Wemindji Cree Observations and Interpretations of Climate Change: Documenting Vulnerability and Adaptability in the Sub-Arctic

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ABSTRACT

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Andra Leona Syvänen

The effects of climate change in polar regions of the planet are occurring thirty years ahead of predictions, triggering research on recent and likely future impacts on Arctic indigenous peoples and their response. Comparable research in the sub-Arctic is lacking and the relevance of Arctic research methodologies and findings to the sub-Arctic has not been adequately considered. Drawing on climate change related observations, interpretations, and responses of members of the James Bay Cree community of Wemindji, in northern Québec, this thesis applies established Arctic-based approaches to the study of human impacts and responses to the Wemindji case. The importance of understanding less tangible aspects of climate change, such as those that are tied to local beliefs, taboos, stories and legends, is highlighted confirming that local observations and interpretations of climate change are deeply embedded and implicated in local cosmology. An application of the Community Adaptation and Vulnerability in Arctic Regions (CAVIAR) framework to determine current and future vulnerabilities of the Wemindji community to climate change is also included. Findings suggest further research in the sub-Arctic is needed to capture the complexities of increasing vulnerabilities and support the most relevant policy implications. Overall, climate change entails both challenges and opportunities for the Cree people of Wemindji. The strategies applied by Wemindji in response to these changes can inform the experience of other sub-Arctic indigenous communities, contributing to a future where northern communities are actively engaged in decisions and actions concerning climate change.

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[1] Gibran, Kahlil. (1923). *The Prophet*. New York: Knopf, p.56.

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LIST OF ACRONYMS

AANDC: Aboriginal Affairs and Northern Development Canada (formerly Indian and Northern Affairs Canada, INAC)

ACIA: Arctic Climate Impact Assessment

CAVIAR: Community Adaptation and Vulnerability in Arctic Regions

CBPR: Community-based Participatory Research

CCS: Climate Change-integrated Conservation Strategies

CIER: Center for Indigenous Environmental Resources

CRA: Cree Regional Authority

CTA: Cree Trappers' Association

ENGO: Environmental Non-governmental Organization

ICC: Inuit Circumpolar Council

IK: Indigenous Knowledge

IPCC: Intergovernmental Panel on Climate Change

IUCN: International Union for Conservation of Nature

JBNQA: James Bay Northern Québec Agreement

PA: Protected Area

UNDP: United Nations Development Programme

UNFCCC: United Nations Framework Convention on Climate Change

CHAPTER 1

Introduction

The unprecedented rate of climate change in circum-polar regions is of increasing concern. Specifically, evidence suggests that changes in ice-cover in the Arctic are occurring approximately 30 years ahead of previous estimates (Serreze, 2008). These changes and their effects on northern populations have attracted the attention of several large-scale research endeavors, including the Arctic Climate Impact Assessment (ACIA) (Hassol, 2004) and the development of a framework to assess the vulnerability of Arctic communities (Smit, Hovelsrud and Wandel, 2008). These initiatives have documented local manifestations of and responses to climate change, generating a baseline of evidence in support of our understanding of how Arctic regions and indigenous populations there are being affected by climate change.

Observations of climate change by indigenous populations have been documented as part of this research, confirming that northern communities are indeed experiencing unprecedented and unpredictable changes. Despite the richness of these accounts, which tend to focus on tangible aspects of climate change, such as those associated with changes in weather, seasons, plants, animals, and ice, attention to the less tangible dimensions of change and the cultural embeddedness of these observations has been limited. This includes consideration of questions such as: what influence do local cosmologies have on how and why people make the observations they do? Without a clearer understanding of these *in*tangible aspects of indigenous peoples' observations of climate change, there is a risk that the most relevant and appropriate responses won't be identified.

Another important gap in human dimensions of climate change research relates to

the limited attention the sub-Arctic has received relative to research in the Arctic. The assumption that the sub-Arctic is not sufficiently distinct to merit separate attention may be flawed and almost certainly underestimates the potential for climate change to have a major impact on the ecological, socio-economic, and cultural character of the sub-Arctic. The implications of the under-representation of the sub-Arctic region include significant gaps in climate change policy and capacity building in sub-Arctic communities.

This thesis attempts to address both these gaps. A manuscript-based approach is taken which includes two manuscripts (Chapter 2 and Chapter 3), each focused on a case-study exploration of how and why these gaps can and should addressed. Chapter 2 examines how indigenous knowledge (IK) and the taboos, myths, legends and stories unique to an indigenous community contribute to the understanding of the impacts of climate change in sub-Arctic regions and support the capacity of northern indigenous communities to respond to the challenges and opportunities that climate change brings. Chapter 3 includes an application of an Arctic-based research framework for exploring human dimensions of climate change in order to contribute to a more comprehensive picture of the distinctive features of the sub-Arctic experience. The research takes a case-study approach focused on the Cree First Nation of Wemindji, located on the eastern shores of James Bay in the province of Québec (Figure 1). The historical and contemporary context of this community is discussed in Chapter 2, with specific attention to the various social and political actors and institutions that operate within the community.

1.1 Purpose and Objectives

In order to fulfill the goal elucidated above, the primary objective of the research

described within this thesis is to understand how climate change is experienced by members of the Wemindji Cree Nation, and in turn, how the strategies they employ to respond to change and unpredictability contribute to or alleviate their vulnerability in the face of climate change. Fulfilling this objective requires an analysis of the following three questions:

1) What observations and interpretations do Wemindji Cree make in relation to climate change?
2) What coping and adaptive strategies do they employ in response to these changes over both the short- and long-term?
3) What are the community's current and future vulnerabilities to climate change?

Chapter 2 provides a comprehensive account of the observations and interpretations of members of Wemindji First Nation to a changing climate in addition documenting the coping and adaptive strategies they employ. In doing so, it highlights the importance of considering not only the tangible but also the intangible effects of climate change for the identification and support of appropriate responses to change. Chapter 3 describes the application of an Arctic-based approach to vulnerability assessment to the Wemindji case via the Community Adaptation and Vulnerability in Arctic Regions (CAVIAR) framework (Figure 2). In doing so, it highlights the complexity of the social-ecological components of the community's current and future vulnerabilities to climate change, demonstrating that further research into the sub-Arctic is needed to reflect the distinctiveness of indigenous communities' experiences there.

Overall, given the importance of indigenous perspectives to effective climate change policy-decision making, documenting successful adaptive strategies employed at the scale of one small indigenous community underscores the value of indigenous knowledge, the capacity of some communities and the value of place-based responses to

climate change (Berkes and Henley, 1997; Anisimov *et al.*, 2007; Smit, Hovelsrud, Wandel, 2008).

The research approach and theoretical framework that have guided this research will be described more completely in Chapters 2 and 3. However, in short, my research responds to a call to action from several authors (see for example Berkes and Henley, 1997; Hodge and Lester, 2006; Anisimov *et al.*, 2007; Berkes, Kislalioglu-Berkes, and Fast, 2007; Louis, 2007; and Smit, *et al.*, 2010) for more locally-specific, community-based climate change research. It also responds to a need for more sub-Arctic based research (CIER, 2009; Lemieux, *et al*., 2010). As such, this research is collaborative in nature and has relied on recommendations from community members regarding its direction and goals, the importance of which is described further in Chapter 2.

The following section provides a brief review of the primary literature from which this research draws; additional discussions of the literature are included in the manuscript chapters. Following the literature review, the methodological approach applied in my research is outlined; the methodology is also described in Chapters 2 and 3.

1.2 Literature Review

The literature describing indigenous environmental knowledge is vast. The contribution of this knowledge to sound decision-making concerning natural systems has been noted time and time again (see for example Scott, 1996; Berkes and Henley, 1997; Berkes, Colding, and Folke, 2000; Berkes, 2002; Duerden, 2004; Ford and Smit, 2004; Hassol 2004; Huntington *et al.*, 2004; Berkes, Kislalioglu-Berkes, and Fast, 2007). Several themes within this body of literature have informed my research questions and objectives. These general themes are explored below in order to establish the state of the

research at this point in time as well as to demonstrate the contribution of my research to perceptible gaps within this literature. Chapters 2 and 3 include an additional review of literature that relates more specifically to the questions and themes explored in each manuscript.

In order to situate the aims of this thesis within the greater context of participatory climate change research, the broad theme of indigenous knowledge (IK) is explored. A section highlighting the current IK of climate change in both Wemindji specifically, and other sub-Arctic and Arctic contexts, generally, follows. In addition, a section is devoted to elucidating the concepts of vulnerability and adaptation, as well as describing the CAVIAR framework. Finally, a review of the literature on protected areas (PAs) in the context of climate change highlights the implications that changing climatic conditions may have on the ability of these areas to provide protection to human and natural systems. This literature also speaks to the potential of PAs to reduce the vulnerability of these systems.

1.2.1 Foundations of IK

In recent decades, there has been an increased recognition of the vast wealth and contribution of IK; with that has come a slew of studies, research initiatives, findings, and definitions (see for example Freeman, 1992; Wenzel, 1999; Huntington *et al.*, 2004; Berkes, Kislalioglu-Berkes, and Fast, 2007; and Failing, Gregory, and Harstone, 2007). An analysis of the literature pertaining to the value of IK requires first an exploration of how IK is defined by the fields of cultural anthropology and human geography. Numerous authors have attempted to define IK, yet there is no universally agreed upon definition for the concept (Berkes, 1993). However, it is important that a unified

definition is made explicit prior to further analysis of it; therefore, for the purposes of this research, IK refers to "a cumulative body of knowledge and beliefs, handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment" (Berkes, 1993: 3).

Defining Features

One of the defining features of IK is that it is very deeply rooted in its context (both temporal and spatial) (Agrawal, 1995). It has been argued elsewhere (see for example Berkes, 1993; Agrawal, 1995; Wenzel, 1999, Usher, 2000; Jolly and Berkes, 2001; Gilligan *et al.*, 2006) that knowledge of surrounding environments becomes embedded in the social fiber of a community as IK holders are themselves the main users of the resource and make close observations and acquire knowledge of their environments over extended periods of time; this knowledge is passed down over generations and the community intrinsically tied to its surrounding environment. The importance of this feature of IK, and its implications for responding to climate change, is explored further in Chapters 2 and 3.

According to Berkes (1993), in general, IK is intuitive, holistic, and treats mind and matter as one. IK focuses on the observation of conditions, trends, and variations (in particular unusual or abnormal ones), since these might be the most relevant for safety or survival (Usher, 2000; Huntington *et al*., 2004; Berkes, Kislalioglu Berkes, and Fast, 2007). According to several authors (see for example Berkes, 1993; Agrawal, 1995; Freeman, 1999), rather than concentrating on individual parts of an ecosystem in isolation, IK focuses on the ecosystem as a whole, highlighting the relationships and feedbacks between different components, including humans. The holistic nature of IK

also accounts for its integrated treatment of mind and matter. In this way, interactions between humans are comparable to relations between humans and nonhuman entities, and the identity of the self is closely tied to the rest of the world; according to Folke and Berkes (1995), IK is an integrated system of awareness, observation, *and* belief.

It has been noted elsewhere (see for example Berkes, 1993; Usher, 2000; Peloquin and Berkes, 2009) that IK uses a qualitative approach whereby empirical observations are made and facts are accumulated by trial-and-error, with IK holders hesitant to generalize beyond their own experiences and careful to distinguish their own observations from those of others (Usher, 2000). According to Wenzel (1999), IK is held in the minds and oral traditions of its knowers, and when taken out of context, can lose its meaning and significance. It is for this reason that Wenzel (1999) calls for the respect of the *production* of this knowledge by IK holders if we are to benefit from IK's ability to contribute to non-indigenous understandings of complex ecologies; this view is supported by several authors (see in particular Freeman, 1992; Berkes, 1993; Usher, 2000; Huntington *et al*., 2004; Berkes, Kislalioglu Berkes, and Fast, 2007; Failing, Gregory, and Harstone, 2007).

The potential contributions of IK to reaching a more balanced approach to studying nature are thus significant (Snively and Corsiglia, 2000). Increasing recognition of this is reflected in the amendments made to the Ecuadorian Constitution in 2008 and Bolivia's Law of Mother Earth (2011), which support a more just treatment of nature, based on an acknowledgement of local indigenous belief systems. The Convention on Biological Diversity (1992) represents an international initiative that acknowledges the contribution of IK to the protection of global biodiversity. However significant these

acknowledgements are, more must be done to incorporate spirituality into science, potentially through the contributions of IK (Snively and Corsiglia, 2000).

Several authors have raised concerns and caveats with respect to the incorporation of IK into western scientific approaches, including: highlighting the special roles and responsibilities of those who study, interpret, and report IK, and the importance of getting the informed individual consent of IK holders (Wenzel, 1999; Nadasdy, 2003); the problem of decontextualization and how to address it (Usher, 2000); and importance of feedback and sharing research outputs with informants to ensure that misinterpretation has not occurred.

1.2.2 IK and Climate Change

Northern regions of both Eurasia and North America have been experiencing substantial warming since the early 1970s (Serreze, 2008). The rate of this change is unprecedented and until recently underestimated, with evidence that climate change in arctic regions is occurring 30 years ahead of initial projections (Hassol, 2004; Serreze, 2008). As Serreze (2008: 4) so eloquently states, "the projected future of the Arctic is today". Several authors (see for example Krupnik and Jolly, 2002; Berkes, 2008) argue that the urgency of the observations made with regard to climate change is one motivation behind the growing number of Arctic-based indigenous climate change research projects in recent years. Other reasons for the attention given to Arctic studies of climate change are described in Chapter 2. What follows is a review of the current state of research pertaining to IK of climate change in northern Canada.

The documentation of IK holders' observations and interpretations of climate change spans several regions of the northern Canadian landscape. From Cree and Inuit

populations of the Hudson Bay bioregion (McDonald, Arragutainaq, and Novalinga, 1997), to the Inuvialuit populations of Sachs Harbor on Banks Island in the western Canadian Arctic (Jolly *et al.*, 2002), to Inuit in Arctic Bay, Nunavut (Ford, Community of Arctic Bay, 2006), to the Dené of the Great Slave Lake region of the Northwest Territories (Woo *et al.*, 2007), insights on climate change from IK holders have been gathered. Several volumes, many arising from community-based research projects, are now available on this topic (see for example Krupnik and Jolly, 2002; Riewe and Oakes, 2006). While the findings of each of these various community-specific studies documents place-specific observations, there are several features of these studies and numerous types of observations that are common to most northern indigenous observations of climate change; the latter include categories of sea ice, permafrost, changing seasons, weather, and northern fauna (Jolly and Berkes, 2001). Examples of indigenous observations of each of these components are described below.

Sea Ice

Changes in sea ice have been documented in several studies; Fox (2002), Ford and the Community of Arctic Bay (2006), Peloquin (2007), and Peloquin and Berkes (2009) all speak to increasing unpredictability of ice conditions that leads to dangerous situations for individuals who use the ice to travel on and fish and hunt from. Several authors report that the sea ice is thinner than in the past (Jolly and Berkes, 2001; Fox, 2002; Jolly *et al.*, 2002; Ford, Smit and Wandel, 2006; Woo *et al.*, 2007; Aporta, Taylor, and Laidler, 2011). Other authors highlight an earlier breakup and slower freeze-up (Jolly and Berkes, 2001; Jolly *et al.*, 2002; Peloquin, 2007; Berkes, 2008; Peloquin and Berkes, 2009; Aporta, Taylor, and Laidler, 2011). Changes in the colour and texture of the ice

have been noted in the literature as well, with ice generally having a poor and less "durable" quality (McDonald, Arragutainaq, and Novalinga, 1997; Jolly and Berkes, 2001; Jolly *et al.*, 2002).

Overall, the evidence in the literature suggests that there is a trend toward less predictable, more dangerous sea ice conditions in northern regions of Canada (McDonald, Arragutainaq, and Novalinga, 1997; Jolly and Berkes, 2001; Fox, 2002; Jolly *et al.* 2002; Ford, Smit, and Wandel, 2006; Peloquin, 2007; Berkes, 2008; Peloquin and Berkes, 2009). For indigenous inhabitants who have relied on ice as a mode of transportation, source of drinking water, and venue for hunting, climate change-induced impacts to sea ice imply increased risks and require adaptations on the part of local hunters.

Permafrost

Melting permafrost is another outcome of climate change that has been observed in by indigenous populations. Some observations with regards to the effects of climate change on permafrost include: land subsidence, resulting in a decrease in the size and number of pingos, which have been used as navigational landmarks (Jolly *et al*., 2002; Nickels *et al*., 2002); more landslides, both inland and along the coast (Jolly *et al*., 2002); exposed layers of ground ice on hillsides (Jolly *et al*., 2002); an increase in the depth and thawing of the active layer of soil in the spring (Furgal, Martin, and Gosselin, 2002; Jolly *et al.*, 2002); water instead of ice in the ground, and increased occurrences of puddles and mud on the land (Jolly *et al*., 2002; Nickels *et al*., 2002); and an increase in the dryness of the ground, leading to low water supplies and even increasing vulnerability to forest fires (Furgal, Martin, and Gosselin, 2002; Jolly *et al.*, 2002).

According to the findings of ACIA, the degradation of permafrost is projected to occur over 10-20% of the presently covered area, with the southern limit of permafrost expected to move northward by several hundred kilometers by the end of the 21st century (ACIA, 2005). This melting of previously permanently frozen ground will result in deleterious impacts to transportation networks, buildings, and other infrastructure related to the oil, gas, and forestry industries (ACIA, 2005). In addition, melting permafrost has led to psychosocial disruption via impacts on infrastructure, forced population displacement, and dietary issues linked to decreased access to traditional food sources (Furgal, Martin, and Gosselin, 2002). Overall, as permafrost continues to degrade and landscapes are altered beyond recognition, indigenous communities living in these areas will continue to be affected socially, economically, and spiritually.

Changing Seasons

A change in the seasons is one of the most pronounced observations by northern indigenous populations. Several themes appear again and again in the literature. First, the winter season starts later, is shorter, and tends to be warmer than in the past (McDonald, Arragutainaq, and Novalinga, 1997; Fox, 2002; Jolly *et al*., 2002; Peloquin, 2007, Berkes, 2008, Peloquin and Berkes, 2009), which has implications for travel and clothing needs during the winter. Second, the spring thaw tends to be earlier and quicker in some areas (McDonald, Arragutainaq, and Novalinga, 1997; Fox, 2002; Jolly *et al*., 2002; Peloquin, 2007; Berkes, 2008; Peloquin and Berkes, 2009), but longer and later in others (McDonald, Arragutainaq, and Novalinga, 1997). Third, the spring season is warmer than in the past (McDonald, Arragutainaq, and Novalinga, 1997; Fox, 2002; Furgal, Martin, and Gosselin 2002; Jolly *et al*., 2002). Fourth, the summer season has also become

warmer and longer (Fox, 2002; Furgal, Martin, and Gosselin 2002; Jolly *et al*., 2002; Peloquin, 2007; Berkes, 2008; Peloquin and Berkes, 2009). Finally, the fall season tends to be shorter (Fox, *et al.*, 2002; Jolly *et al.*, 2002), which, when considered with changes in the spring season, means that the transitional seasons are increasingly difficult to predict (Jolly *et al*., 2002). The experiences described by these authors would suggest that the seasons are no longer predictable, and the activities that were once dependent on particular seasonal norms can no longer be practiced as they once were. Thus, with unpredictable changes in the occurrence of the seasons comes an increased element of uncertainty for the populations whose lives revolve around seasonal activities.

Weather

Closely related to northern indigenous populations' observations of changes in the seasons are changes in overall weather patterns. Similar to the observed seasonal variation discussed above, changes in weather are defined by an element of unpredictability, which makes them not only more difficult to cope with but also nearly impossible to anticipate. Several authors (McDonald, Arragutainaq, and Novalinga, 1997; Fox *et al.*, 2002; Jolly *et al*., 2002; Ford, Smit, and Wandel, 2006; Woo *et al.*, 2007) have reported changes in wind direction (it changes more quickly and more often) and strength (both increases and decreases in wind speed). Changes in rainfall events are also mentioned in the literature (see for example McDonald, Arragutainaq, and Novalinga, 1997; Jolly *et al*., 2002; Ford, Smit and Wandel, 2006; Woo *et al*., 2007) with respect to rainfall events occurring in the winter and less rain during normally rainy seasons. An increase in hotter weather and the strength of the sun's rays has been reported (Fox *et al.*, 2002; Jolly et al., 2002), as has the occurrence of thunder and lightning events with

resultant forest fires (Jolly *et al*., 2002; Woo *et al*., 2007). An increased incidence of haze in the atmosphere has also been documented (McDonald, Arragutainaq, and Novalinga, 1997; Jolly *et al*., 2002). Several researchers have elucidated informants' specific concerns about how sudden, intense, and unpredictable the changes are (Nickels *et al.*, 2002; Ford, Smit, and Wandel, 2006).

Overall, the current IK of changes in the weather in northern regions is characterized by an element of substantial unpredictability. As climate change progresses, the magnitude of this unpredictability may increase, creating a more unstable environment for human and animal populations inhabiting northern regions.

Northern Fauna

Wildlife species are adapted to live in harsh northern climates and contribute to the regional biodiversity (ACIA, 2005). In addition to their contribution to northern ecosystems, these species are an integral part of the economy, diet, and culture of northern indigenous populations (ACIA, 2005). Thus, the potential for climate change to affect these species and those who depend on them should not be underestimated; observed changes in the distribution and number of these species indicate that many of these ecosystems are already under stress. In the James Bay and Hudson Bay regions, evidence from several authors (see in particular McDonald, Arragutainaq, and Novalinga, 1997; Peloquin, 2007; Berkes, 2008; Peloquin and Berkes, 2009) suggests a correlation between changing climatic conditions and the migration, breeding patterns, and behaviour of Canada geese. The significance of these changes for the Cree Nation of Wemindji will be discussed in greater detail in the chapters to follow. Evidence of exotic and foreign species of birds, fish, and insects has been reported by several authors (Fox,

2002; Jolly et al., 2002). Many authors describe a situation where the number, behaviour, and health of several species including caribou, seals, polar bears, walrus, moose, and fish has changed drastically (McDonald, Arragutainaq, and Novalinga, 1997; Fox, 2002; Jolly *et al.*, 2002). The list of evidence of climate change impacts on northern flora from IK is extensive (see for example: Nickels *et al.*, 2002; ACIA, 2005; Ford and the Community of Arctic Bay, 2006; Smith, Gilchrist, and Johnston, 2006).

Implications

Overall, the risks associated with climate change in northern regions, such as access to marine and terrestrial environments, the unpredictability of environmental factors, and environmental hazards, are expected to increase, making communities in these regions more vulnerable (Ford and Smit, 2004; Ford, Smit, and Wandel, 2006; Smit and Wandel, 2006; Smit, Hovelsrud, and Wandel, 2008). As a result, populations will have to strive to minimize the risk and uncertainty that comes with increasing variability (Jolly *et al*., 2002). Coping strategies and adaptations represent an opportunity for risk minimization and increased potential to respond to unpredictable situations (Nickels *et al.*, 2002; Ford and Smit, 2004; Ford, Smit, and Wandel, 2006; Smit and Wandel, 2006; Smit, Hovelsrud, and Wandel, 2008). The following section will discuss the concepts of vulnerability and adaptation, with a specific emphasis on the experiences of indigenous populations in the Canadian north.

1.2.3 Vulnerability, Adaptation, and Adaptive Capacity

The reality of climate change is indisputable, especially in northern regions, as demonstrated by the evidence presented in the preceding section. Thus, the need for action is paramount. The United Nations Framework Convention on Climate Change

(UNFCCC) has outlined two key areas for climate policy: mitigation and adaptation (Klein and Smith, 2003; Smit and Pilifosova, 2003; Ford, 2008). These priorities have also been highlighted in the Intergovernmental Panel on Climate Change (IPCC's) Third Assessment Report (2001) and the Human Development Report of the United Nations Development Program (UNDP) (2007). Mitigation initiatives focus on legally requiring countries to reduce their fossil fuel emissions over a specific period of time, thereby reducing future anthropogenic greenhouse gases and ensuing climatic changes (Ford, 2008). However, as the literature demonstrates, northern regions in Canada and around the globe are experiencing these changes today, and will continue to in the future as the effects of residual amounts of greenhouse gases play out (Burton, 2003; Ford, 2008; Serreze, 2008). Thus, as succinctly put in the literature, "mitigate we might, but adapt we must" (Ford, 2008: 27).

While attention to mitigation has traditionally overshadowed adaptation as a policy response to climate change, there is a growing recognition that adaptation should be the focus of research initiatives (Ford, 2008). At the 2007 Bali Conference and 2009 Copenhagen Conference for example, the UNFCCC emphasized the need for enhanced action on adaptation. Similar goals have been outlined at the federal, provincial, and territorial levels in Canada, with federal agencies such as Aboriginal Affairs and Northern Development Canada (AANDC) and the Government of Nunavut taking steps to develop and implement adaptation plans in collaboration with research institutes and affected communities (Ford, 2008; Smit, Hovelsrud, and Wandel, 2008). These initiatives are the informed by the CAVIAR framework, which facilitates the identification of communities' vulnerabilities to climate change, their capacity to adapt, and the

adaptations they can employ, in both present and future climatic scenarios. As mentioned in section 1.1, this framework is applied and assessed as part of the research presented here, so as to facilitate comparability and integration of specific findings into the wider body of results from northern vulnerability assessments (Smit, Hovelsrud, and Wandel, 2008). An appreciation of this framework requires an overview of what the concepts of *vulnerability, adaptation,* and *adaptive capacity* each entails. A final section discusses the contribution of this framework to our understanding of northern indigenous experiences of climate change.

Vulnerability

Broadly defined, vulnerability has been referred to in the literature as the susceptibility of any system at any scale to harm by hazardous conditions presented by an outside stimulus or stimuli and the ability to cope with these conditions (Adger, 2003; Klein and Smith, 2003; Smit and Pilifosova, 2003; Ford and Smit, 2004; Ford, Smit, and Wandel, 2006; Smit and Wandel, 2006). In short, it is the balance between accumulated resilience and sensitivity (Chapin *et al*., 2004). When applied to human populations, this vulnerability can be biophysical, referring to the sensitivity of humans to natural events, or social, referring to the social, economic, and political factors that influence exposure and coping ability (Adger, 2003; Ford and Smit, 2004; Ford, Smit, and Wandel, 2006). Recently, both the biophysical and social dimensions have been incorporated to describe overall vulnerability, which will then be place- and system-specific (Ford and Smit, 2004; Ford, Smit, and Wandel, 2006; Smit and Wandel, 2006). The vulnerability of a community to a given stimulus or stimuli is a function of both the exposure of the community to that stimulus over time as well as the capacity of the community to cope

with that stimulus over time (Adger, 2003; Smit and Pilifosova, 2003; Ford and Smit, 2006). The crucial point here is that vulnerability can be reduced; that is, there are measures that can be taken by a community to reduce its vulnerability to hazards.

Adaptation

The term adaptation often brings to mind the Darwinian concepts of natural selection and evolution in a biological sense. However, the application of the notion of adaptation to the human condition was spearheaded by anthropologist and cultural ecologist Julian Steward and persists as an important aspect of social scientific research (Robbins, 2004; Smit and Wandel, 2006). Broadly defined, adaptation refers to any ecological, social, or economic changes, processes, or actions that humans make in response to an outside stimulus or stimuli so as to better enable us to manage or adjust to the hazards or risks associated with this stimulus or stimuli (Klein and Smith, 2003; Smit and Pilifosova, 2003; Smit and Wandel, 2006). While the definitions can vary from discipline to discipline, the main theme that unites them is that of adjustments; that is, adaptation refers to an entity's ability to change so as to better cope with a stressful situation (Smit and Wandel, 2006). As with vulnerability, adaptation is system- and place-specific (Smit and Pilifosova, 2003). Thus, what works as an adaptation for one group may be completely maladaptive for another, and what works as an adaptation to one event might not work for the same group experiencing a different event (Smit and Pilifosova, 2003; Ford and Smit, 2004). Adaptations are essentially ways of reducing vulnerability (Smit and Wandel, 2006). In this way, adaptations in human communities are closely associated with and reflective of vulnerability, and are thus manifestations of an entity's ability to adapt to these vulnerabilities, a concept broadly referred to as

'adaptive capacity' (Ford, Smit, and Wandel, 2006; Smit and Wandel, 2006).

Adaptive Capacity

Adaptive capacity has been widely referred to in the literature as the ability or potential of an entity or system to address, plan for, accommodate, cope with, avoid and/or recover from certain exposure effects or sensitivities (Adger, 2003; Klein and Smith, 2003; Smit and Pilifosova, 2003; Ford and Smit, 2004; Ford, Smit, and Wandel, 2006). Adaptive capacity is equivalent to robustness, resilience, coping ability or range, stability, flexibility, etc. (see for example Smit and Pilifosova, 2003; Chapin *et al.*, 2004; Smit and Wandel, 2006). Overall, it is context-specific and varies spatially and temporally, from the local to the global scales over time (Ford, Smit, and Wandel, 2006; Smit and Wandel, 2006). Just as the interaction of environmental and social forces determines exposures and sensitivities, so do they determine adaptive capacity. Thus, the adaptive capacity of a particular group reflects the broader social (economic wealth, infrastructure, social capital, etc.) and biophysical conditions in which the group functions (Klein and Smith, 2003; Smit and Pilifosova, 2003; Ford and Smit, 2004; Ford, Smit, and Wandel, 2006; Smit and Wandel, 2006). As is the case with adaptations, the possession of adaptive capacity does not ensure its effective usage; the crucial concern is a balance between the enhancement of adaptive capacity overall and implementing certain adaptations (Klein and Smith, 2003). As the following section will demonstrate, this concern is of particular significance when the conceptual framework of vulnerability, adaptation, and adaptive capacity is applied to the context of climate change.

The Vulnerability Framework in the Context of Climate Change

While the value and richness of IK of climate change in northern regions is increasingly recognized, others have argued that the approaches generally used to document this IK do not adequately address the specific sensitivities, vulnerabilities, or robustness of northern communities, which as a result, are not adequately compared to other experiences or considered in policy-making (Smit and Pilifosova, 2003; Chapin *et al*., 2004; Ford, Smit, and Wandel, 2006; Smit, Hovelsrud, and Wandel, 2008). The CAVIAR framework provides an opportunity to address these limitations since it facilitates documenting specific communities' experiences while upholding the concerns of comparability and inclusion (Figure 2). CAVIAR's application in numerous communities internationally demonstrates its robustness as a tool to speak to vulnerability in northern communities (Smit, Hovelsrud, and Wandel, 2008). Through a stakeholder approach that incorporates local inputs as well as inputs from natural and social scientific studies, the framework addresses both current and future sensitivity and adaptive capacity to determine a community's main vulnerabilities as well as the most appropriate policy avenues for increasing adaptive capacity and decreasing sensitivity to exposure (Smit and Wandel, 2006; Smit, Hovelsrud, and Wandel, 2008). Hence, the framework operates in two stages: assessing current vulnerability; and assessing future vulnerability (Ford and Smit, 2004; Ford, Smit, and Wandel, 2006; Smit and Wandel, 2006; Smit, Hovelsrud, and Wandel, 2008).

The effectiveness and appropriateness of the CAVIAR framework for the research described here will be discussed more extensively in Chapter 3. The framework was originally amended from a more general UNDP framework and developed for large-scale research in an Arctic setting but is applied here at a different scale and in a different

context. Chapter 3 includes specific recommendations as to how CAVIAR might be modified and adapted to better suit community-scale research in a sub-Arctic context.

1.2.4 Protected Areas and Climate Change

Since the mid-1980s, researchers have sought to explore the relationship between conservation initiatives and climate change (see for example, Peters and Darling, 1985; Graham, 1988; Peters and Myers, 1991; and Peters, 1992). A primary concern of these studies was the implications of a changing climate for the efficacy of reserves, parks, and protected areas (PAs) to safeguard certain species and ecosystems. That same concern is echoed in the literature of today, along with a repeated call for more action on the question of the role of PAs in the face of climate change (Halpin, 1997; Scott, Malcolm and Lemieux, 2002; Suffling and Scott, 2002). PAs are acknowledged to have fundamental difficulties when faced with changing climatic (and thus biophysical) conditions (Peters and Myers, 1991; Lemieux and Scott, 2005; Scott and Lemieux, 2005). There are both external and internal factors that determine the ability of PAs to function as intended as the climate changes. However, they are also recognized to have the potential to serve as an effective strategy to deal with these changes, as long as their creation and management incorporates certain key elements that address the external and internal factors mentioned above (Halpin, 1997; Hannah, Midgley, and Millar, 2002; Hannah *et al.*, 2007; Hannah, 2008; McLeod *et al*., 2009). Thus, with appropriate implementation and management, PAs could contribute to decreasing the vulnerability of a community or ecosystem to unpredictable climatic changes ("Protected Areas Helping People Cope," 2010). Applied under the vulnerability framework described above, then, PAs have the potential to act as adaptive strategies. While there has been limited research

on this specific aspect of PAs, a review of the current literature will demonstrate this potential.

PAs in Canada

As a signatory of the Convention on Biological Diversity in 1992, Canada had pledged for the "establishment and maintenance by 2010 for terrestrial and by 2012 for marine areas of comprehensive, effectively managed, and ecologically representative national and regional systems of protected areas" (CBD, 1992). However, today only 10 percent of Canada's terrestrial area is now protected, which falls short of the 12 per cent recommended by the Commission on Environment and Development (1987), and only 0.5 per cent of Canada's marine area has been awarded protective set designation (Dearden and Rollins, 2009). Overall, Canada falls short of national and international commitments in terms of PAs, but is making progress (Dearden and Rollins, 2009). Furthermore, with climate change a current and future reality, Canadian governmental and non-governmental agencies alike will need to adjust commitments and practices accordingly (Scott, Malcolm, and Lemieux, 2002; Suffling and Scott, 2002; Lemieux and Scott, 2005; McLeod *et al.*, 2009). Indigenous groups have also become important players in protected area development, as the case of the Wemindji PAs demonstrates (Bussières, 2005; Dearden and Rollins, 2009; Mulrennan, Bussières, and Scott, 2009).

The Potential of PAs to Minimize Vulnerability

As mentioned above, international organizations such as the International Union for Conservation of Nature (IUCN) (2010), the IPCC (2001), the UNFCCC (2008), and the UNDP (2007) identify two important responses to climate change: mitigation and adaptation. The literature of two decades ago recognized that: mitigation is key, but it

alone cannot preserve biodiversity, thus adaptation is also important (Peters and Myers, 1991); we *must* plan for future climatic changes today (Peters and Darling, 1985; Graham, 1988); and early planning is necessary if we hope to manage the inevitable conflicts between the goals of conservation and the needs of development (Peters and Myers, 1991). Stemming from these recognitions is the current debate over when climate change adaptation strategies should be implemented (Scott and Lemieux, 2005). Hannah *et al*. (2007) argue that the sequence in which protected area responses to climate change are realized will influence the cost of these strategies; that is, an early response will be more cost effective and will better incorporate a species' current and anticipated range, thus offering better protection. Laissez-faire approaches to climate change adaptation in PAs have several potential drawbacks, including: last-minute strategies that will be more costly and less effective than precautionary approaches; unexpected and more severe climatic changes resulting in increased vulnerability of socio-ecological systems; and potentially irreversible outcomes, such as species extinctions (Scott and Lemieux, 2005, 2010). Hence, climate change adaptive strategies that incorporate PAs are urgently needed (Hannah *et al.*, 2007).

The framework of Climate Change-integrated Conservation Strategies (CCS) provides opportunities for the development of such adaptive strategies (Hannah *et al*., 2002; Hannah, Midgley, and Millar, 2002). Tailored to individual regions, CCS focuses on (1) the expansion of current PAs, (2) the management of the matrix land use outside of PAs, and (3) the regional coordination of management actions (Hannah *et al*., 2002; Hannah, Midgley, and Millar, 2002), all of which have been emphasized as crucial to decreasing vulnerability of PAs in the face of climate change (Peters and Darling, 1985;

Scott, Malcolm, and Lemieux, 2002; Hannah, 2008; Malcolm, 2009; McLeod, 2009; Theberge and Theberge, 2009). In particular, support for increasing the size of current PAs, greater levels of protection of the land surrounding them, and the establishment of dynamic or transient boundaries has been recommended by the IUCN (2005) to make PAs more adaptive under changing conditions.

The first objective under CCS includes the strategy of increasing connectivity between PAs, which can bolster the adaptive capacity of individual PAs and overall conservation efforts alike (Hannah, 2008; McLeod, 2009). If the changes in vegetation cover presented by Scott, Malcolm, and Lemieux are realistic projections, several parks within Canada will experience substantial, if not complete, alterations in natural cover, with potentially devastating socio-ecological effects. For example, changes in vegetation and ice cover in the Hudson Bay bioregion threaten polar bears, a species that is both inherently valuable as well as having high cultural and economic value for Inuit communities (Freeman and Wenzel, 2006; Dowsley and Wenzel, 2008; Lemelin, Peerla, and Walmark, 2008). Therefore, while it represents only one of the important features of CCS, increasing the number of and connectivity between PAs can decrease their vulnerability and lead to an increase in the adaptive capacity of socio-ecological systems they represent (Hannah *et al*., 2002; Hannah, Midgley, and Millar, 2002).

According to Hannah (2008) PAs are an untapped policy response to climate change that must be adopted if there is hope for reducing vulnerability and bolstering adaptability of natural and human systems alike. This sentiment is echoed by the IUCN (2010), which has expressed its support of the significant potential of PAs to bolster the adaptive capacity of both human and natural systems in the face of climate change.

1.3 Methodology

In order to fulfill the objectives of my research and answer the three main questions posed in the introduction, I have applied an ethnographic research approach. Ethnography is one of the many approaches used in social scientific research, and since the early 20th century, it has become central to the methods applied in anthropology (Hammersley and Atkinson, 2003). Ethnographic research is defined by qualitative methods, which have as their goal an understanding of the nature of rather than the magnitude or distribution of a phenomenon (Dewalt and Dewalt, 2002).

Overall, I completed 20 formal semi-structured interviews with 18 informants and engaged in participant observation on several occasions. This ethnographic research was carried out over the course of a six-and-one-half-week period during the summer of 2010 and a week-long period in October 2010, during which I lived in the community of Wemindji as well as taking a three-day trip out along the James Bay coast to visit several families at Old Factory Island.

While the timing of my fieldwork was largely determined by the sequencing of my master's program, other factors certainly played a role. First, because many families spend the summer out on the land), it was advantageous to complete my fieldwork at that time; second, since many members of the Wemindji Protected Areas Project were conducting research from the period of July to August, collaborating and sharing information with them was facilitated while our field seasons corresponded. My second visit in October was scheduled to correspond with the annual Wemindji Moose Festival, which provided an excellent opportunity to communicate with several individuals on the state of the fall hunting season and participate in community activities.

Interviews were carried out in the homes and places of work of informants as well as at my place of residence, and they lasted between 15 minutes and two hours. For several interviews, an interpreter was used to translate between English and Cree. I interviewed both men and women who were of varying ages. My youngest interviewee was in his late 30s while my oldest was in her 80s. Several of the informants were tallymen/women and others were senior hunters within the community. Participant observation took place both in the town of Wemindji as well as out in the coastal Bay environment and on offshore islands. The informant selection-process as well as data collection and analysis is described in further detail in Chapters 2 and 3.

Many opportunities contributed to the success of the fieldwork. First, prior to the commencement of my graduate program, I co-animated a 6-week camp program for the youth of Wemindji during summer of 2009. This experience introduced me to Wemindji Cree community and culture. Being known and appreciated for the work I did the previous summer greatly facilitated my engagement with community members during the fieldwork stage of my research. The friendship I made with the (now former) Culture Coordinator in 2009, which was rekindled during the 2010 field season, was particularly valuable in this regard. This individual assisted in establishing first contact with several informants in addition to translating several of the interviews. Beyond formal research, the conversations and time spent with this individual provided me with contextual insights that have allowed a understanding of the Wemindji Cree experience.

A meeting of the Wemindji Protected Area team in July of 2010 provided me with an opportunity to present an informal poster to both team and community members, discuss the research with new colleagues, and forge new ties within the community.

Over the course of the fieldwork, I faced several challenges. Among these was the issue of gender, both my own as well as that of my informants. While ethnicity, social standing, and age are some characteristics of the ethnographer that may influence the fieldwork, the issue of gender has two implications for the research described here. First, there is the issue of my own gender as the researcher. It has been noted by others that gender is an important variable in data collection, since it can influence how the researcher perceives others and can limit her access to certain information (Mead, 1986; Bernard, 2003; Dewalt and Dewalt, 2006). While there have been suggestions that women tend to make better fieldworkers because they are more sensitive to others (Dewalt and Dewalt, 2006), it was still imperative to be aware of how my position as a woman affected my interactions within the community.

Second, the existence of gendered knowledge within the community needed to be addressed. Findings from research in Sachs Harbor demonstrate how men and women play different roles in traditional activities, with women having the responsibility to forecast weather, for example (Ford and Ashford, 2000). In Cree traditional livelihoods, roles and knowledge are also gendered. While men generally take care of hunting, fishing, and trapping, women prepare meat, chop wood, and lay spruce boughs in teepees and longhouses (Beverly Mayappo, pers. comm., July 2009; Low, 1974). Throughout my fieldwork, I was aware of the gendered nature of Cree knowledge and selected informants to take account of this.

In addition to gender, the issue of my own "positionality," and its implications for the research, was also a challenge. For example, being a "white" researcher with 20 years of Western education that has privileged "rational" scientific thinking, I expected that I

might encounter difficulty appreciating and understanding the significance of the various taboos, myths, and stories that inform Wemindji cosmology (Chapter 2). As the field season progressed, I was deeply affected by the power behind these taboos, myths, and stories. However, my position as a cultural "outsider" made it impossible to grasp the full significance and implication of these different aspects of Wemindji cosmology.

Another challenge lay in the fact that I am unable to speak Cree. While most individuals within the community speak English in addition to Cree, many of the Elders are monolingual, which made approaching them more difficult. As mentioned above, a translator assisted, but as others have argued (see for example Phillips, 1960) with translation there is always a risk of certain nuances being "lost in translation".

Another constraint that affected the pace of the research was a high level of social upheaval within the community over the course of only a few weeks. Wemindji is a relatively small and tight-knit community; therefore, when emotionally charged events such as weddings, deaths, or funerals occur, many people are directly affected. Several of these events took place during the field season, and in order to respect the individuals involved, I ceased conducting interviews and focused instead on preliminary analysis.

Overall, grappling with these constraints, while at times frustrating, allowed for a deeper understanding and contextualization of the Wemindji Cree way of life. They provided insight into certain practices, beliefs, and institutions that contribute to the resilience of the community, including an emphasis on maintaining the Cree language, and supporting the celebration or mourning of individuals as a community. Like the opportunities encountered, they have played an integral role in the progression of the research.

CHAPTER 2

Beneath the Thinning Ice: The Importance of Cultural Context in Supporting the Responses of a James Bay Community to Climate Change

Abstract

The attention given to documenting indigenous peoples' observations and interpretations of climate change has grown in recent decades. Much of this research has involved descriptive accounts of local observations, focused primarily on tangible aspects of change, including changes in weather patterns, the seasons, and related environmental conditions. The last decade has also seen a response to critiques of indigenous methodologies through an increased attention on the need for community-based participatory approaches. In the context of climate change, these approaches seek to recognize and support appropriate coping and adaptive strategies. However, the conventional descriptive assessments of indigenous observations and interpretations of climate change do not adequately address the contextual nature of these observations and interpretations. Through a case-study approach, this paper demonstrates that more intangible dimensions of change, such as those reflected in various beliefs, taboos, and legends, are equally important considerations in the recognition and support of coping and adaptive strategies. By working closely with members of the Cree Nation of Wemindji to identify the complexity of climate change in their territory, this research also responds to calls for a community-based participatory approach. In doing so, the research identifies some of the recent and innovative responses the community has made, such as the strategic use of protected areas, which may inform other communities' responses and contribute to their resilience in the face of change.

2.1 Introduction

Research into Arctic climate change suggests that changes in ice-cover in the Arctic are 30 years ahead of what previous studies had predicted (Serreze, 2008). The concern with the rate at which this change is occurring in the Arctic has prompted the United Nations Framework Convention on Climate Change (UNFCCC) to call for initiatives in mitigation (slowing or stopping current change) and adaptation (coping with change now and preparing for change in the future) (Klein and Smith, 2003; Smit and Pilifosova, 2003; Ford, 2008). Among the efforts borne of this call to action are: the Arctic Climate Impact Assessment (ACIA) (2004), the Arctic Human Development Report (2004), the International Polar Year (2007/2008), and the ArcticNet program (ongoing).

The last decade has seen increasing research into circum-polar indigenous peoples' observations and experiences of climate change, in addition to some of the adaptations of these groups to the effects of climate change (see in particular Jolly et *al*., 2002; Nickels *et al*., 2002; Ford *et al*., 2006; Ford, 2008; Hovelsrud and Smit, 2010; Lemelin *et al*., 2010). In general, this research has sought to examine the impact of climate change on community members, using primarily ethnographic methodologies. The findings of these studies (see in particular McDonald *et al*., 1997, Jolly and Berkes, 2001, Woo *et al*., 2007) are often descriptive, identifying and classifying climatic changes according to key themes aligned with specific components of the environment being affected. These themes include: weather, seasons, flora/fauna, permafrost, and ice. In general, most studies have found increased rates of unpredictability in the environment, including: changes in the timing of the seasons (McDonald *et al*., 1997; Fox, 2002; Jolly *et al*., 2002; Peloquin, 2007, Berkes, 2008, Peloquin and Berkes, 2009), a higher number of extreme weather events (McDonald *et al*., 1997; Fox *et al.*, 2002; Jolly *et al*., 2002; Ford *et al*., 2006; Woo *et al.*, 2007;), changes in sea and lake ice conditions (McDonald *et al*., 1997; Fox, 2002; Ford *et al*., 2006, Jolly and Berkes, 2001; Jolly *et al.*, 2002, and Woo *et al.*, 2007), changing and new species of flora and fauna (McDonald *et al*., 1997; Fox, 2002; Jolly *et al.*, 2002; Nickels *et al.*, 2002; ACIA, 2005; Ford and the Community of Arctic Bay, 2006; Smith *et* al., 2006), and changing permafrost conditions (Furgal *et al*., 2002; Jolly *et al*., 2002; Nickels *et al*., 2002). Adaptation studies have identified several types of responses, including, for example: changing the timing or mode of travel (Berkes and Jolly, 2001; Jolly *et al.*, 2002; Ford *et al*., 2006), changing the composition of species harvested (Jolly, 2001; Berkes and Jolly,

2001), changing the timing or location of hunting activities (Jolly, 2001; Berkes and Jolly, 2001; Ford *et al*., 2006), the adoption of new forms of technology (Ford *et al*., 2006; Laidler *et al*., 2009), and incorporating climate change into community planning policies (CIER, 2009).

These studies, combined with the vocal assertions of indigenous leaders and advocates in national and international fora, have drawn attention to the growing reality of climate change for northern indigenous populations[2]. The challenges involved in presenting this evidence is considerable; numerous studies, sometimes supported by video productions, provide insight into the type of changes that are occurring as well as their impact, however, this approach sometimes delivers somewhat obvious and underwhelming findings, which fail to do justice to the complexities and significance of the experiences of climate change for many indigenous communities. Consider, for example, the findings described in Table 1, which will also be described below. Table 1 refers to tangible aspects of climate change, and the comments appear de-contextualized and distilled. If the research described here had stopped there with the documentation of these observations it would have been relatively impoverished, since these observations could also be measured using Western scientific data collection methods. In this way, this type of approach does not adequately capture the cultural context that influences how and why these observations are made, and what the changes mean to observers. This challenge is conveyed in Cruikshank's (2001) question: "are there ways of speaking to

[2] Inuit activist Sheila Watt-Cloutier has played a particularly important role in this respect. In 2005, Watt-Cloutier filed a petition with 62 Inuit hunter and Elders from various communities across Canada and Alaska to the Inter-American Commission on Human Rights, asserting that unchecked anthropogenic greenhouse gas emissions from the United States had violated the 1948 American Declaration on the Rights and Duties of Man.

global issues such as climate change that accord weight to culturally specific understandings as well as to the universalistic frameworks of science?" (p. 389). The present research, by going further and exploring the cultural context that underpins local indigenous observations and interpretations of climate change, seeks to address this question.

My efforts in this respect are informed by growing interest in community-based participatory research (CBPR) in recent years as the basis of an "inter-subjective approach […] for sustained decolonizing of institutional practices and research frameworks in geography" (Hodge and Lester, 2006: 46). In this sense, these new approaches to conducting research in an indigenous context "not only address th[e] rift between knowledge systems and research paradigms, but also narrow it" (Louis, 2007: 131). Acknowledging that indigenous peoples' knowledge systems and research interests are legitimate allows these new methodologies to break away from their colonial and positivist histories and better serve the needs of indigenous peoples in the process (Hodge and Lester, 2006; Louis, 2007). Core principals of CBPR approaches include: 1) local definition of research needs, 2) local engagement in research, and 3) the production of meaningful research outputs from a community perspective (Mulrennan *et al*., under review). This form of research addresses the need for what Brosius and Hitchner (2010: 56) call "hybrid research methods," which support multiple perspectives and forms of agency (Mulrennan *et al*., under review). The foundations of CBPR, then, can serve to bolster approaches that seek to understand the experiences of northern indigenous groups in relation to climate change. Ford and Pearce (under review) argue that in order to best identify and support adaptation actions, the nature of vulnerability of those being exposed

to climate change must be identified. Doing so requires working closely with communities via the CBPR approach so that the most relevant climate conditions and feasible adaptive strategies are identified by community members (Pearce *et al*., 2009). Many groups involved in this research (see for example McDonald et al., 1997; Krupnik and Jolly, 2002; Hovelsrud and Smit, 2010) have adopted a community-based participatory approach whereby community members play an active role in directing the research. While Ford and Pearce (under review) highlight that this type of research has gained momentum over the last decade, they point out that the methodologies used to highlight vulnerability in northern communities are continuing to evolve and benefit from their application in new settings.

In response to the potential of these emerging methodologies, this research was undertaken in collaboration with community members of the Cree Nation of Wemindji, mid-northern Québec, as an effort to document local observations and interpretations of climate change and record key responses that the community has availed of, such as the establishment of culturally appropriate protected areas (PAs) within their territory. A second goal of the research was to explore and recognise the cultural context within which these observations, interpretations, and responses are made. The former is consistent with the mandate of CBPR and contributes to new indigenous research methodologies while also partially addressing the limited coverage climate change impacts on sub-Arctic indigenous communities has received (Syvanen 2011b).

Specifically this research seeks to address the two following questions:

1) What observations and interpretations do members of the Wemindji Cree Nation make in relation to climate change?

2) What coping mechanisms and adaptive strategies do they employ in response to these changes over both the short- and long-term[3]?

The research speaks to the many, and sometimes opposing, views and methods that community members have employed, and in doing so, it demonstrates that the recognition and support of coping mechanisms and adaptive strategies benefits from a more contextual research approach.

2.2 Study Area

The Cree Nation of Wemindji is located in the mid-northern portion of the province of Québec on the east shore of James Bay, a shallow inland sea in a sub-Arctic environment (Kottek *et al.*, 2006; Figure 1). As part of the greater Hudson Bay bioregion, James Bay is affected by the ocean currents of Hudson Bay to the north and the large number of rivers emptying along its coast (McDonald *et al*., 1997; Mulrennan *et al*., 2009). While the territory of the Cree Nation of Wemindji spans several thousand square kilometers along the James Bay coastline and inland, the village settlement of Wemindji is located at 53° 0′ 38″ N latitude, 78° 49′ 52″ W longitude on the shore of the Maquatua River, approximately 10 km inland from James Bay (Denton, 2001). A relatively small community of 1,200 individuals, its population is growing rapidly due to a high birth rate (Statistics Canada, 2009). Since the James Bay Northern Québec Agreement (JBNQA) of 1975, Wemindji, along with all Cree communities in the region (known as Eeyou Istchee, Cree for the "People's Land"), falls under the jurisdiction of the Grand Council of the Crees.

[3] For the purposes of the research described here and consistent with the use of these terms by others (see for example Jolly *et al.*, 2002), coping strategies include behavioural changes, such as modifying the timing or mode of travel, or switching from one prey species to another, which allow individuals to cope with small changes in the short term. Adaptive strategies, on the other hand, are large-scale and/or long-term, such as the strategic use of terrestrial and marine PAs, or the adoption of new educational programs.

Recent research demonstrates that the region has been undergoing a process of isostatic rebound for several thousand years (Andrews and Peletier, 1976; Mitrovica *et* al., 2000; Pendea *et al.*, forthcoming). As a result, many coastal Cree say that the "land is growing" (Sayles, 2008). Major shifts in the coastline (Dionne, 1980; Pendea *et al.*, forthcoming) have meant that the social-ecological systems in Wemindji's territory have been experiencing large-scale changes in landscape (and a need to adapt to them) for thousands of years. Most recently, the effects of isostatic rebound prompted the relocation of the community in 1959 from a small island in Eastern James Bay approximately 45 kilometers north to its current location (Denton, 2001). It is now connected to the James Bay highway by a 100-kilometer long access road and is serviced twice daily by a local airline.

Since the 1970s, Wemindji, along with several other Cree communities in the James Bay region, has experienced significant environmental and social effects associated with large-scale hydroelectric development on many of the region's rivers. Extensive areas of the Cree's traditional territory were and continue to be flooded as these dams are built, and with many long-term ecological implications (Rosenberg *et al.*, 1997). The extension of roads, airports, and other infrastructure into the region has brought with it a growing number of recreational hunters, who introduce an additional level of disturbance by affecting animal behaviour (Mulrennan *et al*., under review). In addition to hunters, there has been a growing interest in mining in the area. The "opening up" of the northern region to southern influences also brought with it new social issues, such as increased alcoholism, drug abuse, and violence (Niezen, 1993; Whiteman, 2004).

Despite these external intrusions, the Cree Nation of Wemindji retains a strong

sense of community and cultural identity, which is intimately tied to their relationship with the land. Wemindji define themselves as the "iiyiyiuch," or "people of the land" (Chief Rodney Mark, 2010). A project conducted by Chief Mark (Core Values Project) with Elders highlighted the importance of the family unit, affinal dualism, reciprocity, animism, and the power of the hunt, which are described elsewhere as key aspects of the Cree worldview (Speck, 1935; Feit, 1986, 1992; Scott, 1996). Their relationship with the Canada goose hunt is also of critical importance to the Cree, and much research has demonstrated their importance in Cree diets (Belinsky, 1998) as well as Cree culture (see for example Scott, 1986, 1988, 1992, 1996; Peloquin, 2007; Sayles, 2008). The implications that climatic change may have on this relationship will be further described below.

Another important group within the community includes the "tallymen," or hunting bosses, who "speak for the land and the animals, who cannot speak for themselves" (Chief Rodney Mark, 2010). These individuals take on the role of stewards for the different hunting territories that constitute Wemindji's territory. Two of the main responsibilities of the tallymen include the coordination of sustainable harvesting activities and the monitoring of the ecological health of these grounds.

The transmission of knowledge between the Elders, Youth, and tallymen is extremely important to the Cree Nation of Wemindji. However, the community has faced numerous challenges in encouraging that opportunities for knowledge transmission continue, such as the increasing pressures of industrial-scale development. However, the community is demonstrating leadership and innovation in addressing these challenges, as seen in the high level of collaboration between the local school and the Wemindji Health

and Wellness, Culture, and Youth Departments in the running of activities that involve opportunities for knowledge transmission and inter-generational cooperation.

Of particular relevance to the present study is the engagement of the community, under the leadership of Chief Rodney Mark, in an ongoing research partnership involving university-based researchers, various regional Cree entities, government agencies and an environmental non-governmental organization (ENGO) to establish culturally specific PAs in both the terrestrial and marine environments of Wemindji (Mulrennan *et al*., under review). More specifically, this partnership seeks to "establish a network of protected areas anchored in Cree knowledge and institutions for land and sea management, to achieve combined goals of regional sustainability, biodiversity protection, and cultural continuity" (Paakumshumwaau-Wemindji Protected Areas Project[4]). The guiding principles behind the Wemindji Protected Areas Project foster a collaborative, community-based, and inclusive approach to conducting research within the community (Mulrennan *et al*., under review).

To date, this project has been successful in the creation of the accepted Paakumshumwaau-Maatuuskaau Terrestrial Biodiversity Reserve as well as the proposed Marine (Tawich) National Marine Conservation Area. In addition, several related research studies that have been supported by project, including research on coastal landscape changes (Sayles, 2008; Sayles and Mulrennan, 2010), continuity in the Canada goose hunt (Peloquin, 2007, Berkes, 2008, and Peloquin and Berkes, 2009), and a significant archaeological survey of a large area covered by the Terrestrial Biodiversity

[4] The Wemindji Protected Areas Project began in 2001, and has evolved as a partnership between members of the Cree Nation of Wemindji, researchers from several Canadian universities, government agencies, and an environmental non-governmental group (ENGO). It has received funding from the Social Sciences and Humanities Research Council's Community-University Alliance program, among other sources. For more information on the project, please consult the following website: http://www.wemindjiprotectedarea.org/

Reserve (see for example Wren (Nielsen), 2010, and Pendea *et al*., forthcoming). While some of this research (see in particular Peloquin, 2007, and Sayles, 2008) explored elements of climatic change within the territory, no research has focused specifically on the topic. Therefore, by speaking directly to the effects of climate change on Wemindji's natural and human environments from a community perspective, this research contributes to the Wemindji Protected Areas Project by addressing an important gap in the research conducted by the project to date.

2.3 Methods

A qualitative approach was taken in this study, drawing on research methods applied in cultural anthropology, human geography, and ethnobiology, with ethnography as its foundation (Dewalt and Dewalt, 2002; Bernard, 2006). Particular attention was given to documenting Cree indigenous knowledge (IK) of climate change with respect to the human, natural, and spiritual components of Cree cosmology and their interconnectedness in the Cree ethno-ecosystem (Feit, 1992).

The research involved two separate visits to the community. The first of these consisted of a 6 and-a-half week period from June 20th to August 3rd, 2010.. A second visit took place between October 20th and October 25th, 2010. The research also benefitted from the experiences gained while co-animating a summer Science Camp for Wemindji youth aged 6-14 over the course of 6 weeks during the summer of 2009, which gave me the opportunity to meet and establish connections with several community members as well as gain a better sense of what life in Wemindji is like. Over the course of the two field visits, a total of 20 formal interviews were carried out with 18 informants. Of these, four were women, one of whom is the only female "tallyman" in the

community. The youngest of the informants is in his late 30s, while the eldest is in her 80s. Overall, 14 of the informants are considered "Elders" by the community. Three of the informants are tallymen, and 10 are active hunters within the community. Two of the informants are members of the Wemindji Band Council, and one of the senior hunters is also the Executive Director of the Wemindji Cree Trappers Association (CTA). Another of the informants holds the position of Weather Officer at the Wemindji Airport. These informants were chosen on the basis of recommendations from community members and researchers involved in Wemindji Protected Area Project, who attested to the extensive knowledge of the informants with respect to climate change. I also availed of opportunities to enlist new informants among community members who expressed an interest in discussing the research.

Interviews were between 15 minutes and two hours in length. They were carried out in person (face-to-face), mostly at the informants' place of residence or mine, with the remaining interviews taking place at the informants' place of employment. For five of the interviews, an interpreter was needed since these informants were mono-lingual Cree speakers. The interpreters were either family members or close friends of the informants, and they translated between Cree and English.

Interviews were semi-structured; that is, I developed an interview guide with several questions of interest, which were modified or expanded as necessary in the context of each individual interview. In two instances, interviews were carried out in groups of two or three individuals who were close family members. All but two interviews were recorded using a digital audio recorder as well as written field notes. These interviews were subsequently transcribed.

Fieldwork also involved participant observation, in addition to many informal conversations with several informants and other community members. During the summer 2010 field season, of particular significance were two trips I made out to the coast and offshore islands. These trips greatly facilitated conversations with informants about climate related changes, and gave me the opportunity to experience first-hand the increasing unpredictability of environmental conditions. In the fall 2010 field season, my visit coincided with the annual Moose Festival, which offered a significant opportunity to assist with and observe the traditional preparation of the moose harvest. These experiences were catalogued via field notes as well as a personal journal.

Consistent with comparable research conducted in an Arctic context (see for example McDonald *et al*., 1997, Jolly and Berkes, 2001 and Jolly *et al*., 2002), the interview material was organized thematically according to different aspects of climate change. The rationale for this included: to recognize the persistence of these common themes across the various informants; to standardize and thereby facilitate comparison between previous studies and the research described here; and, to contribute to the establishment of a more comprehensive regional picture of climate related changes. Many of the themes identified in Arctic studies were identified as significant by the informants. Informants also spoke to themes that have not, to my knowledge, been documented in previous climate change studies; these include celestial bodies. Other themes, such as permafrost changes, did not emerge as significant in the context of this study. In total, six different themes relating to climate change were identified through informant testimonies; these include weather, seasons, flora/fauna, snow, ice, and celestial bodies.

As mentioned earlier, a limitation of the thematic approach is that it may contribute to a distillation and compartmentalization of indigenous knowledge by Western science. As Nadasdy (2003) points out, efforts to prove the empiricism of indigenous knowledge assume that seemingly discrete components of indigenous knowledge can be extracted and subsequently analyzed via Western scientific approaches without consideration of their socio-cultural context while still retaining their "indigenousness." However he further suggests that considering this knowledge without acknowledging the source and context of this knowledge undermines the basis of community-directed approaches (Nadasdy, 2003). Consistent with such concerns, it is recognised here that the organization and presentation of my findings according to discrete themes is potentially problematic,, with the potential to understate the complex associations and connections inherent in the knowledge, reducing and distilling local knowledge to what might appear to be obvious and perhaps not very insightful statements with dubious utility or application. To counter this, the paper also addresses climate change with respect to Wemindji Cree cosmology with an emphasis on specific stories, legends, taboos, and myths that demonstrate the more profound spiritual experience of climate change for some community members. As an "outsider" to Wemindji, it would have been easy to dismiss these stories as a medium for teaching a lesson or eliciting fear in children, ignoring their broader application to the identification of appropriate and relevant coping or adaptive responses. However, having been exposed first hand to the power of Wemindji Cree stories where death, illness, and other tragedies followed certain actions on three separate occasions, the relationships between these events were too significant and the results too devastating in the community for me to dismiss them based

on Western science's "rationality".

Renee Louis (2007, p. 135) argues that despite the difficulty in doing so, academic researchers must strive to "write adequately for both audiences," those being academia and indigenous communities. She also emphasizes the importance of providing indigenous community participants with feedback and written copies of the work that they have helped the researcher to produce (Louis, 2007). In order to fulfill these important components of CBPR, I presented a poster summary of my work to community members at the summer 2010 Wemindji Protected Area Project team meeting. This gave the community an overview of the research and allowed community members to come forward and express their interest in sharing their experiences. In addition, I compiled a short report for the community, based on preliminary findings from the summer fieldwork session. This report summarized informants' responses and included several recommendations concerning what steps the community might take to share their experiences with the entire Eeyou Istchee region. It was written in non-technical language that included terminology used by several of the informants and was presented to the community during my return visit to Wemindji in the fall of 2010. Several copies of the report were left at the Community Council Office, while a fourth copy was left with a key informant and his family. Feedback from community members with regard to both the poster and report was used to help identify the most pressing concerns of the community with regard to climate change. A final document that summarizes key findings will be delivered to the community in the fall of 2011, ensuring that knowledge-sharing has gone both ways in the research process (Louis, 2007).

Establishing close ties with the community enhanced the success and significance

of the research (Mulrennan *et al*., under review). It has also opened the door for potential follow-up research and future collaboration. In particular, it contributes to a recent report compiled by the CTA (2011) speaking to the effects of climate change on the Eeyou Istchee region. Connecting the research described here with the CTA's Cree-directed local initiative is consistent with the CBPR approach taken in this research. Finally, it allowed the community to express its most significant concerns and vulnerabilities. The richness of the insights gathered during this research is testament to the passion and sincerity with which the informants spoke of their experiences of climate change.

2.4 Findings

This section is divided into three subsections. The first subsection documents specific observations of climate change in relation to key themes that emerged through interviews with Cree informants. The second subsection addresses Cree interpretations of climate-related changes, with emphasis on the spiritual dimension of this experience. The final subsection examines short-term coping mechanisms and long-term adaptations that have been and continue to be applied by members of the Wemindji Cree community in response to unprecedented climate change within their territory.

2.4.1 Wemindji Cree Observations of Climate Change

Observations of climate-related changes are organised according to six key themes that emerged through the interview process. These include: weather, seasons, flora/fauna, ice, snow, and celestial bodies. Many informants made similar statements concerning each of these themes, and a summary of these statements can be found in Table 1. An account of the observations made in association with each theme is provided below.

Weather

The terms and associations that emerged most often when individuals were asked about the weather included: worry, change, difference, unprecedented, and unpredictable.

> Sometimes we worry what the weather's going to be; we have to pay better attention. Fred Stewart, Wemindji Tallyman, October 24th, 2010.

> The weather is starting to change a lot; it's getting worse. Daisy Atsynia Sr., Wemindji Tallywoman, June 23rd, 2010.

> There's lots of changes in the weather. The clouds are different; we don't see the ones that can tell you what the weather will be like tomorrow anymore. Sinclair Georgekish, Wemindji Elder, July 8th, 2010.

Most informants observed changes in weather patterns in recent years, with the 2009/2010 winter identified as the most changed. Changes include fog events that occur at times that are inconsistent with past patterns; the relationship between the wind and the tide is unpredictable, and at times, completely counter to what it was before; day-long blizzards no longer occur; the temperature fluctuates drastically, and it is generally not as cold as it used to be; and thunderstorms have begun to strike in what used to be "the dead of winter".

> In 2004, it rained in March, and people were shocked. They had never heard of rain in March before, and there were no stories talking about it in the past. Sammy Blackned, Wemindji Band Council, July 7th, 2010.

> Last year it was very strange when we had thunder in March. I've never seen that before. Leslie Kakabat, Wemindji Airport Weather Officer, July 19th, 2010.

Several Elders reported that they had heard of strange weather events like these in the early 20th century. Some believe that the changes occurring now demonstrate an environmental cycle that is simply repeating itself. One individual in his mid-40s attested to this, claiming that depending on when a person was born, he/she might see these

events more than once in his/her lifetime. Several individuals also mentioned the contributions of the El Niño Effect, or the proximity of hydroelectric reservoirs to the north and their effects on local weather patterns. These all represent important potential contributors to the changes in the weather that Wemindji is experiencing. However, all informants expressed a view that the weather is undergoing definite changes, and that these changes have become more pronounced in the past 3-4 years.

Seasons

Changes in the seasons have always brought changes in weather patterns across the James Bay region. However, recent changes in the length and timing of the seasons have resulted in unpredictable weather conditions.

> Sometimes in the spring, it's like the snow melts really quickly; the summer, it's almost like you don't expect it, summer is already here. It's so fast. It's like the climate is changing […] in the fall again it gets cold very fast, we don't have time to see the fall and it's already winter. It doesn't transition like it used to. The transition months are shorter. This is what I have noticed. Winnie Asquabenaskum, Wemindji Elder, October 24th, 2010.

The abruptness and inconsistency of seasonal changes was mentioned over and over again by informants. The timing of the changes is no longer the same. In the spring of 2010, for example, the community witnessed a thunderstorm and above-freezing temperatures for a month. Then, in late May, a huge snowstorm hit. Winter, once a six-month period of sub-zero temperatures according to informants, averages around four months now, and temperatures do not dip to the same extremes as they did in the past.

> It wasn't cold enough this winter for me to have to wear my parka. Irene Mistacheesik, Wemindji Elder, June 29th, 2010.

> The winter used to be colder. It would get down into the minus 40s, but this year it only got to minus 37. Albert Gilpin, Wemindji Elder, July 2nd, 2010.

> It's not as cold in the winter as before. When I was a kid, I used to find it so cold, but that doesn't happen anymore. Just the past few winters, like 3 or 4, it wasn't cold at all. Leslie Kakabat, Wemindji Airport Weather Officer, July 19th, 2010.

> In the winter, it doesn't get as cold as before. It used to get to -40, but now not as cold. Minnie Matches, Wemindji Elder, July 26th, 2010.

In addition to warmer and shorter winters, the community experiences less snow that melts much faster and much earlier. This affects the spring months, which were much wetter in the past. Individuals reported that there is much less rainfall in the spring, which has led to a shortage of water. According to George Kudlu, drier winter and spring months have caused a decrease in the runoff of rivers emptying into James Bay over the past few years. George claimed that this in turn has caused some previously submerged rocks and shoals to become exposed, which poses a risk to individuals traveling by freighter canoe who may not be aware of these new and potentially hazardous obstacles.

Flora/Fauna

Informants provided detailed accounts of their observations concerning the arrival of new animal species, changes in the abundance of certain wildlife, behavioural changes in some animals, and changes in the types or relative distribution of vegetation.

> The animals know the changes, they notice. Minnie Matches, Wemindji Elder, July 26th, 2010.

> The decrease in snow this year had an impact on the fur animals. Edward Georgekish, Director, Cree Trappers Association, Wemindji Chapter, July 13th, 2010.

> There are caribou here now, but there weren't any here before. They've seen a lot of caribou these days. Sinclair Mayappo, Wemindji Elder, July 13th, 2010.

> There has been an increase in the amount of grass that grows in the goose feeding areas. It covers over a lot of their food. Fred Blackned, Wemindji Elder, June 24th, 2010.

These statements convey the interrelatedness of several themes of climate change: less snow leads to poor quality of fur on species like beavers, fox, marten, and lynx; and a longer growing season increases the production of shrubs and other forms of undergrowth.

All 20 informants spoke to the theme of flora/fauna in relation to climate change, with 15 of them mentioning changes in the Canada goose hunt. These individuals had observed a marked decrease or shift in the Canada goose migration through their territory, which has made it more difficult for them to access this important traditional food source.

> There are hardly any geese in the Bay now, and there are hardly any stopovers. Fred Blackned, Wemindji Elder, June 24th, 2010.
>
> The geese don't land in the Bay because there is nothing to eat. There is mud covering the eelgrass. Albert Gilpin, Wemindji Elder, July 2nd, 2010.
>
> No eelgrass means no geese. Sam Georgekish, July 6th, 2010.
>
> The spring goose hunt was really bad. Because of the early spring there was no snow and the geese flew over and didn't respond to goose calls. Edward Georgekish, Director, Cree Trappers Association, Wemindji Chapter, July 13th, 2010.
>
> My husband only caught one goose this year, compared to around 40 in past years. Minnie Matches, Wemindji Elder, July 26th, 2010.

Another observed change in Wemindji's flora and fauna is the presence of foreign and potentially invasive species. Several informants mentioned a significant increase in the number of bald eagles compared to the past. These birds, once endangered, are protected by provincial and federal laws which include a significant fine if a hunter is caught shooting them. However, bald eagles prey on many species of geese and ducks and are widely regarded as a source of disturbance.

An increase in the number of moose in the territory, which some people have attributed to an increase in the production of undergrowth and less snow, has meant there are more available to hunt. On the other hand, one individual stated that the presence of moose has disrupted his goose hunt on several occasions.

Many of the concerns of community members with regard to changes in flora and fauna are also echoed in the CTA's (2011) report: in Waskaganish, bald eagles are affecting the behaviour of Canada geese; long-necked geese seem to be on the rise, and their migration patterns are changing; an increase in the growth of vegetation along the shore has led to a decrease in the geese feeding there, and; there is an increased number of sightings of turkey vultures in the region. Positive in some cases and negative in others, changes in flora and fauna are definitely affecting communities across the Eeyou Istchee.

Snow

Changes in the timing and distribution of snow were closely tied to changes in weather patterns and seasonal shifts. A consistently held observation was the marked change over the last three to four years in the amount and distribution of snowfalls.

> There is more snow on the coast area than inland compared to the past. Daisy Atsynia Sr., Wemindji tallywoman, June 23rd, 2010.
>
> There is less snow than before. Sinclair Mistacheesik, Wemindji Tallyman, June 29th, 2010.
>
> It snows quite a bit this year inland to the east. Albert Gilpin, Wemindji Elder, July 2nd, 2010.
>
> There was hardly any snow this past winter. Edward Georgekish, Director, Cree Trappers Association, Wemindji Chapter, July 13th, 2010.
>
> We used to get like 4 feet of snow, but this year it was much worse; it was the worst year in terms of less snow. Sinclair Mayappo, Wemindji Elder,

July 13th, 2010.

> It snows less in winter every year. Fred Stewart, Wemindji tallyman, October 24th, 2010.

The quality of the snow has also changed. At least two informants described the snow as much softer than before, especially in November, and that it was often too soft for them to travel by snow mobile. Others mentioned that the snow had the consistency of baking powder, and that it was very dry with no water, causing it to melt more quickly. Yet another informant reported that the snow was much wetter than before, and that he could no longer wear his moccasins, as they would soak through. While these accounts appear contradictory, both informants were consistent in observing unprecedented changes in the quality of the snow.

Ice

The presence of ice on inland lakes, small rivers and on James Bay Ice is central to the continuity of Cree traditions and lifeways. The rugged and indented shoreline makes travelling by snow mobile or ATV challenging and time consuming in contrast to the smooth surface for travel provided by the ice. Also, fish comprise an important component of the traditional Wemindji diet and in the winter months are only available by ice fishing. All hunting territories used by community members have access either to the Bay and/or lakes and rivers. Concerns about changes in the quality of ice and its impact on travel and safety were raised by many informants:

> I noticed that the ice was thinner last year. I was afraid to go out on the ice last year, I didn't want to go. The ice wasn't that thick, that's why I was afraid. Leonard Asquabenaskum, Wemindji Tallyman, October 24th, 2010.

> You used to be able to go out on the ice during Goose Break at the beginning of May, but you can't anymore. Sinclair Mistacheesik, Wemindji Tallyman, June 29th, 2010.

> The ice is soft, very soft. It's dangerous to go on, both inland and in the Bay. It is thinner and soft. […] You have to know where the ice doesn't freeze, and the younger generation doesn't know. There is no one to tell them. Albert Gilpin, Wemindji Elder, July 2nd, 2010.

> The changes in the ice are the worst. George Kudlu, Wemindji Elder, July 9th, 2010.

> The places where I was taught that it wasn't safe to go on because they don't freeze over are getting bigger. Sometimes they don't freeze over at all, like this past winter. Albert Gilpin, Wemindji Elder, July 9th, 2010.

Falling through the ice poses great risks for Cree hunters and trappers. In fact, reference to the tragic death of a member of the Eastmain community to the south of Wemindji this past winter when he fell through the ice was made during many interviews and conversations. In Wemindji during the spring of 2010, several families were stranded at goose camps on offshore islands because the ice was not safe to return l back to the mainland.

Several informants provided descriptions of changes in the quality, colour and composition of the ice.

> The changes in the ice are worst. […] The ice is thinner and it has three layers now – ice then a little water, ice then a little water, ice then a little water. George Kudlu, Wemindji Elder, July 9th, 2010.

> The lakes were very slushy this year, making trapping conditions treacherous. […] The ice is usually four feet thick, but this year it was only two feet. The bottom layer of ice that was usually hard was gone, and they've [Elders] never seen that before. Edward Georgekish, Director, Cree Trappers Association, Wemindji Chapter, July 13th, 2010.

> The ice wasn't good this year, it was white, it was really white. There's a difference between the ice when it's clear and when it's white. The clear ice is good. The white ice melts faster. Sinclair Mayappo, Wemindji Elder, July 13th, 2010.

> You know that ice that is clear? There wasn't much of that last year. Last winter there wasn't that much. It's better, when there's lots of that, that

> colour, it's better. Like last winter when I was making a whole in the ice, there was slush, ice and slush, and the ice was soft. That's what I noticed last year. Leonard Asquabenaskum, Wemindji Tallyman, October 24th, 2010.

The consistency in these descriptions of changes in the ice was noteworthy. Details of changes in colour, the presence of layers of ice and slush or water, and the ice being "soft" came up again and again. This is not surprising given that the quality of the ice can mean the difference between catching fish or not, or being able to travel home rather than getting stranded.

Celestial bodies

Indigenous observations of changes in celestial bodies have been described by others (see for example the film *Inuit Knowledge and Climate Change*, Igloolik Isuma Productions, 2010). Changes in celestial bodies, particularly the sun, moon and stars, were noted with great concern by 4 senior Wemindji hunters and linked to recent changes in climate. According to Sinclair Georgekish, the sun, moon, and stars have traditionally been used by Crees as weather predictors and for navigation. Many older Crees continue to rely on these tools with more confidence than modern electronic technology such as GPS units. For them, the stars, moon, or sun will always work (unless covered by clouds or fog), whereas a GPS can fall victim to dead batteries or other malfunctions. As such, changes in previously-unfailing celestial bodies, including changes in the orientation of the sun, moon, and stars, as well as the length of the night, are of concern

> There is a big change in the last few years in where the sun rises and sets. The sun used to set on the south side of the mountain near my camp, but now it sets on the north side. […] There is a change in the location of the Big Dipper. Fred Blackned, Wemindji Elder, June 24th, 2010.

> The full moon used to indicate a change in the weather patterns or a big storm, but that doesn't happen anymore. […] A lot of people, we are

> finding that the nights are getting shorter. Like at 1:30 in the morning, you see the light coming. Compared to a few years ago, the night is shorter in the summer. Sinclair Georgekish, Wemindji Elder, July 9th, 2010.
>
> The location where the moon used to set has changed, and it looks much closer than it used to. […] The position of the sun has changed. It's more north and a lot longer. This means that the Earth has twisted a bit and we are more north. George Kudlu, Wemindji Elder, July 9th, 2010.

These individuals all mentioned that the changes that they had observed in celestial bodies were strange because they had never heard their Elders talk about such changes in the past. They were unable to provide an explanation for these changes and all expressed concern for the loss of a valuable tool, guide or predictor.

2.4.2 "The snow…it Calls Peoples' Spirits with it when it Goes"

Cree observations and understanding of change extend beyond the physical manifestations of change addressed above. Their perspective is informed by a worldview or cosmology that is defined by a close respect for and relationship with the natural environment. Many Elders possess a wealth of knowledge about natural phenomenon and provide insight and guidance to others regarding the occurrence and interpretation of new and strange events. Stories, myths, taboos and superstitions are often used to assist in their explanations, many of which identify indicators, triggers or a foreboding of a change in weather conditions as well as the possibility of human or non-human intervention in or control of those conditions. A selection of some associations that were made by informants include:

- Seeing a lynx or bear at a strange time of year or in a strange place is an omen of something bad.
- A bird that gets trapped inside a building must be killed; if it escapes, it will bring bad luck.
- Pointing at certain islands on the Bay will cause the wind to change, or will bring very bad weather.
- Blowing on a fire will bring the wind up.

- Seeing a duck/loon fly inland means bad weather is coming.
- Seeing the tracks of certain animals indicates a change in the weather.
- If it storms for a few days on the Bay (high winds, fog, rain), there will be good weather for 4-5 days after

The possibility of a cause-and-effect relationship between certain natural and human events has important implications for how people understand and behave in response to climate change. According to Leslie Kakabat, the Weather Officer at the Wemindji Airport, the Wemindji Cree have learned from their Elders that if they see a halo around the sun, they should prepare for bad weather. Leslie claimed that because there has been consistency in Elders' ability to predict, their knowledge has been and continues to be valued in its ability to explain the otherwise unexplainable.

There is a deeply held understanding that the spirits of non-human entities are capable of acts of retribution. A taboo mentioned by five informants warns against pointing at the outer islands when traveling by freighter canoe on the Bay. According to the taboo, if a person points at the islands, the wind will come up. According to Bradley AJ Georgekish, one of five informants who described the island taboo, the spirits of the island are disrespected by being pointed at, and in retaliation cause a change for the worse in the wind or weather. One informant stated that he had been told this taboo by his father, while another said a group of Elders had told him. I witnessed firsthand people's compliance with this restriction: when travelling out in the Bay on two separate occasions, Cree guides restrained from pointing to islands, preferring to gesture with their heads or describe the location orally.

Another important aspect of Wemindji Cree cosmology is a shared belief in the agency of non-human entities. The animistic beliefs of the Wemindji Cree assert that

natural entities have agency and can play an active role in determining the direction of certain events. Many of the stories shared by informants demonstrated this feature of the belief system. During an interview with the oldest informant, for example, she revealed that she had heard from her Elders that when snow melts early and quickly, it calls people's spirits with it. The spring of 2010 was associated with an early and very rapid snowmelt. It also marked by a high number of suicides in the community. The informant went on to explain that those individuals had been called by the spirits of the melting snow, and that is why they had taken their own lives. In this case, she explained, there was nothing that anyone could have done to avoid the suicides; the influence of the snowmelt was simply too powerful.

While the power of non-human agencies may limit the ability of humans to intervene in the outcome of some events, there is a strong sense of cause-and-effect between the actions of humans and the ensuing phenomenon. The taboo against pointing at islands is a clear demonstration of this: if you point to the islands (cause), the wind will come up and the weather will change for the worst (effect). George Kudlu, an Inuit man who married a local Cree woman and has lived in the community for 30 years, is self-described and described by others as being very spiritual. For George, depositing ashes from a cigarette or the wood stove on the beach at his late father-in-law's cabin on Cape Hope Island would make the wind drop and make travelling easier. He claimed that laying down ashes was a sign of respect for the spirits on the island, who in turn would calm the winds. In this case, the ritual has a positive cause-and-effect outcome. Another informant explained that when he was a child, he blew on the fire in his grandfather's teepee to help it burn. Upon seeing this, his grandfather became very agitated, berating

his grandson for attracting bad spirits that would stir up a storm. Sure enough, within an hour, the weather had changed and a storm kept the family stranded for several days. It was not until a special ceremony was executed that the weather settled. This informant claimed that to this day he has never blown on a fire because of his fear of attracting evil spirits.

Legends and stories about the agency of humans in relation to natural entities are widely known among Cree communities. Three informants mentioned a legend thought to be associated with the neighboring community of Chisasibi that describes how the Cree people came to have seasons. The legend, entitled *The Quest for Summer*, begins by describing a time when Cree people lived in eternal winter (Natachequan, 1997). A young boy in the community becomes so fraught following the death of his grandfather, that other community members decide that retrieving summer and bringing it to him is the best hope for cheering him up. After a long quest that draws upon the cooperation, respect, and resourcefulness of the community, they succeed in stealing summer from a neighbouring community, highlighting the potential for human intervention in relation to natural phenomenon, such as the seasons. The significance of this and other legends is described more fully below.

In recent years, changes in local, regional and global climatic patterns have begun to undermine the validity of local knowledge and practice. The observations described in Table 1 indicate that climate-related changes are occurring. Whether these are indicative of cyclical climate variability or irreversible climate change is more difficult to ascertain. Nonetheless all 20 informants interviewed observed some manifestation of climate related change and from the perspective of at least three informants, these changes are

having serious consequences on the validity and relevance of long established indicators and predictors. For example, weather patterns on the Bay now change so quickly that while some predictors remain valid, others are less valid and some are not longer valid at all. As George Kudlu and Sinclair Georgekish stated, if there is a particularly severe storm event on the Bay, they can no longer be confident that more stable weather, typical in the past, will follow; rather, storms increasingly follow each other quite closely. Similarly, according to Beverly and Priscilla Mayappo, a loon flying inland no longer guarantees the approach of bad weather. According to Leslie Kakabat, these changes have caused many people (younger generations, especially) to question the Elders' knowledge: Why would a man listen to his grandfather's warning about a halo around the sun if he has seen the halo before without any bad weather after? Why would anyone be convinced that a lynx sighting is indicative of an imminent death if no one died following the last sighting?

Climate change has undermined the reliability of the Elders' predictors, causing some community members to begin to question the beliefs and traditions of the past. Leslie Kakabat expressed his concern that if people no longer have the faith in the Elders and their beliefs, this will undermine the spiritual fabric that holds the community together. The changing climatic conditions are also causing many Elders to lose confidence in their own knowledge. As George Kudlu so succinctly stated:

> I can't read what weather we're going to have anymore, and the radio and television are always wrong too! I can't read by my own eyes now. At 66 years old, I used to know that. Now I feel like I am 6 years old (July 8th, 2010).

George's statement, similar to concerns expressed by other informants, reflects a growing sentiment that climate change has begun to undermine the reliability of the knowledge that the Elders pass down.

2.4.3 Short-term coping mechanisms

Climate change is an increasing reality for the community of Wemindji, with many individuals affected on a day-to-day basis. Of the 20 individuals formally interviewed, 15 were asked if the climatic changes they have seen are a concern or worry for them. Of those 15, 11 of them (73%) responded positively, saying some changes were a source of worry or concern for them. Interestingly, of the four who reported they were not worried or concerned, three are women. One of these women claimed that because she wasn't engaged in hunting or fishing-related activities, the changes didn't affect her directly, but that they are of greater concern for her husband who is a hunter.

While concern related to climate change is evident, the short- and long-term effects of the changes the community is experiencing are difficult to identify. Interactions between different causative factors, their potential outcomes, and the changing context that affects how community members observe and respond to them are complex. Nonetheless, discussions with community members did highlight various coping mechanisms that have enabled them to respond to changes. These strategies can be organized into three main categories: modifying the location of harvesting activities; mixing or omitting species that are harvested; and modifying the mode and/or timing of travel. Table 2 describes some of the key coping mechanisms and adaptive strategies that were described by informants.

Since most hunters have access to a combination of inland and coastal hunting

grounds, modifying the location of harvesting activities is relatively easily done. Thus, when ice conditions are too uncertain on the coast, some families choose to go inland to hunt, trap, and fish. With respect to dangerous sea ice conditions during the spring of 2010, one informant claimed:

> It's much safer to go up the road. We go inland instead of going out to the coast. Then when it's safe we go out to the camp [on the coast]. Leonard Asquabenaskum, Wemindji Tallyman, October 24th, 2010.

Several informants spoke of similar experiences, claiming that when conditions on the Bay are too unpredictable, they choose to engage in hunting, fishing, and other harvesting activities further inland.

Changing the location of harvesting was also mentioned in the context of the displacement of certain species that are hunted or trapped.

> Because there aren't as many white ptarmigan [along the coast], some people go inland on the Trans-Taiga [Highway] to hunt them. Daisy Atsynia Sr., Wemindji Tallywoman, June 23rd, 2010.

> Some people go hunt further south and inland since you can get more geese, but this leads to trouble with the police because the hunters don't have gun permits down there. Sam Georgekish, July 6th, 2010.

In these cases, as well as others that were mentioned, hunters have chosen to follow the species they harvest, in some cases quite far (500km +), rather than switching species or going without.

A second coping strategy involves adjusting the assortment of species harvested. This includes replacing species with others as well as simply omitting a species. For example, many individuals have observed a decrease in the number and quality of Brant geese:

> Brants, I didn't see that many. They say they don't taste good anymore either. I got Brants last year; I got really sick. Leonard Asquabenaskum,

> Wemindji Tallyman, October 24th, 2010.
>
> There are hardly any Brant geese anymore. Irene Mistacheesik, Wemindji Elder, June 29th, 2010.

With fewer Brant geese overall and the risk of sickness associated with them, many individuals simply pass up this species. Canada geese also play an important role in their diets, but according to informants, there are fewer and fewer in the area. This may be as a result of redistribution of the Canada goose population inland and away from the coast, which the community attributes to variables including climate change, the presence of hydroelectric reservoirs inland and to the north, and the increasing use of helicopters in the region (see Peloquin, 2007 for a more detailed description). These reservoirs draw many geese inland, resulting in a change to the traditional migratory pattern of this species (McDonald *et al*., 1997). According to several community members, hunters have also switched to the sub-species of Canada geese that they harvest. In the words of one informant:

> Some people are switching to hunting the long neck variety, but this is a fall-back strategy since they usually eat the short neck traditionally. We must get our traditional food, but the long neck is not the one we usually eat, it is less desirable. Edward Georgekish, Director, Cree Trappers Association, Wemindji Chapter, July 13th, 2010.

Because Canada geese are of cultural significance to Wemindji Cree, it would appear they are choosing to harvest a less desirable sub-species, rather than simply eliminate it from their diet[5] (Sayles and Mulrennan, 2010).

A third category of coping strategy involves changing the mode and/or timing of travel. Many community members have taken advantage of the emergency helicopter

[5] This strategy of switching from the short to long neck subspecies of Canada goose also represents a longer-term adaptive strategy, since it will require for a larger-scale cultural modification. For example, community members will have to adapt to new ways of hunting the long neck Canada goose, and perhaps modify their "taste" for its meat.

airlift service offered by the CTA in order to get to and from camps because of dangerous ice conditions. While this strategy is a relatively new option in the community, the Director of the Wemindji Chapter of the CTA, Edward Georgekish, expressed concerns that it was not sustainable over the long term. Hiring a pilot and helicopter even for one hour costs the community thousands of dollars. He also admitted that the need for helicopters or emergency support more generally will inevitably increase as climate change continues to affect the community.

Helicopters are also associated with disturbance to wildfowl and other species. Sammy Blackned reported that several tallymen have created "no-fly zones" over their hunting territory prohibiting helicopters during critical periods of goose migration. The community is thus faced with a dilemma in which climate change has prompted the use of helicopters as an alternative, safer option for travel, but one that is not cost effective over the long-term, and which can further exacerbate climate-change related impacts (for a further discussion of this dilemma, please see Syvanen, 2011b).

An alternative response to unsafe ice conditions is to avoid travelling on it until its safety has been confirmed. Some hunters, particularly younger hunters, have begun to make use of text messages as a way to instantly share information about ice conditions with others. The dissemination of this information also occurs via the community radio station, satellite phones, as well as over the short-wave "bush" radio that many families use.

Several individuals also spoke about the desirability of reintroducing sled dogs as a safer mode of travel on questionable ice.

> Dogs are better than snow mobiles […] snow mobiles can't go on thin ice, the dog knows where the thin ice is and won't go there. George Kudlu, July

9th, 2010.

> Dogs are very good on the ice. They can read it very well. My father used to be able to travel from Wemindji to Moosonee and Chisasibi. Alan Matches, July 22nd, 2010.

> We might have to bring back the traditional method of a dog team, since this is the safest way to travel. You always have a canoe on your dog sleigh, so even if you go through, you have the canoe to float on. Edward Georgekish, July 13th, 2010.

Relying on a dog-team as a back-up mode of travel when ice conditions are less safe might represent a short-term coping strategy that is less costly for the community. However, some informants did not consider this a viable strategy because the community no longer has the dogs needed for teams. In the past huskies were used, but these were all eradicated from the community in a short sighted and unnecessary culling, according to George Kudlu. Other informants consider snowmobiles to be easier to maintain. Overall, the inconsistency between peoples' responses and their differing views on the issue of dogs versus snow mobiles may represent an important process by which individuals work through the feasibility and desirability of different coping options. In particular, it may represent an essential means by which they cope at a psychological level through the establishment of shared concern with others, as well as at a practical level through decisions about how best to respond to change personally and as a community.

In general, several of the responses mentioned by community members were also highlighted in the CTA (2011) report, including: the use of helicopters to access the land; a change in the timing of the hunt to reflect changing animal behaviors; a change in the timing of travel to the land; and an increased reliance on other sources of food to compensate for a decrease in the availability of traditional food sources. The consistency of Wemindji Cree responses to climate change with those being employed in other Eeyou

Istchee communities contributes to the CTA's initiative, serving to increase knowledge about the impacts throughout the region.

2.4.4 Long-Term Adaptive Strategies

Many of the long-term adaptive strategies identified during interviews and conversations with community members have evolved and been transformed from short-term coping strategies into more permanent, well-established, and community-wide practices that have the potential to support adaptation to climate change over the longer term. These include: adopting new forms of technology for disseminating information concerning the location of species or the safety of ice conditions, the establishment of a coastal route, a sustained effort in maintaining opportunities for knowledge transmission, participating in the wide-spread dissemination of their experiences, and the strategic adoption of PAs.

The adoption of new technologies and forms of media for information dissemination has the potential to serve as a long-term adaptive strategy in Wemindji. Several individuals mentioned using cell or satellite phones to call or text others about the arrival of geese within the territory. As the geese adjust their migratory behavior, often traveling during the night and remaining within the territory for a shorter period than in the past, the use of instantaneous alert systems can support adjustments in the behavior of hunters, allowing them to know sooner the timing and location of the geese. As geese travel northwards along the James Bay coast, more southerly Cree communities have begun to alert communities further the north that the geese are coming. Over the long-term, this strategy can minimize uncertainty for hunters and better enable them to adapt

to changes in the Canada goose populations and behavior[6]. Similarly, creating a more formal and official monitoring program for ice conditions, with community-wide dissemination of results via text message or radio broadcast would allow the community to adapt as ice conditions continue to change. The foundations for this program are already in place:

> Trappers are making use of helicopters to go out and check the conditions of the ice from the air, with Elders taking part in the surveys. The precautionary measures are expensive but entirely necessary. Edward Georgekish, Director, Cree Trappers Association, Wemindji Chapter, July 13th, 2010.

This initiative also reflects community awareness and recognition of the importance of Elders' knowledge. In supporting and making this knowledge available to the entire community through various forms of media it can promote the transmission of knowledge, contribute to improved preparation of hunters, and minimize unnecessary injuries or loss of life due to dangerous ice conditions. Warnings and notices about dangerous ice conditions and the importance of increased vigilance when going out on the land and water have appeared in recent years on websites, newsletters and magazines. For example, in March of 2010, the following public announcement by Grand Chief Matthew Coon Come was included in *The Nation*:

> "Ice is disappearing more quickly than usual on our lakes, rivers and in the Bay. […] If we take some extra precaution like checking the thickness of ice around our camps and near our commonly traveled routes, we can all enjoy a safe and healthy cultural break." (CRA and Grand Council of the Crees: 26).

These types of public notices, used in concurrence with other systems of information

[6] The behavior of Canada geese has been affected by a number of environmental stressors, other than climate change, including the presence of the hydroelectric reservoirs inland. Please refer to Peloquin's (2007: 101) work for a more complete discussion of how these multiple stressors affect the migratory path and behaviour of Canada geese in the region.

dissemination such as bush radio announcements, can serve as a long-term adaptation to changing ice conditions within the community as well as within the greater Eeyou Istchee region.

A second response that was identified as having the potential to support adaptations to changing ice conditions over the long-term is the creation of a coastal travel route. As mentioned above, the rugged landscape of much of the territory, which is crisscrossed by rivers, muskeg, and large granite outcroppings, makes traveling by snow mobile or ATV more difficult than using the smooth ice surface of lakes, rivers, and the Bay. However, because ice conditions are becoming more unpredictable, a maintained land-based trail would allow hunters to travel to and from their hunting territories safely, both along the coast and inland. Regardless of high costs and a need for the approval and support of tallymen whose hunting territories would be crossed, an employee of the Wemindji chapter of the CTA praised the idea, pointing out that it would make traveling down the coast safer in both winter *and* summer. Despite being a huge undertaking for the community, it could mean safer traveling conditions into the future.

A third long-term adaptive strategy is seen in efforts by the community to support and encourage knowledge transmission from Elders to the youth, which was identified as a particular challenge for the community's ability to adapt to climate change in the long term.

> The youth no longer listen to the Elders' stories, advice, or knowledge. Daisy Atsynia Senior, Wemindji Tallywoman, June 23rd, 2010.

> For us, the knowledge was passed down from our Elders (fathers and grandfathers), but now the youth are having a hard time – now the youth need all the help they can get and we need to pass on the knowledge so that they can take care of the land. Sinclair Mistacheesik, Wemindji Tallyman, June 29th, 2010.

> The younger generation doesn't know. If you try to tell them something that you have learned in the past, they won't listen. Albert Gilpin, Wemindji Elder, July 2nd, 2010.

In response to an increasingly apathetic youth, the community organizes traditional events such as the Old Factory Visit, the Old Factory River Canoe Expedition, and the Wemindji Moose Festival. During these events, youth are encouraged to observe Elders as they perform traditional activities and then participate themselves. For the Cree, traditional learning happens by watching and then doing (Fred Stewart, Wemindji Tallyman, pers. comm., 2010). In the short-term, these activities are important as they foster a respectful intergenerational relationship between youth and Elders. Over the long-term, they also represent an important adaptive strategy in the face of climate change, since they ensure a forum where knowledge sharing can occur.

The widespread dissemination of Wemindji Crees experiences of climate change represents a fourth long-term adaptive strategy. At a smaller-scale, community-level governing bodies, such as the CTA, Youth and Culture Departments share information amongst themselves about how community members are responding to changes. This dialogue allows the community to monitor what types of changes are occurring at the local level. At a broader scale, the regional CTA manages Cree GeoPortal[7], an online climate change monitoring program that aims to decrease individual vulnerability to the manifestations of climate change by enabling knowledge sharing within the community as well as the entire Eeyou Istchee about the progression of climate change in the region. The potential benefits and limitations of this project as a short- and long-term response to climate change are described below.

[7] For more information on the Cree GeoPortal climate change monitoring program, please visit the following website: http://www.creegeoportal.ca/geoportal/index_climate_change.php

Finally, the establishment of PAs as part of the Wemindji Protected Areas Project represents an innovative adaptive strategy that responds to external development pressures as well as concerns related to climate change. Much research (see for example Peters and Myers, 1991; Halpin, 1997; Hannah *et al.*, 2002; Hannah, Midgley, and Millar, 2002; Scott, Malcolm and Lemieux, 2002; Suffling and Scott, 2002; Lemieux and Scott, 2005; Scott and Lemieux, 2005; Hannah *et al.*, 2007; Hannah, 2008; McLeod *et al*., 2009; Lemieux *et al*., 2010) has focused on the ability of PAs to function while climatic changes affect the species and habitats they protect. However, more recently it has been argued by others (see in particular Lemieux *et al.*, 2010) that PAs represent an important adaptation to climate change, since they ensure that both the ecological as well as socio-cultural elements of an environment are protected. Lemieux *et al.* (2010) demonstrate that because sub-Arctic areas may be more vulnerable to the effects of climate change, they require increased measures of protection and benefit from PAs that enhance connectivity and biodiversity, while minimizing direct and large-scale human-induced changes. The Paakumshumwaau-Maatuuskaau Biodiversity Reserve and proposed Tawich (Marine) Conservation Area (which is proposed to encompass the coastal and marine territories of Waskaganish, Eastmain, and Chisasibi in addition to Wemindji) can fulfill these two important features. In particular, when considered in conjunction with the PAs already established in Western James Bay and in and adjacent to Hudson Bay, these PAs have important implications for the enhancement of connectivity and protection of flora and fauna that will be affected by climate change, such as the most southerly polar bear population in the world (Mulrennan *et al*., 2009). The establishment of PAs also supports research and public appreciation as well as

enhancing understanding of certain environments. Therefore, while a protected area cannot prevent climate change-related changes in ice, seasons, or species, it *can* pose limits on or prevent the potential added affects of hydro, forestry, or mining developments. The community of Wemindji is well-aware of the benefits of the protected area model (Mulrennan *et al*., under review) and has adopted it as a strategic adaptation that addresses the pressures of large scale development, seeks to protect culturally significant areas from these pressures, and allows the people of Wemindji to maintain a level of control over their territory.

2.5 Discussion

The observations made of and responses to climate change by members of the Wemindji community mirror many of the findings from Arctic contexts. Similar coping mechanisms and adaptive strategies are applied in these contexts with the overall goal to "minimize risk and uncertainty" (Jolly *et al*., 2002: 114). Arctic-based research has also sought to engage in similar kinds of long-term community-based monitoring that have been described by informants from Wemindji. Other approaches applied in an Arctic setting (Hovelsrud and Smit, 2010) highlight the need for continued community involvement and agency in the development of responses and policies. While these policies might reflect some community members responses, in some cases they do not adequately consider some of the more intangible and contextual aspects of climate change, which can lead to an incomplete understanding of the complexity of the observations and interpretations and may contribute to inappropriate, inadequate, or irrelevant policy measures. The importance of considering taking account of the wide

cultural context within which Wemindji Cree observations and interpretations of and responses to climate change are made is discussed below.

Beneath the thinning ice: the importance of context

It has been argued elsewhere that members of the Wemindji Cree community actively seek to maintain ties to the past while also embracing change (Sayles and Mulrennan, 2010). For these Crees, continuing to participate in traditional activities is extremely important in encouraging the continuity of beliefs and practices that have been part of their culture for millennia. The Old Factory Visit, the Youth Canoe Expedition, the Moose Festival, and the Blueberry Festival all provide opportunities for members of the community to engage in traditional activities and ensure that the knowledge of these traditions is passed down to younger generations. However, embracing change is also a feature of Cree lifeways, as reflected in the adoption of new technologies as well as recent initiatives such as the Cree GeoPortal and PAs development. Continued support of Cree culture and traditions bolstered by these new tools and initiatives has supported a level of confidence that the natural environment will self-sustain, and that climate change will not have devastating effects on community life.

Adaptive strategies also have implications for knowledge transmission. According to Mulrennan *et al.* (under review), "there is a strong feeling on the part of community leaders, Elders, and young people that mobilizing knowledge of the land is essential for revitalizing Cree teachings and reinforcing cultural identity" (23). Adaptive strategies such as a land-based coastal trail facilitate being on the land by allowing safer travel to and from hunting camps along the coast. However, this strategy may also contribute to a growing detachment from the land, with implications for hunters' knowledge and

understanding of the land. For example, during the winter of 2010/2011 senior hunters who could once describe ice conditions on the Bay in relation to thickness, consistency, and colour were unable to relay this information because they had been accessing the coast via the land-based trail on snowmobiles (C. Scott, pers. comm., 2011). While establishing a land-based coastal trail seems like a rational long-term adaptation to increasingly unsafe and unpredictable ice conditions, this example suggests that reliance on such a trail may also undermine knowledge transmission between Elders and youth in relation to ice conditions. Here, then, is an example of an adaptive strategy that may not align with the overall vision of the community for making a connection in "the communication between [the] Elders and [the] youth" (Cree Nation of Wemindji, 2009) with regard to "reading" the ice. Such dilemmas and compromises are inevitable in the search for adaptive responses but early recognition and discussion of the trade-offs involved in pursuing different adaptive options can lead to informed consensual decisions.

Myths, taboos, stories, and legends can also provide guidance in the selection of appropriate coping and adaptive strategies. Their role in fostering sustainable relations between Wemindji Crees and the land was mentioned previously. This is consistent with what Turner and Berkes (2006) refer to as the "ecological understanding model," which posits that people who understand their environment learn to live within its constraints. According to Turner and Berkes (2006), legends play an important role in promoting understanding, and in doing so have implications for conservation, since these legends often feature the experience of "going without". Consider, for example, *The Quest for Summer* legend. This legend does several things. First, it suggests that at one time in the

past, Cree people had to live without summer, and this was a time of great hardship. This experience would have instilled in people a great longing and appreciation for summer as well as confidence in their capacity to survive in difficult times. Second, it speaks to the achievements of past generations; Cree people had to undertake a great quest to retrieve summer. This feature of the legend instills a sense of gratitude and respect for their ancestors who made summer "possible". Third, it shows that summer can be "stolen" if it is not cared for properly; in doing so it might encourage people to take better care of nature's 'gifts. Legends such as this, which are passed down from Elders, often support conservation practices and respect for the natural environment and in doing so perpetuate the community's continued adherence of these practices. As argued elsewhere (Colding and Folke, 2001;Turner and Berkes, 2006), ecological understanding accumulated over generations and passed down in the form of stories and legends becomes embedded in the community's actions and management practices and contributes to the resilience of the community's social-ecological systems over time.

Another aspect of Cree cosmology revealed through various legends and taboos is the importance of human agency. Through stories, as well as their own personal experiences, people have learned that human actions can have real and serious consequences in nature, and that components of the environment have agency and will react to peoples' actions. An appreciation of such perspectives is essential to understanding local responses to climate change. For example, the practice of scattering ashes on the beach to placate the spirits and bring favourable weather may no longer be required if a land-based coastal travel route is available. However, for those who fear that the spirits might feel betrayed by this alternative and resort to acts of retribution, the

land-based route becomes problematic. This reinforces the importance of considering more deeply embedded beliefs and customs when planning for responses to climate change. Doing so may make the identification of responses more challenging, but it also plays a role in ensuring their appropriateness for the community.

Overall, the myths, taboos and legends of the Wemindji Cree belief system reflect a long-standing respect for the agency of environmental processes, rooted in extensive experience with and knowledge of nature. Over time, certain aspects of local knowledge become codified as legends, taboos and myths, which inform how people will act in certain instances. Taking account of this dimension of Cree cosmology and gaining a more contextualized sense of the actors (human, natural, and spiritual) that play a role in a community's experience of climate-related changes is essential to supporting a place-based response to those changes.

The CTA's GeoPortal project is one initiative that has an important role to play in this respect. Because it is directed and managed by several Cree collaborators, its approaches are often informed by the Cree worldview and motivated by locally defined goals. However if the monitoring program hopes to establish comprehensive monitoring in the region in the future, more precise data and more rigorous data-collection methods may be needed. For example, no specific individuals have been mandated to collect data; rather, any individual who wishes to make a contribution may do so. Also, the program has just completed its testing stage, with only three communities (Waskaganish, Whapmagoostui, and Mistissini) included, and it has not been widely advertised to other communities in the Eeyou Istchee. While it represents an opportunity for the community to take part in a long-term and wide spread collection and dissemination of data related to

climate change within the region, it faces the additional challenge of youth apathy as well as the difficulty in capturing the complexity of changes and the interrelated nature of them. Its successful implementation will depend on whether it can overcome these challenges.

2.6 Conclusion

From a community perspective, the Cree Nation of Wemindji is experiencing unprecedented climate change in its territory. According to community members, these changes are reaching far beyond the natural stochasticity that has defined this environment and to which their people have adapted over the last 5000+ years. Seasons no longer occur at the same time, weather patterns have changed, new species of plants and animals are being observed, and some of those that flourished in the past are disappearing or changing drastically. Experienced hunters who have depended on certain environmental predictors for generations can no longer "read" these predictors, and as a result, they are often left feeling lost.

This research documents the manifestations of climate change from a community perspective, including particular attention to the less tangible or more spiritual aspects of Cree understanding of climate-related change. By focusing on the important role that this cultural "embeddedness" plays, the research hopes to contribute to a more nuanced approach to studies of the human dimension of climate change and greater sensitivity to the range of considerations and trade-offs at play in the identification and implementation of appropriate coping and adaptive strategies.

On a practical level, it is hoped that this exploration of the strategies being considered and implemented by the Wemindji Cree Nation can contribute to a growing

pool of experience and expertise among northern communities in responding to climate change. In this respect, the potential of PAs as a possible adaptive strategy is an area that needs further consideration (Lemieux *et al.*, 2010), particularly given the number of PAs both proposed and recently established in northern regions and the uncertainty surrounding their to function within a context of unprecedented environmental change.

Overall, this paper calls for a greater consideration of context, which can inform research addressing the human dimension of climate change, particularly with indigenous communities. New and revised indigenous methodologies that break colonial and positivist boundaries are being called to action (Hodge and Lester, 2006; Louis, 2007). To that end, CBPR has the potential to support a more nuanced assessment of the experience of climate change and the identification of appropriate response strategies. Wemindji has been endowed with the institutional, political and social capital to face climate change head on. It is hoped that sharing their experiences will raise further awareness about the human face of climate change in the Canadian sub-Arctic and encourage further investigation in the topic.

CHAPTER 3

Climate Change in the Sub-Arctic: Applying a Framework of Vulnerability to a James Bay Cree Community

Abstract

Concerns about the rapid pace of climate change in the Arctic reinforced by political and economic interests in the region have supported scientific studies of climate change and the documentation of the human dimensions of that change. At the same time, relatively limited research on climate change has been conducted in the sub-Arctic justified by an assumption that changes in the sub-Arctic differ only in degree from those occurring in the Arctic. By exploring to what extent the approaches and findings applied in the Arctic are appropriate to and relevant for the sub-Arctic, this paper seeks to bolster support for sub-Arctic research. Through a case-study approach, it applies one established Arctic-based framework - the Community Adaptation and Vulnerability in Arctic Regions (CAVIAR) framework - to a sub-Arctic context. The Cree First Nation of Wemindji in mid-northern Québec is a resilient community that has adapted to environmental stochasticity for millennia, but is now experiencing the effects of recent climate change. As such, it represents an ideal case for the application of the CAVIAR framework in a sub-Arctic Canadian context. This paper highlights the vulnerabilities of the Wemindji community to climate change and addresses the subtle complexities of climate change at a community level in the sub-Arctic. In doing so, it calls for new directions and approaches to research in the sub-Arctic which can support more effective responses to climate change across Canada's northern regions.

3.1 Introduction

A defining feature of many indigenous populations is the close connection between society and surrounding natural environments (Berkes and Folke, 2000), which in the northern settings is often characterized by a high level of environmental variability (ACIA, 2005). This variability includes extreme weather conditions, which can exacerbate cycles of abundance and scarcity among certain wildlife populations (ACIA, 2005). Against this backdrop, recent manifestations of climate change are occurring at an unprecedented pace, with for example, the decrease in sea ice extent is 30 years ahead of previous estimates (Serreze, 2008). While mitigation efforts to reduce greenhouse gas emissions are being encouraged (Crowley, 2010), there is growing recognition that adaptation measures will need to be considered and adopted by northern communities

(see for example Budreau and McBean, 2007; "Adapting to Climate Change," 2007; Ford *et al*., 2010; Pearce *et al*., 2010; "Sharing Knowledge for a Better Future," 2011).

Research speaking to the situation in Canada's north highlights some of the adaptations of some First Nations and Inuit populations across the Arctic and sub-Arctic to the effects of climate change (see in particular Jolly et *al*., 2002; Nickels *et al*., 2002; Ford, 2008; Ford *et al*., 2006; Hovelsrud and Smit, 2010; Lemelin, 2010), with the majority of this research focused on communities "north of 60," or within an Arctic-defined setting.

This attention to the Arctic can be attributed to several factors. First, as mentioned above, climate change in the Arctic is occurring at an unprecedented pace, the impacts of which may have drastic impacts felt across the globe. As a result of the urgency of the situation in the Arctic, the last two to three decades there has been a convergence of science and politics that has funnelled significant funding into northern research. Scientific research began highlighting manifestations of climate change in the Arctic in the mid- to late-1990s, with the discovery of drastic changes in ice cover (see for example Johannessen, *et al*., 1999, Maslanik *et al.*, 1999, Rothrock *et al*., 1999, and Vinnikov *et al.*, 1999), coastal erosion and sea level changes (see for example Shaw *et al.*, 1998), thawing of permafrost (see for example Woo *et al.*, 1992 and Weller and Lange, 1999), and changes in the ranges of certain fish species (see for example Babaluk *et al.*, 2000). Alongside these scientific discoveries was a growing political recognition that an international response to climate change was needed. The 1992 Earth Summit saw the creation of the United Nations Framework Convention on Climate Change, which in turn led to the Kyoto Protocol of 1997. Interest in and support for Arctic-based studies

followed, resulting in several research initiatives, including the Arctic Climate Impact Assessment (ACIA), and the ArcticNet program.

Political and financial support for Arctic-related climate change research is also inextricably tied to the uncertainty about and concern for Arctic sovereignty and security. According to the ACIA report (ACIA, 2005), sea ice cover in the Arctic has declined over the past 50 years, and current models project an acceleration of this trend into the future. Longer melting seasons and less ice cover overall means that new shipping routes and a longer shipping season are realities that Arctic-adjacent countries must now consider, particularly as potentially resource-rich areas of the sea floor become accessible (ACIA, 2005). Such interests and concerns have become central to Canadian government agendas, as reflected in the development of "Canada's Northern Strategy" as well as in funding opportunities and support for Arctic-based research ("Fact Sheet: Northern Strategy", 2010).

A third force that has played an important role in eliciting support for Arctic issues has been strategic use of media and other opportunities by Inuit leaders and representatives to voice their concerns about the impacts of climate change. The Inuit Circumpolar Council (Canada) (ICC) has been particularly prominent in communicating the interests of Inuit across Canada. Collaborations and partnerships between Arctic communities and researchers have also arisen (see for example Jolly and Berkes, 2001; Fox, 2002; Jolly *et al.* 2002; Nickels *et al.*, 2002; Ford *et al*., 2006).

This focus on the Arctic has inevitably limited the attention other regions have received, particularly the sub-Arctic. Some exceptions to this trend included the Hudson Bay project, which was conducted in the mid-1990s (McDonald *et al*., 1997). More

recently, the Center for Indigenous Environmental Resources (CIER) has sought to increase the level of attention the sub-Arctic is receiving in relation to climate change (see for example the report entitled *Climate Risks and Adaptive Capacity: An Assessment South of 60 Degrees Latitude*, 2009).

Greater attention to sub-Arctic climate change is needed for numerous reasons related to the distinct and important ecological and social character of the region (Lemieux *et al.*, 2010). . For example, the area surrounding eastern James Bay represents the southernmost limit for polar bear populations (Mulrennan *et al*., 2009), and the northernmost limit for the North-American moose (Feldhamer *et al.*, 2003). Changes in the local climate, including possible increases in temperature and precipitation by as much as 7.1˚ C and 35.5%, respectively by the year 2080 (Allard, *et al.*, 2010), have the potential to affect the ranges of these individual species as well as the ecosystems of which they are a part. A possible northward migration of the boreal and temperate forest ecosystems of 515 km by the year 2050 will also have dramatic effects on the composition of species and habitats in the sub-Arctic (Allard *et al*., 2010). As such, it is critical to focus on the populations that will be affected by these changes since in many respects they are the most vulnerable and their local responses may be indicative of larger scale changes that will occur elsewhere later. Recent commitments made in Canada to the creation of representative protected areas (PAs) throughout the country (Dearden and Rollins, 2009) that will play a role in the protection of these species and habitats require the support of assessments that look into the possible effects of climate change (Lemieux *et al*., 2010). From a socio-economic standpoint, the outcome of governmental proposals such as the Québec government's *Plan Nord* will be affected by climate change, which

will likely improve conditions for hydro, mining, and forestry ventures in the next 50 years (Lemmen *et al.*, 2008; Allard *et al*., 2010). in order to reach the goals of sustainable development it is critical to explore the role that climate change will play in the future. Finally, there are many First Nations for whom the sub-Arctic region of Canada is home. According to the 2006 Canadian Census, of the total 1,172,785 aboriginal peoples in Canada, 46% continue to live in rural parts of the country ("Aboriginal Population", 2011) with many of them in sub-Arctic regions ("The Atlas of Canada", 2010).

In addition to a paucity of research that specifically addresses human dimensions of climate change in the sub-Arctic, the region faces further challenges because of the questionable relevance of the findings from Arctic climate change studies in a sub-Arctic context. This is tied to an assumption that solutions or responses to climate change in the Arctic will be directly applicable to sub-Arctic environments. While this may be partially true at a macro –level, it may be inaccurate at a scale appropriate to policy development (CIER, 2009). For example, many parts of the sub-Arctic will not experience the effects of wide-spread permafrost thawing, for example, but could experience drastic shifts in vegetation (see for example Lemieux and Scott, 2005). Other issues relate to the unique socio-economic position of Canada's sub-Arctic (CIER, 2009). The incompleteness of our understanding of the effects of climate change on indigenous peoples in Canada's sub-Arctic provided the motivation to carry out the research described here.

In light of the urgency for research into human dimensions of climate change in the sub-Arctic, it is advantageous to make use of well-established frameworks for research in the circum-polar region. One potential advantage of adopting these frameworks for a Canadian sub-Arctic setting is that they can produce comparable

results, which can then be used to evaluate the sub-Arctic in relation to the Arctic in terms of similarities and differences between the two. The CAVIAR framework will thus be applied to highlight some of the complexity and distinctiveness of the sub-Arctic in order to encourage more research in the region. The approach applied by CAVIAR is also consistent with emerging indigenous methodologies (such as community-based participatory research) that others (see in particular Louis, 2007, and Hodge and Lester, 2006) have encouraged.

A primary goal of the present research is then to apply this Arctic framework to determine the vulnerability of sub-Arctic indigenous community. A rapidly growing body of literature has shown that the arsenal of adaptive strategies utilized by indigenous groups is a strong determinant of their vulnerability to climate change; groups that that are able to adapt quickly and effectively are less vulnerable (Chapin *et al*., 2004; Duerden, 2004; Ford, 2008; and Ford and Smit, 2004). This literature has contributed to the development of the CAVIAR project over the last decade, which involves a robust framework that identifies the vulnerabilities/ adaptive capacities of communities in the face of climate change, and it has been applied in both indigenous and non-indigenous communities as well as in non-Arctic settings (Ford *et al*., 2006; Smit, *et al*., 2008; Smit *et al.*, 2010, Figure 2). The application of the framework fulfills the second goal of the research, that being to highlight both current and future vulnerabilities of Wemindji Cree to climate change in order to make a case for further research in the sub-Arctic .

In order to fulfill these goals, the research has involved collaborative, community-based research with members of the Cree First Nation of Wemindji, in mid-northern Québec (Figure 1), which has been described elsewhere (see for example Sayles and

Mulrennan, 2010; Peloquin and Berkes, 2009) as a resilient community. In 1975, the James Bay and Northern Québec agreement (JBNQA), placed Wemindji and its surrounding Cree communities under the jurisdiction of the Grand Council of the Crees, and the region is now referred to as the Eeyou Istchee. As inhabitants of one of the most dynamic coastlines in the world (Pendea *et al*., forthcoming) Wemindji Crees are no strangers to environmental stochasticity and the possibility of adaptation to change (Sayles and Mulrennan, 2010). Wemindji has also experienced social and cultural disruptions associated with the impacts of large-scale development, notably the James Bay hydroelectric project. The community is however recognized for its strong leadership and political capacity, as demonstrated by its involvement in the development, implementation, and management of both marine and terrestrial PAs[8] (Mulrennan *et al*., under review). These elements of resilience and adaptive capacity make Wemindji a relatively ideal setting in which to assess the value of the approaches to northern climate change research. In order to fulfill these goals, this research has sought to answer the two following research questions:

1) What are the current and future vulnerabilities that the Wemindji Cree face in relation to climate change, and;

2) How can the Wemindji case inform broader sub-Arctic research approaches?

This case is instructive in several aspects. First, it makes a much-needed contribution to the literature on sub-Arctic indigenous experiences of climate change by documenting the response of an exemplary sub-Arctic community in terms of its resilience. Second, through the use of a case-study approach, it provides an evaluation of

[8] For more information on the Wemindji Protected Area Project, please visit the following website: http://www.wemindjiprotectedarea.org/

the merits and limitations of existing approaches and frameworks used in the study of indigenous experiences of climate change. In highlighting not only the vulnerabilities but also the social-ecological context of the community, the research demonstrates that more must be done to consider the complexities of northern indigenous responses to climate change in order to fully capture their vulnerabilities and resilience.

3.2 Methods

The fieldwork involved two periods of research (20 June 20 – 3 August 3 and 20 to 25 October, 2010) over a total of seven-and-a-half weeks in the Cree village of Wemindji. During this time I worked closely with 20 informants, including three tallymen and the sole tallywoman of the community. The majority of the informants are senior hunters in the community. Two individuals are members of the community's Band Council, and one is the director of the local Cree Trappers Association (CTA). The hunting territories represented by informants included those located along the coast of James Bay as well as several further inland with no coastal access. These informants were considered experts by the community, and their selection benefitted from referrals made by both community members and other researchers familiar with the community.

During the summer fieldwork period, I was also able to work in close collaboration with several members of the Wemindji Protected Areas team, both from within the community as well as researchers from outside the community, an opportunity that proved useful for a clearer establishment of the research goals.

The primary vehicle for exploring Wemindji Cree vulnerabilities to climate change was participatory ethnographic fieldwork. Both semi- and unstructured interviews were carried out in addition to participant observation. Interviews focussed on the

identification of changes related to several themes of climate change, including: weather, seasons, flora/fauna, ice, snow, and celestial bodies. Informants also expressed how these changes were affecting them, both physically and spiritually. Finally, informants identified the types of responses they were using to deal with the challenges and opportunities associated with climate change. Interviews were usually carried out in English; however, in several cases, community members were mono-lingual Cree, and interpreters, who were either close friends or family members of the informants, assisted in the translation between English and Cree.

Participant observation allowed for an examination of how some Wemindji Cree interact with their environment, paying close attention to the same themes featured in the interviews. Participant observation also provided the opportunity to engage with community members in daily activities, which offered further insight into the complexity of the effects of climate change.

Interviews were recorded both with a digital voice recorder as well as using hand-written notes. The digitally recorded interviews were then transcribed, and along with hand-written notes, were organized thematically in order to facilitate a comparison with the findings of others (see in particular Jolly *et al*., 2002, and Jolly and Berkes, 2001) as well as to identify similarities and differences in informants' responses. In addition to an analysis of thematic changes, coping mechanisms and adaptive strategies were analyzed using the (CAVIAR) framework (Figure 2) to highlight the current and future vulnerabilities of the community.

In accordance with the CAVIAR framework, the first step of the identification of vulnerability in northern indigenous communities involves documenting the experiences,

knowledge, and observations of community members so as to establish current sensitivities, adaptive capacities and vulnerabilities (Ford and Smit, 2004; Ford et al., 2006; Smit, *et al.*, 2008; Smit *et al.*, 2010). In order to fulfill this step, informants were asked to describe their observations of specific manifestations of climate change and to explain how these manifestations affected their lives, both positively and negatively. The second aspect of determining current vulnerabilities is to identify and assess what types of current adaptive strategies or other responses the community is employing to deal with current sensitivities, Fulfilling this step required an analysis of discussions held with informants on the different types of short-term coping mechanisms and longer-term adaptive strategies that they have employed in response to the manifestations of climate change that they had described. CAVIAR does not explicitly differentiate between short-term coping mechanisms and long-term adaptive strategies; however as Smit *et al.* (2010: 5) explain, adaptive strategies are indicative of adaptive capacity, which "reflects an individual's or community's ability to cope with, adjust to or recover from an exposure-sensitivity." Based on the differentiation of responses in terms of coping mechanisms and adaptive strategies by others (see in particular Jolly *et al*., 2002), both categories are used here to better reflect the types of responses reported by informants. Working closely with the community fulfilled the requirement of acquiring primary-sourced testimonials and is consistent with the approach prescribed by CBPR. The work of other members of the Protected Areas research team (see in particular Peloquin, 2007, and Sayles, 2008) provided additional and crucial information concerning vulnerabilities.

The second stage of CAVIAR calls for an assessment of future vulnerabilities (Ford and Smit, 2004; Ford et al., 2006; Smit *et al.*, 2008; Smit *et al.*, 2010), and it

involves assessments made by both the natural and social sciences and community insights. The identification of future sensitivities in Wemindji incorporated community-level insights with evidence speaking to both natural and social impacts. For example, evidence from Lemieux and Scott (2005) Ouranos (Allard *et al*., 2010), and the CTA (2011) provided information with regard to possible future changes in temperature and precipitation patterns, the extent and distribution of animal and plant species, and some of socioeconomic impacts of climate change that Wemindji might experience. Contributions to the Wemindji Protected Areas Project were also considered here (in particular Peloquin, 2007: 101) with respect to changes in the Canada goose population, a species of important cultural significance for the Wemindji Cree.

The second component of this stage of CAVIAR involves the examination of the community's future adaptive capacity. In order to fulfill this component of an assessment of future vulnerability, key informants who are implicated in local resource management institutions in Wemindji discussed and identified how the community is planning for the future and how adaptive capacity might evolve given current conditions. Drawing insights from the types of responses employed and considered in other sub-Arctic indigenous communities (see in particular the work of CIER, 2009, Lemelin *et al*., 2010, and CTA, 2011) also allowed for an identification of potential responses that may be relevant for Wemindji.

One of the primary limitations to applying CAVIAR in the Wemindji case study were constraints imposed by the scale and scope of the research described here. The timeframe of my master's degree is six semesters, which meant that the fieldwork component had to take place over the course of four months during the third semester to

ensure enough time for analysis and write-up of the results. Also, the findings described here, unless otherwise stated, describe participatory research that was carried out by me as the sole investigator in collaboration with with my informants. The methodologies employed in CAVIAR research, on the other hand, have the benefit of teams made up of student and professional researchers, social and natural scientists, and local research assistants who can draw on and learn from each others' experiences in northern CAVIAR case study localities (Smit *et al*., 2010). This feature allows for more extensive fieldwork and analysis that can draw on a multitude of perspectives, which accounts for the richness of CAVIAR case studies (Hovelsrud and Smit, 2010). The encouragement and support of similarly extensive research throughout the sub-Arctic would do well to highlight vulnerability in sub-Arctic indigenous communities.

3.3 Findings

3.3.1 Step 1: Assessment of Conditions that Contribute to the Current Vulnerability of Wemindji Cree

Current Exposure-Sensitivities of Wemindji Cree

As prescribed by the CAVIAR framework, determining current vulnerability requires the identification of current exposure-sensitivities. Working closely with community members, we identified the local manifestations of climate change that appear to be of most concern to the community. These manifestations, organized thematically, are listed in Table 1. While a more detailed description of specific informants observations is made elsewhere (see Syvanen 2011a), the overall trends are described here. With regard to the weather, informants described more extreme weather events, large fluctuations in the temperature, changes in the relationship between the wind and the tide, and a decrease in the "readability" of the clouds, which have been used to predict

what future weather conditions. Seasonal changes that were discussed include a change in the timing of the seasons, with an earlier spring, a shorter winter, a longer summer, and fewer months with snow on the ground. In addition to winters being shorter, they are less cold and blizzard events aren't as common. All 20 informants mentioned changes in the flora and fauna of the territory, which they attributed to climate change. Of particular significance was the attention given to descriptions of changes in the migration pattern, behavior, number, and distribution of Canada geese, a species whose significance is described elsewhere (see in particular Peloquin, 2007). Informants also mentioned a higher number of bald eagles, turkey vultures, and moose in the region. With regard to flora, informants reported a higher rate of growth in vegetation along the shoreline, which appears to be growing earlier as well as faster. Observations of changes in ice were mentioned by nearly all informants, who spoke to changes in the consistency, colour, and extent of ice on both the Bay and on inland lakes and rivers. On different occasions, four informants made nearly identical descriptions of the ice now having three distinct layers with water and slush between the layers, which makes it unsafe to travel on. Changes in the snow described by informants were similar to changes in the ice in relation to an earlier melt and a change in consistency, with implications for modes of travel that depend on it (such as using a snowmobile). Also, informants have observed that snow melts much faster and not as much of it falls during the winter. Four informants also highlighted changes in celestial bodies. According to these informants, they have observed a change in the location of sunrise and sunset, a change in the location of the Big Dipper (Ursa Major) and the moon, and shorter nights during the summer. One informant, George Kudlu, attributed these changes to a "twisting of the earth," which he

stated has moved the location of Wemindji further north. Overall, several individuals spoke to the fact that so many aspects of the environment are changing so quickly, which makes them concerned about how the community will respond.

An additional element of exposure-sensitivity that was not covered in the thematic assessment of climate change but that was mentioned by several informants was the issue of a decreased interest of the youth of Wemindji in the traditional way of life. According to several informants, many youth are no longer interested in and no longer listen to the knowledge of the Elders. According to these informants, this increasing level of apathy among some youth makes the transmission of knowledge about climate change and the ability "to read" the environment much more difficult, especially in a context where certain aspects of Westernization and modernization are already challenging the traditional way of life.

Current Adaptive Strategies of Wemindji Cree

Vulnerability assessment under CAVIAR also requires the identification of current adaptive strategies, or the responses employed by community members to deal with exposure-sensitivities (Smit *et al.*, 2010). Three main exposure-sensitivities emerged in the informants' descriptions of their responses to the sensitivities they identified with respect to climate change. These included: changes in the ice with respect to an earlier breakup, unsafe conditions, and changes in consistency; changes in the Canada goose hunt, with respect to fewer geese available in Wemindji's territory and geese coming at different times, and; the decreased level of interest of the youth in learning about and engaging in traditional activities (Table 2). The short-term coping mechanisms discussed by informants related mostly to those responses that were being employed on an

individual level and tended to be ad hoc in nature. With regard to changes in sea ice, they related mostly to using new modes of travel to access camps safely, such as helicopters. Some informants also stated that they simply abstained from traveling on the ice and instead accessed camps via snowmobile or all terrain vehicle. In terms of more long-term adaptations, which included responses that could be applied at a community-wide level, informants suggested the importance of being more vigilant about ice conditions and adopting more community-wide information-sharing media whereby the condition of the ice could be relayed throughout the community via local radio announcements or text messages. Another long-term adaptation included the establishment of a land-based coastal trail adjacent to the shoreline of James Bay by the Wemindji CTA so that community members can access camps safely when ice conditions are unsafe. At least two informants also mentioned the potential for dog sled as an alternative mode of travel to snowmobiles for travel on the ice, since according to their experiences, dogs are better able to sense the thickness and safety of the ice.

With respect to sensitivities related to changes in the Canada goose population, informants described several types of responses. In terms of short-term coping mechanisms to deal with a decrease in the number of geese available for hunting in the territory, one informant mentioned purchasing geese from other communities that had a surplus of geese or were willing to sell them. In fact, during a visit to the small community airport that services Wemindji, I saw frozen goose carcasses being unloaded. These geese had been caught in a community south of Wemindji, and according to Wemindji's Culture Coordinator, had been purchased by the Culture Department for a traditional feast. Informants mentioned that the spring of 2010 had been a very poor year

for the goose hunt, and that the community was availing of the opportunity to access this important resource from another source. Another short-term coping mechanism availed of by informants for addressing changes in the goose population was to follow geese further inland or out in the Bay, in response to changes in their migratory paths. Informants admitted that this response is often less than ideal, since it requires more preparation and resources to travel inland, and traveling further into the Bay and out of the protection of the coastal offshore islands is often dangerous.

Responding to a decreased interest of the youth in the traditional way of life has been a challenge for the community, according to some informants including Edward Georgekish. According to Edward, local institutions such as the CTA work with the Wemindji Band Council office and community departments such as the Youth, Culture, and Health and Wellness departments work in collaboration to run knowledge transmission programs and programs in which Cree youth can gain experience of life on the land. The Old Factory Visit, for example, is a 10-day long event during which many community members travel to Old Factory Island approximately 40 kilometers south of Wemindji in James Bay. This island, and the islands surrounding it, was the original site of the settlement of Wemindji, then known as "View Comptoir" (or "Old Factory"). During this visit to Old Factory, youth and Elders are encouraged to participate in traditional activities in a setting where many of the modern distractions of town living are not present. According to Edward, the continued use of goose and fish camps during the goose hunt and summer fishing season also offers the youth an opportunity to attend, learn about, and engage in traditional resource management practices. These settings also allow for informal setting where community members can discuss climate change, which

can contribute to knowledge transmission about these changes and potentially decrease vulnerability in the long run.

3.3.2 Step 2: Assessment of Conditions that Contribute to the Future Vulnerability of Wemindji Cree

Future exposure-sensitivities of Wemindji Cree

According to the CAVIAR framework, the assessment of a community's overall vulnerability is incomplete without a consideration of future vulnerabilities (Figure 2). The identification of future exposure-sensitivity in Wemindji was based in part on an analysis of informants' descriptions as well as on the predictions and projections by several recent initiatives. For example, one informant in particular spoke to the increasing growth rates of flora in the region. This informant explained that he has seen an extension in the length of the growing season of trees in addition to an increase in the rate of growth during each season, which he thought might also might lead to a northward migration of some tree species. The possibility of a northward migration of tree species has been described in the literature. In some cases it has been projected that there could be a northward migration of climate zones (and thus the species that are present) by 515 km by the year 2050 with an expected average annual temperature increase of 3.2˚ C in the region surrounding Wemindji (Allard *et al*., 2010). Others (Lemieux and Scott, 2005) suggest that in at least two climate change scenarios, the forest ecosystem around Wemindji could change from boreal to temperate. The CTA (2011) study also raised the possibility that changes in habitat distributions of tree species in the region could lead to a new composition of plant species; this potential has been expressed by others (Forget *et al*., 2003; Rizzo and Wilken, 1992). However, others argue that limitations imposed by nutrient requirements and other factors mean that the northward migration of forest

ecosystems would be much slower than the rate at which these habitats are affected by climate change (see in particular Weber and Flannigan, 1997; Parker *et* al., 2000; Price *et al.*, 2001; Malcolm *et al.*, 2002; Neilson *et al.*, 2005, and; Aitken *et al.*, 2008).

At present, Wemindji's territory is currently north of the commercially harvested area. However, the possibility of a northward migration of tree species as well as an increase in the rate of growth in tree species already present there raises concerns about possible forestry interests. In particular, the same informant mentioned above expressed concern that a warming climate could mean that the northern limit of economically desirable trees could migrate further north in the future and disrupt northern ecosystem, which will already be under stress. Given that the *Plan Nord* includes plans for expanding forestry activities, the benefits of longer growing seasons and more economically desirable lumber mean that Wemindji could experience logging in their territory in the future.

The Ouranos (2010) and CTA (2011) studies also suggest that climate change will make the boreal forest more susceptible to the effects of forest fires and outbreaks of spruce budworm, the latter of which may benefit from warmer conditions. The same informant who expressed concerns about the growth of flora above also expressed concerns with spruce budworm, since he thought that climate change would make conditions in Wemindji more favourable to this species.

Although many informants spoke to the issue of increasing temperatures as a current sensitivity-exposure, especially in the winter months, none of them mentioned the potential for these observed changes to become more pronounced as climate change progresses. However, there is much evidence in the literature that speaks to the potential

for increased temperatures and their affects on the Wemindji territory. According to Warren and Egginton (2008), the James Bay region is predicted to experience temperature changes of between 2.5 and 3˚ C in the spring, summer, and fall months, and increases of more than 5˚ C in the winter by 2050. The CTA (2011) report predicts an average increase in warming of between 3.5 and 6.5˚ by 2050, with more pronounced warming occurring in the winter months. Allard *et al.* (2010) provide projections of warming in central Québec for 2020, 2050, and 2080 as presented in Table 3. Based on the projections and estimates of Warren and Egginton (2008), the CTA (2011), and Allard *et al*. (2010) comes the conclusion that relative to the climate of the region between 1961 and 1999, Wemindji could experience winter months with a minimum increase in the average temperature of 1.8˚ C by 2020 and a maximum increase of 7.1˚ C by 2080. Of course, the upper limits of these predictions represent worst-case scenarios with uncurbed and large-scale emissions, which may or may not end up the reality. Nonetheless, the region stands to experience some level of warming, and this potential warming may result in shorter periods of snow cover and a decrease in the duration and thickness of river, lake, and Bay ice, with the possibility of river and Bay ice breakups occurring during the winter months, both of which will have impacts on the availability of snow and ice on which to travel as well as their relative safety (CTA, 2011).

Future exposure-sensitivity could also come in the form of changes in precipitation in the region. As with temperature changes, future changes in precipitation were identified through the analysis of the projections of climate models, since informants were not asked specifically how they expected precipitation regimes to change. However, findings from the CTA (2011) report include projections for this aspect

of climate change, which suggest that a larger increase in precipitation is predicted for more northern parts of the James Bay Cree territory by 2050, with the northern part of the territory receiving up to ~30% more precipitation. As Figure 1 demonstrates, Wemindji is located in the mid-northern portion of the territory; therefore, it may be affected by these projected increases in precipitation. According to Warren and Egginton (2008) the James Bay region will experience an overall increase in precipitation year-round relative to 1961-1990 levels, with summer and fall experiencing changes of between 0 and 10%, the spring experiencing changes of between 10 and 20%, and the winter experiencing changes of between 30 and 40%. Estimates from Allard *et al*. (2010) again include specific projections for winter, spring, summer, and fall for 2020, 2050, and 2080 and are also presented in Table 3. Based on the projections presented by these sources, it would appear that climate-change related overall increases in precipitation could be expected for the region, with the winter receiving the highest changes.

Future sensitivities may also come in the form of increased pressure on the transmission of knowledge to youth. The CTA (2011) report acknowledges that as the impacts of climate change reduce access to the land, youth may not have as many opportunities to learn and practice traditional Cree values. Edward Georgekish expressed his concern that the changing ice conditions will make the planning and execution of knowledge transmission activities more challenging, which will only exacerbate the issue of an already and increasingly apathetic youth.

Wemindji also potentially faces added sensitivities in the form of intensifying development pressures. As mentioned above, the Québec government's *Plan Nord* has as its goal to open up Québec's "vast, rich, and diversified northern area" to sustainable

development initiatives, which will encompass mining, energy, and forestry industries as well as environmental protection ("Plan Nord – À propos du Plan Nord, 2011"). Slated to take place over the next 25 years, the *Plan Nord* has the potential to "be to the coming decades what […] James Bay[9] w[as] to the […] 1970s" ("Plan Nord – À propos du Plan Nord, 2011"). While such statements are intended to conjure images of a self-sufficient, independent, and resource rich province, the social and environmental impacts that hydro development brought and continue to bring with them have been described in great detail by others (see for example Niezen, 1993; Rosenberg *et al.*, 1997; Hornig, 1999; and Whiteman, 2004). The development pressures associated with the *Plan Nord* thus have the potential to present both future opportunities, in terms of economic development and infrastructure, as well as future challenges, such as altered landscapes and disruptions to species.

Wemindji, and the Eeyou Istchee region in general, is also characterized by a rapidly growing population. According to the *Plan Nord*, the period of 1991 to 2006 saw an increase in indigenous youth aged 14 and under by a factor of two; on average, 50% of the population of indigenous communities in Québec's north is composed on individuals aged 24 or under ("Plan Nord – Overview of Northern Québec"). With an increasing youth population, the birth rate has increased as well. According to the Cree Nation of Wemindji community profile, Wemindji's population birth rate is around 29 births per year, which contributes to a population growth rate of 24 individuals per year. As a result of the high growth rate and limited housing, over-crowding is an issue that the community is facing; however, it has extensive plans to construct new dwellings that will

[9] "James Bay" here is referring to the hydroelectric infrastructure established in the James Bay area in the 1970s.

better accommodate the growing population in the future. However, building projects are financially and physically costly for the community; therefore, the financial, physical, and institutional ability of the community to continue to address this issue in the future may also represent an important future sensitivity.

Future adaptive capacity of Wemindji Cree

In the face of the potential future sensitivities imposed by increased temperatures, increased levels of precipitation, changes in species composition, an increasingly apathetic youth, and again, the probability that the changes will affect many features of the environment, the community does possess adaptive strategies that can help them respond. Of particular significance in discussions with community members were the types of responses they envisioned with regard to changes in the Canada goose population. If Canada geese continue to move away from traditional coastal migratory paths as well as change the timing of their migration, several informants advocated a more extensive adoption of new technologies to report the arrival of the geese from the south. Edward Georgekish in particular spoke to the potential of adopting practices like cell phone messaging or the use of satellite phones as a feasible and effective coping mechanism by which Wemindji (and other Cree communities) can spread information about the arrival of geese. This practice is already being employed by some community members, such has Sam Georgekish, who has friends and family members in more southern communities who will send text messages to alert him to the presence of Canada geese. Edward Georgekish thought that if this practice was adopted as a community-wide and long-term strategy, it would assist the community in being better prepared to respond to long-term or permanent changes in goose migration patterns.

Edward also spoke to how the community has seen an increase in the long-necked variety of Canada geese alongside a decrease in the short-necked variety. According to Edward, of the two sub-species of Canada geese present in Wemindji (see Peloquin, 2007 for a more complete discussion of this distinction), the short-necked variety is preferred in Wemindji Cree diets. However, he admitted that if Wemindji wants to continue to access traditional sources of food but Canada goose behavior continues to change, over the long term the community might be required to switch the focus of hunting to the less-desirable long-necked variety. This might require a community-wide change in taste and preference rather than a reliance on other communities for access to Canada goose meat in the future. According to Edward, this adaptation should help ensure that the community will continue to have access to this culturally significant food source.

In terms of the current and future sensitivity related to youth apathy, the community is preparing responses. As described above, they already have in place many programs to encourage knowledge transmission between youth and Elders in addition to programs to ensure youth have access to the land. According to Edward Georgekish, one program in particular was of key importance to ensuring these opportunities exist, but is also very vulnerable to current and possible long-term changes brought about by climate change: ice fishing demonstrations. In order to ensure that this important program can continue to be offered, Edward admitted that program managers must respond to the future sensitivities (temperature, changes in the length of seasons) to sea ice. This might include running the programs earlier in the season and taking extra precautions to ensure the safety of participants, which might include performing extensive ice safety checks, rather than relying on previously sound assumptions about when the ice is safe.

As the predictions and projections of others (CTA, 2011; Allard *et al.*, 2010; Warren and Egginton, 2008) suggest, the community of Wemindji faces a future where the local effects of climate change may drastically alter the land and resources on which they depend. If these predictions and projections are accurate, the changes have the potential to affect many components of the environment. The CTA (2011) report addresses this issue, and recommends that all Cree communities interested in adapting to climate change as it progresses should take part in the CTA's program and adopt the following four actions: 1) the creation of local climate change committees, to address local priorities, organize activities, and consider the approaches used by other indigenous communities; 2) the implementation of community-based monitoring activities, with emphasis on community participation in the CTA's Cree GeoPortal, which features a GIS-based online climate change monitoring database; 3) the establishment of ice monitoring and safety programs, which could involve many local community institutions such as the school board, and the local health and safety department; and finally, 4) the involvement of Cree youth, who could play an important role in monitoring activities and engage in the dissemination of information via different forms of media (web, radio, print, etc.). According to the regional CTA, and emphasized again by Edward Georgekish, an adoption of these types of responses as well as the sharing of experiences with other Cree communities throughout the Eeyou Istchee represent important long-term adaptations to the future sensitivities brought about by climate change.

Another example of a strategy employed by the Wemindji Cree that contributes to their future adaptive capacity is represented by their strategic use of PAs within their traditional territory. As Mulrennan *et al*. (under review: 8) explain, the community is

committed to "the identification of strategies for environmental protection that […] respond to priorities for cultural continuity and development on locally-defined terms". Through the sustained efforts of community members, university researchers, and governmental bodies, Wemindji's territory now contains the community now benefits from an established Terrestrial Biodiversity Reserve under the management of the Government of Québec, which covers an area covering nearly 5000 km^2, or approximately 20% of Wemindji's territory (Mulrennan *et al.*, under review). In addition to the terrestrial component, a proposed National Marine Conservation Area that would fall under the management of Parks Canada seeks to protect an area covering 20000 km^2 of coastal and offshore James Bay that would include hunting territories of the Wemindji, Chisasibi, and Eastmain Cree Nations. Both the terrestrial and marine components have been Cree-directed initiatives, and both stipulate that the Cree maintain the right to inhabit and hunt, trap, and fish in these areas. PAs have been recognized to contribute to ecosystem resilience and also have the potential to control the possible added pressures of externally driven mining, forestry, or hydroelectric development, while allowing the community to continue to have access to an important part of their land. Having this type of protection in the face of climate change enhances the community's overall adaptive capacity, which can reduce vulnerability in the long run.

3.3.3 Current Vulnerabilities of Wemindji Cree Based on CAVIAR Assessment

Through an application of CAVIAR to the case of Wemindji, several conclusions can be drawn concerning the community's current vulnerability to climate change. Based on the exposure sensitivities and adaptive strategies that were identified by community members and other sources, the current vulnerability of Wemindji with respect to climate

change seems to be mostly related to changes in the Canada goose population, changes in the ice, and an increasing level of youth apathy with regard to traditional ways of life.

As described above, Canada geese have played an integral role in the culture and identity of Wemindji Cree for generations (Peloquin, 2007). However, the community has been struggling with a significant decrease in the number of geese available during the spring and fall goose hunts in the last decade, with more marked declines in the last three to four years. Peloquin (2007) demonstrates that Canada goose populations are affected by climate change but also to a host of other factors, including pollution, habitat declines, and pressures imposed by hunting and development. Regardless of the specific cause of the changes, the loss of this species could have serious effects on the cultural wellbeing of the community. Some of the coping mechanisms described above are allowing the Wemindji Cree to respond to present changes in goose behavior; these include, modifying the timing of the hunt and making use of new technologies to alert the community to the arrival of the geese. Overall, the current vulnerability of the community with respect to changes in the Canada goose population is reduced by the present short-term responses that are being employed. Whether these same responses will be adequate in the future is difficult to determine, and this weighs heavily on the minds of some community members.

Ice plays an important role in the lives of the Wemindji Cree as a medium on which to travel and from which to hunt and fish. Informants were particularly vocal about the significance of ice and the overwhelming nature of the changes in the ice. The short- and long-term coping and adaptive strategies to these changes as described above demonstrate that the Wemindji Cree are communicating and coordinating an innovative

response to change. In recent years, there have been no ice-related casualties or severe injuries within the community. While physical injuries have been avoided, the psychological effects felt by individuals are significant. Jolly *et al*. (2002: 115) describe similar effects on the Inuvialuit population of Sachs Harbor, who have become "lonely for ice". For the Wemindji Cree, the psychological effects relate more to an increasing inability to "read" the ice, which at least one informant described as waking up one day to find that you are blind. This is the sentiment that many individuals conveyed during interviews. In an environment where being able to accurately interpret ice conditions might mean the difference between life and death, suddenly losing this ability is disturbing and of grave concern. This also has implications for intergenerational transmission of knowledge between Elders and youth. Therefore, with respect to changes in ice conditions, the community's current vulnerability lies in the physical, psychological, and social affects its continued change will have.

3.3.4 Future Vulnerabilities of Wemindji Cree Based on CAVIAR Assessment

As noted by others (see in particular Adger *et al.*, 2004; CIER, 2009) the level of social capital within a community is an important factor when determining vulnerability. In the case of Wemindji, future vulnerability lies primarily in the current "unknowns" about how climate change will progress, especially with regard to changes in precipitation, temperature, species habitat composition, and decreasing interest of youth in traditional ways of life. Social capital, which includes "features of social organization, such as networks of secondary associations, high levels of interpersonal trust and norms of mutual aid and reciprocity which act as resources for individuals and facilitate collective action (Lochner *et al*., 1999, cited in Adger *et al*., 2004) is regarded as an

important tool for responding to climate change, since it can assist in the effectiveness of the types of community-wide actions prescribed by the CTA (2011). Wemindji success in initiating and leading a community-level project to protect ecologically and culturally significant portions of its territory via terrestrial and marine PAs is a measure of the extent of its social capital (Mulrennan *et al*., under review). Its record of achievements suggests that it is well positioned to face climate change with a strong foundation of collective action, which may reduce its vulnerability in the future.

According to the 2009-2010 CTA activity report (CTA, 2010), the best way to decrease individual vulnerability to the manifestations of climate change is to share knowledge within the community as well as the entire population of the Eeyou Istchee. At least two informants agreed with this argument claiming that the more people talked about their experiences, the more they could learn from each other about possible challenges and opportunities associated with climate change. Therefore, it would follow that Wemindji could reduce its future vulnerability if it commits to an active engagement in the types of climate change monitoring projects that the CTA envisions. However, as described elsewhere (see in particular Syvanen, 2011a), the CTA must take the necessary steps to ensure that *all* Eeyou communities are given adequate training to use the GeoPortal if it hopes to achieve the wide-spread adoption of this technology. The community would also do well to consider the types of climate change response methods that have been successfully tested and employed in other sub-Arctic First Nations across Canada, such as those advocated by CIER[10].

[10] See, for example, the *Climate Change Planning Tools for First Nations* guidebooks, which were published by CIER in 2006. This series of six guidebooks covers everything from planning, monitoring, and identifying solutions for indigenous communities south of 60˚ latitude who are dealing with climate change: http://www.cier.ca/information-and-resources/publications-and-products.aspx?id=412

3.4 Discussion

3.4.1 The Complexity of Climate Change in Wemindji

Applying the methods prescribed by the CAVIAR framework to the case of Wemindji has certainly highlighted some of the main contributors to current and future vulnerabilities of the community with regard to climate change. These findings are similar to applications of CAVIAR in the Arctic (see for example Ford et al., 2006; Ford, *et al*, 2008; Pearce, *et al*., 2009). Through this application, certain complexities appeared in the research that speak to the distinctiveness of Wemindji's experience, including: the trade offs involved in some responses; the issue of background noise; and the multi-agency of climate change in the eyes of Wemindji Cree. These are discussed below.

Responses and their trade offs

CAVIAR allowed for the identification of responses of Wemindji Cree to current exposure sensitivities of climate change. However, the trade offs involved in some of the responses to climate change are also important, since they also impose important forces on the social-ecological systems within the community. The interaction between changes in the Canada goose population and changes in ice conditions illustrates the complexity of the responses to climate change on the Wemindji territory. This complexity has been described in detail elsewhere (see for example Peloquin, 2007: 101) and involves various factors including the impact of use of helicopters and their impact on the behavior of geese. Specifically, helicopters are said to scare the geese, such that they will either fly away or avoid certain areas completely. However, with changing ice conditions, hunters have begun to depend on helicopters to get to their camps during the goose hunt. In this case, the use of helicopters as a response to climate change may compound the impact of

change on Canada geese populations. Specifically, helicopters, while helping hunters cope with changing ice conditions, may also contribute to the spatial redistribution of geese away from the coast (Peloquin, 2007: 101). As this example demonstrates, there are often tradeoffs involved in adopting certain responses to climate change.

Another interesting consideration is the role that an increasing dependence on technology, including helicopters, plays on financial resources as well the transmission of knowledge between Elders and youth. In Wemindji, for example, the rental of a helicopter for one hour costs an average of $1000 for the community (Beverly Mayappo, pers. comm., July 2010). According to Leslie Kakabat, the community subsidizes this cost, and hunters only end up paying approximate $40 for a helicopter ride to and from their camps. However, providing the service at such a low cost to hunters is unsustainable. Since the convenience of using a helicopter to access camps is evident, more hunters might avail of the service, and the true cost will be absorbed by the community, who will in turn have less funding for other community services. Therefore, over the long-term, supporting a dependency on helicopters may simply contribute to vulnerability rather than reduce it. Another issue with dependence on helicopters is the fact that in some ways, this form of adaptation reduces the autonomy of hunters and removes them from the land. According to others (see in particular Peloquin and Berkes, 2009; Sayles and Mulrennan, 2010; and Mulrennan *et al.*, under review) travel has always been an important aspect of reading the land for the Wemindji Cree. This is also true of Inuit populations (Laidler, 2009). However, with increasing reliance on forms of travel that "separate" these populations from the land comes a risk that knowledge of the land will be not be transmitted to younger populations and may be lost as a result. The

work of Laidler (2009) in particular demonstrates how the youth's increasing dependence on GPS units has contributed to an erosion of knowledge and land-based skills. Therefore, while the response of relying on technologies, such as GPS and helicopters, may be beneficial in that they can assist in navigation or transportation, the trade off is that they might continue to erode important knowledge concerning the land, which may increase vulnerability in the long run.

Because responses to climate change do involve trade offs that have indirect effects on the social-ecological systems in Wemindji, it is perceived by some informants as a stressor that has the potential to compound existing and other emerging stressors. These informants recognize that the community is already subjected to major cultural, socio-economic and environmental upheavals and disruptions. The protected area strategy represents a response to this recognition in that protect areas ensure that at least some of the territory, part of which has been identified as particularly culturally and ecologically significant, is protected against large scale development stresses which would compound the effects of climate change. The case of Wemindji demonstrates that the strategic use of PAs by sub-Arctic indigenous communities represents an important response with which may not have the same trade offs as other responses. The potential of PAs in this respect has not received enough attention in vulnerability literature to date (Lemieux, *et al*., 2010).

The Issue of Background Noise

An application of CAVIAR indicated that that climate change-related changes are occurring in the territory, but also that some of these changes are explained by other possible causes. This was particularly evident with regards to changes in the Canada

goose hunt. As others have noted (see for example Peloquin, 2007, and Scott *et al.*, 2009), Cree hunters attribute the changes they have witnessed in the Canada goose migration to several factors: the hydro-electric reservoirs further inland; changes in the eelgrass growth along the coast; poor berry production on the islands; and an overall trend towards warmer and drier summers. It has been demonstrated by others (Hornig, 1999) that the hydroelectric developments throughout the James Bay Cree territory have had lasting effects, such as lower river discharges and displaced species of mammals, birds, and fish. The presence of valuable minerals throughout the territory has also attracted large-scale mining activities, which further disrupts the environment. The presence of these other sources of change in the territory thus makes it challenging to identify, let alone isolate, climate change as a factor. While at times during the research, informants made a direct connection between climate change and a decrease in the number of geese in the territory, it is recognized locally that there are many additional factors at play, making it impossible to make definitive assessments of the role of climate change.

Multi-agency of Climate Change

In addition to the issues of trade offs and background noise, the application of CAVIAR to the case of Wemindji highlighted the issue of the "multi-agency" of climate change through the eyes of the Wemindji Cree. Table 1 certainly demonstrates that the community is well aware of the environmental stressors their territory is enduring. The observations shared by informants speak to the many aspects of the environment that are being affected by, according to them, climate change. However, it has been noted elsewhere (see in particular Syvanen, 2011a) that a consideration of these observations of

tangible aspects of climate change is incomplete without an additional consideration of the cosmology behind people's observations, which offers important insights into *in*tangible aspects. For example, some Wemindji Cree believe that natural entities will react to the actions of people. The research described by Syvanen (2011a) demonstrates that in some cases, occurrences of bad weather, sickness, and even death are considered to be the result of acts of retribution on behalf of the spirits of these natural entities who have been disrespected by people's actions. Therefore, in some cases, local manifestations of climate change might be attributed not only to changing weather patterns, but also to the agency of natural entities. The specific application of CAVIAR to the "tangible" observations of Wemindji Cree to assess current vulnerability did not provide an opportunity to include causes of climate change that are more culturally embedded. Overall, then, the application of CAVIAR was not able to fully capture the important issue of the multi-agency of climate change in the eyes of Wemindji Cree.

3.4.2 The Application of CAVIAR in Wemindji

When the CAVIAR framework is applied to the case of Wemindji, we can see that more community-wide policies regarding knowledge transmission, modifications of diet, or increased vigilance might be appropriate to address the current and future vulnerabilities faced by the community in relation to climate change. The inclusion of additional input from other perspectives (e.g. CTA, CIER, Ouranos) on what types of current and future vulnerabilities the region is facing and has the potential to face in the future provides reinforcement of these types of responses.

Constraints of the research process described here, including the scale of the project and a lack of available studies or data on the themes included have limited a fuller

application of the CAVIAR framework to this case. For example, important aspects, such as the long-term effects of climate change on the economy or health of Wemindji and their relative impacts on vulnerability were not covered. While these constraints have meant that Wemindji-specific data regarding current and future rates of changes in temperature, precipitation, and species composition are not available, adapting the framework to incorporate more general data facilitated its application to this small-scale project while still making use of key elements needed to assess vulnerability. Therefore, while CAVIAR has seen a high level of success in contexts with more extensive research-related resources (see for example those described in Hovelsrud and Smit, 2010), it is flexible enough to be useful in the case of smaller-scale initiatives. Modifications to the framework for smaller-scale projects might include the incorporation of more generalized data with regard to current and future exposure-sensitivities. Overall, then, this research has demonstrated that although the CAVIAR framework was developed for use in larger-scale research contexts, it is flexible enough to allow for its application elsewhere, although it may be that the findings are not as exhaustive as those described in projects with more support.

3.5 Conclusion

It is evident through a perusal of the literature pertaining to the effects of climate change on indigenous communities that too little attention has been given to the examination of sub-Arctic experiences. A focus on the Arctic reflects the rapidity of the changes there, which in turn has resulted in significant political and financial support for Arctic-based studies and a relative neglect of the sub-Arctic. According to CIER, "this relative lack of research and understanding increases uncertainty about possible negative

effects and potentially limits the capacity of people and institutions related to Aboriginal communities south of 60˚ to react and cope effectively" (2010: 3). To that end, this research was pursued in response to the paucity of literature relating to the effects of climate change on indigenous groups inhabiting the sub-Arctic region of Canada. It has also sought to challenge some of the assumptions that have guided sub-Arctic initiatives so far. One such assumption is that the sub-Arctic is merely the "bottom" or southern extension of the Arctic, and so the changes that are occurring in the Arctic today might very well be indicative of what is in store for the sub-Arctic as climate change progresses. However, it is critical to consider the possibility that the sub-Arctic is independent enough from the Arctic that it necessitates a tailored research approach that adequately considers some of its defining features, such as the possibility that changing climatic conditions might actually benefit the sub-Arctic region in terms of economic development in mining, hydro, and agriculture (Lemmen, *et al.*, 2008, Allard *et al.*, 2010).

While many of the CAVIAR case studies have involved large-scale projects focused on Arctic communities (see for example Smit *et al.*, 2008 and Smit *et al*., 2010), the small-scale application of the framework to a sub-Arctic community has produced a novel range of findings available for comparison and knowledge sharing, with potential to inform and strengthen research initiatives, community responses, and policy development. For example, the application of the framework to a protected area context is a novel yet important endeavour, given the number of PAs both proposed and recently established in northern regions. In addition, the insight gained by applying the framework in the sub-Arctic context of Wemindji has provided a new opportunity for comparison

and has contributed to the overall understanding of how sub-Arctic indigenous populations will respond to climate change.

It is clear that the future of climate change in the sub-Arctic is fraught with uncertainty. It has been noted elsewhere (see in particular Duerden, 2004) that in order to better prepare for these uncertainties, gaining a clearer picture of the situation "on the ground" and at a small scale is critical. Therefore, the support of governments, academia, and society is needed to ensure climate change assessment embraces a more accurate picture of the north that takes account of the texture of its human and natural components. The research described here contributes to a body of literature that continues to call for this support. The potential costs of increasing the level of funding and support for sub-Arctic, community-based climate change research initiatives are greatly outweighed by the potential benefits, which include enhancing the resilience of these groups in the face of a changing physical, economic, and cultural landscape.

CHAPTER 4

Concluding Remarks

The sub-Arctic is a unique part of Canada, covering vast tracts of the country. Not quite the "true north," but also not the "south," it occupies a liminal position, both physically as well as in the imagination of society. In the province of Québec, the sub-Arctic is home to a strong and proud indigenous population that has played an active role in ensuring that their ties to this land do not go ignored. A growing reality for Québec's sub-Arctic is the looming specter of climate change, but like the fog that tends to blanket the coast of James Bay, its complexity often obscures its short- and long-term effects. The impact of climate change in the Arctic may give some clues as to what regions below the Arctic might experience. But the social, political, and ecological makeup of the sub-Arctic, and the progression of climate change there, may very well have very different outcomes for the people and ecology of the region. Like the sun and winds that burn off the James Bay fog, this thesis has sought to reveal some of the local-scale effects of climate change as observed and experienced by the Cree Nation of Wemindji. It is my hope that in doing so I have underscored the need for research attention to the distinct experience of climate change in the sub-Arctic.

My research draws on research frameworks and methodologies applied in Arctic-based studies of local experiences of climate change and assesses their relevance to understanding climate change in the sub-Arctic. Chapter 2 calls for a deeper consideration of the cultural embeddedness of local indigenous groups' experiences and responses to climate change. Chapter 3 posits that further research into the complexity of the vulnerabilities of local environments and populations in the sub-Arctic can serve to bolster their ability to overcome these vulnerabilities. I argue that better insights into the

cultural and cosmological context that influences how people observe, interpret, and respond to climate change requires an approach that acknowledges the presence, importance and complexity of these intangible dimensions. Taboos, myths, rituals and stories inform local observations and interpretations of climate change. Similarly local preferences for coping and adaptive responses are contingent on the complex nature of the deep-rooted beliefs of community members. Thus, attention to cosmology requires an underlying acknowledgement of complexity. On the other hand, in order to highlight complexity, one must also consider the role that cosmology plays. For example, evaluating vulnerabilities to climate change is not simply about determining what responses are used; rather, it involves an acknowledgement that responses are also informed by considerations other than those that might appear to be obvious, such as underlying belief systems or cosmologies. Therefore, complexity cannot be fully appreciated without a consideration of the cosmology that informs this complexity.

Of course, ensuring that cultural embeddedness and complexity are considered complicates approaches to documenting indigenous populations' observations, interpretations, and responses to climate change. At times, community members may not be willing to discuss aspects of their cosmology, and complexities like background noise and response/ trade off relationships may not always be identifiable. Nonetheless, future efforts would be bolstered if deliberate attempts were made to explore some aspects of cosmology, such as stories, rituals, or taboos. Doing so would allow these approaches to go beyond an inventory of physical changes and address some of the forces behind how and why physical changes are being observed, interpreted, and responded to in the ways that they are. The case of Wemindji demonstrates that Cree cosmology is an enormously

rich and complex area of study, and the insights that are accessible through stories, myths, taboos and rituals bolsters the significance of physical changes.

The findings of Chapters 2 and 3 reflect a growing recognition in the literature on human dimensions of climate change that place-based approaches tailored to the sub-Arctic are needed (see in particular CIER, 2009). Research undertaken in this respect (CIER, 2009; Lemelin *et* al., 2010; Lemieux *et* al., 2010; CTA, 2011) highlights the distinctiveness of human and natural dimensions of the sub-Arctic, and the findings of Chapters 2 and 3 further illustrate this. They reveal that, at least in relation to Wemindji, the sub-Arctic faces a future where climate change presents both challenges and opportunities. For example, developments in forestry, mining, and energy sectors in northern Québec may disrupt habitats and species but may also present employment opportunities and lead to the expansion of infrastructure. In addition, the Wemindji case is valuable in its demonstration of the role that PAs can play as a response to climate change. Both Chapters 2 and 3 highlight the social and ecological benefits of the strategic use of PAs in Wemindji's territory, echoing the findings of Lemieux *et al.* (2010) that PAs offer an ideal approach to addressing the uniqueness of climate change vulnerability in the sub-Arctic.

Limitations of the research conducted include the scope of the research, as discussed in Chapter 3. The incorporation of more specific place-based scientific data concerning climate change would have permitted for a more complete discussion of the current and future vulnerabilities of the community. A longer field season would have facilitated the involvement of more members of the Wemindji community in the research. Also, the richness of the experience of staying with a Wemindji family in October 2010

suggests to me that staying with a Cree family during the summer 2010 field season would have enhanced my understanding of the community's experience of climate change. Part of the reason I had not pursued this possibility was my own apprehension about leaving my comfort zone, especially in a different cultural setting. Rather, I chose to stay with other "southerners" as well as on my own, and it is possible that as a result, I may have missed additional insights into the Wemindji Cree experience.

However, some of the strengths of this thesis also stem from the scale and scope of the research. Conducting fieldwork alone meant that I could decide on a pace that most suited my style of research, and as a result, I was quite efficient considering the brevity of my field season. While I conducted the bulk of my fieldwork alone, I benefitted immensely from the previous and ongoing work of the Wemindji Protected Areas Project team members. Their presence in the community over the last decade has resulted, at least in part, in community members being willing and open to collaborating with me. I also had the fortune of working with a supervisor who is very familiar with the study area and cultural context of the community. Finally, my access to faculty and students who are carrying out research on topics very similar to my own has meant I have benefitted from their advice and guidance as well.

An additional strength of this thesis lies in its adoption of emerging methodologies and approaches into exploring sub-Arctic indigenous groups' observations, interpretations, and responses to climate change. These approaches are innovative in that they engage in place-based research that is community-driven and incorporates local voices, which serves to challenge colonial and positivist attitudes that have informed previous approaches. The adoption of these approaches thus responds to

suggestions in the literature that more must be done to integrate local perspectives in research. Adopting them not only reinforces these types of approaches, but also strengthens the voices of the people of Wemindji, who, in the end, are those who will be directly affected by climate change. Doing so also demonstrates the value of these approaches, which may encourage their use by others.

While these new methodologies are beneficial and a widespread adoption of them would do well to advance sub-Arctic research, additional steps must be taken to encourage sub-Arctic based initiatives. This includes more substantial dissemination of results from the sub-Arctic that could contribute to a more well-established and systematic approach tailored specifically to the region. During a conversation I had with an employee of CIER after participating in a webinar that she had conducted, we both lamented the fact that sub-Arctic based approaches are not connected more often in a coordinated effort to research in the region. She admitted that her organization would benefit from a consideration of the efforts of the CTA, for example, but she had not been aware of its activities until I had mentioned them to her. We agreed that the initiatives of organizations across Canada would benefit from more wide-spread sharing of their experiences. This highlights the need for a more systematic approach to sub-Arctic research. The international application of the CAVIAR framework and its success in different settings demonstrates that frameworks are strengthened when they are applied in and tested by numerous cases; practice makes perfect, in a sense, but communication and coordination are crucial.

The overall significance and contribution of this thesis to the study of indigenous experiences of climate change include: that it presents a novel case from which to assess

the relevance of established Arctic-based approaches; that it demonstrates a need for a greater consideration of the extent to which local understandings and interpretations are informed by cultural context and cosmology; and that it highlights the complexity of the local experience of climate change. Because it has applied the CAVIAR framework, this study can be compared to other CAVIAR case communities, which may offer insights into the similarities and differences that lie between sub-Arctic and Arctic experiences of climate change. In addition, other sub-Arctic communities can use the Wemindji case to identify similarities and differences in their experiences, as well as to determine whether, based on its application in Wemindji, CAVIAR might be a viable option for assessing vulnerability in their own sub-Arctic context. Finally, this thesis might serve to direct attention to the need for more research in sub-Arctic settings. It questions assumptions about the sub-Arctic being an extension of the Arctic such that Arctic-based approaches are relevant there. Indeed, when striving to establish a clearer picture of vulnerability, unsubstantiated assumptions about the sub-Arctic have the potential to exacerbate vulnerability. The important task of elucidating the vulnerability of sub-Arctic indigenous communities to climate change requires a recognition that the sub-Arctic is an important and distinct region in its own right that merits approaches tailored to its character and needs.

This thesis has the potential to act as a jumping off point for other initiatives, both in the Eeyou Istchee as well as in other sub-Arctic indigenous territories across Canada. It documents the experiences of some members of the Cree Nation of Wemindji, and provides an evaluation of approaches applied elsewhere to the case of Wemindji. It identifies coping and adaptive responses that have worked, some that haven't, and what

might be done in the future. Some of these recommendations have already been incorporated into the CTA's climate change monitoring program. There are plans to disseminate my research findings in the academic literature as well as in non-academic fora, such as on the CIER website and in a report to the community. Overall, I hope that it can contribute to establishing a firm foundation for sub-Arctic tailored approaches to studying the observations, interpretations, and responses of indigenous communities to climate change. Completing the foundation and building a more relevant approach can assist these communities in discovering and tapping into their own social-ecological arsenal to face the challenges and embrace the opportunities that climate change will bring with it. I hope the construction does not stop here.

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APPENDIX

Figure 1: Location of the Cree Nation of Wemindji and Surrounding Communities in the Eeyou Istchee

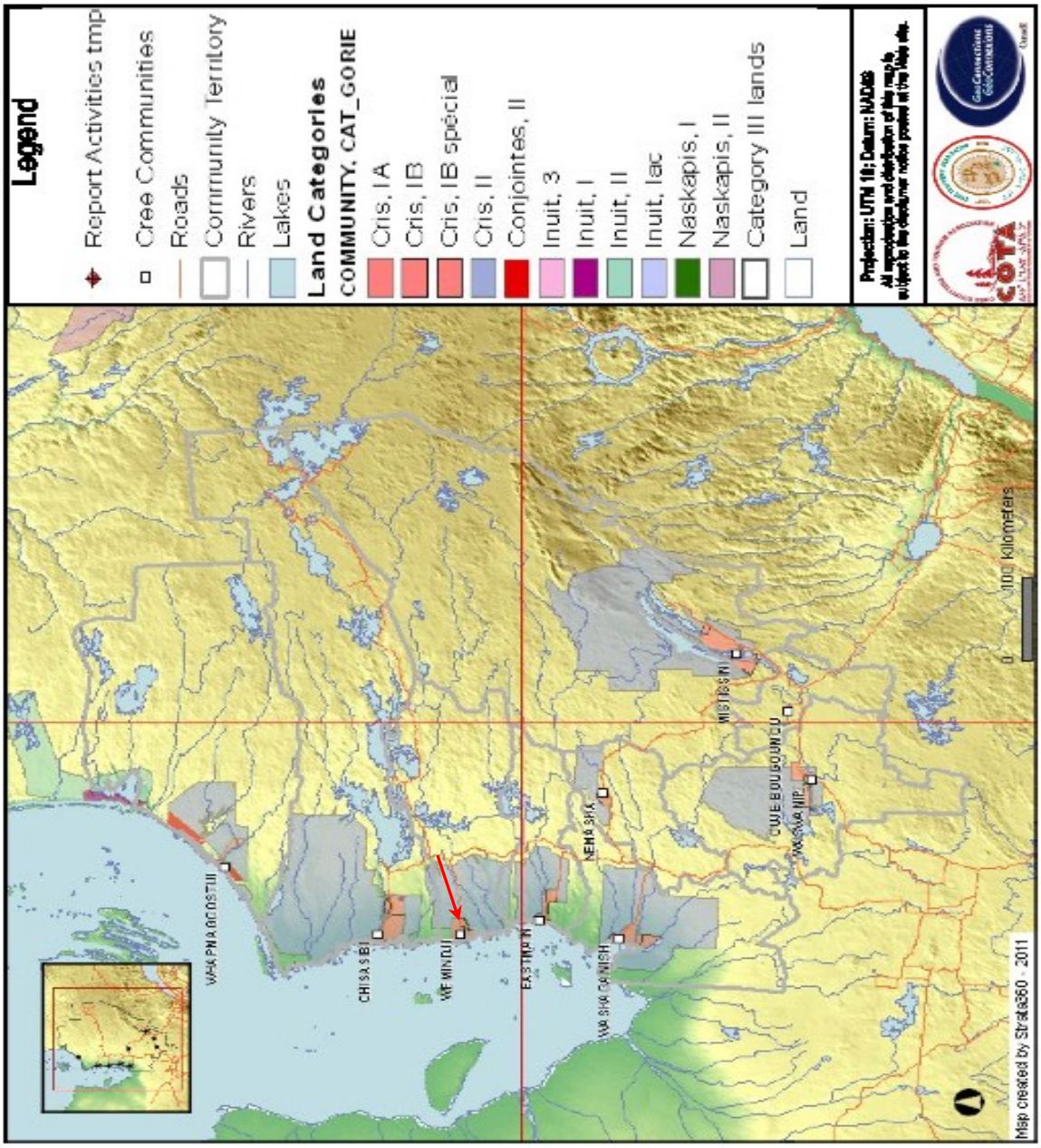
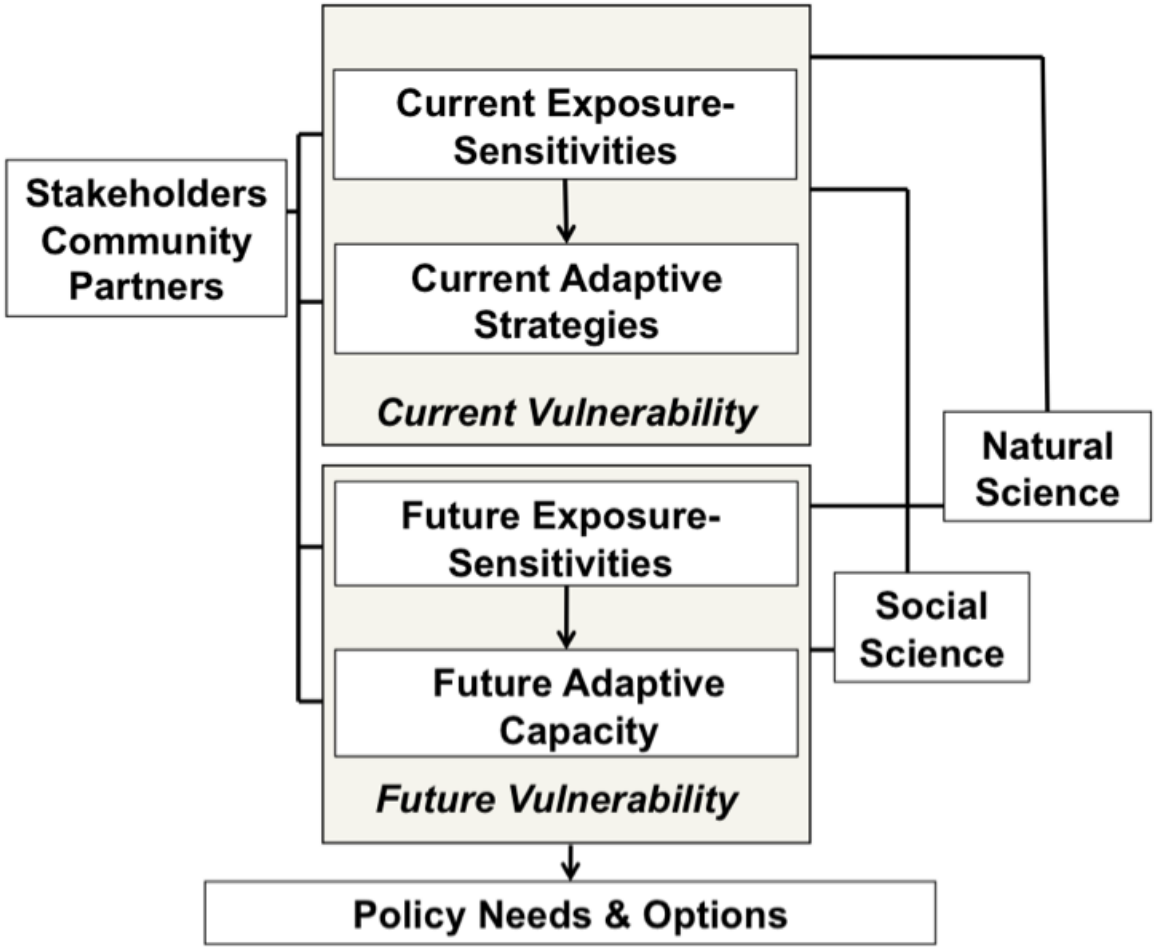


Figure 2: The CAVIAR Framework



Adapted from Smit *et al*., 2010

Table 1: Wemindji Cree Observations of Climate Change

Aspect of Climate Change	Observation
Weather	There are big changes in the weather
	There are more very bizarre weather events (e.g. rain in March, thunderstorms in March, snow very late in the spring)
	The relationship between wind and tide has changed
	There are big changes in the wind (both speed and direction is dif ferent)
	The temperature changes more than it used to
	There aren't as many blizzards as there were in the past
	The clouds are very dif ferent and they are harder to read
Seasons	The timing of the seasons is dif ferent than it used to be – it fluctuates more
	Winters aren't as cold as the Elders remember them
	The spring comes earlier and faster than before
	It freezes much later in the fall/winter
	There is more rain during the winter and less rain in the spring
	There are only 4 months of snow, whereas in the past there were 6 months of snow
	There is less snow in the winter, and there are fewer blizzards
	For the past few years (2-4), there is no snow during goose break
Flora/Fauna	There are not as many geese along the coast for the past 3-4 years
	The geese fly later than before
	There is more grass covering the goose feeding grounds
	There are more moose in the area than before
	There are more caribou than before
	The eelgrass in the Bay is not growing like it used to
	There are more strange species than before (e.g. mourning doves, turkey vultures, eagles)
	The plants are growing earlier
	The beavers are mating earlier
	Polar bears are starting to come onto the islands looking for food
	The fur of animals is changing because of the warmer winters
	Low water levels are af fecting fish spawning grounds
	The trees are growing faster now
Ice	The ice is not the same as it used to be – it is thinner (~2 feet, before it was ~ 4 feet), softer , has 3 layers with water between layers, it is a dif ferent colour (white instead of clear)
	It takes longer for the Bay to freeze over in the fall/winter
	The ice breaks up/melts much earlier in the spring
	The ice is not safe to go on; it is often not thick enough to go on with a snow mobile
Snow	The snow melts earlier than before
	The snow melts much faster than before
	There is less snow overall than before
	The consistency of the snow is dif ferent – it can be very soft, almost like baking powder (makes it hard to go on with a snow mobile), or very wet (too wet to wear moccasins)
Celestial bodies	There is a change in where the sun rises and sets
	There is a change in the location of the Big Dipper
	The moon has changed location in the sky
	The full moon no longer indicates a change in the weather pattern
	Compared to a few years ago, the night is shorter in the summer

Table 2: Current and Future Exposure Sensitivities and Adaptive Strategies of Wemindji Cree

Vulnerability	Short-term coping mechanism	Long-term adaptive strategy
Changes in sea ice (e.g. earlier breakup, unsafe conditions, changes in consistency)	Hire helicopter to fly in/out of camps (especially along the coast)	Be more vigilant about ice conditions; share information throughout the community via different media (radio, text message)
	Don't travel on ice	Establish a trail on the land along the coast
		Go back to different modes of travel (e.g. dog sled)
Changes in the goose hunt (e.g. fewer geese available on Wemindji territory, geese coming at different time)	Buy geese from other communities	Switch from short-neck goose to long-neck goose to ensure traditional food source is still available
	Follow the geese further inland or out into the Bay	Use different technologies to share knowledge about when the geese arrive (e.g. text messages, cell phones)
Decreased interest of the youth in traditional way of life	Encourage youth to partake in traditional activities (e.g. Old Factory visit, goose/fish camps, etc.)	Ensure that knowledge sharing programs are made available by organizations such as the Wemindji CTA, or the Culture Department
	Encourage youth to listen to Elders' stories and legends	As the climate continues to change, be flexible when running the programs (e.g. be vigilant of the fact that ice-fishing demonstrations must take place when the ice is safe)
Overwhelming nature of the changes (e.g. so many aspects are changing so much)	Talk about the changes with other community members and municipal governing bodies (e.g. local CTA,, Council Office, community departments)	Take part in the Cree GeoPortal Climate Change monitoring programme so that Wemindji can share knowledge will all communities of the Eeyou Istchee over the long term
		Avail of opportunities offered by protected area development as a strategy to ensure the protection of ecologically and culturally significant portions of the territory

Table 3: Projections of Climate Change-Induced change in Temperature and Precipitation in Central Québec for 2020, 2050, and 2080

Season		Changes by 2020	Changes by 2050	Changes by 2080
Winter	Temperature	1.8 to 2.9 °C	3.5 to 4.9 °C	4.5 to 7.1 °C
	Precipitation	5.6 to 14.3 %	12.0 to 22.9 %	19.7 to 35.5%
Spring	Temperature	1.0 to 1.7 °C	1.8 to 3.0 °C	2.4 to 4.7 °C
	Precipitation	3.6 to 9.6%	7.0 to 14.3 %	12.6 to 26.0 %
Summer	Temperature	0.9 to 1.8°C	1.8 to 3.0 °C	2.3 to 4.1 °C
	Precipitation	0.4 to 5.2 %	1.1 to 6.9%	3.4 to 9.3%
Fall	Temperature	1.1 to 2.0 °C	2.1 to 3.2 °C	2.6 to 4.3 °C
	Precipitation	1.5 to 7.6%	4.5 to 13.1 %	9.7 to 18.5%

Source: Allard *et al*., 2010