Makkovik's most popular firewood sites, a burned wood area located at Adlavik Brook (Figure 5-3) has only been accessible through sea ice travel routes in the past. The site is sought after because of the good, dry quality wood. Travelling to this site has become difficult and at times impossible due to deteriorating ice conditions, leaving community members to utilize alternative firewood sites to be able to stockpile wood for the winter.

Not only is access to subsistence areas impeded, so is travelling between communities on the Labrador North Coast in general. Poor snow and ice conditions affect winter trail maintenance negatively, for example. Groomed trails cannot be maintained properly if there is not enough snow on the ground. Trails leading over freshwater ice are only groomed if there are at least 24 inches of solid ice. If this requirement is not met, it is impossible to maintain portions of the groomed trail network. Since the groomed trail network was established in 2001, groomers broke through the ice several times around Postville, leading to a conservative approach to grooming in general.

> *Anytime they take the groomer out now they check the ice and double check it and make sure there's enough ice because places that they could go before they can't go now.*
>
> Trail grooming administrator, F, Postville

I fell through the ice twice with the groomer.

Former groomer operator (2001 – 2011), M, Postville

Not only have winter trail conditions been unfavorable in terms of grooming, at times the inability to leave the communities due to poor travel conditions has even led to cancellations or postponements of sports tournaments in the past – again mainly throughout the series of recent mild winters previously mentioned. Being stuck was perceived as especially frustrating during holidays such as Christmas and Easter, when community members traditionally like to travel to visit family and friends in Makkovik or Postville on snowmobile.

> *Even in my time you could get up* [Makkovik] *bay easily before Christmas, but it seems like the farther back you go, the farther back they could get up the Bay in the beginning on December. When I was younger, you could get up the Bay before Christmas, and somebody in their forties or fifties would say they could get up the Bay in the beginning of December.*
>
> Recreational trail user, M, Makkovik [30 years old]

Reduced accessibility of winter trails causes community members to spend less time travelling on the snow and ice to either engage in subsistence or recreational activities. Social change is exacerbating this problem, as the necessity of engaging in wage labor further reduces the amount of time people can afford to spend out on the land and ice.

> *The generation before couldn't afford not to be on the land. They had to be on the land, and they didn't rely on store-bought things. But now, you have to disconnect from the land, and you have to be a person of means to go on the land.*
>
> Teacher, F, Makkovik

While hunters used to spend weeks, if not months, away from the communities, short daytrips have become very popular. This is true even for time intensive activities such as caribou hunting.

> *I am employed full time, during the winter months we have to go out and harvest or cut firewood and if you are working five days a week and you are depending on the weekend, sometimes it could become a problem due to weather, or whatever else. … If we are gone nowadays two, three nights caribou hunting, people say what are they going so long, why are they gone so long, it's just so much change and sometimes I think that the world has advanced almost too rapidly, too fast for us to keep up with.*
>
> Hunter, M, Postville

Interview participants also noted a general shift away from an active traditional/subsistence lifestyle to more sedentary behavior. This shift is attributed to a close attachment to television, video games, and the internet. In addition, for those interested in physical activity an abundance of structured pastime activities for people of all ages exist, including soccer, volleyball, bingo, and yoga. Some elders feel that these activities compete with traditional activities that require leaving the communities and going out on the land and ice. Somewhat contradictory, to a certain extent, is the perception of interview participants that there is an increase in travelling on winter trails for purely recreational purposes. "Freestyle snowmobiling" or "backcountry sledding" has a sports like or competitive character to it, and some community members put a lot of time and effort into upgrading their snowmobiles. While walking through the communities one can see groups of youth on snowmobiles driving around on short routes that include obstacles and jumps.

The combination of less time spent on the land and ice due to environmental conditions in combination with lifestyle changes has implications for community and individual livelihoods. First, community members need to 'cram in' subsistence activities when the time allows. Community members feel that they are often forced to make a choice considering the apparent contradiction of having to be more careful while travelling, yet having to hurry at the same time. They may either choose to take risks and travel in conditions that are not favorable (e.g., at night or in diffuse light conditions), or they may not be able to engage in subsistence activities, such as caribou hunting, at all. Hunters reported that they often do not get enough rest, sometimes up to the point where sleep deprivation leads to hallucinations while travelling. While there are no studies on the effects of fatigue on hunters and other trail users, fatigue is generally known to reduce safety significantly (Canada Safety Council 2012). Second, spending less time on the land and ice can lead to reduced 'subsistence revenues', such as wildlife harvested and firewood gathered. These revenues need to be compensated somehow: every meal that does not come from resources harvested on the land needs to be replaced with store bought food; if firewood is scarce, people usually heat their homes with heating oil, if possible. Third, the reduced exposure to traditional activities negatively affects traditional knowledge and skills, which are essential to be safe while travelling on the land and ice. Interview participants fear that especially younger people will be increasingly vulnerable to travel hazards due to this combination of factors.

5.4. What do these changes mean to community members in Makkovik and Postville?

The physical deterioration of travel routes in combination with changes in the act and experience of travelling also affect individual and community livelihoods indirectly. There are intrinsically desirable qualities associated with winter trails and travelling that contribute to what can best be described as personal well-being. In the context of winter trails and travelling, personal well-being is positively influenced through a sense of security, identity, purpose, and stewardship, and an enhanced sense of space and independence brought about by unimpeded access to the land and ice.

5.4.1. Sense of security with respect to satisfying basic human needs

In 'them days', as the distant past is referred to by locals, many people in Makkovik and Postville derived from the land everything they needed in order to survive, including food, clothing, and materials for making tools and weapons. Nowadays, unimpeded access to the land and ice still provides people with a sense of security in terms of being able to satisfy basic human needs without being vulnerable to influences from outside the region. Accessible winter trails are perceived to be especially important in terms of food security and energy self-sufficiency.

> *I burn wood but I also burn oil. But there's a lot of people in the community that just burn wood. And if they couldn't get in to get wood, I don't know. For me, my expenses would probably go up. If I couldn't get wood, if I couldn't go caribou hunting, partridge hunting, my expenses would probably go up about $12,000 a year. If I had to buy food, all food from the store, and burn all oil. It'd be at least $12,000 for what we get.*
>
> Hunter, M, Makkovik

Access to firewood sites makes community members less vulnerable to power outages, which sometimes happen during storms in the winter.

> *If the power goes out, and if you only got a furnace that's bad, if the power is out for a long time there's no way to heat your house. I've seen that last winter, there was a really bad blizzard and power got knocked out for two days, people that just had furnace went and stayed with friends, that's all they could do.*
>
> Caribou hunter, M, Makkovik

Interview participants also pointed out that community members with lower incomes are likely to be more affected by reduced accessibility of winter trails, as it is more difficult for them to afford store bought foods and heating oil. But even those with sufficient financial means to purchase most of their diet from the store prefer country foods:

> *Personally I don't go to the store for my food, I go out on the land for my food, I try to eat as much wild meat as I can, and fish, from the land, because that's what I grew up with, I am used to it. If I go to the store and buy food and eat it, an hour later I am hungry.*
>
> Hunter and trapper, M, Makkovik

> *We live basically on partridge, fish, this year caribou, I did get my one caribou, and that's getting pretty small now in the quantity, but I don't know what I would do, because I seem like I have to have these wild meats to satisfy my hunger if I am hungry*.
>
> Hunter, M, Postville

It is important for virtually all interview participants to have the opportunity to go out on the land and ice should the need arise to increase the quantity of country foods in their diet, for example due to unexpected economic hardships or because freight planes are delayed and cannot service the community. Interview participants did not identify going on the land and ice to harvest natural resources for making clothing, tools, or

shelter, as a crucial aspect of satisfying their basic human needs. The latter examples do fulfill an important social and cultural purpose, however, as will be discussed in the following sections.

5.4.2. Sense of identity, purpose, and stewardship

The ability to go off on the land and ice in order to engage in subsistence activities, visit family, or simply enjoy the wilderness is deeply rooted in the way of life of people in Makkovik and Postville. Despite physical deterioration of winter trails and changes in travelling brought about by CVC in combination with other factors, there remains a fundamental significance to being able to access the land and ice.

> *I am an indigenous person … it ties me to the land, you know? Our cultures are built on the land, we're of the land. You can't separate one from another. … For us, our connection to the land here, is the whole reason why we're here, anyways. I could easily find a job somewhere else, but I want to be here.*
>
> Teacher, F, Makkovik

Being connected to the land is seen as an integral part of identity, both on individual and community levels. Though lifestyles are changing, the core of the annual, seasonal character of subsistence activities and community life is still in tact. This includes hunting and gathering activities, but also cultural events and holidays, such as the annual Easter Games[11] and various local sports tournaments, all of which require travelling between the communities. Unimpeded access to the land and ice therefore

[11] Easter games take place annually in the communities and consist of dog team races, races in snowshoeing, skiing, and running, and target shooting, among others. The event is also occasionally referred to as 'winter carnival'.

also serves as a unifying element among community members and communities. Being able to go out on the land and ice also provides community members with a purpose for their daily lives. Purpose may be found on economic grounds, on cultural grounds, or on grounds related to mental and physical health. Regardless, they are critical to people's personal well-being:

> *You take this kind of life away from me, you might as well put me down.*
>
> Hunter, M, Postville

> [This way of life] *keeps you sane*.
>
> Recreational trail user, F, Makkovik

Community members take pride in continuing a way of life similar to their parents and grandparents. Taking over stewardship of local and traditional knowledge and skills is a way of showing respect to the teachings of elders, and to their contributions to the culture and traditions of the region. There is also a sentimental value attached to traveling and subsistence participation that is consistent with the ways of previous generations, and contributes to a sense of well being.

> *We need the trails. It's good to be on them, they are part of our heritage. I always feel good when I travel on them.*
>
> Hunter, M, Makkovik

Consequently, interview participants pointed out the importance of passing on traditional knowledge and skills to future generations. Based on the interviews, there is an expectation among community members for youth and young adults to acquire skill sets that allow them to engage in subsistence activities on the land and ice, including

way finding and survival skills. The cultural and traditional significance of winter trails extends to the crafts that are necessary to upkeep traditional activities on the land and ice. These include making snowshoes, komatiks, sealskin boots, mitts, and parkas. Community members who have the skills to make these items, or who are willing to learn the skills to do so, are held in very high regard. For example, interview participants talked about craft makers from other communities, specifically Hopedale, and how important they were for the whole of Nunatsiavut. Importantly, ensuring that young people continue to spend time out on the land and ice is a seen as a possible solution for keeping these traditional skills alive (Figure 5-6).

Figure 5-6: A resident of Makkovik showing a seal net (A) and a snow shoe (B) he made from scratch. Photos by R. Riedlsperger.

Depriving community members of time out on the land and ice is starting to change people's perception of winter travelling. As one interview participant put it: "I think we value it even more, just because you can't do it enough." Until recently, not being

able to access the land and ice has been a rare occurrence. The mild winters of 2008/9, 2009/10, and 2010/11 created an awareness of the issue, leading to a realization that accessible winter trails can no longer be taken for granted.

5.4.3. Sense of space and independence

Interview participants experience a geographical extension of their living space through winter trails. Cabins manifest than extension of the communities as individuals perceive them. Most cabins are within relatively close proximity to people's homes. This allows cabin owners to go there for the weekends, when they are usually frequented the most, or even just for an evening after work. Cabins pointed out by interview participants are shown in figure 5-5. Cabins are also typically the starting point for hunting, ice-fishing, and trapping trips.

> *You might say the communities are isolated, but you can leave the community and go to your cabin, it kind of breaks the isolation, it's like a change, you want to go somewhere, you want to go for a drive, you get on your ski-doo and go to your cabin.*
>
> Recreational trail user, F, Postville

Figure 5-7: Trapper in front of a typical cabin near Postville. Cabins are typically the starting point for hunting and trapping trips. Photo by R. Riedlsperger.

The relative isolation and remoteness of the communities is further alleviated through the opportunity to visit other communities in the winter. Winter trails allow people to leave the region relatively affordably and on their own schedule, if they so wish. Especially the groomed winter trail network is therefore perceived as an equivalent to a highway system, adding to the overall quality of life. In winters where access to the land and ice is impeded, people feel trapped.

> *So you just feel kind of stuck, because that's what you look forward to in the wintertime. To go on skidoo travelling around, or going for a ride, or going to the cabin, or whatever, and then you're not able to do that anymore.*
>
> Hunter, M, Postville

This holds true for all types of winter trails. The sites of the former communities of Hebron, Okak, and Nutak can be accessed through winter trails that lead towards the caribou hunting grounds in the northern region. Access to these areas is not only important for subsistence purposes (mainly caribou hunting), it also adds to the cultural dimensions of the quality of life for community members. Interview participants noted that access to these areas in winter is very difficult for elders, partly because of the distance, and partly because of difficult travel conditions. As an alternative, community members of Makkovik in the past have organized boat tours in the summer to provide an opportunity for elders to re-visit their old homes.

5.5. Current adaptive capacity to changes in winter trails and travelling

While interview participants are affected by deteriorating travel conditions and travel hazards in combination with socioeconomic factors, they have identified mechanisms and strategies to offset some of the negative impacts described above. Adaptation measures can be anticipatory and reactive, private and public, and autonomous and planned in nature (Smit and Pilifosova 2001; Adger et al. 2007). Currently, community members focus on short term, non-continuous solutions to overcome immediate problems. Reactive, private adaptation outweighs anticipatory, public adaptation, even though there is evidence that the latter is starting to play a more important role, as a stronger focus is put on sustainable, long-term solutions to overcome problems associated with deteriorating travel conditions and travel hazards.

5.5.1. Adaptation of trail routes and improved trail maintenance

The most common adaptive measure in the face of CVC is for travelers to regularly adapt established routes ad-hoc on a case-to-case basis in order to avoid travel hazards already known. Communication with other travelers helps trail users cope with deteriorating travel conditions. Travelers are prepared to change their initial routes if they encounter travelers who suggest they should take a different route. Satellite phones are used to call friends and family for updates as well. Travelers also rely on internet, radio, and television updates on weather conditions in order to help them anticipate the need to change a travel route ahead of time. Experienced travelers are better at coping with deteriorating travel conditions because they possess the skills required to read weather and travel conditions, and they know their surroundings in order to be able to anticipate potential travel hazards that might be encountered on alternative travel routes.

> *Depending on how experienced they are, and how well they know the trail, they could go inland, but the not so experienced people would not go, they would wait until the proper route was marked.*
>
> Recreational trail user, M, Makkovik

Winter trails have evolved and have been refined over decades, making the most common travel routes also very efficient ones. Therefore, alternative travel routes often lead over more difficult terrain and are longer than the original routes.

> *If you can't travel on the ice you got to travel on the shore, you have to go in on every little cove and every turn in and every turn out, it makes for a longer trip, it's almost twice as long if you got to go on the shore.*
>
> Hunter, M, Makkovik

Most interview participants voiced their distaste over having to depart from well-known travel routes to find alternative paths on the snow and ice. Figure 5-8 compares an actual winter trail on sea ice near the Benedict Mountains with an imagined alternative travel route that follows the shoreline. The term "imagined" in this context suggests that at the time of data collection no interview participant had actually used the alternative route, even though travel conditions on sea ice in that area have been identified as generally precarious. However, interview participants have used small portions of it in order to avoid travel hazards. The distance from Franks Point to Tilt Cove in the actual travel route is 68 kilometers. If travelers had to avoid sea ice and follow the coastline instead, the length of the route would be closer to 159 kilometers, an increase in travel distance of over 130 percent. Interview participants pointed out that longer travel routes had economic ramifications for individuals, as they are required to spend more money on gasoline. The increased wear and tear on snowmobiles also needs to be taken into account. Furthermore, it affects trail users whose time for being on the land and ice is already limited due to job commitments.

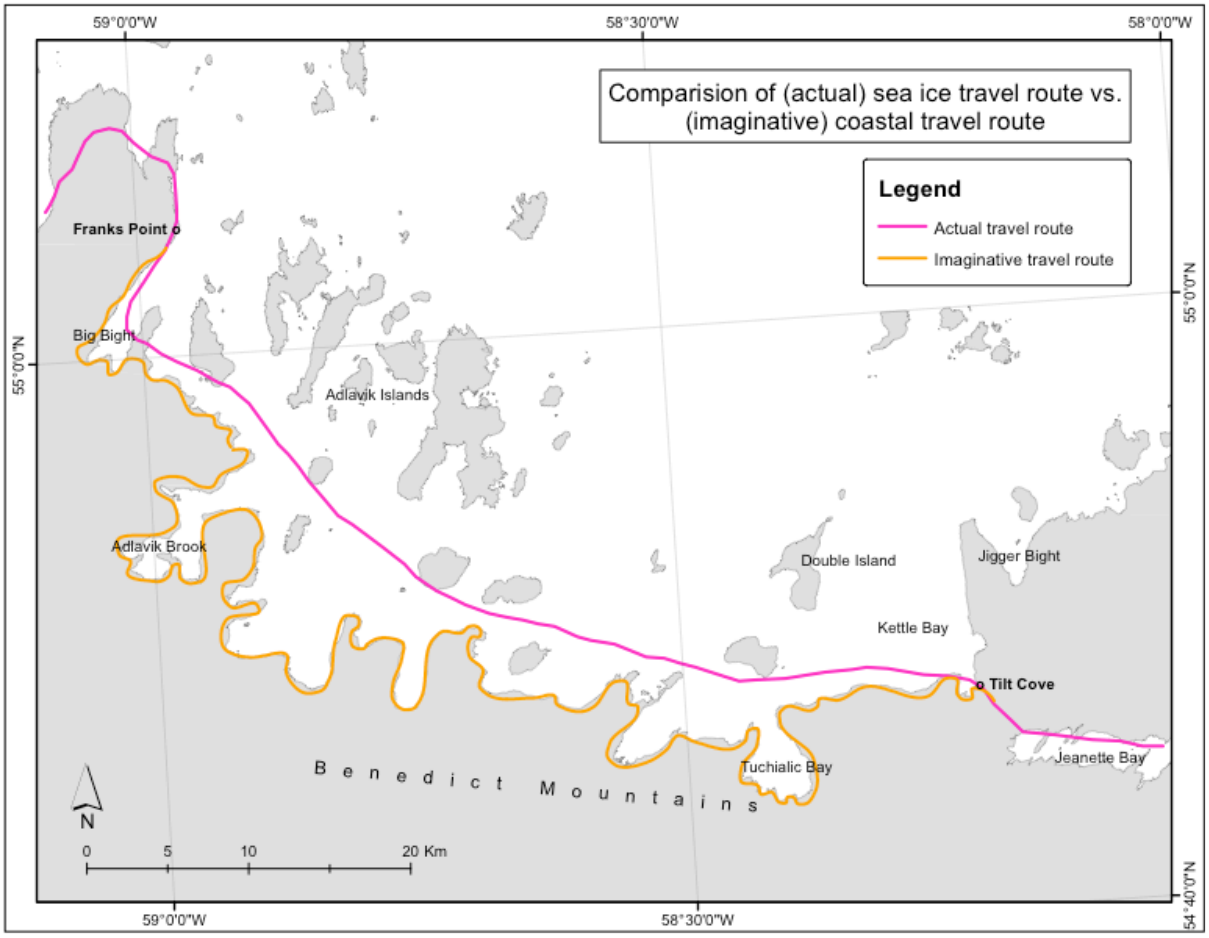


Figure 5-8: Difference in length between actual and imagined winter trail. Map produced by R. Riedlsperger.

The introduction of ever more robust and powerful snowmobiles alleviates the negative effects of deteriorating travel routes to a point, and even has extended the radius that people are able to travel on the land and ice in some cases. The Nipishish Lake caribou hunting area (Figure 5-4) has only been made accessible relatively recently, for example.

> *When we talked about Nipishish Lake, that seemed to* [my grandfather and other elders] *as almost too far South at the time, that was all walking of course, and dogs, but me and my buddy* [name removed] *were probably the first on snowmobile on that lake, that was in 1999.*
>
> Caribou hunter, M, Postville.

Besides allowing penetrating more difficult terrain, powerful snowmobiles make possible bringing more food and gasoline along to accommodate for longer travel routes and carrying boats on komatiks to have an alternative mode of transportation in case the ice becomes too bad to travel. One interview participant explained how travelers adapted with anticipation in the spring of 2011 to manage travelling in difficult terrain:

> *We had a big sea on* [at Jeannette Bay], *and the ice was breaking up and getting bad, got bad right fast, so they had to go around the shore, but they made it back, but they had a boat on the komatik in case they went through the ice, or when they are out there hunting they can't submerge in the water.*
>
> Hunter, M, Makkovik

Interview participants prompted whether they had done the same answered in the negative. One interview participant noted, however, that the reason for not adapting in such a fashion was due to the fact that he did not have access to a boat. Rather than purchasing new or additional equipment to adapt to deteriorating travel conditions, some people in the communities have postponed purchasing new equipment, especially snowmobiles, waiting for better snow and ice conditions in order to reduce the wear and tear on their machines.

Most of the aforementioned adaptation measures are reactive and private in nature. The measures are not sustainable and can be very dangerous if travelers are forced to leave groomed and marked winter trails, especially so for less experienced travelers. As a response to mild winters and the ensuing deterioration of travel conditions, anticipatory adaptation strategies are now undertaken by the ICGs to permanently

adapt travel routes that are the most impacted by CVC. The establishment of the groomed trail networks in the winter of 2000/01 laid the foundation for these efforts. Interview participants involved in the establishment of the groomed trail network stated that its main purpose originally was to increase accessibility of communities in the region. Today, new groomed trails are cut to provide shorter and safer access to subsistence areas that are increasingly affected by CVC. Firewood sites are particularly suitable in that respect as they are relatively permanent and allow for adaptation strategies that take into account potential developments of the next ten to fifteen years, which is the amount of time most of the firewood sites currently utilized are expected to generate firewood. Figure 5-9 shows a newly cut groomed winter trail (completed in the spring of 2011) that provides access to one of Makkovik's important firewood sites, a burned wood area located at South Brook (on maps referred to as Adlavik Brook). Before adaptation took place, utilizing this site had become difficult and at times impossible during the past decade because it was only accessible via sea ice. Other firewood trails in the Big Bight area have also been cut and groomed to improve accessibility and prevent people from getting stuck.

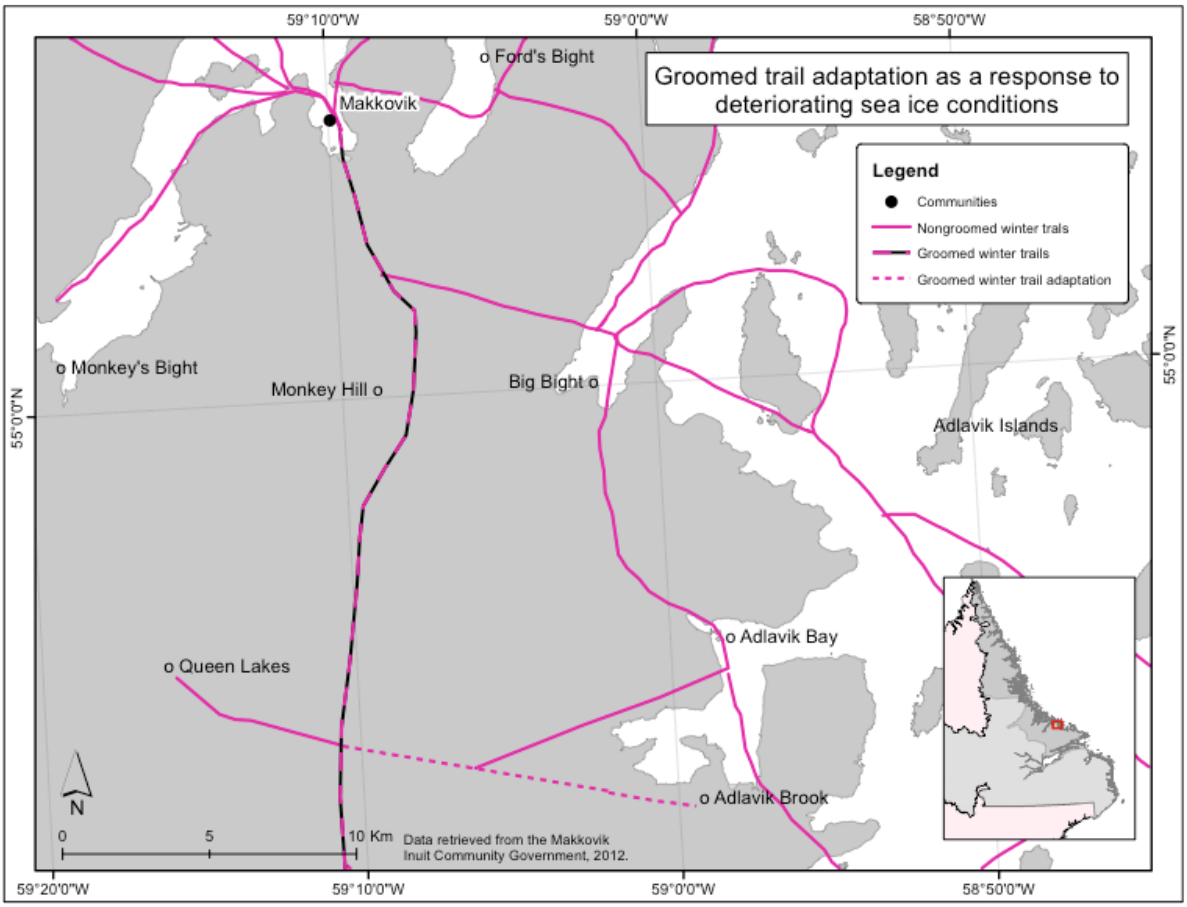


Figure 5-9: Newly cut groomed trail. Map produced by R. Riedlsperger

In addition to cutting and grooming new trails as a response to deteriorating travel conditions, the community governments have put effort into marking non-groomed trails in order to improve travel safety. Flag tape and signs have been put up to warn travelers about travel hazards. To improve orientation for travelers, markers of different colors inform travelers whether they are still on main groomed trails or local community trails. Besides these improvements, trails utilized by residents of Makkovik and Postville are not continuously marked at this point. Interview participants pointed out that trail users still have to have very good local knowledge in

order to avoid getting lost on marked trails. In their current state, the groomed and marked trails would, therefore, not be able to accommodate tourists unfamiliar with the region.

5.5.2. Adaptation of subsistence activities

As a response to the physical deterioration of winter trails, community members are adapting subsistence activities. Two main anticipatory and private adaptation strategies can be identified. First, the dates and time of day to travel to subsistence areas are adapted. Interview participants commented on hauling wood earlier in the winter in order to ensure that enough wood can be gathered to last for the season.

> *This year I am going to get as much as I can, in as little time as possible. In the next couple of weeks I want to see how much wood I can get, just because if it does turn warm I will have my wood for next year, because that's all I got to heat my house. When it turns warm fast* [the snow] *is just going to go like this, I have seen that happen once, and now you know what to expect, if it does happen.*
>
> Caribou hunter, M, Makkovik

In addition to engaging in subsistence activities earlier in the year, interview participants have also commented on adjusting the time of day for travelling. Instead of travelling at night and in diffuse light conditions, when it is very difficult to spot travel hazards, travelers try to take advantage of daylight hours as much as possible.

With respect to country foods, community members adapt to reduced access to subsistence areas by harvesting different wildlife. Hunters not only rely on stable snow and ice conditions to access hunting grounds via winter trails, they also need to take

into account migration patterns of wildlife. In order to compensate for a lack of caribou, hunters resort to moose, partridge, and goose.

> *I probably ate goose once a month, but now I eat it probably twice a month, to make up for having no caribou in the house.*
>
> Hunter, M, Makkovik

This approach is unsatisfying to some. Caribou meat is held in high regard, valued for its taste and nutrients. In this respect, moose is viewed as a poor substitute. Interview participants commented on the bland taste of moose meat. The taste is attributed to the animals' diet, which makes the meat less satisfactory for human consumption. A "last-resort" reactive adaptation measure with respect to hunting is for community members to substitute country foods with store bought foods. This is an unpopular measure that furthermore puts residents with low cash resources at risk.

Trapping appears to be less affected by CVC than the activities of hunting and collecting firewood, even though access to some trap lines has been impeded due to mild temperatures and lack of snow.

> *All over that way, wherever the winter trail is, and people set marten traps on the winter trail that goes along to Goose Bay, that's a massive activity that takes place, there's a lot of people here, in the last ten years there has been an increase in people trapping.*
>
> Hunter, M, Makkovik

Part of the activity's resilience may be attributed to the fact that it most commonly occurs on well-established inland winter trails. Whereas people have to leave established trails for hunting activities and even to collect firewood, trap lines remain in place, and adjustments to changing environmental conditions such as adapting travel

routes are more permanent. Furthermore, interview participants attributed the boom in trapping as a subsistence activity to the good prices fur bearers yield on the market.

5.5.3. Adaptation through proactive mobilization of traditional knowledge and skills

The adaptive capacity of travelers to deteriorating travel conditions and increasing travel hazards can be enhanced through traditional knowledge and skills (Berkes and Jolly 2001; Ford et al. 2006; Pearce et al 2009; Laidler et al. 2009). It is, therefore, crucial to note that experienced interview participants expressed concern about bringing the knowledge and skills of younger community members to the level necessary in order to stay safe while being engaged on the land and ice. Currently, there are two main approaches to how experienced travellers pass on their knowledge. The first approach is informal. Knowledge is shared through conversations during supper, family and community gatherings, or experience is gained directly while being out on the land and ice.

> [F]or *somebody forty years old going around with somebody who's seventy - and knowing that man spent ninety percent of his time on the land or on the sea ice - it's always good to pay close attention, even today, to the stories that they tell you. And I listen very closely to what they say, you can't be too careful when you are out on sea ice.*
>
> Hunter, M, Postville

> *When I was young I was up in the river like I said with my grandfather trapping: "Here's the areas you don't go, whether it's January, February, or October, you don't go there, that's always bad, all winter, due to fast water, and you don't want to get yourself in trouble." So I gained that knowledge, I try to passed that on to whomever, you know, travelled with me.*
>
> Hunter, M, Postville

The second approach is formal, focusing on organized initiatives that teach youth traditional knowledge and skills. Formal approaches received praise and support throughout the interviews. The difference between organized initiatives and informal ways of learning is that the former can proactively target youth that would otherwise not be exposed or introduced to traditional lifestyles. "*Aullak, sangilivallianginnatuk*" ("Going off, growing strong") is an example of an initiative cited by various interview participants, through which experienced hunters take youth out on the land and ice. It currently only exists in Nain, but community members in Makkovik and Postville support an expansion of the program to their region, even though there are similar programs in place. In Makkovik, experienced hunters have visited school classes to talk about subsistence activities and travel safety. A school teacher and recreational trail user explained that traditional skills are absolutely critical, implicitly comparing them to other skills and knowledge:

> *I think it's the only way they will be getting a real education. The only way to keep our culture is through practice. And if they're not doing stuff like that, if they're not doing what's important, and taking care of their family, and taking care of their grandparents and that, then what are we really teaching them? Like what kind of chance to survive in this world do they have if they can't be doing things like that?*
>
> Teacher, F, Makkovik

Another opportunity through which young community members are introduced to traditional knowledge and skills is through the Junior Canadian Ranger program. Led by experienced community members, Junior Canadian Rangers undergo safety training and are introduced to skills important for travelling on the land and ice. The program is available in both Makkovik and Postville.

5.5.4. Adaptation through collaboration

Community members try to alleviate some of the negative impacts of deteriorating travel conditions by collaborating and sharing resources. For example, interview participants stressed the importance of travelling in groups, for reasons of being able to haul the equipment necessary for prolonged hunting trips, and in order to be able to provide help should a traveler get into trouble. In addition, travelers have utilized semi-public cabins after encountering travel hazards such as broken up sections of lake or sea ice. Knowledge of these cabins, therefore, is an important asset while travelling. To support travelers in trouble, interview participants noted the importance of these cabins being well stocked with firewood, matches, and canned food if possible. Travelers communicate with other communities before trips to check weather and travel conditions. Satellite phones may also be used for this purpose. Some travel parties use GPS communication devices that allow family or friends to follow their route on the internet. This makes it easier to provide help should a travel party get off course or not check in at certain waypoints at an arranged time.

Participation in subsistence activities is physically demanding. Deteriorating travel conditions (especially the combination of longer travel routes leading over rough terrain) are detrimental in that respect. Elders, therefore, particularly benefit from collaboration efforts, as they are often no longer able to engage in subsistence activities themselves. In that case, most community members rely on family and friends to haul firewood for them or share country foods.

> *We take over and give them a hand, make sure they have enough wood for the year. Same with wild foods, sharing it, always was our way of life, our tradition, you get your caribou and you give away one, share up.*
>
> Trapper, M, Postville

Makkovik and Postville currently do not have community-freezer programs, but their sharing networks are functional according to interview participants. Hunters share country foods with family, friends, and community members in general. While conducting fieldwork in Makkovik, a party of hunters harvested a moose within close proximity of the community. The moose provided about sixty servings of meat, which were shared with community members. Information on country foods being shared is spread through word-of-mouth, telephone, and, increasingly, social media such as Facebook. Elders also sometimes pay younger community members to haul firewood. In the winter and spring of 2012 the common price for hauling a komatik filled with firewood was CAD 50.

A final important aspect of collaboration involves the relationship between employers and employees. People working for the Nunatsiavut Government are allowed to take five days off work annually, in addition to regular vacation time, to engage in subsistence activities. This alleviates the stress of travelling on the land and ice in suboptimal conditions to a certain extent. Non-governmental employees are not guaranteed such a leave.

5.6. Current barriers to adaptation

Adaptation barriers are obstacles to reaching the adaptation potential of individuals or communities. Creating policies, developing programs, or establishing measures can help to overcome these barriers (Smit and Pilifosova 2001). Makkovik and Postville face several challenges to effectively deal with changes in winter trails and travelling, including physical limitations of trail route adaptation, financial and human resource limitations, and bureaucratic constraints.

5.6.1. Physical limitations of trail route adaptation

Trail route change and improved maintenance are not always sufficient to adapt to deteriorating travel conditions. There are several main reasons for this. First, certain travel areas are more affected by CVC than others. Travel routes that depend on freshwater ice or sea ice in areas where no alternative route overland exists cannot be adapted. Islands and archipelagos, for example, cannot be reached through alternative travel routes in the winter. The trail between Makkovik and Postville also offers an important example. Only when both Makkovik Bay and Kaipokok Bay are frozen is it possible to travel back and forth between the two communities on snowmobile. Furthermore, inland trail route adjustments often require significant trail cutting work (see the example discussed in section 5.5.1.), which cannot be carried out by individuals as part of en-route adaptation, but need to be carefully planned in advance. Adjusting travel routes permanently for hunting grounds is also difficult due to the fact that hunting areas can change significantly from season to season depending on wildlife availability.

Considering current and future challenges, the extension of the winter trail network is advisable. Special emphasis should be put on extending the groomed trail network. In the process, it is important to adapt the trails to improve individuals' and communities' resilience against deteriorating travel conditions. Engineering solutions for adapting to trail route deterioration do exist, but are not currently employed by the communities of Makkovik and Postville. Lessons can be learned and best practices can be drawn from resource development projects in Nunatsiavut. The year round shipping operations at Voisey's Bay provide a starting point on how to adapt to sea ice disruptions caused by ship's tracks, for example. Besides providing the communities with detailed information on ship travel and marking ship's tracks with fluorescent poles visible in difficult light conditions, pontoons are installed to allow travelers to access subsistence areas (figure 6-1).

Figure 5-10: Ship's track pontoon crossing in Voisey's Bay, Nunatsiavut. Source: Sikumiut Environmental Management Ltd. Year N/A. Vale Inco Projects. Accessible online at http://www.sikumiut.ca/Project%20Profiles/Vale%20Inco%20NL/PP-ValeIncoNL.pdf, last retrieved on May 12, 2013

The pontoons can be assembled within a couple of hours and allow the crossings of ship's tracks up to width of 30 meters (Sikumiut 2009). The same approach could be taken for sections of broken up sea ice or ice fissures in the coastal regions of Makkovik and Postville. In Hooper Bay, Alaska, land based ATV (All-Terrain Vehicle) trails have been retrofitted with interlocking plastic grids to protect soil and vegetation as part of a trail protection pilot project (National Park Service, year n/a). A similar approach might be applied for inland winter trails that are subject to poor snow

conditions. The plastic grids that would protect both soil and equipment while making travelling by snowmobile possible even if snow cover is insufficient and allow travelling in wetter snow conditions during rising spring temperatures.

5.6.2. Resource limitations

Resource constraints creating barriers to adaptation encompass financial and human resources. Current adaptation strategies prove costly for individuals and communities. On the individual level, people have to purchase more gas and supplies. If access to subsistence areas is not possible, the increased need for store bought foods strains household budgets, as grocery store items in Makkovik and Postville are considerably more expensive than in less remote regions of Canada. While in 2007 the average Canadian household spent CAD 609 per month on food, the households in Nunatsiavut without children spent CAD 880. Households with children even spent CAD 980 on food per month (IHSN 2008). Community members with lower incomes are, therefore, more vulnerable to changes related to travel route deterioration.

> *The two of us, we're all right. Our income is not the greatest, but we get by, and we do good. But if we didn't have people like her uncle, who already has a boat, and a motor, and those things, we wouldn't be able to go off, cause we can't afford it. We can't afford to have our own boat. Like we just got our skidoo, because she got lucky, she had a good job for a while, and we're putting gas it in when we can, but there's other single moms that could really benefit from wild meat, and those kind of things, but they can't afford to go off on the land. They can't afford to put gas in their skidoo.*
>
> Teacher, F, Makkovik

Adapting to deteriorating travel conditions is also expensive for the community governments. Maintaining the winter trails becomes more expensive with deteriorating

snow and ice conditions. The Postville ICG hired additional workers and allocated more funds towards equipment purchases and rentals necessary to maintain the groomed trail to ensure travelling remained possible. The grooming subsidy does not yet take into account fluctuations in trail maintenance costs due to changing climatic conditions, and community governments have to cover excess costs themselves. Interview participants also noted that a groomed winter trail extending from Postville towards Hopedale and Nain would be appreciated with respect to making northern communities (Hopedale and Nain, but also the heritage communities of Okak, Nutak, and Hebron) and caribou hunting grounds more accessible.

Adaptation to deteriorating travel conditions may also be limited by a reduction in the level of engagement in subsistence activities, which consequently affects traditional knowledge and skills. According to interview participants, the communities struggle to have youth involved in subsistence activities. Most interview participants over the age of thirty expressed concern about younger people's level of engagement in that respect. There is a concrete fear among interview participants that by not acquiring sufficient knowledge and skills, younger people will not be able to travel safely on the land and ice.

> *If you are going to survive in our climate, in our terrain, then you have to know how and you have to learn how.*
>
> Hunter, M, Makkovik

The necessity of wage labor exacerbates this problem as it poses further barriers to acquiring traditional knowledge and skills. Income is needed to be able to afford to

engage in subsistence activities. At the same time, wage labor significantly restricts the amount of time people can spend on subsistence activities. Furthermore, in order to find jobs, many young people in the communities are leaving to advance their education and receive vocational training and/or find jobs outside of Nunatsiavut. As a consequence they are less exposed to subsistence activities and the limited number of jobs available in the communities reduces the incentive for them to return.

5.6.3. Regulatory constraints

A number of regulatory barriers are preventing people from going on the land and ice. Seasonal openings for hunting and trapping, which are set by the Provincial Government through the Department of Environment and Conservation, can inhibit strategies such as trapping and hunting earlier or later in the season when snow and ice conditions are adequate. The same applies to accessing different hunting grounds should access to traditional grounds be impeded. Permits are given out for specific zones, which limits the adaptive capacity for hunters who may wish to access areas in alternate zones that are easier to reach. Interview participants also noted that licenses and permits to purchase and use firearms and ammunition have negative effects on subsistence participation among young people. Provincial age restrictions theoretically prevent youth from actively participating in hunting activities until the age of 16 (Department of Environment and Conservation 2013). In addition, liability issues may impede adaptation as the ICGs' insurance only covers main groomed and marked trails and certain groomed trail extensions. Even though the ICGs receive requests from community members to groom and/or maintain private trails, these wishes cannot be

satisfied. If trail users were to become injured, or equipment were to be damaged, the community governments might be held liable and the grooming subsidy would be jeopardized.

5.7. Future vulnerability to changes in winter trails and travelling

Ongoing CVC in combination with socioeconomic factors will likely continue to have implications for winter trail conditions and travelling. There are two kinds of developments, however, that interview participants feel may significantly alter how the current winter trail network will be utilized in the future. The developments refer to attempts to increase economic revenues in and for Nunatsiavut communities through boosting tourism and resource development projects. Both may at the same time exacerbate and alleviate some of the negative impacts CVC has had on winter trails and travelling.

5.7.1. Tourism and its effects on winter trails and travelling

Nunatsiavut communities have ambitious plans to increase the number of tourists in the future (Harris Centre 2010). Currently the Nunatsiavut Department of Culture, Recreation and Tourism estimates tourism revenues in Nunatsiavut to be about CAD 10 million annually[12]. Makkovik and Postville specifically contemplate making their communities a viable tourism outfitting destination in the winter. Outfitting in this

[12] At the provincial level tourism is at a CAD 1 billion revenue mark. This is based on resident and nonresident travel combined, and includes transportation, accommodation, food, and visits to National Parks and historic sites. Statistics for Labrador and Nunatsiavut specifically are not available (Newfoundland and Labrador Department of Tourism, Culture and Recreation 2013).

context is defined as equipment and guiding services provided by individuals to be used in connection with outdoor recreational activities (Notzke 1999). The Integrated Community Sustainability Plan (ICSP) of Makkovik states:

> With snow shoeing, hunting, fishing, and trapping, and providing dog sled and snow mobile tours all distinct possibilities (sic!), there is a great deal to market, and there are tremendous skills and resources within the community to provide tour guides and outfitters to sustain such an operation (ICSP Makkovik 2009, 19)

There are two main options for adventure tourism, both relying on winter trails: ecotourism, which focuses on wilderness appreciation and wildlife watching in combination with backcountry snowmobiling and hunting tourism, which focuses on harvesting wildlife[13]. Three field trips to subsistence areas provided by interview participants made clear that community members were worried about added pressure on the land by an influx of potential hunters. Interview participants specifically mentioned declining caribou herds for causing reservations towards hunting outfitting. There is fear that the herds could not sustain a further increase in hunters. However, sensible and sustainable guided hunting trips are considered a viable option to increase revenues in the communities. This stance is also reflected in Goldhar et al. (2012).

Both eco- and hunting tourism rely on the safety of travelers, and the knowledge and skills that casual visitors to the region would have to possess cannot be overstated.

[13] A survey conducted for the Newfoundland and Labrador Department of Tourism, Culture and Recreation in 2011 found that interest of tourists coming from outside the province to visit Labrador in the winter time was at 30 percent (n=133), for tourists from the island of Newfoundland interest in taking a winter vacation in Labrador was over 54 percent (n=154, see MQO Research 2012).

Groomed and marked trails would likely have to be adapted in order to be able to accommodate travelers that are not familiar with the region. The success of accessible winter trails as an asset for adventure tourism also depends on knowledgeable and experienced travelers in the region that can serve as tour guides to ensure the safety of tourists. Guides will have to have knowledge of the land and ice in the winter, including wildlife locations and characteristics. Hence it is important to make possible for young adults to learn the skills necessary to become involved in economic opportunities related to winter trails.

5.7.2. Resource development and its effects on winter trails and travelling

In addition to tourism, Nunatsiavut communities are looking at resource development projects to increase revenues (Procter and Chaulk 2012; Goldhar et al. 2012). The Makkovik and Postville region is part of the Central Mineral Belt (CBM). The CMB is characterized by widespread and diverse uranium mineralization, referred to as "one of the most important uranium exploration areas in Canada, second only to the Athabasca basins of Saskatchewan" (Sparks and Kerr 2008, 193). The Nunatsiavut Government lifted a moratorium on uranium mining in 2011. There is hope in the communities that uranium mining in the CMB "could reap enormous economic benefits" (ICSP Makkovik 2009, 20). The claims that already have been staked since the moratorium was lifted are shown in Figure 5-11. With the exception of ongoing exploration sites near Jacques Lake by Paladin, an Australian mining company, none of these claims are currently close to becoming operating mines.

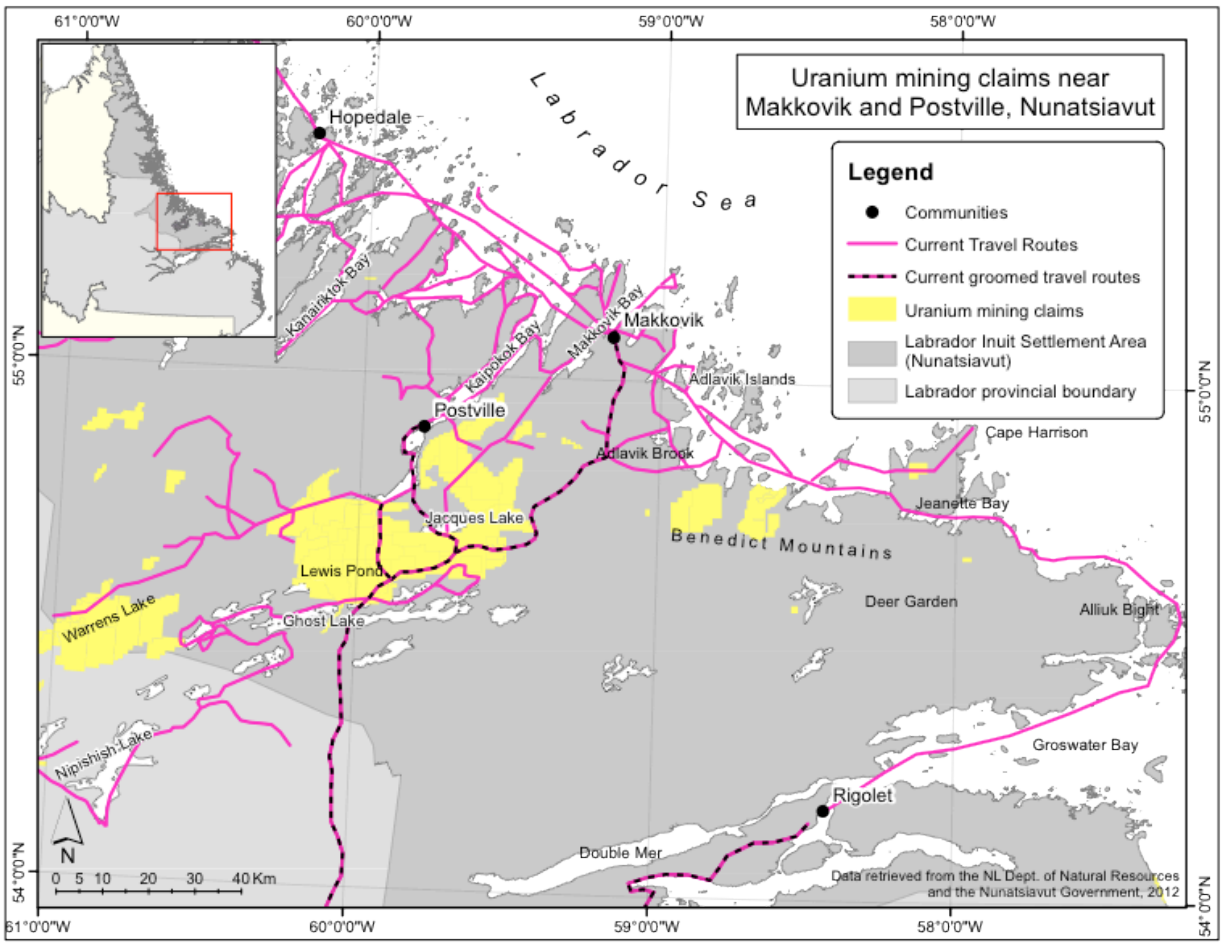


Figure 5-11: Uranium mining claims near Makkovik and Postville. Map produced by R. Riedlsperger.

Interview participants opposed to mining development in the region cited environmental factors, which also include disturbance of wildlife. Interview participants in favor of development also pointed out the potential environmental hazards such developments could pose (also see Procter and Chaulk 2012). As Figure 5-11 shows, uranium mining claims currently overlap with travel routes and subsistence areas. Specifically, uranium mining would impact areas surrounding the groomed trail considerably. The draft version of the LISA land use plan states that

locally important travel routes should not be blocked by economic development. In addition, any form of development should consult with the communities to ensure that winter trails remain accessible (LISA draft land use plan 2010). Resource development projects can impact winter travel routes indirectly as well, as they may affect the availability of wildlife or other resources important for subsistence in the region.

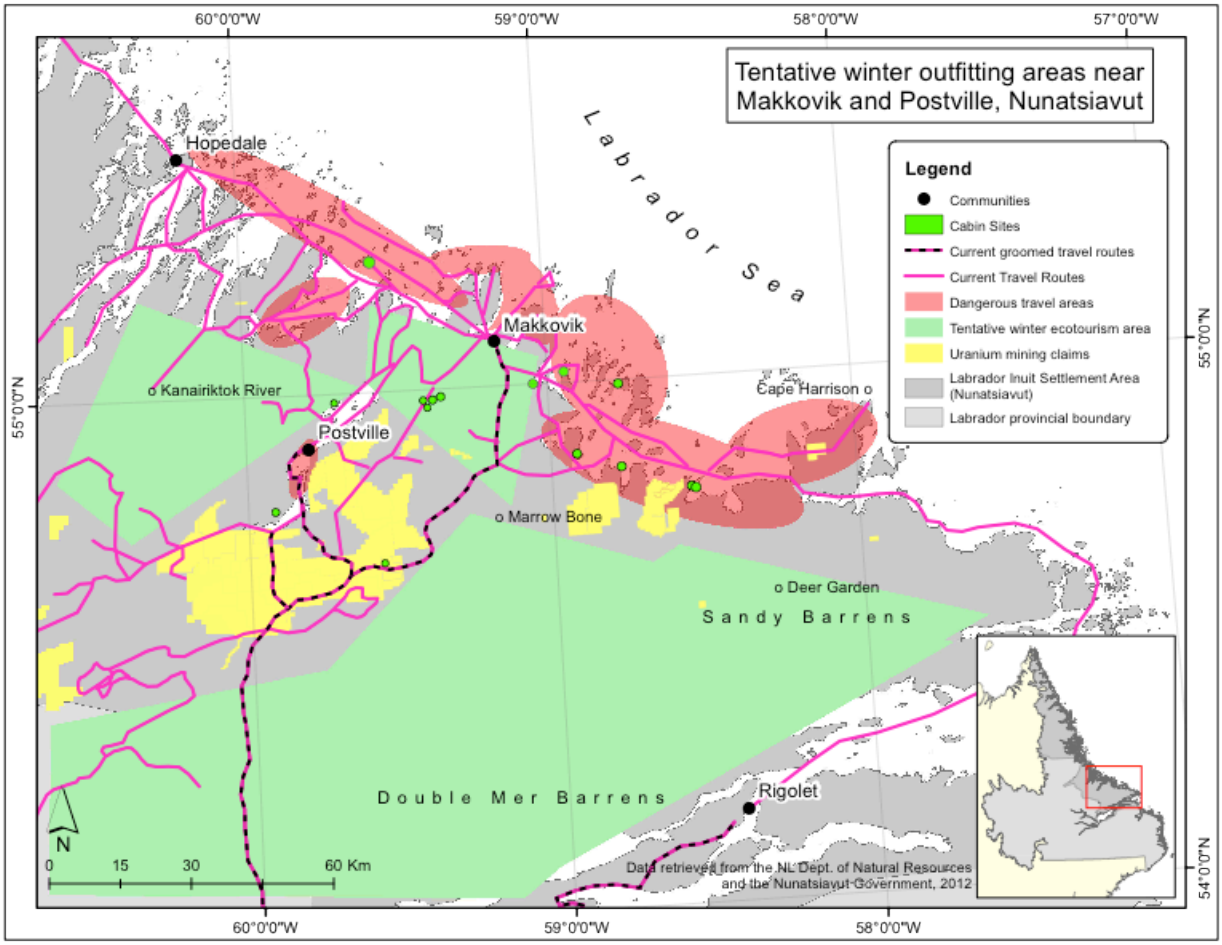


Figure 5-12: Tentative winter outfitting areas for Makkovik and Postville. Map produced by R. Riedlsperger.

Figure 5-12 juxtaposes uranium mining with potential ecotourism areas, taking into account that uranium mining sites are not suitable for adventure tourism purposes. This is due to potential wilderness disturbance, trespassing issues on mining property, and

general travel hazards in open pit mining environments. Figure 5-12 further takes into account that travel routes and areas identified as dangerous by interview participants are not suitable for tourists who might not possess the knowledge and skills required to travel reasonably safely in such terrain. This leaves the areas marked solid green as potential ecotourism areas. These areas are inland and could be made accessible through an extension of the groomed trail networks. In order to do so, investments would be necessary for cutting and adapting the trails.

CHAPTER 6. DISCUSSION

6.1. Discussion

The results of this research confirm the value of a functioning winter trail network for individual and community livelihoods in Makkovik and Postville. Moreover, the winter trail network is an asset for all five Nunatsiavut communities, which, if maintained, has the potential to contribute to economic prosperity and sociocultural sustainability through the fostering of traditional lifestyles. The following discussion expands on the most pressing challenges resulting from an ongoing deterioration of travel conditions in combination with socioeconomic changes. Three main themes emerging from Chapter 5 concern the significance of a functioning winter trail network to the quality of life for people in the region (1), the fear that changes in the act and activity of travelling will both cause and result in irreversible loss of traditional knowledge and skills (2), and the future opportunities and challenges brought about by economic development through tourism and natural resource extraction (3).

6.1.1. Winter trails as an important contributing factor to life quality

Functional winter trails and travel knowledge are crucial for the quality of life of community members in Makkovik and Postville, partly because they contribute to satisfying basic human needs (see section 5.4.). One specific problem that deserves immediate attention concerns food insecurity in Nunatsiavut. The Food and Agriculture Organization of the United Nations (FAO) understands food security to be achieved "when all people, at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for

an active and healthy life" (FAO, 1998). According to the Inuit Health Survey of Nunatsiavut only approximately 55 percent of households are food secure (IHSN 2008). Contributing factors to food insecurity include unemployment, low income, and high food costs. In addition, 75 percent of households would like to be able to consume more country foods as opposed to store bought foods. Consequently, this would involve spending more time travelling on the land and ice to hunt, or have connections to people who do have access to country foods and are able and willing to share. Virtually all of the barriers associated with obtaining country foods relate back to functional winter trails and travel skills. The ability to obtain country foods is specifically limited by the lack of active hunters in the household, lack of appropriate transportation, the high costs of gas and supplies, the difficulty harvesting country food, and limitations due to weather and lack of time (IHSN 2008). While it might be theoretically possible to offset the loss of nutrients from traditional foods through the purchase of high-quality store-bought foods, the cost of the latter can be prohibitive. Furthermore, as the results presented in Chapter 5 indicate, store bought foods are not the preferred choice of among participants in Makkovik and Postville.

People value the activities that provide country foods, the cultural and traditional connection of the harvesting activities, and the rich taste and nutritional value. There are negative implications of reduced country food intake. Wesche and Chan (2010) note that nutritional effects of lower traditional food use likely include reductions in iron, zinc, protein, vitamin D, and omega-3 fatty acids, among others. A decrease in country foods in combination with an increase in store bought foods is furthermore

linked to an increase in obesity rates and its associated diseases such as diabetes and heart failure among Inuit (McCarthy 2005, Jørgensen 2010). Lack of vitamin D brought about by dietary shortcomings in combination with insufficient exposure to sunlight further contributes to this problem (Sharma et al. 2011). Unimpeded access to the land and ice helps ensure that community members are able to consume enough calories, and that the source of these calories comes from country foods of good quality. Studies suggest that physical activity alone is not necessarily an insurance against high levels of diabetes among Canadian Inuit (Hopping et al. 2010). However, travelling on the land and ice can contribute to offsetting vitamin D deficiencies through daylight exposure.

Inhabitants of northern regions are also suffering disproportionally from mental health problems, resulting in above-average suicide rates and high levels of substance abuse (Lehti et. al 2009). Considering the positive influence of unimpeded access to the land and ice on personal well-being demonstrated in section 5.4, the question arises whether being confined to the immediate community during the winter due to poor travel conditions would have detrimental effects on mental health. Billson (2006) established this link, specifically suggesting that Inuit societies turning away from subsistence activities are more vulnerable to increases in domestic violence:

> Violence between intimates occurred "out on the land" with similarly negative consequences, but current rates of domestic violence among the Inuit are the highest in Canada and appear to be higher than in the hunter-gatherer context. Billson 2006, 70

Nunatsiavut currently has among the highest crime rates in all of Inuit Nunangat, with domestic violence being an especially pressing issue (Charron et al. 2010). The ability to engage in lifestyles that are meaningful to people will, therefore, likely have positive effects on both the communal and domestic life of residents, with functioning networks of winter trails providing an important factor for achieving this.

6.1.2. Opportunities for dissemination and mobilization of traditional knowledge and skills relevant for winter travelling

Experienced community members of Makkovik and Postville are concerned that younger people increasingly lack the knowledge and skills necessary to travel safely on the land and ice. Even though research for this project was conducted in two specific Nunatsiavut communities, deteriorating winter trails and changes in the act and experience of travelling are a regional issue that affects Nunatsiavut as a whole. It is, therefore, important to consider dissemination and mobilization options of the traditional knowledge and skills relevant for safe winter travelling. This would contribute to travel engagement (spending time on the land and ice) and travel safety for individuals, and also help provide local and regional decision makers with information on effective adaptation strategies in line with achieving a "vibrant and self-sufficient" Nunatsiavut. While knowledge dissemination simply refers to making information available through a variety of means, knowledge mobilization (KM) more specifically refers to the process of giving and receiving knowledge between two entities on a topic of shared interest (Speed 2011). This includes exchanges between

and among researchers, community groups or organization, and governmental entities (Harris Centre 2012).

There are a variety of potential venues for knowledge dissemination and mobilization, some of which can be especially useful in the context of winter trails and travelling. In this respect it is important to acknowledge the changing or evolving character of information regarding winter trail conditions and the act and experience of travelling. While maps and accompanying information presented in Chapter 5 provide more than a mere snapshot - presented knowledge has been accumulated by interview participants throughout their lifetime – maps are still static entities that warrant frequent updating to reflect new developments. Therefore, more interactive means of knowledge dissemination and mobilization are explored below.

6.1.2.1 Outdoor workshops

Hosting regional workshops in Nunatsiavut communities on the topic of winter trails and travelling could take two different forms: Workshop participants may either focus on sharing among themselves or receiving from experts traditional knowledge and skills, with the specific goal of increasing awareness and knowledge of adaptation options to changing travel conditions. Due to the character of the problem, it might be worthwhile to pursue creative workshop approaches. Rather than assembling trail users in public halls, workshops could take place on the trails, with participants travelling to areas of interest, discussing issues on site. Maps provided in Chapter 5 could build the foundation for such outdoor workshops.

The second option is to conduct workshops with the purpose of carving out the regional extent of the issue, including specifics of the three communities that were not part of this research (Nain, Hopedale, and Rigolet). Adaptation measures discussed in section 5.4 are likely relevant for (and not limited to) all five Nunatsiavut communities. Discussing vulnerability within a larger audience and a variety of stakeholders (trail users and decision makers, for example) might also yield new insights. Furthermore, adaptation measures such as the extension of the groomed trail network are likely to be more successful if the communities are working together on implementation.

6.1.2.2. Policy discussion forums

Compared to outdoor workshops, policy discussion forums provide a more formal venue to bring together AngajukKâks and town managers, regional decision makers, and the general public to address the following questions:

- Are there policies that have become inappropriate with respect to changes in winter trails and the act and experience of travelling?
- Do current policies contribute positively or negatively to the problem?
- How should policies address changes in winter trails and the act and experience in travelling?

Specific policies discussed can include hunting and trapping regulations, subsidies related to winter trails and subsistence activities, and formal plans for teaching local and traditional knowledge and skills. It might also be useful to hold workshops and discussion forums as part of a larger conference or meeting on subsistence activities

and future economic development in the region, as these issues are inextricably linked. For example, the Nunatsiavut Government's Sustainable Communities Initiative is planning on developing an integrated food security strategy (Goldhar et al. 2012b). Knowledge on winter trails and travelling should feed into the crafting of such a strategy. In any event, both workshops and discussion forums are also intrinsically valuable because of interpersonal exchange among participants, which has been identified as a fruitful means of knowledge dissemination and mobilization (Champalle et al. 2013).

6.1.2.3. Teaching curricula development or improvement:

Based on information provided by interview participants, in addition to the Nain youth initiative "Going off – growing strong" there is a need for adapting the teaching curricula in Nunatsiavut schools to reflect the importance of local and traditional knowledge and land skills for individual and community livelihoods. At this point local initiatives have invited elders to share their knowledge in schools. A formal and well structured integration of traditional knowledge and skills would have to be done in consultation with the Newfoundland and Labrador School Board Association (NLSBA), the Nunatsiavut Government, and the Provincial Government. The aforementioned policy discussion forums would help to communicate local needs to regional decision makers.

6.1.2.4. Online knowledge transfer taking the form of communication and collaboration

As of summer 2013, the Nunatsiavut Government and partners began developing an Inuit based sea-ice classification methodology for sea ice travelling, called SmartICE (Sea ice Monitoring And Real-Time Information for Coastal Environments). The project aims at providing near real-time information of sea-ice conditions to community sea-ice users with the aim of aiding the decision making process for safe ice travel. The long term goal of the project is to develop a low-cost product that can be operated by any Arctic community who might have a dependency on sea ice travel and navigation (Goldhar et al. 2012b). Considering the aforementioned static nature of maps, the outcomes of this project will be immensely useful to trail users. Alternatively, more cost effective (albeit less comprehensive) approaches could be explored. Similar to avalanche warning information provided for areas utilized for downhill skiing, information could be updated by community members knowledgeable about travel conditions. Technology developed for the aforementioned *Igliniit* project (see Gearheard et al. 2011) could be adopted to provide real-time travel information accessible through websites. Such information may also be integrated into the online presence of the Nain Research Centre (www.nainresearchcentre).

6.1.2.5. Plain language publications

Publications containing information regarding deteriorating travel conditions and changes in the act and experience of travelling can take a variety of forms, including maps, posters, peer-reviewed and non peer-reviewed articles, brochures, promotional

and educational materiel, and websites. Importantly, information relevant for communities is best presented in clear and simple language (Champalle et al. 2013). Travel and safety guides would provide an effective way of creating awareness of the issue, through pointing out travel hazards and providing steps individuals can take to prepare and adapt to such hazards. Upon completion of this specific project, a poster containing the maps presented in Chapter 5 accompanied by plain language information will be prepared for display in the communities of Makkovik and Postville. To encourage uptake of the map biography method for similar projects of both communities and academic types in the future, an academic poster focusing on the research methodology was published (Appendix D).

6.1.3. Opportunities and challenges of tourism and resource development

As has been explained in section 2.2, the concept of double exposure emphasizes that in order to assess vulnerability to the impacts of climate change contributing socioeconomic factors have to be taken into account as well. Economic development offers a concrete example of the interplay of environmental and socioeconomic realms. Both tourism and mining would alter winter trails and winter trail use in the region and whether they contribute positively or negatively to the adaptive capacity of communities will largely depend on the sensibility with which the goals of increasing revenues are approached. Economic growth can increase people's standard of living and their capacity to participate in political, social, and economic systems (Bone 2009). This might very well add positively to the region's adaptive capacity to deal with future deterioration of travel conditions and to ongoing shifts in the act and

experience of travelling, for instance through allowing individuals to purchase equipment, or for making possible for communities to provide funding for trail route expansion or maintenance.

The mission statement of the Nunatsiavut Department of Culture, Recreation, and Tourism reads: "Tourism Nunatsiavut will stimulate the growth of culturally and environmentally sustainable, responsible, as well as economically-viable travel products, honouring the traditions, legacies and future of Inuit" (Nunatsiavut Government 2012c). Outfitting could significantly increase revenues for all five Nunatsiavut communities. The snowmobile industry in North America generates over USD 28 billion each year in goods and services. Quebec alone accrues over USD 1 billion annually, which is comparable to the annual worth of the nickel output at the Voisey's Bay mine in Labrador (Brown 2012; ISMA 2012). Included in these figures are only outfitting activities that do not involve hunting. Of course, challenges of adopting (eco)tourism as a tool to improve revenues in Inuit regions exist. Using the example of the Inuvialuit Settlement Region, Notzke (1999) identifies the two main challenges for Inuit communities to be

> to protect the integrity of their land-based economy and way of life from trespass and interference of the tourism industry; and to engage in tourism activities in a way which enables the industry to fit into, nurture, and benefit community mixed economies to an optimum degree (Notzke 1999, 67).

Research suggests though that outfitting could very well be part of an adventure tourism strategy that is in line with the values and goals of Inuit (Freeman and Wenzel 2006). Still, the dichotomy of non-hunting and hunting related outfitting could pose

dilemmas. Lemelin et al. (2012) used the example of Nunavik to point out that from a merely financial perspective outfitting should take hunting (as opposed to mere nature- or wildlife watching) into account in order to become profitable. Dowsley (2010) focused on polar bear sports hunting in Nunavut to show that bringing in tourists to the region to pay for hunts can significantly increase the average disposable income for hunters in a community. It is possible, however, that communities might not be comfortable with the commoditization of big game such as polar bears, caribou, or moose, as people may emphasize the cultural, experiential, or traditional values of hunting over financial gains (Dowsley 2010). Based on interviews in this study, the communities of Makkovik and Postville may very well take that stand. However, there are other creative opportunities to attract tourists to a Northern region. Nunavik for instance contemplates "Arctic survival" trips through its Arctic Survival Training Centre. During a ten day trip, different points of interest and communities are travelled to by dog team and snowmobile (NASTC 2012). To improve the accessibility of Nunatsiavut for tourists, an expansion of the ferry system or year round cruise ship tours might be considered. At the same time, Stewart et al. (2007) warn about expectations being too optimistic for increasing cruise ship tourism in Canada as a direct result of sea ice loss. Considering the relative accessibility of Nunatsiavut, however, it might even be feasible employing cruise ships with ice breaker capabilities for tourist transportation in the winter, even though well thought out safety and communication strategies would have to be in place in order to not further affect sea ice travel routes and travel safety for community members.

Besides optimistic outlooks and creative ideas of how winter tourism could potentially be improved, it is important to keep in mind that tourism dependent on winter trails could also potentially affect flora and fauna negatively, which in turn could have unexpected effects on winter trail use. Shortly after the widespread introduction of snowmobiles in the 1960s, studies started to show that the use of snowmobiles does have negative effects on vegetation growth in the tundra and contributes to soil and air contamination (Greller et al. 1974, Adams 1975, Eckstein et al. 1979; Keddy et al. 1979; Collins and Sell 1982; Reimann et al. 2009; Shiveley et al. 2008; Musselman and Korfmacher 2007; Zhou et al. 2010). It is now also known that snowmobile use can disturb wildlife. The use of snowmobiles may cause caribou to abandon their habitat, for example. In addition, extending trails or increasing the number of winter trails would increase accessibility not only for tourists, but also for natural predators, including wolves (Colescott and Gillingham 1998; Creel et al. 2002; Reimers et al. 2003; Borkwowski et al. 2006; Andersen and Aars 2008; Festa-Bianchet et al. 2011; Brown et al. 2012). For these reasons, the potential negative impact of travelling by snowmobile has been reflected in discussions around snowmobile use in national parks in the United States and Canada for recreational purposes (Masyk et al. 1973; Layzer 2005; Prugh 2005). Regulations in that respect also potentially affect the Torngat Mountains and Mealy Mountains National Park Reserves (the latter of which is still in its planning stage). Nunatsiavut also needs to have mechanisms in place to deal with snowmobile accidents. With increasing popularity in snowmobile travel comes an increasing number of injuries sustained in snowmobile accidents (Stewart and Black 2004; Sy and Corden 2005). While locals are aware of travel hazards in generally

dangerous areas, tourists do not possess this knowledge. This presents challenges in managing time-sensitive medical emergencies. Orkin et al. (2012) show that this is a problem that northern indigenous regions in general are facing. Life Supporting First Aid (LSFA) programs that increase the capacity of communities to deal with emergencies would therefore benefit tourists and residents alike. Finally, snowmobiling as a recreational activity is also likely to be more vulnerable to climate change than activities such as downhill skiing or cross country skiing. The former almost completely depends on natural snow cover, whereas the latter can take place on artificial snow. Studies suggest that snowmobiling seasons for recreational/tourist activities in Canada will shorten by between 11 percent and 68 percent due to CVC by 2020, depending on different emission scenarios (McBoyle et al. 2007). Given that there is already great variability in snowmobile season length, climate change could have serious impacts on establishing winter tourism in Nunatsiavut. Outfitting that does not involve hunting is likely to be less vulnerable to future changes in snow and ice conditions, as permanent trails for such activities can be planned along relatively safe terrain. Hunting tourism on the other hand would be more dependent on the availability of wildlife and travel routes would be subject to change based on wildlife location.

Besides tourism, uranium mining offers further significant economic potential in the near future. The President of Nunatsiavut, Sarah Leo, expressed that the region would "encourage [exploration] investment and development" (Fitzpatrick 2012). Like tourism, uranium mining may alter winter trails and trail use in the region. Uranium

mining is a potentially hazardous activity posing dangers for human health and the environment, for example through elevated uranium concentrations in freshwater sources. In regions close to former uranium sites, dietary restrictions with respect to drinking water and intake of fish were proposed to alleviate the negative effects of uranium mining (Stone and Stetler 2009, Kulenbekof and Merkel 2012, Salbu et al. 2012, and Skippereud et al. 2012). Such restrictions may affect subsistence areas negatively, potentially causing certain travel routes to become obsolete in the future. Considering changes in wildlife availability and travel route deterioration due to CVC, finding new winter trails to new subsistence areas may prove very challenging if additional constraints such as mining disturbances are at play. When the Voisey's Bay nickel mine opened near Nain in 2005, residents of the region worried that winter shipping operations, specifically the ship tracks created by ice breakers, would disrupt travel routes, increase travel danger, and impede access to subsistence areas. The LIA only lent their support to the construction of the mine after safeguards were put in place that allowed locals to continue their activities on landfast ice in the winter (Labrador Inuit Association 1998; Rowel and Metcalfe 2005).

The Nunatsiavut Government has a legislated act in place to ensure that mining is carried out in a manner that limits impacts on the environment (Nunatsiavut Government 2012). Uranium mining conducted in such fashion might be an important contributor to economic prosperity in the region, directly through providing revenues, and indirectly through providing jobs, therefore enhancing communities' and individual's adaptive capacity to solve financial resource limitations. It will certainly

be a challenge for Nunatsiavut to develop a strategy that allows focusing on uranium mining and tourism at the same time. Specific questions that need to be answered include the willingness of tourists to travel to a destination with ongoing uranium mining operations, considering the potential environmental and ethical implications that come with the activity. It is important to keep in mind that Nunatsiavut is in competition with well established arctic and subarctic winter tourism destinations such as Iceland, Greenland, the Yukon, the Northwest Territories, or Alaska. In addition, other parts of Northern Canada, such as Nunavut, have been trying to diversify their economies through the increase in tourism for some time now, with varying success (Lemelin et al. 2012).

CHAPTER 7. CONCLUSION

7.1. Conclusion

Winter trails are crucial for individual and community livelihoods in Makkovik and Postville. They are a means to an end, the key that provides access to the land and ice. The winter trail network that community members utilize is extensive, with round trips exceeding 800 km in length. The majority of winter trails are unmarked, semi-permanent features on the landscape, for which exact routes depend on environmental conditions and wildlife availability. Sea ice is the preferred surface for travelling, as it allows for smooth, fast, and direct travelling. Only a small portion of winter trails is marked, and an even smaller portion is groomed and maintained regularly. Winter trails make possible subsistence participation. In addition, they contribute to economic, cultural, and social life by facilitating communication and exchange between individuals and communities.

Climate variability and change in combination with socioeconomic factors are negatively affecting winter trails and the act and experience of travelling. Physical deterioration of travel routes is most pronounced in coastal areas on sea ice. To a lesser extent inland routes are affected as well. Changes in the act and experience of travelling are manifested in a perceived increase in travel hazards, attributed mostly to poor snow and ice conditions, but also to changes in knowledge and skills related to travelling. Partly as a consequence of the physical deterioration of winter trails, trail

uses are changing as well. The activities of hunting and collecting firewood are affected the most. Partly due to its exposed location, residents in Makkovik seem to be more immediately affected by deteriorating travel conditions than community members in Postville, but overall very few differences could be identified between characteristics of winter trails and travelling in the two communities. Possible cultural or socioeconomic differences (Makkovik has a strong Moravian tradition, Postville is influenced by Pentecostalism) seem not to be reflected in perceptions on winter trails and travelling.

While there is a strong intrinsic value to winter trails and travelling – community members enjoy travelling on the land and ice for the sake of travelling - accessible winter trails are also linked to a sense of livelihood security, identity, purpose, stewardship, space, and independence. The contribution of the winter trail network to the well being of individuals and communities is compromised due to the changes described above. The inability to partake in subsistence (hunting or collecting firewood) and sociocultural activities (celebrating religious holidays and/or visiting family and friends) is of concern to community members. Negative impacts encompass economic losses and a perceived decrease in the overall quality of life[14].

[14] As an external examiner of this thesis pointed out, from a health geography standpoint it would be interesting to further investigate the effects of travelling on the land and ice and consuming country foods on managing heart disease, diabetes, and obesity, among others, also because being active guards against a sedentary lifestyle. This matters in terms of life course and the potential burden on the health care system, especially given the high cost of travel for medical intervention. However, to answer

In order to adapt to the negative consequences of changes in winter trails and in the act and experience of travelling, trail users are employing a variety of adaptation measures. First and foremost, the adaptation of trail routes helps individuals to respond to travel hazards and areas inaccessible due to poor snow and ice conditions. In many cases, adapted travel routes are longer and more difficult to negotiate than the original routes. At the community level, increased efforts are undertaken to ensure that the groomed and marked portions of the winter trail network are well maintained. Trail users are also adapting subsistence activities to accommodate deteriorating travel conditions and socioeconomic changes, such as increasing travel costs due to longer travel routes. Communities also respond through targeting youth learning of traditional knowledge and skills. These are considered crucial to travel safety, especially considering deteriorating travel conditions. Collaboration among trail users and those who cannot engage in travelling on the land and ice was also identified as an adaptation measure. The former involves sharing information about travel conditions, and working together on the trails to ensure safe and successful travel experiences. The latter relates to sharing subsistence goods that depend on access to the land and ice, such as firewood, with those in the community who can't travel to gather or hunt these goods themselves.

There are several barriers to sustainable and comprehensive adaptation to deteriorating travel conditions and changes in the act and experience of travelling. Physical

---

these questions would have been outside the feasible time frame and scope for this study.

limitations don't allow the adaptation of trail routes in certain areas, especially in coastal regions. Therefore, vulnerability to physical deterioration is not distributed evenly among community members, as it is strongly defined by travel locations on the one hand, and the activities people engage in on the other. As mentioned above, travelers are most affected by deteriorating travel conditions if they utilize sea ice trails. They are also more likely to become subject to the negative impacts of CVC on winter trails if they engage in hunting and gathering activities, as opposed to recreational activities. Importantly, the level of traditional knowledge and skills that community members possess influences their vulnerability. People with sufficient travel experience might feel comfortable with continuing certain activities or travelling to certain places, whereas less experienced travelers might put off travelling until conditions improve. Due to socioeconomic changes, however, there is fear in the communities that fewer people are acquiring the knowledge and learning the skills that are necessary "to survive out on the land", as one interview participant put it.

There are also limitations with respect to resources that individuals are able to allocate towards CCV adaptation. Financial resources are needed for purchasing equipment and supplies needed to venture on longer, more tedious travel routes, or to make up for a decrease in harvested recourses through purchasing market foods and heating fuel. Again, resources related to the possession of knowledge and skills play an important role. If there is a sufficient number of community members knowledgeable and skilled enough to travel on the land and ice to engage in subsistence participation, the

vulnerability of elders and other people who might not travel themselves decreases, as they can partake in informal sharing networks that provide them with country foods and firewood. Finally, regulatory constraints prohibit individual adaptation to a certain extent. An example is hunting and trapping regulations that restrict flexible subsistence activity and therefore trail use and travel timing.

Until recently, dealing with deteriorating travel conditions and increasing travel hazards fell solely on the shoulders of individuals. As a result, ad-hoc and sporadic coping mechanisms outweigh planned adaption strategies. Partly in response to the mild winters of 2009-2011, the ICGs have started to take a more proactive role in alleviating some of the stresses. While the communities are not fully resilient to the negative impacts of CVC on winter trails and travelling, efforts are now undertaken to improve their adaptive capacity through cutting new trails to make certain subsistence areas more accessible. Currently, such adjustments of the groomed winter trails are few in number. ICGs, too, are confined by financial limitations that currently make it impossible to maintain and mark the full extent of the winter trail network that people are utilizing, let alone keep up with necessary trail adaptations. As travel conditions continue to deteriorate, more funds will be needed to ensure the continuing of current levels of trail grooming and maintenance. It will be crucial, however, not only to maintain but also to expand the current network of groomed trails to provide viable inland alternatives. At this point, travelers continue to venture out on deteriorating ice conditions, as travelling on inland routes is often perceived as too difficult. Where

cutting groomed trails is not feasible due to the changing nature of semi-permanent trails, it will be important to mark frequently travelled sections to improve orientation, and to ensure that information on current travel conditions is made available for the areas that people are travelling to.

A functioning winter trail network based on extensive segments of groomed and marked trails brings several advantages. The adaptive capacity of individuals to the negative effects of CVC in combination with socioeconomic changes is improved. Community members can travel relatively safely, even if they do not possess the traditional knowledge and skills of land use experts. In other words, while deteriorating travel conditions have a prohibitive influence on travelling, a functioning network of winter trails would allow community members to actively use the land and ice. This practice in turn leads to accumulation of knowledge and skills that will make travelers more resilient against changes in the environment. In addition, a sound strategy on how to improve the economy in the region will have to take into account winter trails and travelling. Considerable parts of the current trail network (groomed as well as ungroomed) are in or close to areas under consideration for resource extraction. Adapting the winter trails accordingly would allow locals to find access to subsistence areas without having to travel through mining areas. Tourism development would benefit, too, as less experienced visitors should be able to travel in areas that are considered relatively safe, and, ideally, do not disturb subsistence activities of local residents. Tourism areas and subsistence areas will not have to be mutually exclusive,

of course. In fact, winter trail tourism that allows visitors to learn about subsistence activities and traditional lifestyles could be a further asset for the communities.

This research is relevant because it gives insight into the significance of winter trails and travelling with respect to individual and community livelihoods in Nunatsiavut, which is something that has not been studied in depth before. In addition, understanding and recognizing that winter trails are a crucial component contributing to the quality of life of people in the region is important from a policy perspective on the local, regional, and national level. The Strategic Plan of the Nunatsiavut Government mentioned above already acknowledges the importance of a lifestyle that is closely linked to the land, for both health and/or cultural considerations (Nunatsiavut Government 2012a). Since decisions made outside of Nunatsiavut will continue to have an impact on the autonomous region, however, linking functioning winter trails to the UN Declaration on the Rights of Indigenous Peoples, which Canada has endorsed in 2010 (see Aboriginal Affairs and Northern Development Canada 2010), may provide a means of protecting the character of winter trails and travelling in Nunatsiavut in the future.

REFERENCES:

Aboriginal Affairs and Northern Development Canada. 2010. Canada's statement of support on the United Nations Declaration on the Rights of Indigenous Peoples. Retrievable online at www.aadncaandc.gc.ca/eng/1309374239861/1309374546142, last accessed on October 28, 2013.

Adams, E. 1975. Effects of lead and hydrocarbons from snowmobile exhaust on brook trout (Salvelinus fontinalis). Transactions of the American Fisheries Society 104(2): 363-373.

Adger, N. 2006. Vulnerability. Global Environmental Change 16. 268-281.

Adger, N., Agrawala, S., Mirza, M., Conde, C., O'Brien, K., Pulhin, J., Pulwarty, R., Smit, B. and Takahashi, K. 2007. Assessment of adaptation practices, options, constraints and capacity. In: Parry, M., Canziani, O., Palutikof, J van der Linden, P., and Hanson, C. eds. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, UK. 717-743.

Adger, N., and Kelly, P. 1999. Social vulnerability to climate change and the architecture of entitlements. Mitigation and adaptation strategies for global change, 4(3-4): 253-266.

Ames, R. 1977. Land use in the Postville region. In: Brice-Bennett, C., Cooke, A., and Davis, N. eds. Our footprints are everywhere. Nain: Labrador Inuit Association. 205-235.

Andersen, M., and Aars, J. 2008. Short-term behavioral response of polar bears (Ursus maritimus) to snowmobile disturbance. Polar Biology 31/4: 501-507.

Anderson, K. 2007. Influences Preceding Nunatsiavut Self-Determination: Historical, Political and Educational Influences on the People of Northern Labrador (Canada). Australian Journal of Indigenous Education 36:101-110.

Aporta, C. 2004. Routes, trails and tracks: Trail breaking among the Inuit of Igloolik. Etudes/Inuit/Studies 28(2): 9-38.

Aporta, C. 2005. From map to horizon; from trail to journey: Documenting Inuit geographic knowledge. Etudes/Inuit/Studies 29(1-2): 221-231.

Aporta, C. 2009. The trail as home: Inuit and their pan-arctic network of routes. Human Ecology 37: 131-146

Aporta, C. 2011. Shifting perspectives on shifting ice: documenting and representing Inuit use of the sea ice. The Canadian Geographer/La Géographe canadien 55 (1): 6-19.

Aporta, C. and MacDonald, J. 2011. An elder on sea ice: An interview with Aipilik Inuksuk of Igloolik, Nunavut. The Canadian Geographer/La Géographe Canadien 55 (1): 32-35.

Aporta, C., Fraser Taylor, D., and Laidler, G. 2011. Geographies of Inuit sea ice use: Introduction. The Canadian Geographer/La Géographe Canadien 55 (1): 1-5.

Armitage, P. and Stopp, M. 2003. Labrador Innu land use in relation to the proposed Trans Labrador Highway, Cartwright Junction to Happy Valley-Goose Bay, and

assessment of highway effects on Innu land use. Innu Environmental Limited Partnership. Happy Valley-Goose Bay.
Arzhanov, M., Eliseev, A., and Mokhov, I. 2012. A global climate model based, Bayesian climate projection for northern extra–tropical land areas. Global and Planetary Change 86–87: 57–65.
Atlantic Canada Opportunities Agency. 2011. Press release regarding the Government of Canada's support of the 2011 Cain's Quest snowmobile endurance race. Accessible online at http://www.acoa-apeca.gc.ca/eng/Agency/mediaroom/NewsReleases/Pages/3217.aspx, last retrieved on May 20, 2013.
Aurora Energy Ltd. 2008. The Michelin Project Update: August 2012. Distributed by Paladin Energy Ltd. Group of Companies.
Barnet, C. Theory. In: Gregory, D., Johnston, R., Pratt, G., Watts, M., and Whatmore, S. eds. The Dictionary of Human Geography. Blackwell Publishing. 751.
Bell, T., Chuenpagdee, R., Jacobs, J.D., Martin, B., Tucker, A., Tytelman, C., and Wolf, J. 2009. Climate change adaptation in Labrador: consolidating the base. Unpublished report. Labrador Highlands Research Group, Memorial University. St. John's.
Ben-Dor, Shmuel. 1966. Makkovik: Eskimos and settlers in a Labrador community: A contrastive study in adaptation. St. John's: Institute of Social and Economic Research, Memorial University of Newfoundland.
Berkes, F., Folke, C., and Colding, J. 2000. Linking social and ecological systems: management practices and social mechanisms for building resilience. Cambridge: Cambridge University Press.
Berkes, F., and Jolly, D. 2001. Adapting to climate change: social-ecological resilience in a Canadian western Arctic community. Conservation Ecology, 5(2).
Bennett, K. 2002. Participant observation. In: Shurmer-Smith, P. ed. Doing Cultural Geography. Sage Publications. 139-150.
Berman, M., Nicolson, C., Kofinas, G., Tetlichi, J., and Martin, S. 2004. Adaptation and sustainability in a small arctic community: Results of an agent-based simulation model. Arctic 57 (4): 401-414.
Billson, J. M. (2006). Shifting gender regimes: The complexities of domestic violence among Canada's Inuit. Études/Inuit/Studies, 30 (1).
Bohle, H., Downing, T., and Watts, M. 1994. Climate change and social vulnerability: toward a sociology and geography of food insecurity. Global Environmental Change, 4(1): 37-48.
Bone, R. 2009. The Canadian North – Issues and challenges. Third edition. Oxford: Oxford University Press.
Borkowski, J., White, P., Garrott, R., Davis, T., Hardy, A., and Reinhart, D. 2006. Behavioral responses of bison and elk in Yellowstone to snowmobiles and snow coaches. Ecological Applications 16(5): 1911-1925
Burton, I. 1972.Cultural and personality variables in the perception of natural hazards." In: Wohlwill, Joachim F. and Carson D. eds. Environment and the social sciences: Perspectives and applications. , Washington, DC, US: American Psychological Association. 184-195.

Bradley, C. 2002. Travelling with Fred George: The changing ways of Yup'ik star navigation in Akiachak, Western Alaska. In: Krupnik, I., and Jolly, D. eds. The earth is faster now: Indigenous observations of Arctic environmental change. Fairbanks: Arctic Research Consortium of the United States. 240-265.

Brody, H. 1977. Permanence and change among Inuit and Settlers of Labrador. In: Brice-Bennett, C., Cooke, A., and Davis, N. eds. Our footprints are everywhere. Nain: Labrador Inuit Association. 97-203.

Brown, C. 2012. Newfoundland and Labrador Mineral Sector Overview 2012. Department of Natural Resources. Government of Newfoundland and Labrador.

Brown, C., Hardy, A., Barber, J., Fristrup, K., Crooks, K., and Angeloni, L. 2012. The Effect of Human Activities and Their Associated Noise on Ungulate Behavior. PLoS One 7(7): e40505.

Brown, R., Lemay, M., Allard, M., Barrand, N., Barrette, C., Begin, Y., Bell, T., Bernier, M., Bleau, S., Chaumont, D., Dibike, Y., Frigon, A., Leblanc, P., Paquin, D., Sharp, M.J. and Way, R., 2012. Climate variability and change in the Canadian Eastern Subarctic IRIS region (Nunavut and Nunatsiavut). In: Allard, M. and Lemay, M. Nunavik and Nunatsiavut: From science to policy. An Integrated Regional Impact Study (IRIS) of climate change and modernization. ArcticNet Inc., Quebec City, Canada, 57-93.

Brown, R., and Mote, P. 2009. The Response of Northern Hemisphere Snow Cover to a Changing Climate. Journal of Climate 22(8): 2124-2145.

Callaghan, T., Johansson, M., Brown, R., Groisman, P., Labba, N., Radionov, V., Barry, R., Bulygna, O., Essery, R., Frolov, D., Golubev, V., Grenfell, T., Petrushina, M., Razuavev, V., Robinson, D., Romanov, P., Shindell, D., Shmakin, A., Sokratov, S., Warren, S., and Yang, D. 2011. The changing face of Arctic snow cover: A synthesis of observed and projected changes. AMBIO 40:17-31.

CBC News. 2012. Scientist calls for stop to aboriginal George River caribou hunt. Retrievable online at http://www.cbc.ca/news/canada/newfoundland-labrador/story/2012/08/20/nl-720-caribou-hunting-ban-proposal.htmll, last accessed November 8, 2012.

Canada Safety Council. 2012. Fatigue. Retrievable online at http://canadasafetycouncil.org/node/723, last accessed November 8, 2012.

Champalle, C., Tudge, P., Sparling, E., Riedlsperger, R., Ford, J., and Bell, T. 2013. Adapting the built environment in a changing northern climate: A review of climate hazard-related mapping and vulnerability assessments of the built environment in Canada's North to inform climate change adaptation. Report for Natural Resource Canada, Climate Change Impacts and Adaptation, Ottawa, Canada.

Chapin, M., Lamb, Z., and Threlkeld, B. 2005. Mapping Indigenous Lands. The Annual Review of Anthropology 34: 619-38.

Charest, P. 2003. Methods for native land use and occupancy (LUO) research. In: Rasmussen, R. and Koroleva E. eds. Social and environmental impacts of the North. Dordrecht: Kluwer Academic Publishers. NATO science series. IV. Earth and environmental sciences 31: 463-478.

Charron, M., Penney, C., and Senécal, S. 2010. Police-reported crime in Inuit Nunangat. Statistics Canada.
Chaulk, K. 2008. Labrador's renewable resources: Past and present. In: Bell, T., Jacobs, J.D., Munier, A., Leblanc, P., and Trant, A. 2008. Climate change and renewable resources in Labrador: Looking toward 2050. Proceedings and report of a conference held in North West River, Labrador, 11-13 March. St. John's: Labrador Highlands Research Group, Memorial University of Newfoundland. 17-21.
Colescott, J., an Gillingham, M. 1998. Reaction of moose (Alces alces) to snowmobile traffic in the Greys River Valley, Wyoming. Alces 34(2): 329-338.
Collins, B., and Sell, N. 1982. Lead contamination associated with snowmobile trails. Environmental research, 27(1): 159-163.
Costello, A., Abbas, M., Allen A., Ball, S., Bell, S., Bellamy, R., Friel, S., Groce, N., Johnson, A., Kett, M., Lee, M., Levy, C., Maslin, M., McCoy, D., McGuire, B., Montgomery, H., Napier, D., Pagel, C., Patel, J., Puppim de Oliveira, A., Redclift, N., Rees, H., Rogger, D., Scott, J., Stephenson, J., Twigg, J., Wolff, J., and Patterson, C. 2009. Managing the health effects of climate change. Lancet 373: 1693–73.
Crawford, A. 2013. "The trauma experienced by generations past having an effect in their descendants": Narrative and historical trauma among Inuit in Nunavut, Canada. Transcultural Psychiatry 0(0). 1–31.
Creel, S., Fox, J., Hardy, A., Sands, J., Garrott, B., and Peterson, R. 2002. Snowmobile activity and glucocorticoid stress responses in wolves and elk. Conservation Biology 16(3): 809-814.
Department of Municipal Affairs. 2009. Integrated Community Sustainability Plan development toolkit. Released by the Gas Tax Secretariat, Municipal Finance Division.
Deser, C., Holland, M., Reverdin, G., and Timlin, M. 2002. Decadal variations in Labrador Sea ice cover and North Atlantic sea surface temperatures. Journal of Geophysical Research 107(C5): 3035.
Destination Labrador. 2012. Labrador fishing and hunting outfitters. Retrievable online at www.destinationlabrador.com/guide/fishing_and_hunting_outfitters.htm#contentTop, last accessed on November 7, 2012.
Dilley, M., and Boudreau, T. 2001. Coming to terms with vulnerability: a critique of the food security definition. Food policy, 26(3), 229-247.
Dowsley, M. 2010. The value of a polar bear: evaluating the role of a multiple-use resource in the Nunavut mixed economy. Arctic anthropology, 47 (1): 39-56.
Dunn, K. 2010. Interviewing. In: Hay, I. ed. Qualitative research methods in Human Geography. Oxford University Press.
Duerden, F. 2004. Translating Climate Change Impacts at the Community Level. Arctic. 57(2): 204-212.
Eckstein, R., O'Brien, T., Rongstad, O., and Bollinger, J. 1979. Snowmobile effects on movements of white-tailed deer: a case study. Environmental Conservation 6(1): 45-51.

Faille, G., Dussault, C., Ouellet, J. P., Fortin, D., Courtois, R., St-Laurent, M. and Dussault, C. 2010. Range fidelity: the missing link between caribou decline and habitat alteration? Biological Conservation 143(11): 2840-2850

Felt, L. 2011. Land claims agreements and Aboriginal governance issues in Labrador: The Nunatsiavut experience. Northern Policy Papers. Published by Action Canada.

Felt, L., Natcher, D., Procter, A., Sillitt, N., Winters, K., Gear, T., Winters, D., Nochasak, S., Anderesen, S., Ford, R., Flowers, H., Rich, S., and Kemuksigak, R. 2012. The more things change: Patterns of country food harvesting by the Labrador Inuit on the North Labrador Coast. In: Natcher, D., Felt L., and Procter, A. eds. 2012. Settlement, subsistence, and change among the Labrador Inuit: The Nunatsiavummiut experience. University of Manitoba Press. 209-230.

Ferguson, S., Stirling, I., and McLoughlin, P. 2005. Climate change and ringed seal (Phoca hispida) recruitment in western Hudson Bay. Marine Mammal Science 21(1): 121-135

Festa-Bianchet, M., Ray, J., Boutin, S., Côté, S., and Gunn, A. 2011. Conservation of caribou (Rangifer tarandus) in Canada: an uncertain future. Canadian Journal of Zoology 89(5): 419-434.

Fitzpatrick, A. 2012. Nunatsiavut open to mining exploration. The Telegram. November 4. Retrievable online at http://www.thetelegram.com/News/Local/2012-11-04/article-3113655/Nunatsiavut-open-to-mining-exploration/1, last accessed on December 1, 2012.

Fleming, L., DeSantis, R., and Smit, B. 2012. Adapting to climate change in Hopedale. In: Natcher, D., Felt L., and Procter, A. eds. 2012. Settlement, subsistence, and change among the Labrador Inuit: The Nunatsiavummiut experience. University of Manitoba Press. 209-230.

Ford, J., Bell, T. and St-Hilaire-Gravel, D. 2010. Vulnerability of community infrastructure to climate change in Nunavut: A case study from Arctic Bay. In: Hovelsrud G. and Smit, B. eds. Community adaptation and vulnerability in Arctic Regions. Springer. 107-130.

Freeman, M. and Wenzel, G. 2006. The nature and significance of polar bear conservation hunting in the Canadian Arctic. Arctic 59 (1): 21-30.

Furgal, C., and Prowse, T. 2008. Northern Canada. In: Lemmen, D, Warren, F, Lacroix, J., and Bush, E. eds. From impacts to adaptation: Canada in a changing climate. Government of Canada, Ottawa, ON. 57-118.

Furgal, C., Martin, D., and Gosselin, P. 2002. Climate change and health in Nunavik and Labrador – Lessons from Inuit knowledge. In: Krupnik, I., and Jolly, D., eds. The earth is faster now: indigenous observations of Arctic environmental change. Fairbanks: Arctic Research Consortium of the United States. 266-300.

Gearheard, S., Matumeak, W., Angutikjuaq, I., Maslanik, J., Huntington, H., Leavitt, J., Kagak, D.M., Tigullaraq, G., and Barry, R. 2006. It's not that simple: A collaborative comparison of sea ice environments, their uses, observed changes, and adaptations in Barrow, Alaska, USA and Clyde River, Nunavut, Canada. AMBIO 35 (4): 203-211.

Gearheard, S., Aporta, C., Aipellee, G., O'Keefe, K. 2011. The Igliniit project: Inuit hunters document life on the trail to map and monitor arctic change. The Canadian Geographer 55(1): 42-55.
Graversen, R., Mauritsen, T., Tjernström, M., Källen, E., and Svensson, G. 2008. Vertical structure of recent Arctic warming. Nature 541: 53-57.
Greene, C., and Pershing, A. 2007. Climate change drives sea change. Science 315 (5815):1084-1085.
Greller, A., Goldstein, M., and Marcus, L. 1974. Snowmobile impacts on three alpine tundra plant communities. Environmental Conservation 1: 101-110.
Goldhar, C. 2012. Water ways: Vulnerability to freshwater changes in the Inuit Settlement Region of Nunatsiavut, Labrador. MA Thesis. Memorial University of Newfoundland, Department of Geography.
Hachem, S., Allard, M., and Duguay, C. 2009. Using the MODIS land surface temperature product for mapping permafrost: an application to northern Québec and Labrador, Canada. Permafrost and Periglacial Processes 20(4): 407-416.
Hall, E. 1971. The 'Iron Dog' in Northern Alaska. Anthropologica 13 (1-2): 237-254.
Hare, F.K. 1952. The climate of the island of Newfoundland: A geographical analysis. Geographical Bulletin 2: 36-88.
Harris Centre. 2010. Summary report of the Harris Centre regional workshop: Memorial University partnering with Nunatsiavut Government. Nain, April 20 – 22. Accessible online at http://www.mun.ca/harriscentre/outreach/regionalworkshops/zone1/Nain_RegionalWorkshop_Report.pdf, last retrieved on April 10, 2013.
Heath, H. and Cowley, S. 2004. Developing a grounded theory approach: A comparison of Glaser and Strauss. International Journal of Nursing Studies 41. 141-150.
Helander-Renvall, E. 2007. Logical adaptation to modern technology–Snowmobile revolution in Sámi. In: The Borderless North. Proceedings of the Fourth NRF Open Meeting, Oulu and Tornio, Finland and Haparanda and Luleå, Sweden. 27-33.
Hermanutz, L. 2008. Can trees climb mountains? From tundra to trees – a tale of changing treeline in the Highlands of Labrador. In: Bell, T., Jacobs, J.D., Munier, A., Leblanc, P., and Trant, A. Climate change and renewable resources in Labrador: Looking toward 2050. Proceedings and report of a conference held in North West River, Labrador, 11-13 March. St. John's: Labrador Highlands Research Group, Memorial University of Newfoundland. 31-43.
Hewitt, K., and Burton, I. 1971. The hazardousness of place: A regional ecology of damaging events. Toronto. University of Toronto Press.
Hopping, B., Erber, E., Mead, E., Roache, C., and Sharma, S. 2010. High levels of physical activity and obesity co-exist amongst Inuit adults in Arctic Canada. Journal of Human Nutrition and Dietetics 23: 110-114.
Huntington, H., and Weller, G. 2005. An Introduction to the Arctic Climate Impact Assessment. In: Symon, C., Arris, L. and Heal, B. eds. Arctic Climate Impact Assessment. New York: Cambridge University Press. 3-20.

Hurrell, J. and Deser, C. 2009. North Atlantic climate variability: the role of the North Atlantic Oscillation. Journal of Marine Systems 78(1): 28-41.

IPCC. 2007. Summary for Policymakers. In: Parry, M.L., Canziani, O.F., Palutikof, J.P., van der Linden, P.J., and Hanson, C.W. eds. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge: Cambridge University Press. 7-22.

Jacobs, J. and Bell, T. 2008. Labrador's changing climate. In: Bell, T., Jacobs, J.D., Munier, A., Leblanc, P., and Trant, A. Climate change and renewable resources in Labrador: Looking toward 2050. Proceedings and report of a conference held in North West River, Labrador, 11-13 March. St. John's: Labrador Highlands Research Group, Memorial University of Newfoundland. 13-16.

Johnston, D., Bowers, M., Friedlaender, A., and Lavigne, D. 2012. The Effects of Climate Change on Harp Seals (Pagophilus groenlandicus). PLoS ONE 7(1): e29158.

Johnston, D., Friedlaender, A., Torres, L., and Lavigne, D. 2005. Variation in sea ice cover on the east coast of Canada from 1969 to 2002: climate variability and implications for harp and hooded seals. Climate Research 29(3): 209.

Jørgensen, M. 2010. Obesity and diabetes–an Arctic challenge. International Journal of Circumpolar Health, 69(4): 320-321.

JW Consulting Associates. 2009. Makkovik Integrated Community Sustainability Plan. Prepared for the Makkovik Inuit Community Government.

Kearns, R. 2010. Seeing with clarity: Undertaking observational research. In: Hay, I. ed. Qualitative research methods in human geography. Oxford: Oxford University Press. 241-258.

Keddy, P., Spavold, A., and Keddy, C. 1979. Snowmobile impact on old field and marsh vegetation in Nova Scotia, Canada: An experimental study. Environmental Management 3(5): 409-415.

Kennedy, J. 1982. Holding the line: Ethnic boundaries in a Northern Labrador Community. Social and economic studies No. 27. Institute of Social and Economic Research. Memorial University of Newfoundland.

Keskitalo, E. 2009. Governance in vulnerability assessment: the role of globalising decision-making networks in determining local vulnerability and adaptive capacity. Mitigation and Adaptation Strategies for Global Change 14(2): 185-201.

Kistler, R., Kalnay, W., Collins, S., Saha, G., White, J., Woollen, M., Chelliah, W., Ebisuzaki, M., Kanamitsu, V., Kousky, H., van den Dool, R., and M. Fiorino, 2001: The NCEP-NCAR 50-Year Reanalysis: Monthly Means CD-ROM and Documentation. Bull. Amer. Meteor. Soc. 82: 247-268

Kofinas, G., Chapin, F., BurnSilver, S., Schmidt, J., Fresco, N., Kielland, K., Martin, S., Springsteen, A., and Rupp, T. 2010. Resilience of Athabascan subsistence systems to Interior Alaska's changing climate. Canadian Journal of Forest Research 40: 1347-1359.

Konstantinov, Y. 2010. Socioeconomic Life of Climate Change: Extensivity in Reindeer Husbandry in Relation to Synergies between Social and Climate Change (Kola Peninsula). Acta Borealia 27(1): 44-65.

Kral, M., Idlout, L., Minore, B., Dyck, R., Kirmayer, L. 2011. Unikkaartuit: Meaning of well-being, unhappiness, health, and community change among Inuit in Nunavut, Canada. American Journal of Community Psychology 48 (2-3). 426-438).

Kulenbekov, Z., and Merkel, B. 2012. Environmental impact of the Kadji-Sai uranium tailing site, Kyrgyzstan. The New Uranium Mining Boom. Springer Berlin Heidelberg. 135-142.

Labrador Affairs Office. 2012. Grants and programs. Accessible online at http://www.laa.gov.nl.ca/laa/programs_we_offer/index.html, last retrieved on November 07, 2012.

Labrador Inuit Association. 1998. Submission by Labrador Inuit Association (LIA) on the proposed Voisey's Bay mining development – Marine Transportation. Submission to be addressed during the technical session on Marine Transportation held in Nain, Labrador, September 15 and 16, 1998.

Labrador Inuit Settlement Area [LISA] Regional Planning Authority. 2010. Draft regional land use plan for the Labrador Inuit Settlement Area. Released by LISA Regional Planning Authority. Nunatsiavut.

Laidler, G. 2007. Ice, through Inuit Eyes: Characterizing the importance of sea ice processes, use, and change around three Nunavut communities. PhD thesis, University of Toronto, Toronto, Ontario.

Laidler, G., Ford, J., Gough, W., Ikummaq, T., Gagnon, A., Kowal, S., Qrunmut, K., and C. Irngaut. 2009. Traveling and hunting in a changing arctic: Assessing Inuit vulnerability to sea ice change in Igloolik, Nunavut. Climatic Change 94 (3-4): 363-397.

Laidler, G., Elee, P., Ikummaq, T., Joamie, E., and Aporta, C. 2010. Mapping Inuit Sea Ice Knowledge, Use, and Change in Nunavut, Canada (Cape Dorset, Igloolik, Pangnirtung). In: Krupnik, I., Aporta, C., Gearheard, S., and Kielsen Holm, L. eds. SIKU: Knowing our ice. Springer. 45-80.

Laidler, G. and Ikummaq, T. 2008. Human geographies of sea ice: freeze/thaw process around Igloolik, Nunavut, Canada. Polar Record 44 (229): 127-153.

Layzer, J. 2006. Playground or paradise? Snowmobiles in Yellowstone National Park. In. Layzer, J. The environmental case: Translating values into policy. Washington, DC: CQ Press. 223-249.

Lehti, V., Niemelä, S., Hoven, C., Mandell, D., and Sourander, A. 2009. Mental health, substance use and suicidal behavior among young indigenous people in the Arctic: a systematic review. Social Science & Medicine, 69(8): 1194-1203.

Leichenko, R. and O'Brien, K. 2008. Environmental changes and globalization: double exposures. Oxford: Oxford University Press.

Lemelin, R., Johnston, M., Dawson, J., Stewart, E., and Mattina, C. 2012. From hunting and fishing to cultural tourism and ecotourism: examining the transitioning tourism industry in Nunavik. The Polar Journal 2(1): 39-60.

Markus, T., Stroeve, J., and Miller, J. 2009. Recent changes in Arctic sea ice melt onset, freezup, and melt season length. Journal of Geophysical Research 114: C12024.

Markey, S., Halseth, G. and D. Manson. 2010. Capacity, Scale and Place: Pragmatic Lessons for doing Community-based Research in the Rural Setting. In: The Canadian Geographer 54 (2): 158-176.

Masyk, W. 1973. The Snowmobile: a recreational technology in Banff National Park: environmental impact and decision making. University of Calgary.

McBeath, J. and Rosenberg, J. 2006. Comparative Environmental Politics. Springer. The Netherlands.

McBoyle, G., Scott, D., and Jones, B. 2007. Climate change and the future of snowmobiling in non-mountainous regions of Canada. Managing Leisure 12(4): 237-250.

McCabe, G. J., and Wolock, D. M. 2010. Long-term variability in Northern Hemisphere snow cover and associations with warmer winters. Climatic Change 99(1): 141-153.

McCarthy, J., Martello, M., Corell, R., Selin, N., Fox, S., Hovelsrud-Broda, G., Mathiesen, S., Polsky, C., Selin, H., and Tyler, N. 2005. Climate Change in the Context of Multiple Stressors and Resilience. In: Symon, C., Arris, L., and Heal, B. eds. Arctic climate impact assessment. Cambridge: Cambridge University Press. 945-988.

Miller, F., Osbahr, H., Boyd, E., Thomalla, F., Bharwani, S., Ziervogel, G., Walker, B., Birkmann, J., Van der Leeuw, S., Rockström, J., Hinkel, J., Downing, T., Folke, C., and Nelson, D. 2010. Resilience and vulnerability: complementary or conflicting concepts?.Ecology and Society 15(3): 11.

MQO Research. 2012. Labrador travel survey – Final report. Accessible online at http://www.tcr.gov.nl.ca/tcr/publications/2012/Labrador_Travel_Survey_Final_Report_June_2012.pdf, last retrieved on April 22, 2013.

Müller‐Wille, L. 1978. Cost analysis of modern hunting among the Inuit of the Canadian Central Arctic. Polar Geography 2(2): 100-114.

Munier, A., Hermanutz, L., Jacobs, J. D., and Lewis, K. 2010. The interacting effects of temperature, ground disturbance, and herbivory on seedling establishment: implications for treeline advance with climate warming. Plant Ecology 210(1): 19-30.

Musselman, R., and Korfmacher, J. 2007. Air quality at a snowmobile staging area and snow chemistry on and off trail in a Rocky Mountain subalpine forest, Snowy Range, Wyoming. Environmental monitoring and assessment 133(1): 321-334

Natcher, D. 2001. Land use research and the duty to consult: A misrepresentation of the aboriginal landscape. Land Use Policy 18. 113-122.

Natcher, D., Felt, L., McDonald, J., and Procter, A. 2009. Subsistence and the social economy of Nunatsiavut, Labrador. Poster presented at the Social Economy and Sustainability Research Network ‘Building Policy4 the Social Economy” policy colloquium Halifax, Nova Scotia.

Natcher, D., Felt, L., and Procter, A. eds. 2012. Settlement, subsistence, and change among the Labrador Inuit: The Nunatsiavummiut experience. University of Manitoba Press.

National Park Service. Year n/a. Sustainable Subsistence ATV trail. Rivers, trails, and conservation assistance program of the National Park Service, U.S. Department of the Interior. Accessible online at http://www.nps.gov/akso/community/rtca/PDFs/hooper-bay-project.pdf, last retrieved on May 1, 2013.

Newfoundland and Labrador Department of Tourism, Culture and Recreation. 2013. Backgrounder year-end provincial tourism performance 2012 and early tourism outlook 2013. Accessible online at http://www.tcr.gov.nl.ca/tcr/publications/2012/Tourism_Performance_2012_Province_Final_March_2013.pdf, last retrieved on April 10, 2013, last retrieved on June 22, 2013.

Newfoundland and Labrador Department of Environment and Conservation. http://www.env.gov.nl.ca/env/wildlife/education/index.html#tec

Newfoundland and Labrador Statistics Agency 2009a. Postville Community Account. Government of Newfoundland and Labrador. Accessible online at http://nl.communityaccounts.ca/table.asp?_=vb7En4WVgaauzXRjVlnXxaGduraUiL2UvYioxpKjlIzFi2GQ, last retrieved on November 8, 2012.

Newfoundland and Labrador Statistics Agency 2009b; Makkovik Community Account. Government of Newfoundland and Labrador. Accessible online at http://nl.communityaccounts.ca/table.asp?_=vb7En4WVgaauzXNkWFnXxaGduraUiL2UvYioxpKjlIzFi2GQ, last retrieved on November 8, 2012.

Notzke, C. 1999. Indigenous tourism development in the Arctic. Annals of Tourism Research, 26 (1): 55-76.

Nunatsiavut Government. 2005. Fiscal Financing Agreement. Executive Council of Newfoundland and Labrador. Accessible online at http://www.exec.gov.nl.ca/exec/igas/land_claims/ng_fiscal_financing_agreement.pdf, last retrieved on May 09, 2013.

Nunatsiavut Government. 2012a. Nunatsiavut Strategic Plan 2012 -2015. Released by the Nunatsiavut Government. Nain.

Nunatsiavut Government. 2012b. Labrador Inuit Land Claims Agreement Highlights. Released by the Nunatsiavut Government. Nain.

Nunatsiavut Government 2012c. Tourism mission statement. Department of Culture, Recreation, and Tourism. Accessible online at http://www.nunatsiavut.com/index.php/en/culture-tourism-and-recreation/tourism, last retrieved on December 1, 2012.

O'Brien, K., and Leichenko, R. 2000. Double exposure: assessing the impacts of climate change within the context of economic globalization. Global Environmental Change 10: 221-232.

O'Brien, K., Leichenko, R., Kelkar, U., Venema, H., Aandahl, G., Tompkins, H., Javed, A., Bhadwal, S., Barg, S., Nygaard, L., and West, J. 2004. Mapping vulnerability to multiple stressors: Climate change and globalization in India. Global Environmental Change 14: 303-313.

O'Brien, K., Sygna, L., and Haugen, J. 2003. Vulnerable or resilient? A multi-scale assessment of climate impacts and vulnerability in Norway. Climatic Change 00. 1-33.
O'Brien, K., and Wolf, J. 2010. A values-based approach to vulnerability and adaptation to climate change. WIREs Climate Change 1: 232-242.
Orkin, A., VanderBurgh, D., Born, K., Webster, M., Strickland, S., and Beardy, J. 2012. Where There Is No Paramedic: The Sachigo Lake Wilderness Emergency Response Education Initiative. PLoS Medicine, 9(10): e1001322.
Overland J. and Serreze, M. 2012. Advances in Arctic Atmospheric Research. In: Lemke, P. and Jacobi, H.-W. eds. Arctic Climate Change: The ACSYS Decade and Beyond. Springer. 11-26.
Parkinson, C., and Cavalieri, D. 2008. Arctic sea ice variability and trends, 1979–2006. Journal of Geophysical Research 113(C7): C07003.
Payette, S. 1993. The range limit of boreal tree species in Quebec-Labrador: an ecological and palaeoecological interpretation. Review of Palaeobotany and Palynology 79: 7-30.
Pearce, T., Smit, B., Duerden, F., Ford, J., Goose, A., and Kataoyak, F. 2009. Inuit vulnerability and adaptive capacity to climate change in Ulukhaktok, Northwest Territories, Canada. Polar Record 46 (237): 157–177.
Pedersen, S., and Coffing M. 1984. Caribou hunting: land use dimensions and recent harvest patterns in Kaktovik, Northeast Alaska. Fairbanks: Alaska Department of Fish and Game. Technical paper No. 92.
Pelto, P. 1973. The snowmobile revolution: technology and social change in the Arctic. Cummings Publishing Company.
Perovich, D., and Richter-Menge, J. 2009. Loss of Sea Ice in the Arctic. Annual Review of Marine Science 1: 417-441.
Popp, J., Schaefer, J., and Mallory, F. 2011. Female site fidelity of the Mealy Mountain caribou herd (Rangifer tarandus caribou) in Labrador. Rangifer, 31(2): 87-95.
Prinsenberg, S., Peterson, I., Narayanan, S., and Umoh, J. 1997. Interaction between atmosphere, ice cover, and ocean off Labrador and Newfoundland from 1962 to 1992. Canadian Journal of Fisheries and Aquatic Sciences 54 (1): 30-39.
Procter, A. and Chaulk, K. Our beautiful land: Current debates in land use planning in Nunatsiavut, In: Natcher, D., Felt L., and Procter, A. eds. 2012. Settlement, subsistence, and change among the Labrador Inuit: The Nunatsiavummiut experience. University of Manitoba Press. 232-251
Prugh, H. 2004. To Sled or Not to Sled: The Snowmobiling Saga in Yellowstone National Park. Hastings West–Northwest Journal of Environmental Law & Policy 11: 149
Prowse, T., Furgal, C., Melling, H., and Smith, S. 2009. Implications of climate change for Northern Canada: The physical environment. AMBIO: A Journal of the Human Environment 38(5): 266-271
Rankin, L. In: Natcher, D., Felt L., and Procter, A. eds. 2012. Settlement, subsistence, and change among the Labrador Inuit: The Nunatsiavummiut experience. University of Manitoba Press. 209-230.

Rattenbury, K., Kielland, K., Finstad, G., and Schneider, W. 2009. A reindeer herder's perspective on caribou, weather and socio-economic change on the Seward Peninsula, Alaska. Polar Research 28: 71-88.

Raymond, C., Fazey, I., Reed, M., Stringer, L., Robinson, G., and Evely, A. 2010. Integrating local and scientific knowledge for environmental management. Journal of Environmental Management, 91 (8): 1766-1777.

Reimann, S., Kallenborn, R., and Schmidbauer, N. 2009. Severe aromatic hydrocarbon pollution in the Arctic Town of Longyearbyen (Svalbard) caused by snowmobile emissions. Environmental science and technology 43(13): 4791-4795.

Reimers, E., Eftestøl, S., and Colman, J. E. 2003. Behavior responses of wild reindeer to direct provocation by a snowmobile or skier. The Journal of Wildlife Management 67 (4): 747-754.

Richmond, C. and Ross, N. 2009. The determinants of First Nation and Inuit health: A critical population health approach. Health & Place 15 (2). 403-411.

Riewe, R. 1991. Inuit Use of the Sea Ice. Arctic and Alpine Research 23 (1): 3-10.

Robinson, M., and Ross, M, 1997. Traditional land use and occupancy studies and their impact on forest planning and management in Alberta. The Forest Chronicle 73 (5), 596–605.

Rowell, J., and Metcalfe, L. 2005. Voisey's Bay project – A challenge to Inuit use of the landfast ice. Proceedings of the 18th International Conference on Port and Ocean Engineering Under Arctic Conditions 1. 109-118.

Russell, D., and Gunn, A. Caribou and reindeer (rangifer). Arctic Report Card: Update for 2011. Accessible online at www.arctic.noaa.gov/reportcard/reindeer.html, last retrieved on November 07, 2012.

Salbu, B., Burkitbaev, M., Strømman, G., Shishkov, I., Kayukov, P., Uralbekov, B., and Rosseland, B. 2012 (in press). Environmental impact assessment of radionuclides and trace elements at the Kurday U mining site, Kazakhstan. Journal of Environmental Radioactivity.

Schwartz, 1977. Land use in the Makkovik region. In: Brice-Bennett, C., Cooke, A., and Davi, N. eds. Our footprints are everywhere. Nain: Labrador Inuit Association. 239-278.

Scott, D., Dawson, J., and Jones, B. 2008. Climate change vulnerability of the US Northeast winter recreation–tourism sector. Mitigation and Adaptation Strategies for Global Change 13(5): 577-596.

Sjare, B. 2008. Climate change and seals: A Labrador perspective with a focus on the importance of sea ice. In: Bell, T., Jacobs, J.D., Munier, A., Leblanc, P., and Trant, A. 2008. Climate change and renewable resources in Labrador: Looking toward 2050. Proceedings and report of a conference held in North West River, Labrador, 11-13 March. St. John's: Labrador Highlands Research Group, Memorial University of Newfoundland. 44-53.

Sen, A. 1981. Poverty and famines: an essay on entitlement and deprivation. Oxford University Press, USA.

Serreze, M., and Barry, R. 2011. Processes and impacts of Arctic amplification: A research synthesis. Global and Planetary Change 77: 85-96.

Sirait, M., Prasodjo, S., Podger, N., Flavelle, A., and Fox, J. 1994. Mapping customary land in East Kalimantan, Indonesia: a tool for forest management. AMBIO 23 (7): 411-417.

Sharma, S., Barr, A., Macdonald, H., Sheehy, T., Novotny, R., and Corriveau, A. 2011. Vitamin D deficiency and disease risk among aboriginal Arctic populations. Nutrition reviews, 69(8): 468-478.

Sharma, S., Couturier, S., and Côté, S. 2009. Impacts of climate change on the seasonal distribution of migratory caribou. Global Change Biology 15(10): 2549-2562.

Shively, D., Pape, B., Mower, R., Zhou, Y., Russo, R., and Sive, B. C. 2008. Blowing smoke in Yellowstone: Air quality impacts of oversnow motorized recreation in the park. Environmental Management 41(2): 183-199.

Silva, J., Eriksen, S., and Ombe, Z. 2010. Double exposure in Mozambique's Limpopo River Basin. The Geographical Journal 176 (1): 6-24.

Skipperud, L., Strømman, G., Yunusov, M., Stegnar, P., Uralbekov, B., Tilloboev, H., Zjazjev, G., Heier, L., Rosseland, B. and Salbu, B. 2012 (in press). Environmental impact assessment of radionuclide and metal contamination at the former U sites Taboshar and Digmai, Tajikistan. Journal of Environmental Radioactivity.

Sletto, B. 2009. Special issue: indigenous cartographies. Cultural geographies 16. 147-152.

Smit, B. and Pilifosova. 2001. Adaptation to climate change in the context of sustainable development and equity. In: McCarthy, J., Canziani, O., Leary, N., Dokken, D., and White, K. eds. Climate Change 2001: Impacts, adaptation, and vulnerability. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.

Smit, B., and Wandel, J. 2006. Adaptation, adaptive capacity and vulnerability. Global Environmental Change 16: 282-292.

Smit, B., Hovelsrud, G. K., Wandel, J., and Andrachuk, M. 2010. Introduction to the CAVIAR project and framework. In Community adaptation and vulnerability in Arctic regions (pp. 1-22). Springer Netherlands.

Smith, L. 1972. The mechanical dog team: A study of the Ski-Doo in the Canadian Arctic. Arctic Anthropology 9 (1): 1-9.

Sparkes, G., and Kerr, A. 2008. Diverse styles of uranium mineralization in the Central mineral belt of Labrador: An overview and preliminary discussion. Current Research, Newfoundland and Labrador Department of Natural Resources, Geological Survey, Report 81: 193-227.

Statistics Canada. 2007a. Makkovik, Newfoundland and Labrador. Aboriginal Population Profile. 2006 Census. Statistics Canada Catalogue no. 92-594-XWE. Ottawa. Released January 15, 2008. Accessible online at http://www12.statcan.ca/census-recensement/2006/dp-pd/prof/92-594/index.cfm?Lang=E, last retrieved on November 8, 2012.

Statistics Canada. 2007b. Nain, Newfoundland and Labrador. Aboriginal Population Profile. 2006 Census. Statistics Canada Catalogue no. 92-594-XWE. Ottawa. Released January 15, 2008. Accessible online at

http://www12.statcan.ca/census-recensement/2006/dp-pd/prof/92-594/index.cfm?Lang=E, last retrieved on November 8, 2012.
Statistics Canada. 2007c. Hopedale, Newfoundland and Labrador. Aboriginal Population Profile. 2006 Census. Statistics Canada Catalogue no. 92-594-XWE. Ottawa. Released January 15, 2008. Accessible online at http://www12.statcan.ca/census-recensement/2006/dp-pd/prof/92-594/index.cfm?Lang=E, last retrieved on November 8, 2012.
Statistics Canada. 2007d. Rigolet, Newfoundland and Labrador Aboriginal Population Profile. 2006 Census. Statistics Canada Catalogue no. 92-594-XWE. Ottawa. Released January 15, 2008. Accessible online at http://www12.statcan.ca/census-recensement/2006/dp-pd/prof/92-594/index.cfm?Lang=E, last retrieved on November 8, 2012.
Statistics Canada. 2012a. Makkovik, Newfoundland and Labrador. Census Profile. 2011 Census. Statistics Canada Catalogue no. 98-316-XWE. Ottawa. Released February 8, 2012. Accessible online at http://www12.statcan.ca/census-recensement/2011/dp-pd/prof/index.cfm?Lang=E , last retrieved on April 3, 2013.
Statistics Canada. 2012b. Postville, Newfoundland and Labrador. Census Profile. 2011 Census. Statistics Canada Catalogue no. 98-316-XWE. Ottawa. Released February 8, 2012. Accessible online at http://www12.statcan.ca/census-recensement/2011/dp-pd/prof/index.cfm?Lang=E, last retrieved on April 3, 2013.
Statistics Canada. 2012c. Nain, Newfoundland and Labrador and Newfoundland and Labrador. Census Profile. 2011 Census. Statistics Canada Catalogue no. 98-316-XWE. Ottawa. Released October 24, 2012. Accessible online at http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/index.cfm?Lang=E, last retrieved on April, 2013.
Statistics Canada. 2012d. Rigolet, Newfoundland and Labrador. Census Profile. 2011 Census. Statistics Canada Catalogue no. 98-316-XWE. Ottawa. Released October 24, 2012. Accessible online at http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/index.cfm?Lang=E, last retrieved on November 7, 2012.
Statistics Canada. 2012e. Hopedale, Newfoundland and Labrador. Census Profile. 2011 Census. Statistics Canada Catalogue no. 98-316-XWE. Ottawa. Released October 24, 2012. Accessible online at http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/index.cfm?Lang=E, last accessed November 7, 2012.
Stewart, E., Howell, S., Draper, D., Yackel, J., and Tivy, A. 2007. Sea ice in Canada's Arctic: Implications for cruise tourism. Arctic 60 (4): 370-380.
Stewart, R. and Black, G. 2004. Snowmobile trauma: 10 years' experience at Manitoba's tertiary trauma centre. Canadian journal of surgery. 47(2): 90.
Stone, J., and Stetler, L. 2009. Assessment of environmental impacts near abandoned uranium mines within the Cave Hills and Slim Buttes complexes, Custer National Forest, South Dakota. In Joint Conference, Annual Meeting of the

American Society of Mining and Reclamation and 11th Billings Land Reclamation Symposium, Billings, MT. June.
Stroeve, J., Serreze, M., Drobot, S. Gearheard, S., Holland, M., Maslanik, J., Meier, W., and T. Scambos. 2008. Arctic Sea Ice Extent Plummets in 2007. Eos Transactions American Geophysical Union 89 (2): 13.
Stroeve, J., Serreze, M., Holland, M., Kay, J., Malanik, J. and Barrett, A. 2012. The Arctic's rapidly shrinking sea ice cover: A research synthesis. Climatic Change 110: 1005-1027.
Strong, C., Magnusdottir, G., and Stern, H. 2009. Observed feedback between winter sea ice and the North Atlantic Oscillation. Journal of Climate 22 (22): 6021-6032.
Sy, M. and Corden, T. 2005. The perils of snowmobiling. Wisconsin Medical Journal 104(2): 32-34.
Taillon, J., Festa-Bianchet, M., and Côté, S. 2012. Shifting targets in the tundra: Protection of migratory caribou calving grounds must account for spatial changes over time. Biological Conservation 147: 163-173
Tanner, V. 1947. Outlines of the geography, life and customs of Newfoundland – Labrador. Volume II. Cambridge University Press.
Tobias, Terry. 2009. Living Proof. Ecotrust Canada.
Tivy, A., Howell, S., Alt, B., McCourt, S., Chagnon, R., Crocker, G., Carrieres, T., and Yackel, J. 2011. Trends and variability in summer sea ice cover in the Canadian Arctic based on the Canadian Ice Service digital archive, 1960 – 2008 and 1968 – 2008. Journal of Geophysical Research 116: C03007
Timmerman, P. 1981. Vulnerability, resilience and the collapse of society - A review of Models and possible climatic applications. Environmental Monograph No. 1. Institute for Environmental Studies, University of Toronto, Canada.
Usher, P. J. 2002. Inuvialuit use of the Beaufort Sea and its resources, 1960-2000. Arctic 55(1): 18-28.
United Nations Disaster Relief Coordinator (UNDRO), 1979. Natural Disasters and Vulnerability Analysis. Report of Expert Group meeting (9-12 July 1979). UNDRO, Geneva.
Vasseur, L., and Catto, N. 2008. Atlantic Canada. In: Lemmen, D., and Warren, F. eds. From Impacts to Adaptation: Canada in a Changing Climate 2007. Ottawa: Government of Canada. 27-56.
Warren, F., and Egginton, P. 2008. Background information. In: Lemmen, D., and Warren, F. eds. From Impacts to Adaptation: Canada in a Changing Climate 2007. Ottawa: Government of Canada. 27-56.
Way, R. and Viau, A. 2010. Multi-scale climate variability in the Labrador region of Canada during the past century. In prep.
Wesche, S. and Chan, H. 2010. Adapting to the impacts of climate change on food security among Inuit in the Western Canadian Arctic. EcoHealth 7(3): 361-373.
Wenzel, G. 2009. Canadian Inuit subsistence and ecological instability – if the climate changes, must the Inuit? Polar Research 28: 89-99.
Wilkinson, J. 2011. Tradition and technology: Sea ice science on Inuit Sleds. Eos 92 (1).

Wittmer, H., McLellan, B., Serrouya, R., and Apps, C., 2007. Changes in landscape composition influence the decline of a threatened woodland caribou population. Journal of Animal Ecology 76(3): 568-579.

Walker, B., Carpenter, J., Anderies, J., Abel, N., Cumming, G., Janssen, M., Lebel, L., Norberg, J., Peterson, G., and Pritchard. R. 2002. Resilience Management in social-ecological Systems: a working hypothesis for a participatory approach. Conservation Ecology 6.1:14.

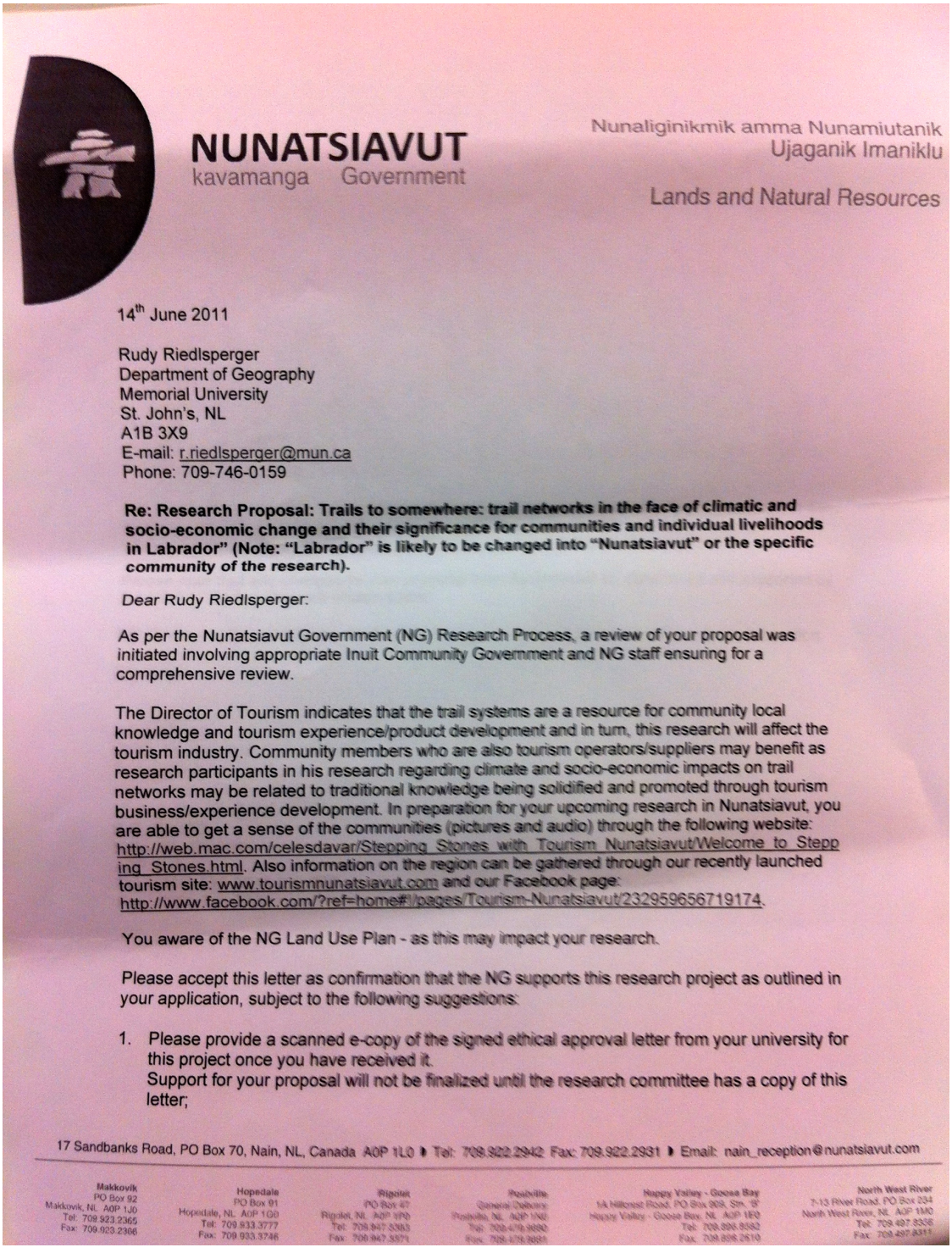
Wolf, J., Allice, I., Bell, T. 2012/In press. Values, climate change, and implications for adaptation: Evidence from two communities in Labrador, Canada. Global Environmental Change.

Wolf, J., Bell, T., Allice, I. 2010. Stuck in slush – Values in adaptation to climate change in two Labrador communities. ArcticNet Annual Scientific Meeting, 14-17 Dec. 2010, Ottawa ON.

Zhou, Y., Shively, D., Mao, H., Russo, R., Pape, B., Mower, R., and Sive, B. 2010. Air toxic emissions from snowmobiles in Yellowstone National Park. Environmental science and technology 44 (1): 222-228.

Zimmerly, D. 1975. Cain's Land revisited: Culture Change in Central Labrador, 1775-1972. Social and economic studies No. 16. Institute of Social and Economic Research. Memorial University of Newfoundland.

APPENDIX A: Nunatsiavut Government research permit



NUNATSIAVUT
kavamanga Government

Nunaliginikmik amma Nunamiutanik
Ujaganik Imaniklu

Lands and Natural Resources

14th June 2011

Rudy Riedlsperger
Department of Geography
Memorial University
St. John's, NL
A1B 3X9
E-mail: r.riedlsperger@mun.ca
Phone: 709-746-0159

Re: Research Proposal: Trails to somewhere: trail networks in the face of climatic and socio-economic change and their significance for communities and individual livelihoods in Labrador" (Note: "Labrador" is likely to be changed into "Nunatsiavut" or the specific community of the research).

Dear Rudy Riedlsperger:

As per the Nunatsiavut Government (NG) Research Process, a review of your proposal was initiated involving appropriate Inuit Community Government and NG staff ensuring for a comprehensive review.

The Director of Tourism indicates that the trail systems are a resource for community local knowledge and tourism experience/product development and in turn, this research will affect the tourism industry. Community members who are also tourism operators/suppliers may benefit as research participants in his research regarding climate and socio-economic impacts on trail networks may be related to traditional knowledge being solidified and promoted through tourism business/experience development. In preparation for your upcoming research in Nunatsiavut, you are able to get a sense of the communities (pictures and audio) through the following website: http://web.mac.com/celesdavar/Stepping_Stones_with_Tourism_Nunatsiavut/Welcome_to_Stepping_Stones.html. Also information on the region can be gathered through our recently launched tourism site: www.tourismnunatsiavut.com and our Facebook page: http://www.facebook.com/?ref=home#!/pages/Tourism-Nunatsiavut/232959656719174.

You aware of the NG Land Use Plan - as this may impact your research.

Please accept this letter as confirmation that the NG supports this research project as outlined in your application, subject to the following suggestions:

1. Please provide a scanned e-copy of the signed ethical approval letter from your university for this project once you have received it.
   Support for your proposal will not be finalized until the research committee has a copy of this letter;

17 Sandbanks Road, PO Box 70, Nain, NL, Canada A0P 1L0 ◗ Tel: 709.922.2942 Fax: 709.922.2931 ◗ Email: nain_reception@nunatsiavut.com

Makkovik
PO Box 92
Makkovik, NL A0P 1J0
Tel: 709.923.2365
Fax: 709.923.2368

Hopedale
PO Box 91
Hopedale, NL A0P 1G0
Tel: 709.933.3777
Fax: 709.933.3746

Rigolet
PO Box 67
Rigolet, NL A0P 1P0
Tel: 709.947.5353
Fax: 709.947.3579

Postville
General Delivery
Postville, NL A0P 1N0
Tel: 709.479.9880
Fax: 709.479.9881

Happy Valley - Goose Bay
1A Hillcrest Road, PO Box 909, Stn. 'B'
Happy Valley - Goose Bay, NL A0P 1E0
Tel: 709.896.8582
Fax: 709.896.2610

North West River
7-13 River Road, PO Box 234
North West River, NL A0P 1M0
Tel: 709.497.8336
Fax: 709.497.8311

2. You have: visited Makkovik and Postville; consulted with people from Labrador and your supervisors Trevor Bell and Johanna Wolf, on what communities might be appropriate. You also have taken 'researcher's fatigue' into account and the most important criterion of course is that the community is interested and approving of the research.

   Once you have decided on an Inuit community/ies where the research will be conducted please provide a letter of support from the Inuit Community Government.

3. The Director of Tourism indicates recent research being conducted/completed this summer in Rigolet regarding climate change and health entitled "Changing Climate, Changing Heatlh, Changing Stories" which led to the development of the Digital Storytelling Lab and recording local stories of present and past experiences may be an interesting connection to make for this trail research.

4. Please provide copies of any reports, journal articles, papers, posters or other publications related to this project to the Nunatsiavut Inuit Research Advisor, the NG Deputy Minister / Director of Lands, Director of Environment and Director of Tourism, and the Inuit Community Governments where the research will be conducted upon completion of your work. A plain language summary detailing the work, translated into our dialect of Labrador Inuktitut (Roman Orthography) should also be provided.

We would also appreciate copies of any photographs that you acquire during your research in the Nunatsiavut area as the NG is developing a digital database of regional photos. Recognition will always be given to the photographer.

Please note that any changes to your proposal must be provided to, considered and supported by the NGRAC before they are implemented.

We thank you for considering our feedback on your work and look forward to more collaboration.

Sincerely,

John Lampe
Chair, Nunatsiavut Government
Research Advisory Committee
Nunatsiavut Government
25 Ikajuktauvik Road
P.O. Box 70
Nain, NL, Canada
A0P 1L0
Tel.: (709) 922-2942 Ext. 235
Fax: (709) 922-2931

APPENDIX B: Data collection manual including consent forms

COMMUNITY VULNERABILITY TO CHANGES IN WINTER TRAILS, TRAIL USE AND TRAVELLING IN NUNATSIAVUT

2012 USE AND OCCUPANCY MAP SURVEY

DATA-COLLECTION MANUAL

Prepared for the communities of Postville and Makkovik, Nunatsiavut

Rudy Riedlsperger
Department of Geography at Memorial University
January 2012

ASSIGNING RESPONDENT NUMBERS

Assigning each respondent a respondent identity number (PIN) is one of the interview-procedure steps (Page 4).

1) Each interviewer has a specified block of 25 PINs

Rudy Riedlsperger	1-10
Marilyn Winters	11-20

2) If an interviewer uses all their PINs, they are given the next available block of 10 numbers. If, for instance, Rudy were to assign respondents the numbers 1-10 – and he were the first to assign all of his numbers – he would be given numbers 21 through 30.

3) Each PIN is assigned according to the sequence of interviews, in ascending order. The first respondent, interviewed by Rudy, for instance, gets PIN1. The second person he interviews is assigned PIN2.

4) Once a respondent is assigned a PIN he or she keeps that PIN number for as long as the research mandate lasts. The same person never gets assigned two PINs. For example, if Rudy does an interview with John Doe and assigns him PIN08, and the session finishes without having covered the entire interview questions, a follow-up session is required. Let's say Marilyn (not Rudy) does the follow-up months later. Even though Marilyn's block of numbers runs from 11-20, John is still PIN08.

If John is asked to participate in another survey ten years from now, he will still be PIN08.

5) If two interviewers are working as a team during a map session, that one who is going to take the lead role is the one who assigns the PIN, from her or his block of numbers. The lead interviewer is the one who asks most of the questions and marks most of the data on the maps, and fills out the interview record form (page 38) afterwards.

Map-Biography Interview Consent Form

Participant Identification Number: Name of Interviewer:

You are invited to take part in a research project entitled *"Community vulnerability to changes in winter trails, trail use and travelling in Nunatsiavut".* This form is part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. Please take the time to read this carefully and to understand any other information given to you by the researcher. You may indicate your agreement to the terms of your participation by checking the boxes provided and signing the consent form. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. It is entirely up to you to decide whether to take part in this research. If you choose not to take part in the research or if you decide to withdraw from the research once it has started, there will be no negative consequences for you, now or in the future.

Introduction to the research project:

This research focuses on the winter trails in your community. The research aims at finding out whether winter trails are subject to change and if that is the case, how these changes affect communities and individuals. Research in other parts of Canada suggests, for example, that CVC increases travel risks and compromises travel routes. This research should help to find out whether this also applies for the Makkovik region and what reasons might be responsible for bringing about changes in trails, trail routes and trail use as well.

Purpose of the study:

The purpose of the research is to learn how community members perceive and explain changes in winter trails and what these changes mean to community members. The broader aim of this research is to help identify adaptation measures that offset negative effects and harness positive effects of changes in the trail networks.

Why have I been chosen and what will you ask me about?

We would like to learn about your views and opinions of the trail networks your community is connected with.

Do I have to take part?

No. Your participation is entirely voluntary and you have the right to withdraw, without reason, at any stage. If you withdraw, any information you have already provided will be destroyed. If you agree to take part you will be asked to read and sign a consent form before the interview starts. You will be given a copy of it to keep.

What happens to me if I take part?

The interviewer will carry out the interview at the community hall or at a location convenient to you. The time commitment for the interview will not exceed 90 minutes. To help accurately represent your views we would like to tape record the interview. If you do not want the interview being audio taped, we would like to take written notes instead. After your interview you will be able to review the transcript of your interview, and to add, change, or delete information from the transcripts as you see fit.

Will my taking part in the study be kept confidential?

All of the researchers agree to safeguard the confidentiality and the research team will not pass on your personal details to anyone else. All of the data will be kept anonymous and your name will not appear in any documents published from the research. If you wish, however, you may wave your right to anonymity. You will then be included in an acknowledgement section of the thesis resulting out of this research and potentially be identified in reports, publications or presentations that may result out of this research. If you are identifiable on any pictures taken as part of this research project, you may allow the researcher to use those pictures in reports, publications or presentations, or deny that use. Please be aware that that other people might be able to identify you based on the pictures and the implications this has on your anonymity regarding this research project.

What will happen to the results from the study?

We hope to report our findings in academic journals and at conferences and present them in your community. We will inform you when we will visit your community to report on our findings. You will not be identified in any reports or publications arising from the study. The data of this study will be stored in locked cabinets in Memorial University's Geography department. All data is stored in an anonymous form.

Possible benefits:

We cannot promise that the research benefits you directly. However, the research project encourages you to voice your concerns about changes in the trail networks and therefore helps to address negative aspects that are associated with such changes. In the ideal case, this research helps to inform decision makers on how to meet community members' needs.

Possible risks:

We do not foresee there risks involved with participating in the interview. Please read through the interview questions listed in appendix D to determine you find the topics emotionally upsetting. You may stop the interview process at any point if you feel that answering the questions is making you uncomfortable. Furthermore, if you feel that the interview is tiring, you may request to take a break or stop the interview.

What if there is a problem?

If you have ethical concerns about the research (such as the way you have been treated or your rights as a participant), you may contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at (709) 864-2861. Questions about the research or understanding the research should be addressed to Rudy Riedlsperger at (709) 746-0159 or his supervisors (see contact info below) who will do their best to answer your questions.

Rudy Riedlsperger (principal researcher)
Department of Geography
Memorial University
St. John's, NL
A1B 3X9
E-mail: r.riedlsperger@mun.ca
Phone: 709-746-0159

Dr. Trevor Bell (supervisor)
Department of Geography
Memorial University of Newfoundland
St. John's, Newfoundland, A1B 3X9
e-mail: tbell@mun.ca

Dr. Johanna Wolf (co-supervisor)
Labrador Institute of Memorial University
219 Hamilton River Road

P.O. Box 490, Stn. B
Happy Valley-Goose Bay, NL A0P 1E0
e-mail: jwolf@mun.ca

Who has reviewed the study?

The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have any further questions about this research project please contact Rudy Riedlsperger at 709-746-0159 (see contact info above).

Thank you for taking the time to read this information. Your participation would be greatly appreciated.

Please check box

1. I have read and understand the information sheet for the study. I have had the time I need to think about the information, ask my questions and have had my questions answered. □

2. I understand that I do not have to participate if I don't want to and that I am free to stop participating at any time. I do not need to give any reason for withdrawing and I know I will not face any negative consequences if I withdraw. □

3. I agree to take part in this study. □

4. I agree that my interview can be audio taped. □

5. I agree that the interview can be recorded on paper □

6. If I agree that my interview can be audio taped and/or recorded on paper, I understand that if I chose to withdraw from the research after having being interviewed and taped, the recordings (audio and written) will be deleted permanently. □

7. I hereby agree to be potentially identified in reports, publications, theses and presentations resulting from this research. I understand that if I do not check this box, I will NOT be identified in reports, publications, theses and □

presentations resulting from this research.

8. I understand that the principal researcher agrees to protect my confidentiality. Because the participants for this research project have been selected from a small group of people, all of whom are known to each other, it is possible that I may be identifiable to other people on the basis of what I have said. I understand that the information gathered today will be stored in files that do not have my name or identifying information. □

Your signature on this form means that:

- You have read the information about the research.
- You have been able to ask questions about this study.
- You are satisfied with the answers to all of your questions.
- You understand what the study is about and what you will be doing.
- You understand that you are free to withdraw from the study at any time, without having to give a reason, and that doing so will not affect you now or in the future.

If you sign this form, you do not give up your legal rights, and do not release the researchers from their professional responsibilities. The researcher will give you a copy of this form for your records.

Name of Participant (PRINT)	Date	Signature

Researcher (PRINT)	Date	Signature

The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have ethical concerns about the research (such as the way you have been treated or your rights as a participant), you may contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at (709) 864-2861.

If you have any further questions about this research project, please phone Rudy Riedlsperger at (709) 746-0159 or Dr Trevor Bell at (709) 864-2525.

INTERVIEW PROCEDURE

SETTING UP FOR THE INTERVIEW

(Before respondent arrives)

Step 1 – Put Base Maps in Order – Your set of base maps consists of six sheets (Page 44). Make sure it is organized in a way that allows you to easily find the maps you need. Have at least two of each base map at hand.

Step 2 – Set up Recording Equipment - Set up the digital audio recorder. Attach the extension chord, adapter, and external microphone. ALWAYS USE THE EXTERNAL MIKE – never the recorder's internal one. Make sure there's a battery in the microphone, and a spare on hand. Check that the mike switch is off. WHENEVER THE RECORDER IS OFF, THE MIKE SHOULD BE TURNED OFF AS WELL.

Step 3 – Organize Rest of Toolkit – Here are the toolkit items you should already have ready (Steps 1-3)

- 2 of each base map
- audio recorder
- extension cord
- recorder adapter
- external microphone
- spare microphone battery

Now mare sure the following are at hand:

• 8 *FINE-NIB (0.4 – 0.6mm)* *PERMANENT* marker pens (2 black, 2 red, 2 blue, 2 green)

• 2 *MEDIUM-NIB (0.8-1.0mm)* *PERMANENT* marker pens (black, red or blue)

• scribble pad

• ballpoint pen

□ table lamp and extension cord

□ magnifying glass

□ permission form

□ honorarium form

□ interview record form

□ data-collection manual

□ index map

□ codepiece

□ pencil (respondent's pointer)

□ blank CD- or DVD- Roms

□ copy of interview-procedure checklist (pages 13-16 of this manual)

Step 4 – Organize the interview space – Tidy the room. Make sure the index map is displayed on a wall where the respondent will have easy access. Turn the phone ringer off and post your "interview-in-progress" sign. Make fresh coffee or tea.

Step 5 – Note Starting Code-Sequence Number – If this is the respondent's first map- survey interview, you'll be starting the code sequence with "1". If, however, the interview is a follow-up session, check your file of interview record forms (or the master list Rudy will periodically provide you) to determine the highest sequence number used ruing the respondent's previous interview. Round up to the nearest ten and add one. That's the first code number you'll use once you start the interview. Make a note of it on the scribble pad.

Step 6 – Assign Respondent a PIN – See page 2.

CONDUCTING THE INTERVIEW

(After respondent arrives)

Step 8 – Review Honorarium Form - The first thing you do after welcoming the respondent and thanking him or her for coming in, is briefly discuss the honorarium form. Make sure the respondent understands the arrangement and agrees.

Step 9 – Discuss Consent Form - Ask whether the respondent feels comfortable doing a map session. Make sure to raise the question of confidentiality – Show person the consent form (Pages X-X). Do not read the consent form unless asked. Don't discuss it in detail unless the respondent indicates he or she wants to. If the respondent has concerns take as much time as needed to address them.

Step 10 – Sign Consent Form – Ask respondent to check everything that applies in the consent form and sign it. Fill in the name, PIN, and date. Ask how to spell the person's name if you're not sure. Sign the form and have them sign it. In the unlikely event that he or she refuses, respectfully say that you

cannot carry on with the interview. If the respondent is unable to write their name, as them to make their mark with an “X”. Print the person’s name immediately above the “X” and below it print the words “His Mark” or “Her Mark”. Then sign your name beside it, like this:

Step 11 – Identify Base Maps Needed – Ask the respondent to look at the index map and tell you which maps (A – F) are needed. Write them on the scribble pad. If more than tree maps are identified, as which have been most intensively used over the respondent’s lifetime. Retrieve only those from the set. Never pull four or five maps out all at once.

Step 12 – Set Up Mosaic – Discuss whether the respondent prefers to work with a single base map at a time, or a mosaic made of two sheets. (If you had bigger tables, you could make bigger mosaics.) If they want to work with a mosaic assemble it close to their chair. But make sure it doesn’t overhang the edge of the table. Construct the mosaic one sheet at a time – carefully lining up the edges – and taping each to the table and to each other. Make sure that abutting edges are lined up flush. If the mosaic happens to be set up on more than one table, take special care to prevent the tables from being nudged apart by accident.

Step 13 – Give Respondent a Pencil - Make sure the respondent has a pencil. Explain that you’ll be marking the features in permanent marker pen. Explain that you’ll be asking the person to use the pencil tip to point out the locations of features as carefully as possible.

Step 14 – Check Recording Equipment – After making sure the respondent feels comfortable with starting the interview check the recording equipment.

Turn the mike switch on, and turn the machine's "record" function on. In a normal voice say "Testing one, two, three. Testing one, two, three." Rewind and listen to the playback. If the playback is weak or if you hear static, change the mike battery and repeat. After completing a successful sound test hit the "stop" button. Then hit "record" and begin the interview.

Step 15 – Introduce Session – Start the interview by making the introduction. This should include the interviewer's name, interview date, respondent's name, acknowledgment that he or she signed the consent form, interview location, type of map session, other interviewers present, other adults present, and the medium on which data will be marked. For example,

"My name is Rudy Riedlsperger and today is January 8, 2012. I have just reviewed the consent form with John Doe that he has signed. We're in the town hall conference room in Makkovik, Nunatsiavut. We are here to do a trail use map session. Marilyn Winters is present and will be assisting me. We'll be marking data on 1:250,000 scale standard base maps. We'll be starting with tow sheets: C and D."

Step 16 – Administer Interview questions - Turn to the interview questions (Page 19). Administer it.

Step 17 – Verbally Anchor Data – You must verbally anchor every feature you mark. Read the feature's code out loud, as you're marking it on the map. Consistently using verbal anchors is very important. (See item 9 on Page 29)

Step 18 – Use Codepiece – Move the codepiece every single time you mark a feature code on a map. (See Item 3 on Page 25)

Step 19 – Use Scribble Pad – The pad already shows a record of the starting code number (Step 6) and the base maps identified by the respondent (Step 11). Use it to keep track of loose ends – items you'll want to come back to later in the interview.

Step 20 – Double-Check Recording Equipment - Each and every time you turn off the audio recorder or replace the memory card, check the recording equipment. "Testing one, two, three."

Step 23 – Introduce Each Audio File – Each time you insert a new memory card or start a new audio file, make a one-sentence introduction. (This is not needed for the start of the first audio file. See Step 15.) Specify audio file number, interview type, respondent and date. For example,

"This is the beginning of the 3rd audio file of a trail-use map session with John Doe on January 8, 2012."

Step 24 – Record Last Code-Sequence Number – When it's been decided to end the session, the codepiece will be left standing beside the last (highest) code number that was used. Write that number on the scribble pad.

Step 25 – Check Data Along Map Edges – Check all polygon or line features that cross from the edge of one map sheet onto another. Place the two maps together when you do this. Make sure polygons and lines line up correctly.

Step 26 – Ask if Respondent Ever Travelled out on the Land – Ask whether respondent ever travelled out on the land. Ask him to name any living community members he travelled with. Write that information on your scribble pad.

Step 27 – Close Interview – Close the interview by repeating the same basic information you provided when introducing it (Step 15). Make sure to list all maps for which data were marked. If other adults joined the session, specify who they were and what role they played. For example:

"My name is Rudy Riedlsperger and today is January 8, 2012. We're in the town hall conference room in Makkovik, Nunatsiavut. We've just completed a trail-use map session with John Doe. Marilyn Winters assisted. Jane Doe joined us late in the session for a few minutes, and helped locate traditional trail TTU001. We marked data on two 1:250,000-scale standard paper base maps: Sheets A and C."

Step 28 – Date and Sign Maps – Date and sign each map on which data were marked. Do this on some part of the map not displaying data. Have the respondent and other adults present also sign each map.

"The last thing we are going to do is date and sign the maps. I'm writing the date – January 8, 2012 – and signing my name – Rudy Riedlsperger – near the date, on each of these two maps. And now I'm asking you John, and you Marilyn, to also sign each map anywhere near where I've written the date."

If the respondent cannot sign their name, ask them to make their mark (Step 10). After everybody's finished, check that each has signed the maps. Circle the date and signatures on each map with a medium-nib pen.

Step 29 – Fill Out Honorarium Form – Fill in the person's name, PIN, number of hours and dollar amount. Date and sign the form, and have the respondent sign it.

Step 30 – Turn Off Recording Equipment – When switching off the audio recorder, don't forget to switch off the microphone.

CLEANING UP AFTER THE INTERVIEW

(After respondent leaves)

Step 31 – Print Name and PIN on Maps – Print the respondent's name and PIN on each map, on the appropriate lines in the map's bottom margin. (The lead interviewer also prints his or her name on the "interviewer" line.) Spell the name correctly and don't use nicknames. Print – don't write – and make the characters at least an inch high. Use upper case. Use the medium-nib pen.

Step 32 – Print Date on Maps – Print the date on each map, on the appropriate line in the map's bottom margin. Using the medium pen, print in the upper case, inch-high letters. Print either the full name or abbreviation for month - do not use a number to represent a month.

Step 33 – Print PIN Again on Maps – Print on PIN once more, this time in large characters, somewhere on the map that doesn't display UOM data. Using the medium pen, print in upper case, 4-inch high characters.

Step 34 – Print Map-Sequence Number on Maps – Print a map-sequence number on the appropriate line in the map's bottom margin. Start with "BIOMAP 1." It doesn't matter which map gets which sequence number. Indicate the assigned map number and also the number of maps in the set. For example, "BIOMAP 1 of 2" or "BIOMAP 2 of 2". Using the medium pen, print in upper case, inch-high characters.

Step 35 – Transfer audio files to laptop- Transfer the audio files to a laptop or computer and label them. Each label must indicate 6 pieces of information: respondent's name, PIN, project acronym ("TCM"), date, indicating total number of audio files. (See Item 6 on Page X.) BURN THE AUDIO FILES ON

A BLANK CD OR DVD. Label the blank CD or DVD accordingly. Use a new CD or DVD for every participant.

Step 36 – Fill Out Interview Record Form – Make an official record of the interview by filling in an interview record form (Page 38). All fields must be filled. Don't forget to transfer both the lowest and highest code numbers from the scribble pad (Steps 6 and 24) to the form.

Step 37 – Double-Check Labels and Interview Record Form – Check to ensure all maps and audio files are labeled correctly. Make sure your interview record from is complete and consistent with what you see on the maps and audio file labels.

INTERVIEW-PROCEDURE CHECKLIST

The list starting on the next page contains 37 items. Each of them corresponds to a step that's described in the "Interview Procedure" section (Pages 4-12) of this manual.

Start every interview with a fresh photocopy of the interview-procedure checklist. Using a pen, check off the items as you do them.

INTERVIEW-PROCEDURE CHECKLIST

SETTING UP THE INTERVIEW (BEFORE PERSON ARRIVES)

1) Put Base Maps in Order (Page 4) □

2) Set up Recording Equipment (Page 4) □

3) Organize Rest of Toolkit (Page 4) □

4) Organize Interview Space (Page 5) □

5) Note Starting Code-Sequence Number (Page 5) □

6) Assign Respondent a PIN (Page 6) □

CONDUCTING INTERVIEW (AFTER PERSON ARRIVES)

7) Review Honorarium Form (Page 6) □

8) Discuss Consent Form (Page 6) □

9) Sign Consent Form (Page 6) □

10) Identify Base Maps Needed (Page 6) □

11) Set Up Mosaic (Page 7) □

12) Give Respondent A Pencil to Use as Pointer (Page 7) □

13) Check Recording Equipment (Page 7) □

14) Introduce Session (Page 7) □

15) Administer Interview questions (Page 8) □
(Interview questions starts on Page 19)

16)(Remember) Verbally Anchor Data (Page 8) □

17)(Remember) Use Codepiece (Page 8) □

18)(Remember) Use Scribble Pad (Page 8) □

19)(Remember) Double-Check Recording Equipment (Page 8) □

20)(Remember) Introduce Each audio file (Page 8) □

21) Record Last Code-Sequence Number (Page 9) □

22) Check Data Along Map Edges (Page 9) □

23) Ask If Respondent Ever Travelled Out On The Land (Page 9) □

24) Close Interview (Page 9) □

25) Date and Sign Maps (Page 9) □

26) Fill Out and Sign Honorarium Forms (Page 9) □

27) Turn Off Recording Equipment (Page 9)

CLEANING UP AFTER INTERVIEW (AFTER PERSON LEAVES)

28) Print Name and PIN on Maps (Page 10) □

29) Print Date on Maps (Page 10) □

30) Print PIN Again on Maps (Page 10) □

31) Print Map-Sequence Number on Maps (Page 14) □

32)Transfer audio files to laptop, label and burn them on CD (Page 14) □

33) Fill Out Interview Record Form (Page 14) □

34) Double-Check Labels and Record Form (Page 15) □

USING YOUR INTERVIEW QUESTIONS

1) The interview questions has four (4) parts.

Part	Topic
1	TRAVEL ROUTES – what routes are being travelled and why
2	TRAIL CONDITIONS AND HAZARDS – what is the condition of the mapped trails and what are the travel dangers
3	CONSEQUENCES OF CHANGES IN TRAILS AND TRAIL USE – on livelihood and wellbeing during the lifetime of participant
4	BIOGRAPHICAL INFORMATION – about respondent

2) Start every interview with Part 1 of the interview questions. Do the four parts in sequence – 1, 2, 3, and 4 – if possible.

3) All respondents are to respond to all four parts of the interview questions. *A map biography is completed once the respondent has been asked all of the 28 questions in the interview questions.* It is better to spread the map biography over two interviews than to try and cram it all in one session if the respondent is getting tired or cranky. We're after quality information. Never rush. When administrating the interview questions, you need to be attentive to everything said. You can come across as pretty disrespectful – not to mention silly – if you don't pay attention. Good interviewing takes concentration. If you get too tired to focus, take a break.

4) The purpose of Part 1 is to map travel routes the interview participant is using, and the reasons for why the interview participant is using these routes (for example: hunting purposes, recreation, travelling to visit other communities etc.). We are also interested in learning about the

modes of transportation as well as how long (and at what time of the year) the travel routes have been used. If an interview participant has travelled too many routes to map, ask for the most important routes, i.e. the routes most travelled. You can also ask the participant about the first route travelled that he or she can remember, as well as the last route travelled. Trails that the participants have knowledge about but have not travelled themselves can be mapped as well! Never ask for "all" travel routes. When you sense response burden, your job is to make the respondent's job easier. For instance, if the respondent replies, "Everywhere", you can say, "Show me just *some* of the trails." If he comes back with "Like everywhere in this region," you can make it easer with, "Show me *three* trails along this section you know you have travelled." If he then says, "It's hard to know because I have travelled everywhere along there," you can make it still easier by responding, "Show me three *approximate* places – we can mark them 'approximate." (Item 29 on Page 44).

5) The purpose of Part 2 is to learn about travel conditions and travel dangers participants are or have been encountering on the routes that we have just mapped, or travel dangers they know about in routes they are not using themselves. We are interested in understanding the risk perceptions of the interview participants, and whether or not these perceptions have changed during the interview participant's lifetime.

6) The purpose of Part 3 is to learn more about the significance of trails and travelling for the interview participant's personal life. Participants are asked to reflect about the impacts changes in trails have on their livelihoods.

7) The purpose of Part 4 is to gather basic biographical information from the interview participant.

8) When starting Part 1, *read* the introductory paragraph (Page 19) to the respondent. It explains what it is we want them to indicate. After you've done enough interviews that you know the paragraph well, you can use your own words. Make sure the content is conveyed to each and every respondent.

9) Sometimes you'll see information placed inside boxes.

Information inside a box like this is a reminder for you, the interviewer. Read the content quietly, to yourself. Do not read it to the respondent.

10) Every time you mark a feature you must verbally anchor it. (Item 9 on page 29). This is *critical.*

INTERVIEW QUESTIONS

Introduce Session: "My name is _____ and today is _____, 2012.
I have just reviewed the consent form with _____ that s/he has signed.
We're in the _____ in Makkovik, Nunatsiavut to do a trail use map session.
Other interviewers who are present and assisting are/is _____. Observing the session are/is _____.
Data will be marked on 1:250,000-scale standard paper base maps. We'll be starting with map sheets _____."

PART 1

Thank you very much for participating in this interview. I am now going to ask questions about where you traveled on the land, why you traveled on the land, and what mode of transportation you used. For this part of the interview we want to map only places where you have traveled yourself, either alone or with other people. Of the maps on the wall, please pick up to three, depending on what areas you travel most.

Travel routes are only mapped as lines, not points or polygons.

1) **Why do you go out on the land, in other words, what kind of activities are you engaged in when you go out on the land?**

2) **Please take your time and indicate the areas that are important for you for subsistence activities during the winter time such as hunting, ice-fishing, collecting firewood, but also sacred sites or sites that are**

used for recreational activities. If there are too many such sites, please pick the ones that are most important for you.

3) **Now, please take your time and indicate what routes you have to take to get to the subsistence areas you have identified.**

4) *Follow up in case participant has not indicated mode of transportation:* **What modes of transportation did you use to travel the trails we have mapped so far?** *(Be sure the participant has a chance to list mode of transportations himself/herself. If they mention some of these you can then list the rest and ask if they ever travel using these modes:)* Have you travelled ON FOOT or by SNOWSHOE; SKIS; SNOWMOBILE; DOGSLED; ATV; PICK UP TRUCK OR CAR; BOAT; KAYAK; CANOE; SEA-DOO; or OTHER (please indicate).

5) *Follow up in case participant has not indicated the use for a subsistence area (has not specified what subsistence activity he or she is engaged in) or the use for a trail*: **Of the trails that we have mapped, can you tell me why you were using them? In other words, what are you doing out on the land?** (*Be sure the participant has a chance to list the purpose of the trails himself/herself. If they mention some of these you can then list the rest and ask if they apply.)* Have you used them to VISIT OTHER COMMUNITIES, FAMILY, RELATIVES OR FRIENDS; ACESS CABINS or have you used them to go FISHING; ICE-FISHING; HUNTING; COLLECTING FIREWOOD; PICKING EGGS; PICKING BERRIES; ACCESSING SPIRITUAL/SACRED SITES; for RECREATIONAL PURPOSES; or OTHER (please indicate).

6) **Now that we have mapped those routes, I would like to ask more detailed questions about the trails that we have mapped. Can you tell**

me how many years you have been using those trails? Can you tell me how often you use these trails per year?

7) **Looking at the winter trails, can you indicate what months of the year (for example: mid-October to late April) you have most often been using those trails?**

8) **Within your lifetime, have there been changes on when winter trails could be used? If so, what do you think was the reason for such variations?**

9) **Do you know of trails that are not being used any longer by yourself and other members of the community? If so, can you indicate them on the map? Why do you think the trails are no longer in use anymore?**

10) *Follow up question if participant knows trails that are not being used any longer:* **Do you know approximately since what year the trails are not in use anymore? Do you know approximately through what years the trail was used most often?**

11) **Can you describe how you came to learn about the trails that we have mapped?**

12) *Follow up if participant did not mention it:* **How are younger people in the community learning about travel routes today?**

PART 2

I would now like to ask questions about the conditions of the trails we have mapped and about travel safety. I am interested in learning which travel routes are considered safe, and which are considered dangerous, and if that changes depending of the time of year.

13) **Of the trails that we have mapped, are there some that are more difficult to travel than others? If so, can you point out the trails and talk a little bit about what it is like to travel along these routes?**

14) Follow up if participant did not mention it: **Let us look at winter trails here on the map that go over lake/sea ice. Can you talk a little bit about travelling on the lake/sea ice? Do you consider travelling on lake/sea ice dangerous? If so, why?**

15) **Has travelling on the lake/sea ice changed during your lifetime? If so, how?**

15) Follow up if participant did not mention it: **Let us look at land based winter trails here on the map. Can you talk a little bit about travelling on the land in the winter? What do you have to be careful about when travelling on land based trails in the winter?**

16) Has travelling on the land during the winter time changed during your lifetime? If so, how?

16) **Have you ever been unable to travel the trails we have mapped for any reason? If so, can you show some spots? What were the reasons? At approximately what month of the year did that happen?** *Be sure the*

participant has a chance to list reasons himself/herself. If they mention some of these you can then list the rest and ask if they apply.) Have you ever been unable to travel because the ICE WAS TOO THIN; ICE WAS OF POOR QUALITY; NOT ENOUGH SNOW TO TRAVEL; TOO MUCH SNOW TO TRAVEL; AVALANCHE DANGER; DANGER OF MUDSLIDES; DANGER OF ROCKFALL; UNSTABLE GROUND; WIND TO STRONG TO TRAVEL; TOO COLD TO TRAVEL; TOO HOT TO TRAVEL; OTHER (please indicate).

17) **Did you ever get stuck while travelling due to weather? If so, can you indicate where you got stuck? When did you get stuck? How long did you get stuck there? How did you get out?**

18) **Are there certain areas around Makkovik/Postville where travelling to and fro is considered more dangerous than other areas? If so, can you show some spots? Why are these areas considered dangerous?**

19) **Are there certain areas around Makkovik/Postville that you think might become more difficult to reach in the future? If so, can you indicate the spots?**

20) **Of all the trails we have mapped so far, are there some that are usually in better shape than others? If so, which ones? Why do you think that's the case?**

PART 3

I am now interested in learning more about how important trails and travelling are for your personal life.

21) **Let us look at some of the trails we have mapped. If these trails were not to exist, would this impact your life in some way? If so, how?**

Consider these prompts:

a. **Have you ever had to buy more store bought foods because using the trails to access hunting grounds or berry sites was impossible? When did this happen? What did this mean for you?**
b. **Have you ever had to purchase more heating fuel because you couldn't use trails to access firewood? When did this happen? What did this mean for you?**
c. **Are you spending the same amount of money, more money, or less money on travelling (gasoline etc.) now than 10 years ago? What do you think are the reasons for this? (**Did you need to use longer travel routes to get to a certain point because the original route was inaccessible?)
d. **Has it ever been impossible for you to visit family, relatives and friends because trails were inaccessible? When did this happen? What did this mean to you?**

22) **Do you think the importance of travelling has changed for you compared to your parents? Would you say travelling is more or less important now? Why? How do you think the situation might look like 10 or 20 years from now?**

PART 4

23) What is your birth date?

24) Where were you born?

25) Since when do you live in Makkovik/Postville?

CLOSE SESSION: "My name is _____ and today is _____, 2012. We're here in the _____ building in Makkovik, Nunatsiavut, and we've just finished a trail map session with _____. Other interviewers who assisted me are/is _____. Other people who sat in as observers are/is _____. Data were marked on the following 1:250,000-scale customized paper base maps: _____."

Date & Sign Maps: "The last thing we are going to do is date and sign the maps. I'm writing the date, _____, and also signing my name near the date, on each of these maps. And now I'm asking all the adults present – including the respondent, other interviewers and observers – to also sign each map anywhere near where I've written the date and signed my name."

GUIDELINES FOR CODING AND MARKING DATA

FEATURE CODES

1) Each feature must be identified by a code. The code is made up of two parts. The first is a pair of upper case letters representing the interview questions category. The second is a number that indicates where the feature fits in the sequence of data marking.

2) The code sequence for each interview ascends, starting with number "1". (This is not the case for follow-up interviews. See Item 6 below.) The sequence follows the ascending order that features are mapped, regardless of whether you're jumping back and forth between interview questions categories, or back and forth between base maps, or between points, lines and polygons. The first feature marked during an interview is number one (example, "SS1"). The second feature indicated is two ("SS2"). The third is three ("SS3"), fourth is four ("CS4"), fifth is five ("SS5"), and so on.

3) There cannot be – for any given respondent – duplicate sequence numbers. For instance, the same person's maps should never display two "CM 14"s, or a "CM27" and a "PS27." Ideally, if 194 features are mapped during an interview the sequence would go from 1 to 194. (But we would not worry if it didn't). Get in the habit of using your codepiece. Every time you mark a feature code place the codepiece beside it. This will make it easy to keep track of the latest sequence number used. If you forget to sue the codepiece and find you've lost track of the last assigned number, don't worry about trying to determine precisely what it was. Simply skip ahead a few to a number that you know for sure is not

a duplicate. It is OK to have breaks in sequence continuity, but not duplicate code numbers.

4) The code is always attached to the feature with a line called a leader. (Do not create floating codes). The feature, its code and its leader are always marked in the same color ink.

5) Whenever you code a line feature you must underline the code. This lets the digitizers know that the feature is a line and not a polygon. Usually this is obvious but not always. Sometimes a line feature joins back on itself, in which case it's not clear whether it's a line or a polygon. Perhaps a respondent indicates she has travelled all along a trail that loops back on itself. The absence or presence of the oval tells the digitizer how to process the feature.

[line feature] [polygon feature]

6) If you go back to the same respondent to do a second interview – a follow-up session – you must pay attention to the last code number assigned. These will be recorded on the interview record form (Page 38). (Also, Rudy will have a master list of respondents, PINs, and last-assigned feature numbers.) Start the follow-up interview with the next available 3-digit "tens value" +1. For instance, if the last feature number

assigned during John Doe's 1st interview were 75, the first number assigned during his 2nd session would be 80 + 1 = 81.

7) Sometimes a mapped point feature represents more than one interview questions category. For instance, the respondent might have encountered "avalanche danger (AD)" and "poor snow conditions (PS)" at the same site. All such features require multiple codes. *The number of codes must match the number of categories.*

A variety of leader configuration can be used. When possible use a single leader and a string of codes, with each separated by comma. Having options provides flexibility that minimizes crowding.

The avalanche danger site shown in the example above was the interview's 26th coded item, while the poor snow site was the 27th. Then numerous other sites were mapped and coded prior to returning to the feature "AD26-PS27", to add the 42nd code for not enough snow.

8) Sometimes mapped polygon or line feature represents more than one interview questions category. An example below represents a trail that has been travelled both by “dog sled (DS)” as well as by “snowmobile (SM)”. A few of the possible leader configurations are shown. The features, and their respective codes and leaders are always the same color.

VERBAL ANCHORING

9) Every time you mark a feature on a map you must verbally anchor it. This means speaking the code out loud as you mark it. As your pen is actually laying down the line of ink for “AD26,” the words “avalanche danger twenty-six” should be passing your lips. Speak clearly and in a normal voice when you anchor your sites. Don’t mumble, and don’t drop your voice as you do it.

MORE BASICS

10) Each feature marked on a map will take one of three forms: point, line or polygon (area)

11) Each polygon must be completely closed. The line forming its boundary must come back on itself, creating a closed loop. If it doesn’t you’ve got tow dangling ends. Sometimes a polygon will end abruptly at the edge of a map sheet, creating dangling ends. Make sure that before the session is over you take out the adjoining map and complete the polygon.

12) Make sure that any polygon or line that covers parts of two or more base maps lines up at the map edges correctly. Make sure the feature is coded the same on all maps on which a portion of it is drawn. If a polygon or line covers parts of two sheets, the same code should appear twice, once on each sheet. If it covers parts of three maps, it should appear three times.

CLARITY – LEGIBILITY

Each of the dozens or hundreds of codes you mark during a map biography has to be readable at a glance. This is guaranteed if you acquire the following five habits:

13) Print all letters. Do not write.

14) Use only upper case capital letters. No lower case.

15) Make sure you can see “daylight” in the loop of your letters (B, D, R and so on). This ensures that your codes are printed large enough.

16) Be conventional with your printing. Don’t add punctuation or make it fancy with mysterious loops and wild flourishes. No extra markings.

17) Use pens that are in good shape. Permanent marker pens with fine nibs are the only acceptable instruments when it comes to marking data. When a nib starts to flatten from overuse or the pen begins to run out of ink, discard it.

CLARITY – COLOR

In our system, color is used only to enhance clarity. Color does *not* signify any particular interview questions category. Three conventions guide the use of color.

18) Make sure each feature and its code and leader are the same color.

19) Take advantage of the four pen colors included in your toolkit. Whenever a portion of your map starts to get the slightest bit busy or crowded, switch color. Variety makes a tremendous difference in readability, especially in areas where there are clusters of data.

20) Make sure overlapping polygons and lines that cross are different colors.

CLARITY – LEADERS

21) Mark leaders neatly. Attach them to features in a consistent, crisp manner. Each leader should connect to – actually touch – the feature; don't leave gaps. There should, however, be small gap between the other end of the leader and the code.

22) Avoid crossing leaders. If you find it necessary to draw a leader across another one, make sure they're different colors.

23) When marking data along the base map's linear features – rivers, shorelines, roads, and so on – mark the leaders perpendicular (right angles) to the linear features.

24) Make each leader an appropriate length. This varies, depending on how much data you've already marked. Leaders can be too short and they can be too long. Sometimes it's OK to use a really long leader. The right length for a leader is one that minimizes clutter.

CLARITY – SECOND MAP

It sometimes happens that clarity of mapped data is inadequate even after careful use of the conventions governing legibility, use of color, and leader placement. At some point it can become difficult to read the information due, simply, to the quantity of data. It's important to develop a sense of when you're approaching that point, and to do something about it *before* you get there.

25) That "something" is to recognize the map you've been using with a clean one. It's OK, if necessary, to even use a third map.

ACCURACY

26) You should be the person marking the data on the maps. It's good for the respondent to have a pencil in hand, so that he or she can point out locations of features as precisely as possible. The respondent doesn't mark data.

27) Make sure the *respondent* indicates – and not just nominally – the location and extent of sites. Have him or her indicate sites using a pencil as pointer, and show you the perimeter of polygons. Ask questions: "What *part* of the trail have you encountered poor snow conditions?" Do not whip off polygons carelessly. Base them on the respondent's information, not your assumptions. What you've marked

should make sense to you. Don't settle for things like cabins in the middle of lakes or burial grounds on the sides of cliffs. If something doesn't make sense, ask questions until either it does, or the location is revised.

28) Make sure that sites with multiple codes – especially polygons – are valid. Let's say the respondent points out a site prone to avalanches "AD43." When you get to the travel danger category she indicates the same site as "poor snow conditions (PS45)". Still later, responding to your question about getting stuck while travelling, the respondent says, "Same place as those other two" and you cold it "GS54."

    Unskilled interviewers might make unwarranted assumptions, and mark the three sites like this:

    The above is an example of interviewer bias. (It would *not* be interviewer bias *if* the respondent had clearly specified she'd collected all three categories over the exact same area.) Usually, an accurate depiction would show overlapping polygons, perhaps as seen below. It's your job to be as accurate as you can.

29) Use the “approximate convention” – add a capital “A” to the end of the code – to indicate locations the respondent is unsure about. Use it when the person either cannot point to the site or, if a polygon’s involved, cannot show you its perimeter. This convention is used to indicate that the respondent is confident the site is in the general vicinity, but not necessarily at the precise spot marked.

30) Pay attention to the interview questions specifications that tell you a particular category must be marked as a point, or whether it can be marked as a point, line or polygon (Item 5 on Page 25)

LARGE POLYGONS

31) You shouldn’t mark any large polygons.

CATCH-ALLS

32) There are 4 interview questions categories (Items 3 and 12, Pages XX and XX). The categories are used throughout the interview questions. They’re all listed on Pages 19-24. On Page XX you’ll also see the catch-all codes listed below. Think of the “X” as standing for “eXtra,” or “other.”

XD other travel danger
XM other mode of transportation

A catch-all hast two uses. First, it is used when none of the existing categories apply. For instance, if a respondent indicates a site where he had encountered a black bear and did not feel safe to continue on the trail, code it as “XD.” “Black bears” are not covered by any of the interview questions travel danger categories. The “XD” catch-all allows you to map the site. If somebody shows you a site where he travelled by cross-country skis, you’d mark “XM.”

Second, catch-alls allow you to map sites in instances where the respondent can’t remember – or simply doesn’t specify – the type of resource in question. If, for instance, the person indicates a trail he used to travel but can’t remember the mode of transportation, code it “XM.” In this case “XM” stands for “unidentified mode of transportation.”
Correct use of the catch-alls means you won’t have to create any new categories. It’s important to make a note of every catch-all use, on your scribble pad. Indicate not only the code (example, “XD65”) but also specify what it is (for example, “Unidentified travel danger”.) This information gets transferred to the interview record form (Page 38) after the session is over.

INFORMATION NOT ASKED FOR

33) Sometimes the respondent will volunteer information that the interview questions does not ask for. For instance, when asked about travel dangers on a specific trail, the respondent might mention details regarding gear lost in a snowmobile through ice accident or injuries sustained because of the danger. Do not ask for this extra information, and do not mark any of it on the map. But make sure to verbally anchor it to the code in question.

CORRECTING MISTAKES

34) If you make any kind of mistake when marking data – or any revision is needed – simply cover the error with diagonal hatching. Do this using a color that's *different* than that of the original. Then add the correction or amendment using the same color as the original.

CATEGORY CODES

TRAIL USE CATEGORIES*	**MODES OF TRANSPORTATION**
HT winter hunting trail	SM snowmobile
FWT trails to collect firewood	DS dogsled
CAT cabin access trails	SS snowshoe
IFT ice-fishing trail	SK skis
RT winter recreational trail	OF on foot
CT trail connecting communities	XMT other mode of transportation
ST snowshoe trail	
AWT abandoned winter trail	
XWT other winter trail	

* If trail use category has the suffix 'G' (for example: HTG) it means that this trail is groomed

SUBSISTENCE AREA CATEGORIES	**TRAIL CONDITIONS**
PHA partridge hunting area	GGC (generally good conditions)
CHA caribou hunting area	GCW (good conditions only in cold
SHA seal hunting area	winters)
IFA ice fishing area	GPC (generally poor conditions)

FWA firewood area
SSA sacred site area
RA recreational area
XHA other hunting area (specify in brackets)

TRAVEL DANGERS

DI dangerous spot/area on ice
DL dangerous spot/area inland
SB snowmobile breakdown
FCO forced to camp overnight
XTD other travel danger

REASONS FOR TRAILS NO LONGER IN USE

RAC changes in resource availability
ECC changes in environmental conditions
PR personal reasons
ER economic reasons (gasoline prices too high etc).
XRC other reasons for change

AREA CODES

SA safe area (mark green; summarize why area is considered safe in own words)
DA dangerous area (mark red; summarize why area is considered safe in own words)

COLOR CODES
BLACK trails in use
BLUE trails no longer in use
RED travel danger

GREEN trail conditions

INTERVIEW RECORD FORM

1) Interview date _____ 2) PIN_____

3) Respondent name _____4) Spelled □Correctly□Unsure

5) Interview location: Community_____
Building_____

6) Lead interviewer_____ 7) Other interviewers_____ □ None

8) Observers _____ □ None 9) Consent form □Y □N □Before

10) Audio files used (circle) 1 2 3 4 5 6 7 8 9 10 11) Duration ____min

12) Maps used (circle): A B C D E F G H I J = _____ (total number of maps)

13) Map biography completed □Y □N 14) Parts or items NOT done? _____(back of form if needed) □N.A.

15) Departures from standard methodology? □Y □N If 'yes,' specify

_____
____(back)

16)Comments_____
_____
_____(back) □None

17) Use any catch-all codes □Y □N If 'yes,' list them and specify what they
were_____
_____(back)

18) 1st & last code numbers _____ - _____

19) Interviewer signature _____

USING THE INTERVIEW RECORD FORM

The Interview Record form (Page 38) is a simple one-pager. The forms are very important.
Carefully fill out one o these forms immediately after each interview. And be sure to fill out every one of the 19 fields – put pen to paper for each field, even if it is simply to indicate "not applicable." The form is designed to let you do your record keeping quickly and efficiently.

Basic rules when filling out the forms:

 Fill out the form right after the interview is finished.

 No guessing – the information you enter has to be correct.

 Make sure you respond to all 19 fields.

 Y= Yes N=No N.A. = Not applicable

 Make sure everything on the form is easy to read. Print the information. Don't write. Use ink not pencil.

 Treat completed forms as carefully as maps and tapes.

 Any abbreviations used on the forms must appear in the "abbreviations" section (Page X)

The Interview Record Form (IRF) has the following 19 fields

1) *Interview date:* Print the month (e.g. "January") or it's abbreviation (e.g. "Jan."). Do not represent month with a number. Example: "January 4/04," not "1/4/04."
2) *PIN*, or Participant (respondent) Identity Number.

3) *Respondent name.* Use the person's real name. Don't use nicknames.

4) *Spelled.* Make sure the respondent's name is spelled correctly. If you're not sure about it ask the person.

5) *Interview location*. Record the name of the community (abbreviations will do) where the interview takes place. Also record the building. It's OK to sue abbreviations for buildings, as long as they appear in the "abbreviations" section of the manual.

6) *Lead interviewer.* Enter the name or initials of the person who was lead interviewer (Item 5 on Page 2).

7) *Other interviewers.* Enter the name or initials of other interviewers who were present at the session. Check off the "none" box if there were no other interviewers present.

8) *Observers*: Enter the names of any other adults who were present and observing the interviews. Check off the "none" box if there were no observers.

9) *Consent form?* Check off the "Y" box if a consent form was filled out and signed at this session. This should be a "yes" unless the respondent had already done an interview – in which case he or she would have signed the form at the initial session. The respondent only needs to sign one consent form – follow up sessions do not require additional forms. You'd check off the "No" box only if you forgot to have the form filled out and signed.

10) *Audio files used*. Circle the number of audio files used.

11) *Duration.* Note the (combined) duration of the audio files.

12) *Sheets used (and number of each).* The six base maps – A, B, C, D, E, and F – are listed. Enter the number of "new" map sheets on which you marked data during this session. "New" means you hadn't marked any data on the map in question in a previous interview. (This assumes the current session is a follow-up). If, during a follow up interview, you mark some data on the respondent's maps – let's say Map C – used at his or her previous session, you would *not* account for that particular map

sheet in Field 12. Because that sheet was already accounted for on the IRF from the initial interview. (You would, however, make a note in Field 15, “Marked some of today’s data on Map C used during respondent’s first session.”) Add up the numbers in brackets and enter the value for “TOTAL” number of sheets used.

13) *Map biography completed?* Completing the biography means that you have systematically gone through all interview questions categories for all the map sheets in question. Check off the “Y” box if you have completed it, the “N” box if you haven’t.

14) *Parts or items NOT done?* If you checked the “N” box in Field 13, then you must indicate which part of the interview questions was not completed. Be as specific as you can. Indicate which interview questions parts (1 to 5) or which items were not covered. Sometimes you’ll have to specify which of the base maps used during the session haven’t been finished with.

15) *Departures form standard methodology?* The data-collection manual is your standard methodology. Any changes or departures from the methodology need to be recorded in this field. For instance, if you forgot to have the respondent sign each base map you need to mention it here. Another example is if you paused the recorder for some reason and forgot to start it again after the interview had resumed, you would make a note in Field 15 – something like “paused recorder for coffee break and forgot to turn it back on, lost about 15 minutes of recording while marking dangers on winter trails.”

16) *Comments.* Make a note about anything significant you observed that would likely have detracted from – lessened or weakened – the quality

of data documented during the interview. The methodology assumes that respondents have some map-reading ability and can see the maps, and also that they're cooperative. In many instances there won't be anything to enter in this field. Examples of appropriate entries are the following:

"Respondent had serious difficulty reading maps."
"Respondent had difficulty seeing the maps, said he forgot to bring eyglasses."
"Respondent almost blind."
"Respondent very hard of hearing and sometimes had a lot of trouble understanding what I was asking him."
"Probable response bias, probably underestimating."
"Probable response bias, probably overestimating."

If you make an entry in the "*Comments*" field about response bias, your entry indicates that you had reason to believe the respondent was either deliberately exaggerating the information he was showing you on the map, or deliberately not showing you information that he could have shown you. (Almost any hunter or fisher could keep showing you more kill sites, but that's not necessarily what we are talking about here). If you sense the respondent has made a conscious decision to keep back a lot of information from his or her map, then make a note about it. The opposite also holds. If you think the person is putting information on the map that you have good reason to suspect is not a valid part of his biography, mention it. "Strategic response bias" is quite rare and you may not run into it at all. But if you do, make an entry about it.

17) *Use any catch-all codes?* If you did use any catch-alls, you'll have written them down on your scribble pad during the interview. (See last

paragraph under Item 32, on Page X.) Transfer the information to this field. List all catch-alls used and specify what each is. Examples: "XD27" Thunderstorm

18) *First and last assigned feature numbers.* Enter the first (lowest) code number used during the interview. Also enter the last (highest) code. You will have recorded these on your scribble pad (Steps 6 and 24 on Pages X, X).

19) *Interview signature*. The lead interviewer signs here.

INDEX FOR BASE MAPS

There are eight (9) 1:250,000-scale paper topographic maps in the set. Each is labeled from "A" to "I". In addition, there is one (1) 1:1,000,000-scale paper topographic map covering all of Labrador labeled "J". Map J is only to be used for orientation and in case the travel routes extend the areas covered by maps A – I.

	A: Nain 14 C	
B: Hopedale 13 N	**C:** Makkovik 13-O	
D: Snegamook Lake 13 K	**E:** Rigolet 13 J	**F:** Groswater Bay 13-I
G: Goose Bay 13 F	**H:** Lake Melville 13 G	**I:** Cartwright 13 H & 3 E

J: Labrador GNL3

CONTACT INFORMATION

Contact one of the following people if you have any questions or concerns related to this data-collection manual specifically or the research in general:

Rudy Riedlsperger
Geography graduate student/MUN and Principal Researcher
r.riedlsperger@mun.ca
(709) 746-0159
Memorial University of Newfoundland
St. John's, Newfoundland, A1B 3X9
Office: SN 2005

Dr. Trevor Bell
Professor/MUN Geography
t.bell@mun.ca
(709) 864-2525
Memorial University of Newfoundland
St. John's, Newfoundland, A1B 3X9
Office: SN 1042

Dr. Johanna Wolf
Postdoctoral fellow/Labrador Institute
jwolf@mun.ca
Labrador Institute of Memorial University
219 Hamilton River Road
P.O. Box 490, Stn. B
Happy Valley-Goose Bay, NL A0P 1E0

APPENDIX C: Flyer

Dear community member,

My name is Rudy Riedlsperger and I am a graduate student in Geography at Memorial University. I am here in Postville because I want to learn about different trails (for example winter and summer trails to access hunting grounds) and trail use. I am interested in finding out why trails are important for you. What are trails used for in Postville? Where do they go? Are there different trails for different seasons?

If you have something to share about trails, please don't hesitate to contact me.

My e-mail address is r.riedlsperger@mun.ca and you can reach me at **709-746-0159** (after June 17). Or, simply 'like' my Facebook page 'Trails in Postville'!

Change Detection in Winter Trail Use: A Map Biography Approach

R. Riedlsperger[1], T. Bell[1], J. Finnis[1], J. Wolf[2]
[1]Memorial University, St. John's, Canada; [2]Labrador Institute of Memorial University, Happy Valley-Goose Bay, Canada

inter trail use in Makkovik, Nunatsiavut

(1)(2) Snowmobile parade to mark the 100th day of the school year in Makkovik. The community is situated within the Inuit Settlement Region of Nunatsiavut. Map by Charles Conway, Memorial 2012.

on that lacks paved and gravel roads, travelling by snowmobile nain mode of winter transportation. Trails can be groomed, or semi-permanent tracks on the land or lake and sea ice. ake possible travelling back and forth between communities. In the trails are the key that provides access to important nce areas. Activities that depend on trouble-free access to the l ice include hauling firewood, hunting caribou, and ice fishing courtesy of Brent Jacque], **6**). Winter trails therefore are nt for community and individual livelihoods: the ability to "go off" nter heats homes, feeds families, and allows for recreation.

(3) Simple trees mark many sea ice trails. Groomers avoid sea ice because of the risk of breaking through weak or thin ice.

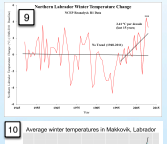
2. The research problem

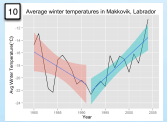
(7) Poor sea ice conditions in Nain impaled travelling during February 2010. Changes in temperature and/or precipitation may impact future travel conditions in the region. Photo courtesy of the Nunatsiavut Government.

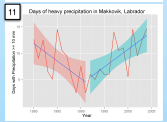
Around 1995 there was a shift from no trend to an increase in average winter temperatures in Labrador (**9**; Kistler et al. 2001). In Makkovik mean winter temperatures (Dec – May) increased by more than 2°C, and the number of days of heavy precipitation more than doubled **(10), (11)**. Labradoreans identified travel and infrastructure safety as an important priority in dealing with the impacts of climate variability and change (CVC; Bell et al. 2008), prompting the key research questions: **1. To what extent CVC in combination with socioeconomic factors affecting winter trails, trail use, and travelling in the Makkovik? 2. How are these changes affecting livelihoods?**

The overarching goal is to help ensure that future generations continue to enjoy unimpeded access to the land and ice.

(8) Due to lack of snow in Forteau in February 20100 trucks were used to haul snowmobiles to patches of snow in order to access the land. Anecdotes of deteriorating winter travel conditions in Labrador are supported by physical measurements.







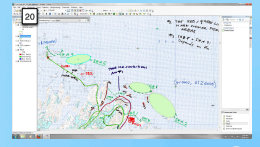
3. The map biography method

A map biography is "an account of a person's life on the land, sea, or ice, as recorded on a map (and audio recording) during a face to face interview" (Tobias 2009). Map biographies allow the visualization of the extent and significance of land use. Secondary purposes include economic planning, natural resource management, and the documentation of history and culture to salvage and reinforce cultural identity (Chapin et al. 2005). Map biographies have been used to show extent and use of winter trails in other parts of Canada (**12**; Tobias 2009).

References:
Bell et al. 2008. Climate Change and Renewable Resources in Labrador. Conference Report. LHRG. Memorial University.
Chapin et al. 2005. Mapping Indigenous Lands. Annual Review of Anthropology. 34: 619-38.
Dunn. 2010. Interviewing. In: Hay, I. (Ed.). Qualitative Research Methods in Human Geography. Oxford University Press.
Tobias, T. 2009. Living Proof. Ecotrust Canada.

he map biography application in Makkovik

1 Community Involvement → 2 Project Planning → 3 Data Collection → 4 Data Analysis → 5 Dissemination



2 Community involvement and project planning

oject was presented to the town council of Makkovik in 011 in part to gain their support **(13)**. Though the h problem was already defined, it was with the help of nity members that research questions were refined and biography approach deemed an appropriate research Makkovik. The town council also helped with finding nodation and workspace, and with the hiring of a h assistant.

(14)(15) Participants at the Labrador Climate Change Conference in North West River in 2008. The needs and concerns of Labrador communities informed this project.

3 Data collection

Data collection took place in January and February 2012. Nineteen community members were interviewed. Map biography participants were chosen based on their experience travelling on the land and sea ice. On 1: 250 000 topographic map overlays they pointed out travel routes for subsistence, travel dangers, environmental conditions, and related changes that have occurred in their lifetime **(16)**. Semi-structured interviews were part of the session. Participants were encouraged to talk about socioeconomic factors, such as the transmission of traditional skills, as well as their values related to living lives that to a significant degree depend on access to the land and ice.

(17) Map biography participants playing traditional Labrador tunes after the interview.

(18) Marilyn Winters (research assistant, left) and local historian Joan Andersen discussing a day's walk

4 Data analysis (in progress)

The map overlays were scanned earlier this month **(19)** and following georeferencing will be digitized **(20)**. The semi-structured interviews are transcribed and organized with NVivo 9 software. The interview data will be subject to manifest (visible, surface content) and latent (themes, implicit meanings) content analysis (see Dunn 2010).

Preliminary observations from the field:

*Negative impacts of CVC have increased in the last ten years
*Loss of traditional skills increases exposure and impairs adaptation
* Short term adaptation is in place, but not comprehensive

5 Dissemination

* The results of this research will be used in the *SakKijânginnatuk Nunalik (Sustainable Communities)* project
* The maps will be accessible through the Nain Research Center, subject to ethics guidelines
* An article is in preparation to be published in a peer-reviewed journal.
* This project is part of an MA in Geography and a journal article is in preparation.

Acknowledgements:
The authors would like to thank the community of Makkovik, the Makkovik Inuit Community Government, the Nunatsiavut Government (Research Advisory Committee), Marilyn Winters and Joan Andersen. The technical support of Scott Hatcher, Robert Way, and Andy Flood is greatly appreciated. Funding for this research was provided by *ArcticNet* and the Provincial Government of Newfoundland and Labrador.