The Vulnerability of the James Smith and Shoal Lake First Nations to Climate Change and Variability

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ABSTRACT

First Nations communities, especially those dependent on natural resources, will be faced with the challenge of adapting to changing climate. This thesis identifies the existing sensitivities and coping capacities to climate and other external stressors of two Saskatchewan First Nation communities, James Smith and Shoal Lake. Following the vulnerability approach, the thesis documents and discusses the current and past exposures and adaptive capacities of the two communities. These communities were selected based on their location within the transition from grassland to boreal forest, a natural region in northern Saskatchewan expected to undergo drastic changes in the future due to climate change. A broad range of social, biophysical, environmental, economic and institutional stressors are found in these two First Nations communities. It is not these conditions in isolation that are beneficial or problematic; it is the combination of conditions that creates a context for vulnerability. James Smith First Nation is challenged with adapting to climate change while having multiple band governments operating on one reserve and diamond mine developments encroaching on traditional lands. Shoal Lake First Nation has fewer adaptation options due to its location on marginal land for forestry and agriculture and limited opportunities for youth. Both communities will be presented with many opportunities and challenges. Their ability to effectively respond depends largely on current initiatives that build capacity to deal with future stresses.

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DEDICATION

This thesis is dedicated to the communities of James Smith and Shoal Lake. The participation of community members in this study is greatly appreciated and I wish to give this thesis back to them in hopes that some good will come of it.

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CHAPTER 1 INTRODUCTION

"This climate change is becoming an issue and there is more and more concern...the impacts it is having on [our] society as First Nations people because of our cultural links with Mother Earth. It has made impacts and...we have to live in the environment." – Respondent

It has become widely recognized and accepted that global climate is currently undergoing change due to anthropogenic causes (Hegerl *et al.*, 2007). Climate is expected to change, not only in terms of shifts in mean precipitation and temperature, but also in variability or deviations from mean conditions (Hegerl *et al.*, 2007; Sauchyn and Kulshreshtha, 2008), creating new opportunities and risks for people. Human and other systems on Earth will all be affected to some degree, both positively and negatively, by the postulated changes. First Nations communities will be faced with many challenges to reduce risk and benefit from new opportunities. They must successfully manage the impacts of climate change in order to cope with or take advantage of their new situations. First Nations communities have varying degrees of sensitivity and resilience to climate depending not only on the nature of the impacts, but also on the social conditions both internal and external to the community (Smit and Pilifosova, 2001; Cannon *et al*., 2003; Downing *et al*., 2006). First Nations communities have a social context distinct from that of Euro-Canadian communities, and as such, can be expected to have different sensitivities and resiliencies. Although work has been done in Inuit communities, there is currently little documentation of the particular exposures of First Nations communities to climate and climate variability, and their capacities to deal with climate risks and opportunities. This

thesis sheds light onto conditions influencing vulnerability to climate, climate change and climate variability in First Nations communities.

1.1 Research Aims and Objectives

This thesis aims to understand the ways in which First Nations communities in the Prairie Provinces are sensitive to, and cope with, climate and other stimuli to determine how climate change can provide opportunities, or create problems for them in light of other changing conditions. Case studies of two First Nations communities, the James Smith and Shoal Lake Cree Nations, were completed by documenting sites of traditional use and importance and the ways that these have been affected by change; documenting current exposures to climate and other stressors and the adaptive strategies used to cope with them; determining how different processes and conditions have served to aid or constrain adaptation within the communities; and using insights into current vulnerabilities and future climate scenarios to gain insights into potential future vulnerabilities related to climate change.

1.2 Research Rationale

First Nations communities were chosen for this study given: 1) their unique social location within Canadian society; and, 2) to investigate the role of traditional knowledge and culture in building resilience and reducing exposure to climate and other stimuli. First Nations communities in Saskatchewan have high rates of poverty and unemployment compared to provincial populations as a whole (Statistics Canada, 2008a,b). Poverty plays a major role in characterizing vulnerability to climate, as poor people lack adequate resources to employ strategies aimed at reducing vulnerability (Schneiderbauer and Ehrlich, 2006). Increased poverty does not always spell out

increased vulnerability, however. Poverty generally refers to minimal wealth in terms of economic capital. Limited availability of goods, lower incomes and reduced wellbeing are all linked with poverty as they relate to wealth (Schneiderbauer and Ehrlich, 2006). Vulnerability is partly dependent on wealth, but is conceptualized much more broadly and includes components related to culture (Schneiderbauer and Ehrlich, 2006), such as human values and practices that help to reduce exposure and increase adaptive capacity. This thesis investigates how the poor economic and social conditions of First Nations communities influence their vulnerability to climate and how the communities deal with its stresses, including how culture is used to manage vulnerability.

The communities of James Smith and Shoal Lake were chosen for their location in the boreal transition ecoregion of Saskatchewan (Figure 1.1). Regions having transitional ecological characteristics, or those that act as buffers between two different ecozones (Acton *et al.*, 1998), are expected to undergo drastic biophysical changes as a consequence of climate change (Wheaton, 1997; Saporta *et al.*, 1998). The First Nation communities located in these regions will be exposed to these impacts of climate change and variability. The biophysical impacts alone do not necessarily increase vulnerability, but often interact with intricate social conditions (Wisner *et al.*, 2004), thus warranting an exploration of how vulnerability to climate currently manifests in order to inform how vulnerability to changes in climate and variability may develop.

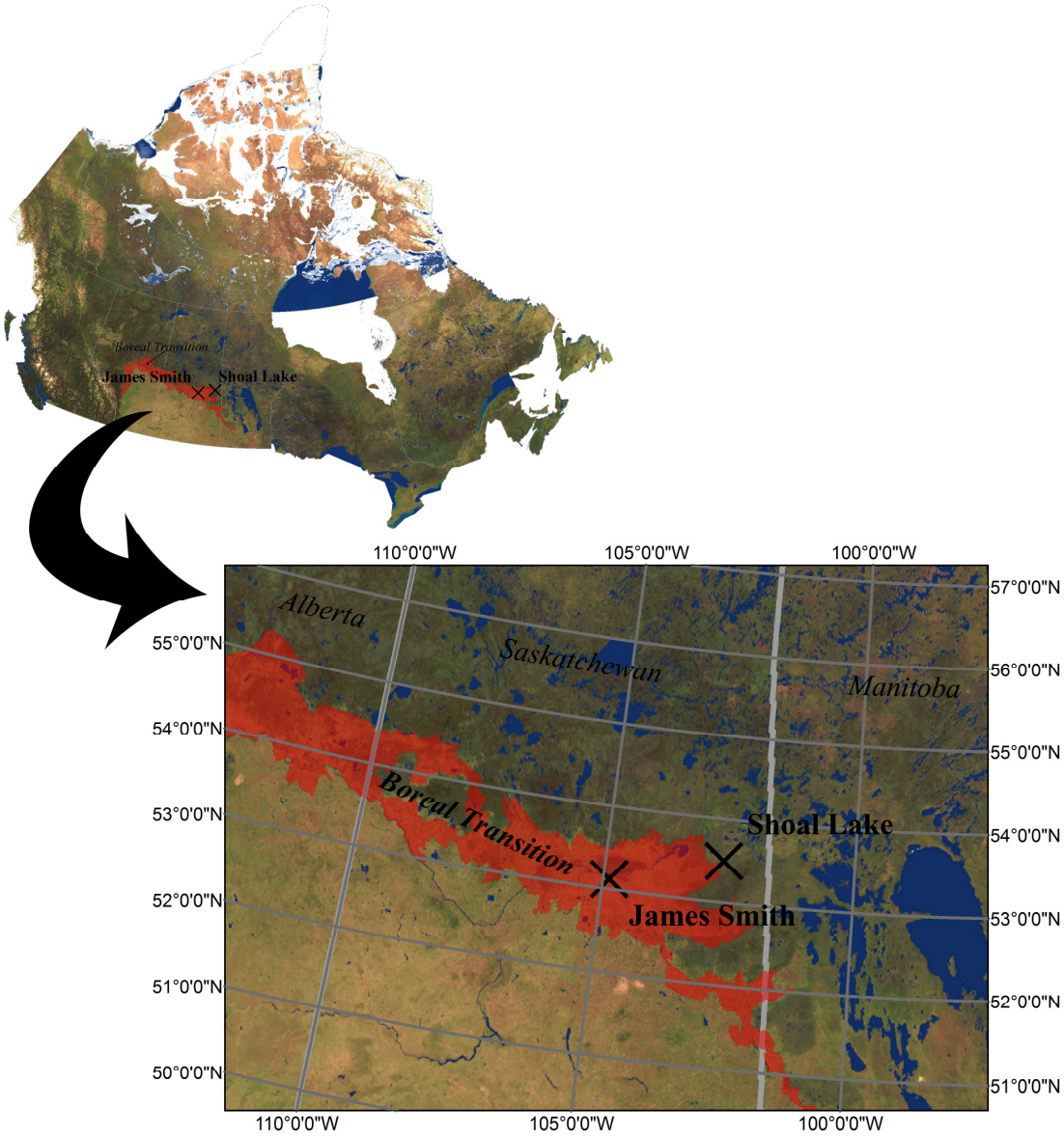


Figure 1.1 Map of James Smith and Shoal Lake showing their position in the Boreal Transition ecoregion (Acton *et al.*, 1998) (original in colour)

As discussed in section 1.4, this thesis conceptualizes vulnerability as a function of exposure and adaptive capacity of a human system (Handmer *et al.,* 1999; Kelly and Adger, 2000; Kasperson and Kasperson, 2001; Smit and Pilifosova, 2001; Downing and Patwardhan, 2003; Turner *et al.,* 2003; Ford and Smit, 2004; O'Brien *et al.,* 2004) and largely a result of the social conditions that characterize the system (Adger and Kelly, 1999; Adger, 2000; O'Brien and Leichenko, 2000; Pelling, 2002; Wisner *et al*., 2004). Participatory methods were applied in this investigation in order to obtain first-hand documentation of vulnerability due to social conditions and physical stimuli from the perspectives of community members. Similar methods have been employed elsewhere (Berkes and Jolly, 2001; Dene Nation, 2003; Ermine *et al*., 2005; Ford *et al*., 2006; Ermine *et al*., 2007; Ermine *et al*., 2008). Community engagement and interaction played a vital role in the completion of this thesis. The researcher not only conducted interviews and workshops in the communities, but was invited to participate in many daily activities and special events with community members (see Chapter 2). Many of the exposures and adaptive strategies noted by respondents during the course of the fieldwork were actually witnessed or experienced by the researcher. In addition, interpersonal barriers between the researcher and the respondents were broken down as respondents often enjoyed including the researcher in their daily activities. The researcher was able to gain better understandings of respondents' testimony and conditions affecting community vulnerability. This thesis is very much an attempt at intercultural cooperation and understanding surrounding one of the most pressing issues currently facing humanity – climate change.

1.3 Thesis Outline

This thesis is divided into nine chapters. Chapter 1, the introduction, which briefly introduces the research project and its goals, and presents the conceptual framework used to guide the thesis. Chapter 2 contains a detailed description of the methodology used to complete the thesis, including techniques from both the physical and social sciences. Chapter 3 provides a description of the study area. This chapter includes statistical information related to climate and the demographics of the communities – James Smith and Shoal Lake – but also places the communities in their historical contexts. Chapter 4 discusses the results of the spatial analysis of land use within the communities. Chapter 5 assesses current vulnerability as it relates to the communities of Shoal Lake and James Smith. Chapter 6 draws from interview data and the assessment of current vulnerabilities to investigate future vulnerabilities of the two communities. Chapter 7 provides a summary of the thesis and discusses the major findings. Reference lists and appendices follow. Appendix A contains the interview guide used while conducting interviews. Appendix B shows the node structure used to analyze the interview data. Appendix C provides some important translations from Cree into English. Appendix D is a statement of ethics approval from the University of Regina Research Ethics Board. Appendix E includes the consent forms given to respondents. Appendix F is a table containing current exposures and adaptive strategies as identified by community members.

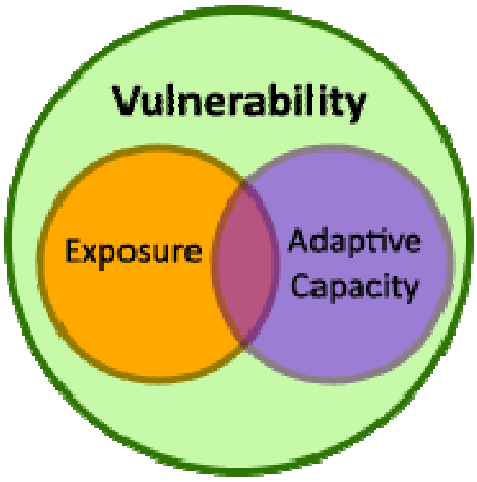
1.4 Conceptual Framework

This thesis employs the concept of vulnerability as a function of exposure to various stimuli and the ability to cope, deal with, take advantage of or manage these

effects (Handmer *et al.,* 1999; Kelly and Adger, 2000; Kasperson and Kasperson, 2001; Smit and Pilifosova, 2001; Downing and Patwardhan, 2003; Turner *et al.,* 2003; Ford and Smit, 2004; O'Brien *et al.,* 2004; Smit and Wandel, 2006 – Figure 1.2).

This expression of vulnerability is not intended for quantification or designation of precise functional relationships specific to each system (Smit and Pilifosova, 2001). Generally, vulnerability is a positive function of exposure and a negative (or inverse) function of adaptive capacity (Smit and Pilifosova, 2001; Ford and Smit, 2004). Resiliency, as it relates to adaptive capacity, is also a negative function of vulnerability (Kofinas *et al.,* 2005).

Exposure is a property of a system relating to the characteristics of stimuli, the system itself (Smit and Pilifosova, 2001; Downing and Patwardhan, 2003) and its sensitivity to a given stimulus over time. Sensitivities, exposures and stimuli do not exist in isolation of one another (Belliveau *et al.*, 2006). Exposure to climate-related stimuli is affected by the current sensitivities of the system to these stimuli, but also by the interaction of other exposures and sensitivities present in the system, which can relate to institutions, culture and economy. Occupancy characteristics and sensitivities develop out of the interaction between multiple exposures that cannot be studied in isolation (Belliveau *et al.*, 2006).



Source: Handmer *et al.,* 1999; Kelly and Adger, 2000; Kasperson and Kasperson, 2001; Smit and Pilifosova, 2001; Downing and Patwardhan, 2003; Turner *et al.,* 2003; Ford and Smit, 2004; O'Brien *et al.,* 2004; Smit and Wandel, 2006

Figure 1.2 Visual representation of vulnerability (original in colour).

The ability of the system to cope with exposures is its adaptive capacity (Wheaton and McIver, 1999; Bryant *et al.*, 2000; Yohe and Tol, 2002; Füssel and Klein, 2002; Smit and Pilifosova, 2003), which is also known as adaptability, coping ability, management capacity, stability, robustness, flexibility or resilience (Stakhiv, 1996; Smithers and Smit, 1997; Adger and Kelly, 1999; Smit *et al.*, 1999; Fraser *et al.*, 2003; Tompkins and Adger, 2004). Changes in adaptive capacity occur over time in response to changes in the system, including the nature or severity of exposures.

The concepts of vulnerability, exposure and adaptive capacity were used to examine two rural indigenous communities in Saskatchewan – the community of James Smith and the community of Shoal Lake. Community here refers to an aggregation of interconnected households with limited spatial extent (Bell and Newby, 1971). As expected, both communities are affected by a variety of internal and external stresses. Some of these stresses are climate-related, but stresses originate from numerous sources, including institutional arrangements, social conditions, environmental conditions and politics. Vulnerability to climate change is analyzed in the context of all stresses or conditions that affect the community (from the perspective of the community members) in order to accurately portray the vulnerability of the communities to climate change.

Vulnerability generally refers to the possibility of being damaged or harmed (Smit and Pilifosova, 2003), but meanings and usages of the term vary depending on the lens through which it is viewed (Cutter, 1996; Füssel, 2005). It has been applied to the fields of food scarcity (Sen, 1981; Watts and Bohle, 1993), environmental change (Liverman, 1994), natural hazards (Cutter, 1996) and climate change (Leichenko and O'Brien, 2002; Adger, 2003). In this last field, vulnerability is most commonly defined as "the degree to

which a system is susceptible, or unable to cope with, adverse affects of climate change, including climate variability and extremes" (McCarthy *et al*., 2001: 995). Much climate change scholarship applies this definition by characterizing vulnerability as a function of the exposure and sensitivity of the system in question to stressors and the ability of the system to adapt to, manage, cope, or deal with these stresses (Smit and Pilifosova, 2001; Turner *et al.,* 2003; O'Brien *et al.,* 2004; Füssel, 2005).

Vulnerability assessments can be conducted at individual, household, community or national scales, and can focus on various groups, locations or activities (Vogel and O'Brien, 2004). All scales and foci are relevant, but vulnerability manifests very differently depending on the scale being investigated. Vulnerability can be presented as an aggregate of the vulnerabilities that exist at various scales (Barnett and Adger, 2003); however it is often understood to pertain explicitly to particular individuals, groups or communities (Adger and Kelly, 1999).

Vulnerability is dynamic (Hewitt, 1997; Adger, 1999; Adger and Kelly, 1999; Handmer *et al*., 1999; Leichenko and O'Brien, 2002; Downing, 2003; Vogel and O'Brien, 2004) as the rate and magnitude of exposures change over time with the rate and magnitude of physical stimuli and the evolution of occupancy characteristics of the system. Similarly, adaptive capacity varies as the environmental, social, economic and institutional characteristics of the system vary over time (Handmer *et al*., 1999; Leichenko and O'Brien, 2002). Trends in vulnerability (Adger, 1999; Adger and Kelly, 1999; Handmer *et al*., 1999) are often more useful as they can provide insights into the nature of the processes shaping the vulnerability of a system.

There have been two main perspectives on vulnerability. Biophysical vulnerability is defined solely as the likelihood of exposure to some biophysical phenomenon (Liverman, 1994; Cutter, 1996; O'Brian *et al*., 2004). It is simply the physical location and physical characteristics of a particular stimulus that determine vulnerability and not the ability of the system to cope with exposure or the conditions that exist within the system to exacerbate exposure. Vulnerability here is seen as an end point or result of a biophysical stimulus. Social vulnerability recognizes that physical stresses alone do not cause vulnerability (Liverman, 1994). Vulnerability in these terms is related to existing social conditions that serve to increase exposure and reduce adaptive capacity (O'Brian *et al*., 2004). These conditions include marginalization, equity, institutional arrangements, economics, politics and resource access/use (Adger and Kelly, 1999; Adger, 2000; O'Brien and Leichenko, 2000; Pelling, 2002; Wisner *et al*., 2004). Properly characterizing vulnerability requires attention to both the biophysical and social vulnerability of a system (Handmer *et al.*, 1999; Adger and Kelly, 1999; Ford and Smit, 2004; Belliveau *et al.*, 2006).

1.4.1 Exposure and Sensitivity

Exposure and sensitivity are interconnected concepts, synonymous to some, that describe how external stimuli interact with the local conditions of a system (Downing, 2003; Smit and Pilifosova, 2003). Sensitivity is sometimes used to refer to the local conditions or occupancy characteristics that produce problematic circumstances in the presence of stimuli, but it is commonly presented as a part of exposure itself (Ford *et al*., 2006). Exposure and sensitivity reflect the internal intricacies of a system that cause effects from disturbances and not simply the nature of the disturbance itself. Systems can

be unexposed or insensitive to certain stimuli despite the presence of these stimuli. For example, a community that is dependent on agriculture is sensitive or exposed to droughts and hail storms, but not to fluctuation in local wildlife herd populations. Since household livelihoods in the community are derived from growing crops and not on hunting, changes in wildlife have less effect on the welfare of the community. Hence, the community is exposed to drought but not to reductions in wildlife populations.

1.4.2 Adaptive Capacity and Resilience

The concepts of adaptive capacity and resilience relate to the ability of a system to cope with change or exposure and the processes involved. Definitions of these terms have been developed in a broad range of fields, ranging from theoretical biology (Webster *et al.*, 1975; DeAngelis, 1980) to climate change (Chiotti *et al*., 1997; Ilbery *et al.,* 1997; Smit *et al.,*. 2000; Smithers and Blay-Palmer, 2001; Bradshaw *et al.,* 2004).

Resilience has been defined as the ability of a system to maintain its same structure and function after a disturbance or change (Holling, 1973, 2001). Systems are said to be resilient if they can easily accommodate disturbances and absorb change. Often, the most resilient systems are those that are diverse over space and time, while homogenous systems typically lack resiliency (Holling, 1973). Originally, the resilience literature discussed mainly ecosystem response (Folke *et al.*, 2002), but has shifted to consider the human dimension as well (Nystrom and Folke, 2001; Folke *et al.*, 2004). Within the climate change field, this term refers to the ability of the system to adjust to and accommodate climate-related exposures (Melillo *et al.*, 1996; Cao and Woodward, 1998; Cramer *et al.*, 2001; Hughes *et al.*, 2003; Turner *et al*., 2003).

Adaptive capacity is commonly defined as "…the ability of a system to adjust to climate change, including climate variability and extremes, to moderate potential damages, to take advantage of opportunities, or to cope with the consequences" (McCarthy *et al*., 2001: 982). In short, adaptive capacity is the ability of the system to adapt. Adaptation, as defined by the McCarthy *et al.* (2001: 982), refers to "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities." Adaptive capacity is the potential of a system to undergo adaptation to new climatic conditions.

Determinants of adaptive capacity include: economic wealth, technology, information, the availability/distribution of resources, social and human capital, institutional structures, political will and the perception of risk (Smit and Pilifosova, 2001; Smit and Pilifosova, 2003). There is also increasing awareness of the cognitive aspects of adaptive capacity and how these affect decision-making concerning adaptation (Grothmann and Patt, 2005). One form of human capital affecting adaptive capacity of particular importance in the communities is traditional ecological knowledge (see Section 1.4.2.1). Social capital and institutions were also found to significantly affect adaptive capacity in the communities (see Section 1.4.2.2).

1.4.2.1 Traditional Ecological Knowledge (TEK)

Traditional Ecological Knowledge (TEK) refers to knowledge that has been developed and used by indigenous peoples throughout the globe in order to live in their respective environments. This form of human capital is often applied by indigenous communities when adapting to or coping with environmental change (Berkes, 2008). These knowledge systems contain information on land use, plant use and animal

behaviour, and are presented through rituals, codes, ethics, teachings and spirituality. The epistemological basis for these systems often differs quite drastically from that of 'western' science. Hiebert and Van Rees (1998: 3), in a study of TEK within the Prince Albert Grand Council, define it as:

> ...cultural beliefs and traditions being passed on from... forefathers to the present generation for the purpose of survival while still living in harmony with the ecosystems. Traditional [ecological] knowledge is something that is learned during a lifetime and realizes the interconnectedness of the trees, soil and water.

The definition by Hiebert and Van Rees (1998) was developed in discussion with community members within the PAGC, and as such, can be viewed as an adequate definition of TEK for the purposes of this study.

TEK was first recognized by researchers from the western tradition in the late 1960s and early 1970s. Anthropologists and ethno-scientists began to note that the cultures they were studying had developed advanced systems for organizing their worlds and classifying plants and animals (Berlin *et al*., 1968; Diamond, 1968; Berlin, 1973; Dwyer, 1976). Similarly, a shift to participatory and collaborative research in the international and community development fields put researchers in direct contact with indigenous knowledge systems and an awareness of their utility and legitimacy began to develop (Sillitoe, 1998). Since then, TEK has been used in investigations of First Nations land use and occupancy (Riewe, 1992; Labrador Inuit Association, 1977; Freeman, 1976), medicine and botany (Hutchens, 1991; Stark, 1992; Lacey, 1993), environmental management (Feit, 1988; Berkes, 1988, 1994; Gunn *et al.,* 1988; Clarkson *et al.,* 1992; Knudston and Suzuki, 1992) and climate change (McDonald *et al.,* 1995; Fox, 1998; 2002; Riedlinger, 1999; Ashford and Castleden, 2001; Berkes and Jolly, 2001;

Krupnik and Jolly, 2002; Nickels *et al.,* 2005; Nuttal, 2005; Ford *et al.,* 2006; Ermine *et al.*, 2005, 2007, 2008).

By incorporating TEK into climate change studies, oral history can provide a window to past climates and experiences with climatic events allowing researchers to gain insights on current and future impacts of climate change (McDonald *et al.,* 1995; Cohen, 1997, Fox, 1998; 2002; Riedlinger, 1999; Joss and Inuktalik, 2000; Ashford and Castleden, 2001; Krupnik and Jolly, 2002; Huntington *et al.,* 2004; Nickels *et al.,* 2005). The meaning of environmental change to affected communities can be documented first hand and techniques for increasing adaptive capacity can be designed with community input in order to increase their applicability (Ashford and Castleden, 2001; Berkes and Jolly, 2001; Nickels *et al.,* 2005; Ford *et al.,* 2006; Ermine *et al.*, 2005, 2007, 2008).

1.4.2.2 Institutions and Social Capital

Within the climate change field, O'Riordan and Jordan (1999) define institutions as "the multitude of means for holding society together, for giving it a sense of purpose and for enabling it to adapt." The importance of institutions in adapting to climate change can be easily understood from this definition – institutions are the underlying framework of society that facilitate or discourage adaptation to climate change. By defining access to resources, interpretation of information and politically acceptable adaptive strategies (O'Riordan and Jordan, 1999), institutions play a major role in both determining adaptive capacity and how these capacities are applied (Næss *et al*., 2005; Diaz, 2008; Diaz and Gauthier, 2008). It is important to make a distinction between formal and informal institutions. Formal institutions refer to public or private organizations, such as government agencies or local resource management committees,

while informal institutions usually refer to organisational patterns that are not formally coded but they still define the ways in which people behave in specific conditions (Diaz and Gauthier, 2008).

Formal institutions play a major role in determining vulnerability by defining the allocation of resources over broad scales. The use of resources in adaptation initiatives, although sometimes implemented at the local, community or household level, is defined by formal institutions operating at federal or provincial levels (Diaz and Gauthier, 2008). Vulnerability is then partially dependent on the ability of formal institutions to allocate resources to groups at risk and define rules for resource use that reflect the needs of vulnerable groups within society (Diaz and Gauthier, 2008; Diaz, 2008).

Social capital is often generated by participation in formal and informal institutions (Diaz, 2008). Social capital can be roughly understood as the breadth and wealth of social relations and networks that can be mobilized to facilitate action against collective problems (Woolcock and Narayan, 2000; Adger, 2001; Svendson, 2006). Adaptive capacity to climate change can be largely affected by the presence or lack of social capital within communities (Adger, 2001). The norms, or rules of behaviour, and networks provide the basis for determining the success and nature of adaptation, and have been shown to facilitate coping with weather-related extremes and hazards (Adger, 1996; Ribot, 1996; Pelling, 1998). Social capital facilitates the transmission of TEK through social norms and networks.

There are three main types of social capital: (1) bonding; (2) networking or bridging; and (3) linkage with the state. Bonding social capital is defined as connections or relationships that exist between members of a defined group that are based on kinship

or location (Adger, 2001). In the case of First Nations communities, Mignone and O'Neil (2005) defined it as "relations within each First Nation community" including friendships, kinships and other interpersonal ties. Engagement in social activities increases the ability of individuals to cope with weather-related stresses (Semenza *et al.*, 1996; Adger, 2001). Social interactions creating networks of reciprocity can be applied to cope with various stressors, but do not always ameliorate negative conditions or contribute to successful adaptive strategies (Fafchamps and Minten, 2001).

Networking or bridging is similar to bonding social capital but is more regional in nature. It is defined as the economic and other ties to outside groups based on trust and reciprocity (Adger, 2001). Mignone and O'Neil (2005) define bridging social capital as "horizontal links with other communities whether they are First Nations communities or other communities." Such social capital can serve to manage risk while adapting to climate change, as legally-sanctioned informal institutions collectively manage resources, settle disputes and allocate benefits and opportunities (Baland and Platteau, 1996; Adger 2000, 2001). This form of social capital reflects the ability of local institutions to interact and work together with similar institutions in other communities towards common goals.

The state affects local adaptive capacity by interacting with groups. Vertical linkages with the state and the nature of these linkages determine important aspects of adaptive capacity. The success of state resourced planned adaptation partially depends on whether the initiatives are reflective of social norms and collective will of the group (Adger, 2001). Collective capacity for adaptation is dependent on synergy between the state and groups that promotes social and policy learning resulting in evolving adaptation and management strategies (Evans, 1996; Adger, 2001). Linkage social capital refers to

community and state linkages, in other words those with all federal and provincial government departments and public and private corporations (Mignone and O'Neil, 2005). Much funding for research and development within First Nation communities comes from federal government bodies or public and private corporations, while provincial governments deal with matters concerning natural resources. The local chief and council must be able to communicate and interact effectively with these bodies in order to ensure that First Nation concerns are not excluded from the design and development of natural resource and community projects and programs, and that these properly deal with the needs of the people.

Combinations of the different types of social capital create ideal conditions for adaptation and coping with climate risks. For example, state linkages may facilitate networks of reciprocity and bonding amongst community members, but these networks may commit a particular community to actions that in fact limit its ability to deal with certain stresses. It is also the nature and intent of networks that define their role in determining adaptive capacity (Woolcock, 1998). Gangs and mafia networks exhibit high social capital, but their collective efforts weaken the social capital of society in general (Arrow, 2000). In short, the ability of a system or group to cope with stresses, including those related to climate and climate change, is partially defined by the presence of bonding and networking social capital in different combinations unique to context, and synergy between the group and the state or the ability of the state to foster security for marginalized sections of the system or group (Woolcock and Narayan, 2000; Adger, 2001).

CHAPTER 2 METHODS

This chapter outlines the methodology used to complete this thesis. Properly characterizing vulnerability in the communities required numerous techniques from a variety of fields. Both qualitative and quantitative information sources, including spatial, meteorological, interview and group discussion data as well as global climate model (GCM) output, were used in an attempt to fully characterize vulnerability in First Nations communities. Engagement of community members is essential when employing the vulnerability approach. Knowledge of climate-related and other risk, adaptation options and resource management strategies is best gained through the documentation of community experience (Ford and Smit, 2004). Individual experiences of community members and those shared among community members have produced detailed observations of local environments (Duerden and Kuhn, 1998; Huntington, 1998; Usher, 2000) that can be used to characterize community exposure and adaptive capacity (Ford and Smit, 2004). The impacts of climate change often intersect with social conditions, necessitating the participation of community members in the research. Also, the inclusion of local perspectives into the vulnerability analysis can help empower locals in the design of adaptive responses to climate change (Paavola and Adger, 2006; Tschakert, 2007). Ethnographic techniques, such as focus groups, group discussions, interviews and participant observation, have been successfully used to document environmental and social change and adaptation responses in indigenous populations (Ferguson *et al*., 1998; Huntington, 1998; Krupnik and Jolly, 2002; Fox, 2002; Nickels *et al*., 2002; DSD, 2003; Government of Nunavut, 2003).

As discussed in section 1.4, vulnerability is conceptualized as a function of exposure and adaptive capacity. Communities are vulnerable to climate-related stimuli not solely based on the physical characteristics (e.g., magnitude and severity) of the stimuli but also due to the social conditions existing within the community (Wisner *et al.*, 2004). The theoretical underpinnings of this conceptualization of vulnerability lie in the realist and constructivist theories. Climate-related stimuli are real phenomena that exist outside of their relationship to the community. But social conditions and human agents play a role in constructing vulnerabilities to these stimuli. Sensitivities to flood, for example, are partially constructed from social processes, such as marginalization, that place some groups within society closer to flood risks or limit coping capacities by excluding certain groups from resource access (Adger and Kelly, 1999). The engagement of community members to understand social conditions and processes creating vulnerability, as well as documentation of existing and future potential climates, is necessary to complete this research. Therefore, the following methods were employed:

1) initial contact with the communities
2) determination of ethical and practical considerations for conducting community research in Cree First Nation communities in Saskatchewan
3) comprehension of cross-cultural understandings of vulnerability to climate change
4) collection of primary qualitative data
5) participant observation
6) analysis of primary qualitative data
7) collection and dissemination of spatial data
8) collection and analysis of secondary data
9) construction of future climate scenarios

2.1 Establishing Contact with the Communities

Interaction with the communities began under the mandate of a project entitled: *Isi Wipan: Climate – Identifying the impacts of climate change and capacity for*

adaptation in two Saskatchewan First Nation Communities (Ermine *et al*., 2007). This was a joint research project with the University of Regina, Luther College, the First Nations University of Canada and the Shoal Lake and James Smith Cree Nations. The goal of the project was to assess the potential impacts of climate change on the two communities. Three trips were made to each community in conjunction with this project – one lasting two days in November of 2006, one lasting one week in January of 2007 and one lasting three days in March of 2007. The first trip was to make initial contact with both communities and to discuss the availability of data and proper acquisition techniques. Data were acquired on the second trip. The third trip was for the purpose of disseminating the results of the project.

During the third and final visit of the *Isi Wipan* project, the Elders and members of the band councils of both communities were asked if research pertaining to this thesis, a vulnerability assessment of each community, could continue. Both bands showed great interest in allowing the research to continue and the researcher was welcomed to make further visits to the community.

Research and consultation visits continued throughout the summer of 2007 in conjunction with the *Institutional Adaptations to Climate Change* (IACC, 2008) project. This project seeks to understand the coping capacities of institutions in dry land regions to climate change, focusing on the Elqui River Basin in Chile and the South Saskatchewan River Basin in Canada. The researcher was engaged in a community vulnerability assessment in the town of Outlook (Saskatchewan) and realised the applicability of methods developed by the IACC project to this thesis. The inclusion of

two First Nations communities found within the South Saskatchewan and Saskatchewan River Basins also fit well with the project's mandate.

Most of the months of July and August 2007 were spent in the communities to further familiarize the researcher with the places, including participation in a family camp hosted by the Shoal Lake Cree Nation. Interviews with community members were conducted in the fall of 2007, with respondents varying in age, gender and social position using purposive sampling techniques. Workshops with Elders in each community were held in December of 2007 and preliminary findings from the interview analysis were disseminated among community members, giving them the opportunity to respond to findings in order to improve their accuracy. The workshops were held in conjunction with another project entitled, *Nikan Oti*: *The Future – Understanding adaptation and capacity in two First Nations* (Ermine *et al*., 2008), which was conducted simultaneously with this thesis research. This project is a continuation of the *Isi Wipan* project, focusing on adaptive capacity and future adaptive strategies for the communities. Another set of workshops were held in March of 2008 in concurrence with the *Nikan Oti* project with the aim of gathering more data on the adaptive capacities of the communities.

Each visit to the communities was conducted in a manner that allowed the researcher to immerse himself in the communities. Lodging was taken with an Elder of the Shoal Lake Cree Nation and with a family of the James Smith Cree Nation. The researcher participated as much as possible in the day-to-day lives of his hosts and became more than welcome in both communities. A sense of acceptance in both communities was attained and the friendships developed will last far beyond the scope of this research project.

2.2 Ethical and Practical Considerations

Ethics approval for this research was obtained from the University of Regina Research Ethics Board. Respectful and unintrusive methods of approaching and interviewing informants are crucial to ensuring healthy relations with community members, ethical research methods, and that relevant and accurate data are acquired. This research was conducted with the utmost care and forethought given to these points.

Community liaisons were consulted before any steps were taken. Liaisons were asked about the proper ways to approach different members of the community and the best strategies to employ to obtain respondents. Under the direction of the liaisons, community members were approached in an open and friendly manner and most were willing to give interviews. The methods used to gain interviews were extremely informal. Respondents could be approached virtually anywhere and could be called at home without bothering them. When talking to Elders, it is respectful to bring a gift of tobacco, as it is the traditional way. When the advice of the Elder is sought, the Elder with the knowledge is approached and asked for help. When the Elder agrees to help, a gift of tobacco is given. The Elder will begin to speak and must be listened to intently without interruption. Although local culture can vary quite extensively in First Nation communities, the aforementioned traits were observed in both communities and can be used as a starting point when designing similar research projects. In addition, ethics approval from the University of Regina Research Ethics Board was obtained to conduct this work (see Appendix D).

For ethical reasons the database containing spatial and land-use information (see Chapter 4) is not presented, but rather a few key findings from this part of the research

are discussed. Elders in the communities are concerned when knowledge such as this is shared with outsiders. They do not want their knowledge exploited for foreign gain. It is hoped that the improper use of indigenous knowledge for gain, as discussed by Battiste and Henderson (2000) and many of the Elders, can be avoided if the database is only made available to the communities. Only understanding the catalysts and conditions that caused changes in the usage of reserve lands and how the community implemented and was affected by these changes is important to this thesis.

2.3 Cross-Cultural Understandings of Vulnerability to Climate Change

The key concepts related to vulnerability were discussed with community members with two objectives in mind: (1) to present the concepts integral to a vulnerability assessment from a western science perspective in the Cree language; (2) to gain insights into cultural characteristics and sensitivities that will allow for the proper application of the conceptual framework to the research. Common understandings from both the perspective of the researcher and the community members played a major role in the success of this research. The researcher wished to make clear his intentions to the best of his ability to ensure the ethical collection of data. It is important to note that these understandings are based on the researcher's experiences interacting with members of the communities. It is acknowledged that the second and sometimes third hand interpretations of certain conversations and teachings may not lead to perfect understandings of the concepts, but will definitely advance the conceptualization of vulnerability in a more indigenous manner for the purpose of analyzing interview data.

The translations presented here were developed from conversations with community members. There were no direct translations of the western scientific words

into Cree. The ideas were better understood as phrases in the Cree language. It is also important to note that the compartmentalization and definition of these concepts by western science differs from that of the traditional intellects within the communities. These concepts, although understandable when presented in Cree, are not engrained into the cultural paradigm. Often the words describing these concepts were out of reach of many community members' Cree vocabularies. It was necessary to consult with Elders on the proper phrasing and word usages because Elders generally have wider vocabularies and better understandings of the Cree language. The appropriation of these concepts into the Cree paradigm is not the goal of this exercise. It is rather to gain a conceptual understanding of vulnerability that is culturally appropriate.

The concepts of adaptation, adaptive strategy, adaptive capacity and resilience were discussed with community members. A phrase in Cree that was conceptually similar to these concepts was developed. This phrase in Cree is: *tansi asi makaskum-mak ka pay mis kutch chi punik, ka si apak;* which translates directly to: the way that change is accepted. At first, it appeared as if community members were uneasy when discussing concepts related to changing their community. First Nations people have been exposed to pressure to change from outside sources in the recent past and are now aiming to preserve and protect their culture. Intrinsic in these concepts is change in community processes and practices, and discussion about this is understandably not necessarily welcomed from an outsider. It is hoped that the focus on local adaptive strategies or techniques was conveyed during the fieldwork. The research was interested in the 'Cree' or 'Shoal Lake' or 'James Smith' way of adapting and not in hoping to impose changes on the communities.

Many Elders were interviewed and participated in workshops throughout this research. They were asked many questions about how they have seen the climate changing, how they have seen their communities affected, how they have attempted to cope with these changes, and other topics. The extremely holistic manner in which they answered was noted. The interconnectivity of all things affecting the community was easily understood from Elders' dialogue. For instance, when asked a question about climate change, Elders would discuss not only changes in the physical properties of the climate, but also changes in the environment in general and the social, political and cultural climate. Many Elders conveyed a sense that climate change was just another stress resulting from the mistakes of the dominant global culture. This is not to say that they do not recognize their part in causing climate change. They acknowledge weaknesses within their communities that can cause climate change and also weaknesses that could be exacerbated by climate change. These are all, however, interrelated. With this in mind, the vulnerability assessment was conducted in as holistic a manner as a Masters' thesis would allow.

It also became apparent that the vulnerability of the communities was largely linked to the vulnerability of the environment in the eyes of the Elders. This observation is supported in the literature surrounding traditional Cree perspectives stating that people cannot be separated from the environment (FSIN, 2007). For this reason vulnerabilities of the environment surrounding the communities from the peoples' point of view were included in the assessment.

Research into the meaning of climate change vulnerability was conducted simultaneously with this thesis research by a project entitled *Nikan Oti*. The results of

this project are used throughout this thesis to guide the researcher on culturally specific values and beliefs as they apply to the concepts of exposure, adaptive capacity and vulnerability. The main results of the project relating to the communities' response to change indicate that past exposures were dealt with by relying on cultural and spiritual virtues, and that these must be reinstated in the community in order to adapt to future changes (see Figure 2.1 and 2.2). Elders were asked about the qualities of their ancestors that allowed them to deal with change. Elders from James Smith noted how work ethic, spirituality and reliance on culture aided their forefathers/mothers in coping with environmental and social stressors. Shoal Lake Elders noted how spirituality increased community resilience during the times of their ancestors. Both groups of Elders believed that these capacities could be developed within their communities by teaching and training the youth in traditional cultural skills and values. A general sense of the importance of individual values, beliefs and actions in determining the adaptive capacity of the community can be understood from this.

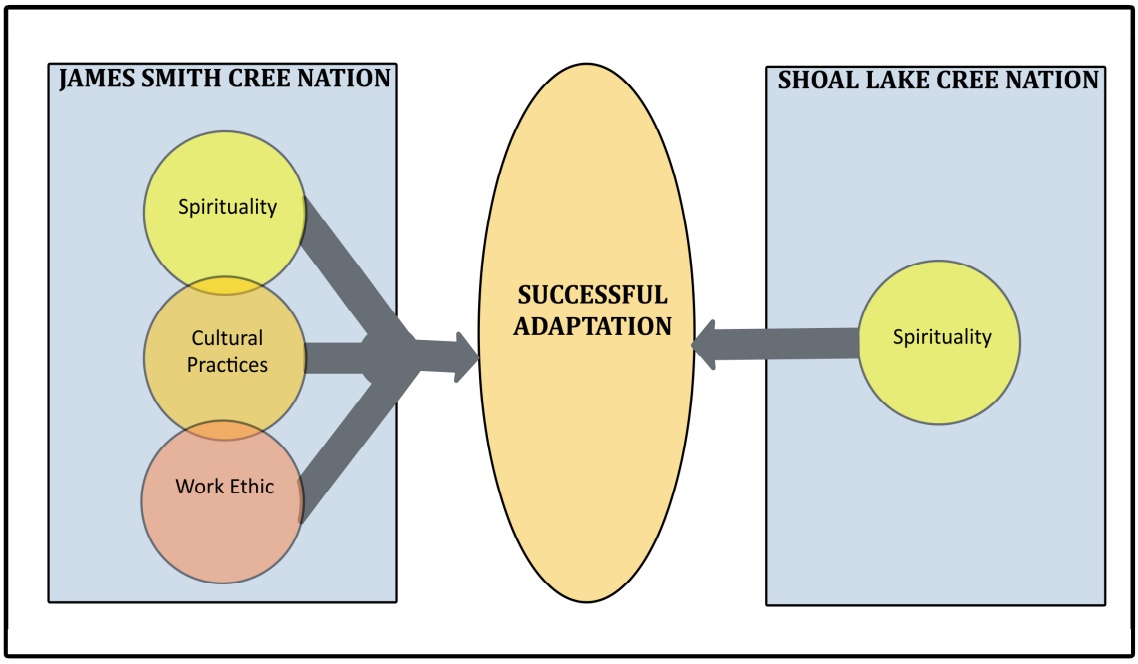


Figure 2.1 Summary of Elder identified adaptive capacities (Ermine *et al.*, 2008) (original in colour).

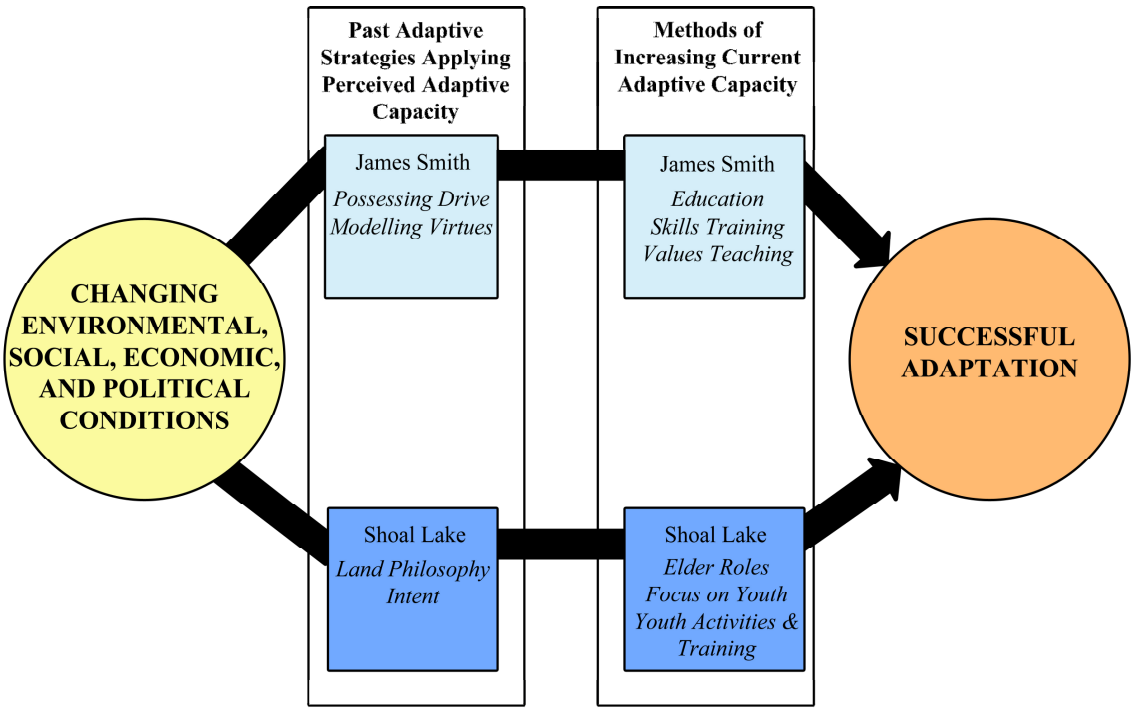


Figure 2.2 Community identified paths to successful adaptation (Ermine *et al.*, 2008) (original in colour).

2.4 Primary Qualitative Data Collection

A number of primary qualitative data sources were pursued and utilised in this study. Multiple methods were engaged and types of data collected to more accurately and thoroughly make use of sources.

2.4.1 Semi-structured Interviewing

Semi-structured interviews are vital to participatory methods and are defined as free flowing conversation centred on open ended questions whose structure is superficially unapparent (Pretty, 1995). They have been widely applied in a variety of settings, including indigenous (usually Inuit) communities (Ferguson and Messier, 1997; Huntington, 1998; Fienup-Riordan, 1999; Ford *et al.,* 2006).

This technique of interviewing was employed as it allows for the information to be gathered on events, opinions and experiences (Hay, 2000). The interviews are focused on predetermined topics but digression is allowed, which tends to increase the detail and accuracy of responses (Berg, 1995). Individuals within the communities were able to freely discuss their concerns regarding certain issues in the community and incorporate their experiences, beliefs and opinions. Detailed observations of exposure, adaptive capacity and the ways these interact to produce vulnerability can be documented, catalogued and analyzed from responses of this nature. Table 2.1 shows the principles used to guide the research. A more detailed explanation is provided in Appendix A. Copies of consent forms given to respondents are presented in Appendix E. There were 17 members of each community interviewed using this technique. The respondents' profiles can be seen in Figure 2.3.

Table 2.1 Themes discussed in interviews with example questions.

Theme	Example Questions
Background History: • Life and work history • Livelihood • Sources of income	*How long have you lived in the community? How old are you? How many people live in your household? Are you employed, and if so, where?*
Activities: • Community involvement • Responsibilities • Usage of environment • Traditional skills	*Do you hunt/trap/fish? Can you openly seek Elder consultation to aid you with your problems? Are you involved in any community activities or organizations?*
Current and Past Exposures: • Problematic conditions • Issues with current situation • Change in aspects of life	*What sorts of things hinder your ability to earn a living? Are there any problems within the community? How do these affect you? How have these changed over the years?*
Current and Past Adaptive Strategies: • Techniques used to cope or manage exposures • Aids and constraints to adaptation	*What have you done in light of the exposures (from above)? What should you have done? What would you have liked to do? What could you do in the future?*
Current and Past Climatic/Environmental Exposures: • Problematic stimuli • Implications for the community • Change in climate/environment	*Are there any problems with the weather? Are there any problems with water quality/quantity? How have these changed and what do they mean to you?*
Current and Past Climatic/Environmental Adaptive Strategies: • Techniques used to cope or manage climatic/environmental exposures • Aids and Constraints to adaptation	*What do you do when (exposure) happens? How have you adjusted? Have your adjustments dealt with the problem? What do you wish you could do? What is keeping you from doing it?*
Participation in Traditional Activities: • Hunting • Fishing • Trapping • Involvement with Elders	*Did you hunt/fish/trap with your father or grandfather? Do you know how to dress wild game? Do you know any stories from the old people? Do you teach your children Cree?*
Future Vulnerability: • Future exposures • Future adaptive capacities • Implications	*What do you foresee for your children/grandchildren? What will they have to face? How are you trying to prepare them for this?*

Theme cont'd	Example Questions cont'd
Conclusion: • Additions • Gaps • Other potential participants	*Is there anything else that you would like to add or discuss? Are there any other people that you think would be interested in participating?*

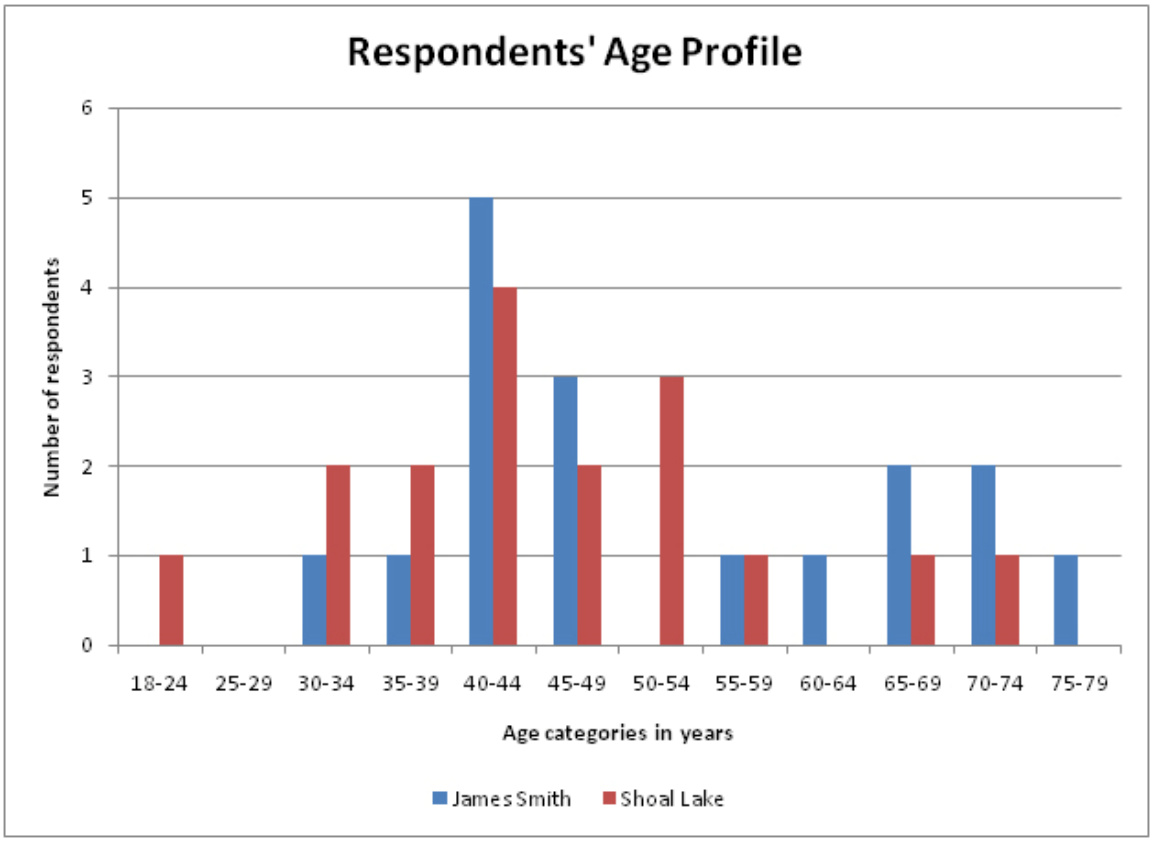


Figure 2.3 Respondents' age profile (original in colour).

2.4.2 Elders Circles (Group Discussions)

Elders circles were used to gain broad insights into the conditions and processes affecting and characterizing the community. They were also used as a means of disseminating and gaining feedback on initial results. This technique has been widely applied in similar research (Huntington, 1998; Ermine *et al.*, 2005, 2007, 2008).

Elders circles are similar to group discussions, except they hold a more powerful cultural and spiritual meaning. The participants are always respected Elders within the community and the discussions are not lead by the researcher. Elders circles allow for unbiased and unprompted discussion to develop and for participants to draw from and respond to one another (Huntington, 1998). Each participant has the opportunity to speak, but can also decline if they so wish. The participants were either presented with a broad open-ended question regarding their vulnerability or with initial results of the vulnerability assessment and asked to respond. Each participant would answer in turn, speaking from his/her own experiences and observations, and building upon the dialogue of the others. All statements were respected by the participants.

Elders circles were an important means of obtaining information in the communities. They are culturally sensitive and the mutual respect that existed within the groups urged participants to speak more freely than they otherwise might. The exact character of the vulnerability of the communities was more easily understood in these settings.

2.4.3 Key Informant Interviews

Interviews were conducted with members of the local band councils. These individuals are in charge of managing their respective aspects of community life, and as such, can provide useful information on the broader forces affecting those aspects that were identified by community members as being problematic or stressful. These interviews were aimed at developing deeper understanding of the vulnerabilities identified by community members and the processes shaping them.

2.4.4 Sampling Strategy

Respondents were selected in a purposive manner, as their participation was dependent upon their knowledge and experience as it relates to this thesis (Patton, 1990; Hay, 2000). Four techniques of purposive sampling were used to select respondents to the interviews and focus group participants: (1) intensity; (2) theory-based; (3) snowball or chain; and (4) opportunistic.

The intensity sampling technique seeks cases rich in information regarding the phenomenon of interest (Patton, 1990). In this research, individuals that had expert knowledge of the land, status based on their age and experience, or held positions within the community that would give them insights into the nature and causes of various problems were selected to participate. The inclusion of hunters/trappers, Elders and band counsellors resulted from the application of this technique.

Theory-based sampling involves the selection of participants based on their theoretically constructed importance (Patton, 1990). The concept of vulnerability and theory surrounding it were used as the grounds upon which participants were selected

using this technique. The theory of social vulnerability in particular was used to guide participant selection in this area. The inclusion of individuals from various social groups was warranted, including women and single parents.

Snowball or chain sampling determines the inclusion of individuals in studies based on their identification as being information-rich in the specific area of inquiry by other members of the community (Patton, 1990). All respondents were asked to direct the researcher towards community members that he/she deemed potentially helpful in the study. Most of the respondents were chosen following this technique.

Purposive sampling in an opportunistic manner involves real time and on the spot decisions about sampling opportunities as they arise during the course of the research (Patton, 1990). Individuals that approached the researcher with interest in participating or who were encountered during daily activities in the community had their inclusion in the sample assessed in this fashion. Often unforeseen sources of information can be obtained using this technique (Patton, 1990).

2.4.5 Sample Size

There are no clearly defined rules for defining sample size in qualitative inquiry (Patton, 1990). The goal of the thesis was to include as many perspectives and experiences from the community as possible. In order to accomplish this, participation in this study was sought with individuals until no new insights were gained from interviews.

2.5 Participant Observation

Participant observation involves the inclusion of the researcher in the events being observed (Hay, 2000; Kearns, 2000). In this case, these are the activities of the

community. A deeper understanding of the community was obtained through experience. This allowed for interviews to be conducted in context with consideration given to local perspectives (Fox, 2002). In this case, the application of this method involved the participation of the researcher in a broad range of activities that varied between the two communities. In James Smith, the researcher participated in elk hunting, swimming, hiking, camping, social gatherings, spent much time walking around the community and lived with a family while staying there. In Shoal Lake, the researcher participated in fishing, moose hunting, duck hunting, family camp, spent time walking around the community and on-reserve land, as well as travelling by boat around the lake, visited the local school and lived with an Elder while staying there. Participating in local activities allowed the researcher to more accurately characterize similarities and distinctions between conditions influencing vulnerability in each community. Respondents were also able to highlight features and processes *in situ* allowing for more accurate descriptions and better interpretation by the researcher.

2.6 Analysis of Primary Qualitative Data

All interviews were digitally recorded and transcribed. Transcriptions were imported into *NVivo 2.0*, commonly used software for analysis of qualitative data, and coded for different nodes (Appendix B). Nodes refer to themes or key issues that become apparent as interviews are reviewed. Sections of text related to the various nodes are highlighted and organized by node for further review based on their connections with other nodes and their relevance to the particular themes. Interviews from communities were analysed separately, but the same node structure was applied in both cases.

2.7 Collection and Dissemination of Primary Spatial Data

The collection of primary spatial data involved mainly the documentation and description of sites and routes of traditional importance and how these have changed over time. Sites and routes were identified from the interviews and workshops. Respondents were not probed as to the location or types of sites and routes that were important to the communities. These were only selected if they were mentioned during an interview or workshop. Respondents were then asked if they would accompany the researcher to the site. If they were willing, transportation was arranged and the researcher would be guided to the particular site by the respondent.

Once on location, the respondent would once again be interviewed as to the significance of the site and any observed changes over time. These interviews were recorded digitally and videotaped. A GPS reading was taken at each site and the route was stored if it was important. Photographs of the site were also taken. All this information was compiled into a GIS by linking the photographs, recordings and footage to their respective site by the GPS data.

The GIS was then delivered back to the communities. In order to ensure universal access throughout the communities, the information was packaged on DVDs that are readable in most home DVD players and computers. Viewers could watch the videos of their fellow community members describing particular sites that were linked together with maps of the area.

2.8 Secondary Data Collection and Analysis

Secondary sources of data on environmental change, adaptive strategies and their determinants were used to characterize the primary data on vulnerability (Duerden, 2001). This thesis used previous ethnographic studies, historical accounts, previous scientific research, climate databases and government reports to complement the interview data. Secondary sources were also integral to the analysis of future exposures. Literature reviews pertaining to climate change impacts on the boreal transition ecozone and First Nations people were used in conjunction with data collected on these subjects. A deeper analysis of the environmental and social effects projected by the climate change scenarios was completed in this manner.

2.9 Construction of Climate Scenarios

Climate scenarios are coherent, internally consistent and plausible future climate descriptions that have been constructed to investigate the potential consequences of anthropogenic climate change (Parry, 2002). They are not predictions of future climate, but rather represent plausible future climates based on assumptions about future greenhouse gas emissions and their effect on global climate. Climate change scenarios provide insight into possible future climates that can be used to hypothesise future impacts of climate change on human-environment systems and the ability of these systems to cope with or adapt to these impacts. For the purposes of this study, climate change scenarios are used to assess whether future adaptive capacity of the study communities is adequate to deal with the forecasted impacts.

Climate change scenarios can be divided into two main types: synthetic and analogue. Synthetic scenarios are the simplest type of climate scenarios. They are

developed by arbitrarily changing particular climatic or related elements by a realistic amount usually determined through a qualitative analysis of climate model simulations (Carter *et al.*, 1999). They are simple to apply and easy to interpret by non-specialists. Although results are realistic, they are rarely highly accurate (Carter *et al.*, 1999; Barrow and Lee, 2003).

Analogue scenarios are developed by identifying either spatial or temporal analogue climates that are expected to resemble the future climate of the particular study region (Carter *et al.*, 1999; Barrow and Lee, 2003). The causes of the analogue climates vary significantly from the causes of changes in future climates induced by greenhouse gas emissions (Carter *et al.*, 1999; Barrow and Lee, 2003). They are based on observed or experienced, as opposed to hypothesized, conditions and can therefore be used to test or validate impact models (Carter *et al.*, 1999; Smith *et al.*, 1998).

Global Climate Models (GCMs) are the most widely used and credible source of climate change scenarios under radiative forcings (Carter *et al.*, 1999). GCMs are numerical models representing how the physical processes and properties of the atmosphere, ocean, cryosphere and land surface behave, operate and interact (Hengeveld, 2000; Ahmad *et al.*, 2001; Barrow and Lee, 2003). GCM output, although the most useful and credible, is at a low spatial resolution, sometimes lower than the processes it is attempting to model, and is affected by various uncertainties mostly related to feedback mechanisms between physical processes.

Greenhouse gas emissions scenarios are another important part of developing climate change scenarios. Global warming is largely attributed to increased concentrations of greenhouse gases in the atmosphere resulting from human activity

(Hegerl *et al*., 2007). Greenhouse gas emissions result from the interaction of complex dynamic systems driven by technology, demographics and socio-economics (Nakicenovic *et al.*, 2000). A number of greenhouse gas emission scenarios have been developed by the Intergovernmental Panel on Climate Change (IPCC). There are two main generations of emissions scenarios: IPCC alternative scenarios (IS92) and IPCC Special Report on Emissions Scenarios (SRES).

SRES emission scenarios are divided into four families (Table 2.2) based on qualitative storylines of different political, social and cultural conditions (Nakicenovic *et al.*, 2000). The SRES scenarios are quantifications of these storylines. In total, there are six SRES scenarios, as the A1 storyline family consists of A1Fl, A1T and A1B.

2.9.1 Defining baseline climate

Baseline climate for the 1961 to 1990 normal period was obtained for the two communities from the Environment Canada (2005) National Climate Data and Information Archive. There were no entries in the archive specifically for James Smith and Shoal Lake. Following the direction of Barrow and Lee (2003), the closest stations with similar topography were chosen to construct normals for the area (Figure 2.4). The stations at Prince Albert, Melfort, Choiceland and Lost River were used to determine normals for James Smith, while Aylsham, Prairie River and Somme were used for Shoal Lake. Data from these stations were averaged and used as the baseline climate for the communities. The results are presented in Chapter 3.

Table 2.2 SRES Emission Scenarios

Scenario Estimates	**1990**	**SRES Marker Scenarios for 2100**			
		A1	**A2**	**B1**	**B2**
Population (billion)	5.3	7.1	15.1	7.2	10.4
CO_2 concentration, fossil fuels (GtC/yr)	60.0	4.3 to 0.3	28.9	5.2	13.8
Sulphur dioxide emission (MtS/yr)	70.9	20 to 40	60	25	48
Global annual-mean temperature change (°C)		2.52	3.09	2.04	2.16
Range (°C)		1.7 to 3.7	2.1 to 4.4	1.4 to 3.0	1.5 to 3.1
Global mean sea-level rise (cm)		58	62	50	52
Range (cm)		23 to 101	27 to 107	19 to 90	20 to 93

Source: Carter *et al*., 1999; Nakicenovic *et al*., 2000

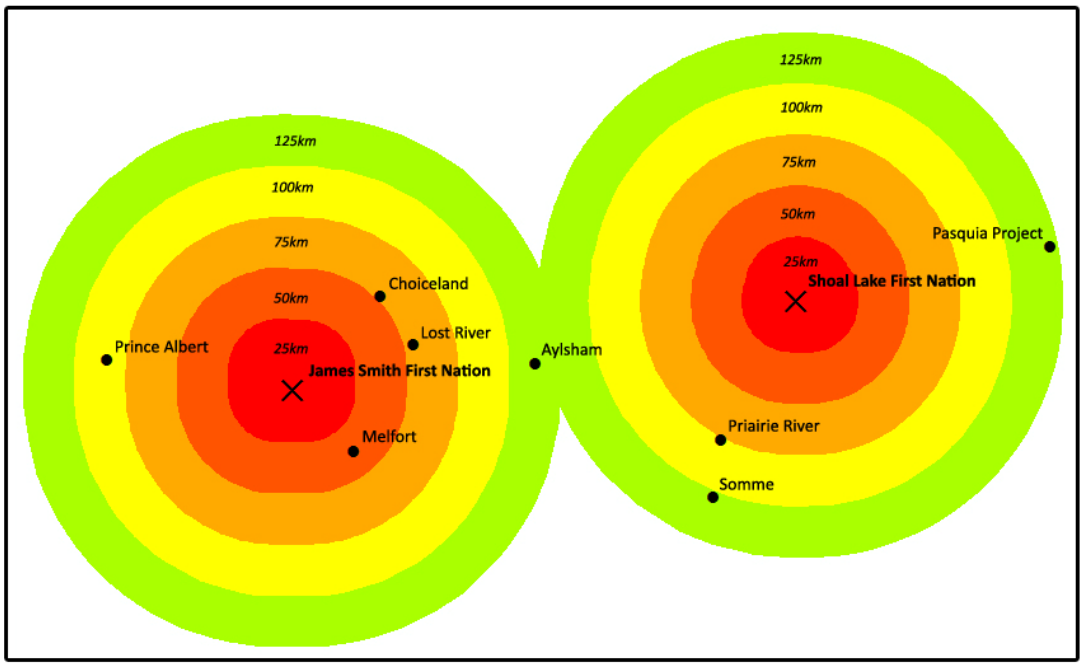


Figure 2.4 Spatial distribution and proximity to communities of normal stations (original in colour).

2.9.2 Choosing Global Circulation Models and Emissions Scenarios

GCM and emission scenario combinations were selected following Barrow and Lee (2003) to show the most extreme and median conditions projected. As such, the warm/dry, cold/wet and median model outputs were used to construct the scenarios. Originally, there were five GCM and emission scenarios chosen: CGCM3T47 SR-A1B, CGCM3T47 SR-B1, CSIROMk3 SR-B1, GISSAOM SR-B1 and HadGEM1 SR-A2. Figures 2.5, 2.6 and 2.7 show the scatterplots used to select GCMs and emission scenarios for the 2020s, 2050s and 2080s, respectively. The model outputs were compared to the normals for each community using paired t-tests to see how well they reflected local climate conditions (Table 2.3). The CSIROMk3 SR-B1 and GISSAOM SR-B1 models did not accurately depict temperature or precipitation for either community and these models were therefore not included in the study. The CGCM3T47 model coupled with SR-A1B and SR-B1 were also shown to be inaccurate representations of precipitation for James Smith, but modeled temperature well. Precipitation in James Smith was the only variable that was not accurately represented by these scenarios, so their exclusion from the study was not necessary.

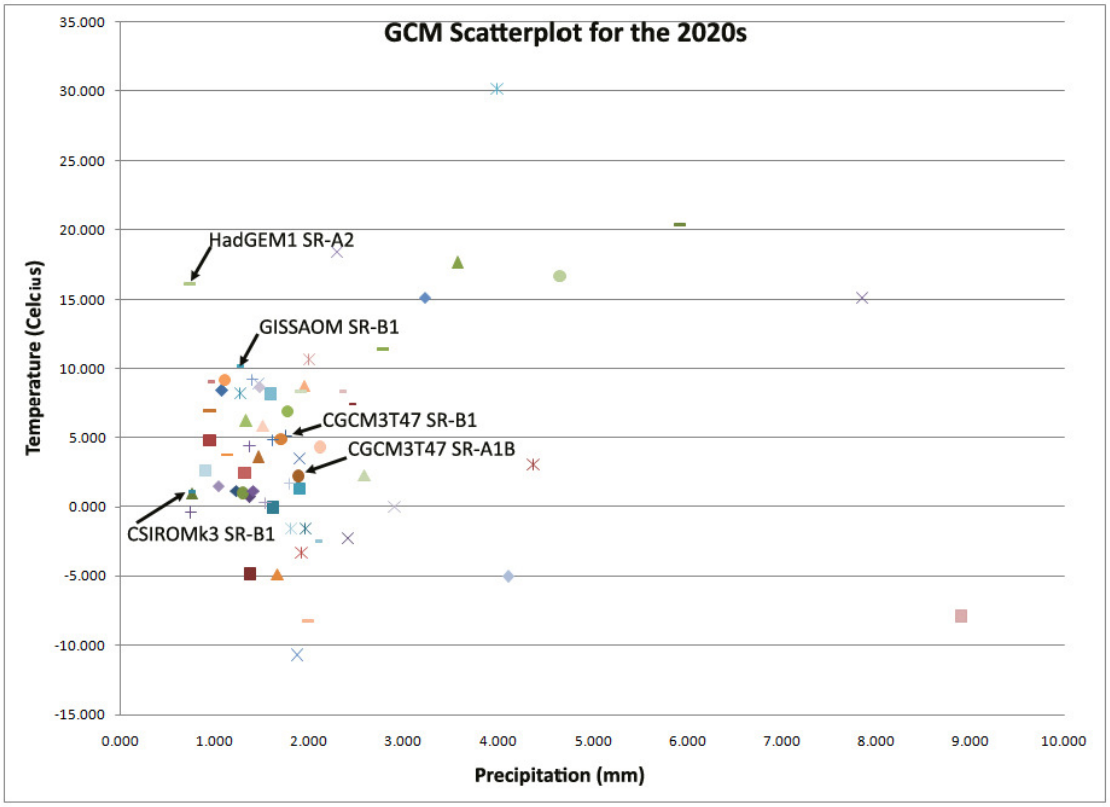


Figure 2.5 Scatterplots of GCM and emissions scenarios for the 2020s (CCCSN, 2007) (original in colour).

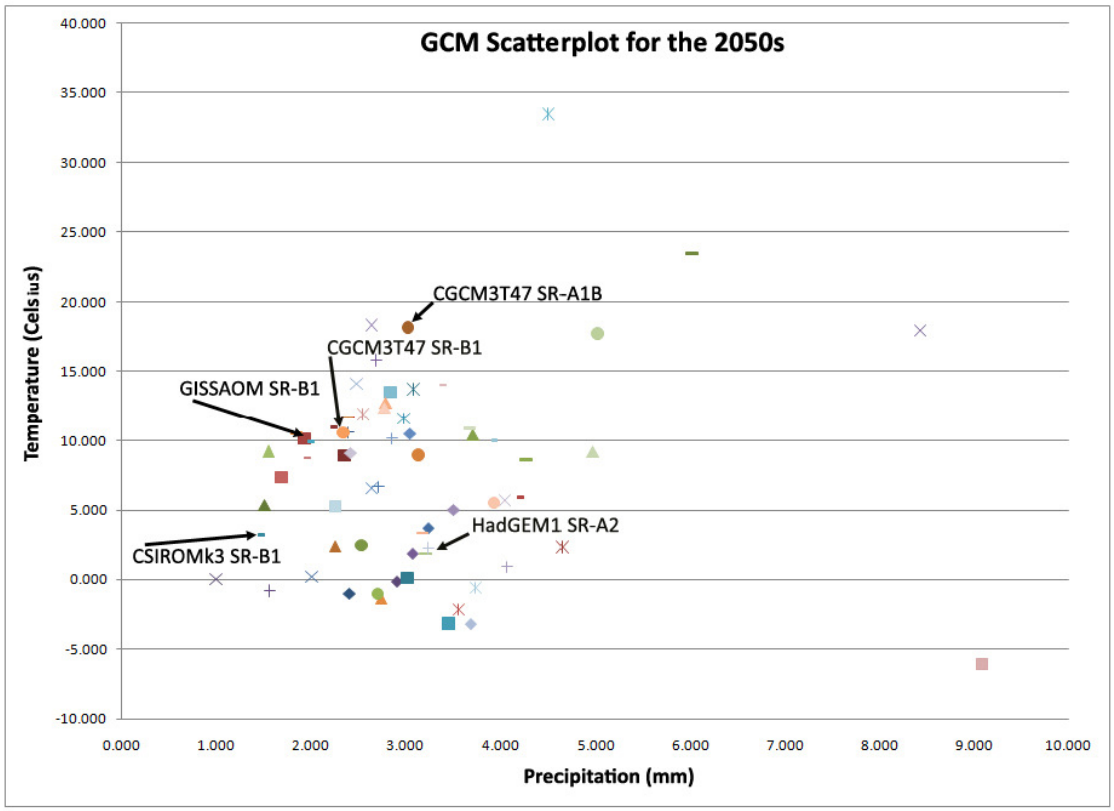


Figure 2.6 Scatterplots of GCM and emissions scenarios for the 2050s (CCCSN, 2007) (original in colour).

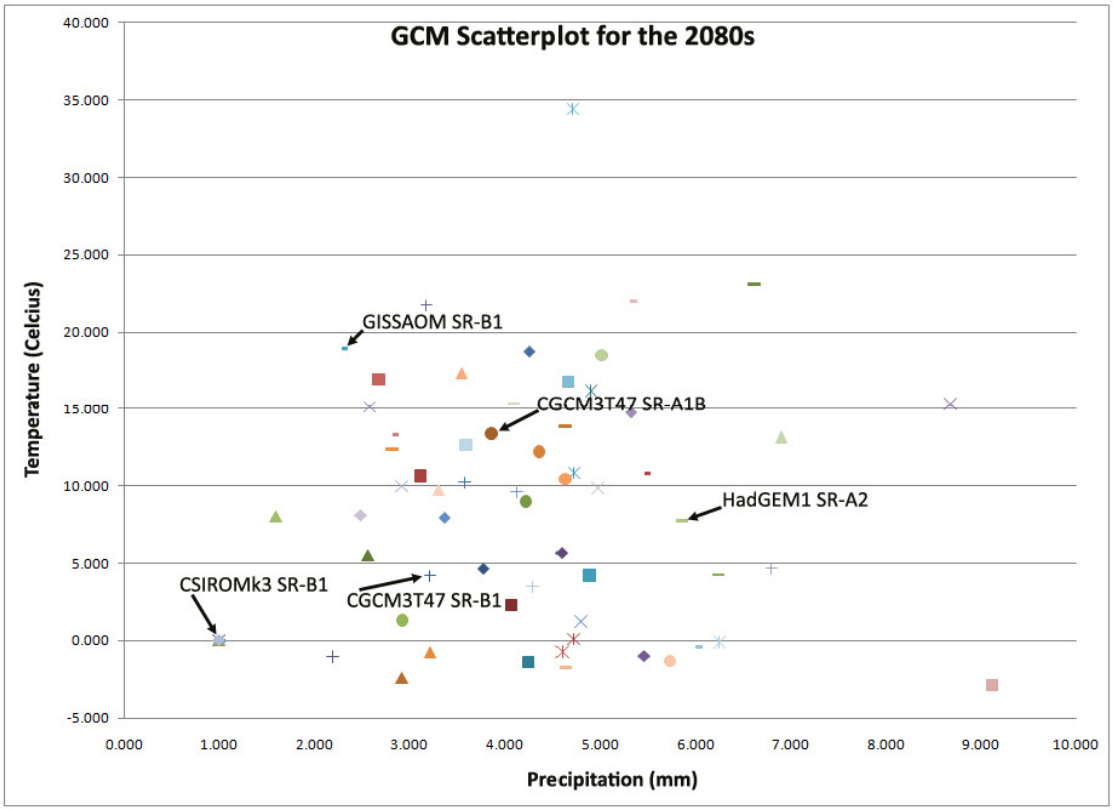


Figure 2.7 Scatterplots of GCM and emissions scenarios for the 2080s (CCCSN, 2007) (original in colour).

Table 2.3 Paired t-test results comparing the observed and modeled values for the normal period of 1961 to 1990

Model	CGCM3T47 SR-A1B				CGCM3T47 SR-B1				CSIROMk3 SR-B1				GISSAOM SR-B1				HadGEM1 SR-A2			
Community	SL		JS		SL		JS		SL		JS		SL		JS		SL		JS	
Variable	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P
Mean Difference	0.64	0.54	0.81	-2.82	0.64	0.54	0.81	-2.82	-2.87	8.66	-2.36	1.28	-2.48	-10.1	-3.00	-4.26	-0.22	-1.28	0.16	-2.28
Standard Deviation	2.31	4.87	2.47	4.83	2.31	4.87	2.47	4.83	2.06	17.18	1.87	15.82	2.12	11.3	2.50	5.99	2.32	38.39	2.46	36.57
Standard Error	0.44	0.64	0.45	0.63	0.44	0.64	0.45	0.63	0.41	1.20	0.40	1.15	0.42	1.0	0.46	0.71	0.44	1.79	0.45	1.75
t	1.46	0.84	1.78	-4.45	1.46	0.84	1.78	-4.45	-6.93	7.24	-5.97	1.12	-5.91	-10.4	-6.58	-6.03	-0.49	-0.71	0.34	-1.30
95% Confidence	√	√	√	X	√	√	√	X	X	X	√	X	X	X	X	X	√	√	√	√

Degrees of Freedom = 11

t-value if p(α)=0.05 is 2.20, t-value if p(α)=0.01 is 3.11 (Varkevisser et al., 2003)

T = Temperature, P = Precipitation; SL = Shoal Lake, JS = James Smith

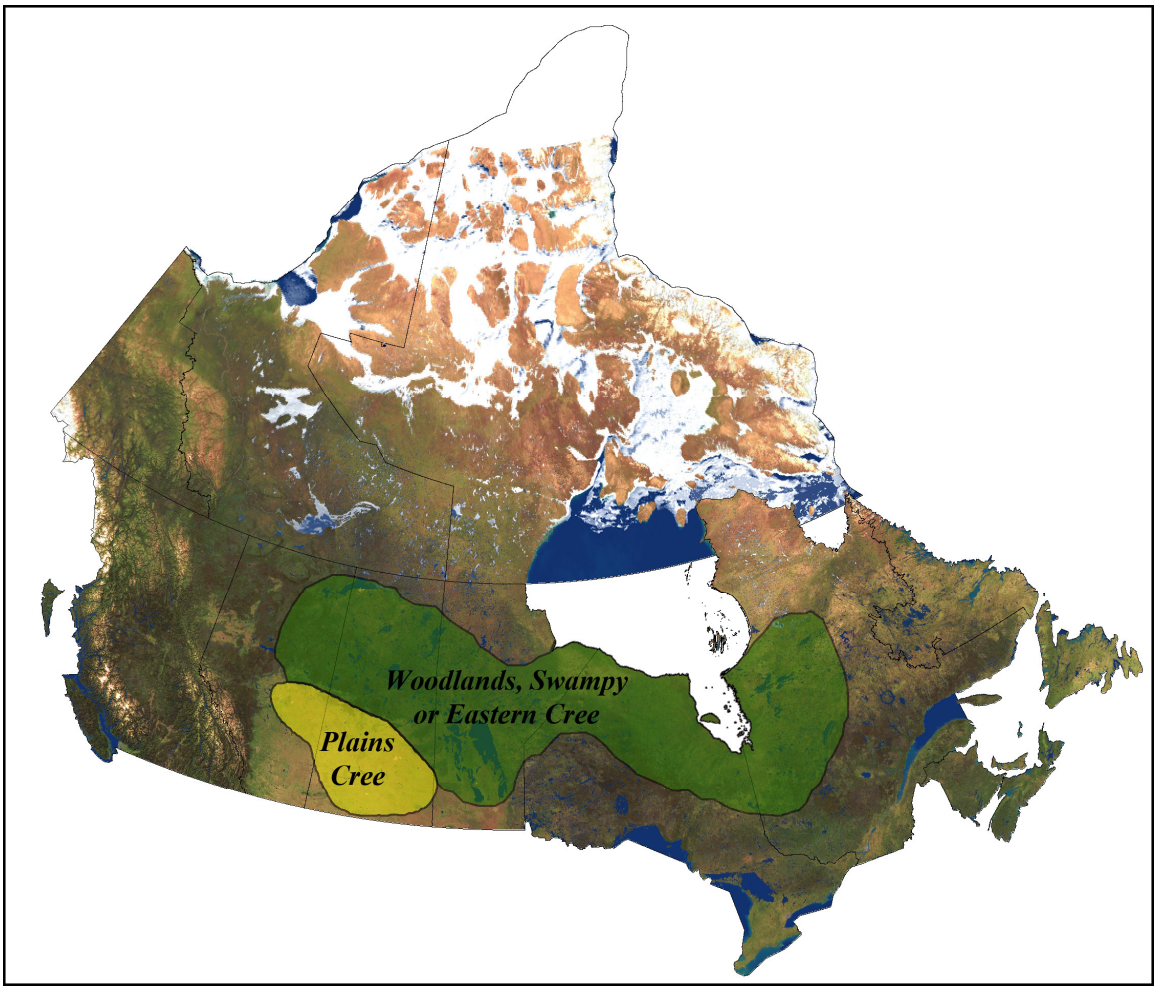
√ = Passed, X = Failed

CHAPTER 3 STUDY AREA

It is essential to accurately and thoroughly describe the communities in order to develop an in depth understanding of their vulnerabilities. Vulnerability is related to current context, and as such, is influenced by history, culture, environment, politics, and many other characteristics of the community. This chapter contains descriptions of the communities of James Smith and Shoal Lake.

3.1 The Cree Peoples' History and Tradition

Cree or *nehiyawak* people (historically also known as Kristineaux, Kilistinon, Home, Nayhathaways, and others) inhabited a large portion of what is now Canada (Figure 3.1). The boundaries of their lands were forever changing, but at its greatest extent, their territory extended from Lake Nitchequon, Quebec in the east to the foothills of the Rocky Mountains in the west and from the northern border of Saskatchewan almost to the southern border (Skinner, 1911; Mandelbaum, 1940; Smith, 1981; Honigmann, 1981; Preston, 1981; Darnell, 2001). They occupied nearly the entire province of Saskatchewan, but were thought to be recent immigrants onto the Plains region (Smith, 1981; Darnell, 2001). The Cree share Algonkin cultural and language ties with the many related groups in the area.



Sources: Franklin, 1823; Skinner, 1911; Mandelbaum, 1940; Honigmann, 1981; Preston, 1981; Smith, 1981; Darnell, 2001

Figure 3.1 Location of areas inhabited by Cree people over the last 500 years (original in colour).

The Cree were a powerful people. They were feared by their enemies and revered by their allies. They had a peaceful disposition, forming alliances with the Assiniboine and the Saulteaux, but were also fierce warriors, battling the Inuit, Nadouessis and Blackfeet (Darnell, 2001). The Cree first came into direct contact with Europeans in 1666, when Jesuit missionaries began their attempts at spreading Christianity to the Crees having heard much about them from the Ojibway (Mandelbaum, 1940; Honigmann, 1981). These attempts, however, were futile as the Cree remained semi-nomadic and exhibited cultural resistance.

The Cree were divided into many bands and subdivisions, but there was one main, relatively new, distinction between the Plains and Swampy Cree (similar to Woodland or Eastern Cree) (Darnell, 2001). Cree people began to permanently occupy the plains during the Nineteenth Century (Mandelbaum, 1940; Darnell, 2001). Until this point in time, they had made hunting excursions onto the prairies from the woodlands but had not yet permanently occupied these lands (Mandelbaum, 1940; Darnell, 2001). This transition was driven by the European desire for beaver pelts and the enterprising endeavours of the Cree people (Darnell, 2001).

3.2 Treaties

Cree people began to show interest in treaties towards the end of the Nineteenth Century. Many Cree leaders within the various bands believed that treaties were the only hope they had to maintain their people, while others viewed treaties as inadequate compensation and a means of subduing First Nations peoples (McLeod, 2007: 5). All leaders, however, wished to pursue peaceful means of coexistence with the arriving European settlers and their governments (McLeod, 2007: 5). Treaties were agreements

between the Queen of England and the First Nations people that framed their coinhabitance of the lands that became Canada. The Crown promised to provide livelihoods for First Nations people and in return settlers were ensured unperturbed access to land.

The treaties that lead to the creation of Shoal Lake and James Smith as Indian Reservations are Treaty Five and Treaty Six respectively. Chiefs representing the ancestors of James Smith and Shoal Lake community members signed treaties with the Crown of England while facing the loss of traditional economies, epidemics and the imminent in-migration of thousands of European settlers. They wanted peace throughout the transitions that were coming upon them and the Crown wanted their land. They made agreements that have been in place for nearly 135 years without many amendments. The communities of James Smith and Shoal Lake as they are known today would not exist if it were not for these treaties.

3.2.1 Treaty Five

Treaty Five was signed on September 24, 1875 at Norway House by First Nations with the Queen of England and the Government of the Dominion of Canada. First Nations in attendance included various Saulteaux, Chippewa and Swampy Cree bands located within what became Manitoba and Saskatchewan. Representatives of the Pas band of Swampy Crees included John Constant, James Cook, John Bell, Peter Bell and Donald Cook – many of these surnames are still common in Shoal Lake today. In the Treaty, they were promised 160 acres of farm land for each family of five. Due to the shortage of farm land around the Pas, they were granted lands around the Pas Mountain, or what became known as Red Earth and Shoal Lake. The terms of the Treaty are very

dated and include articles related to the appropriation of First Nations semi-nomadic hunter gatherer culture into a more sedentary agrarian way of life. They were to be provided with farming equipment and education in exchange for all their rights to their land forever, and were given five dollars each to ensure their good behaviour. The exact wording of the Treaty related to the surrender of lands is as follows (Treaty Five, 1875):

> The Saulteaux and Swampy Cree Tribes of Indians and all other the Indians inhabiting the district hereinafter described and defined, do hereby cede, release, surrender and yield up to the Government of the Dominion of Canada, for Her Majesty the Queen and Her successors forever, all their rights, titles and privileges whatsoever to the...

The lands were delineated as follows (Treaty Five, 1875):

> Commencing at the north corner or junction of Treaties Nos. 1 and 3; then easterly along the boundary of Treaty No. 3 to the "Height of Land," at the northeast corner of the said treaty limits, a point dividing the waters of the Albany and Winnipeg Rivers; thence due north along the said "Height of Land " to a point intersected by the 53° of north latitude; and thence north-westerly to "Favourable Lake"; thence following the east shore of said lake to its northern limit; thence north-westerly to the north end of Lake Winnipegoosis; then westerly to the "Height of Land" called "Robinson's Portage"; thence north-westerly to the east end of "Cross Lake"; thence north-westerly crossing "Foxes Lake"; thence north-westerly to the north end of "Split Lake"; thence south-westerly to "Pipestone Lake," on "Burntwood River "; thence south-westerly to the western point of "John Scott's Lake"; thence south-westerly to the north shore of "Beaver Lake"; thence south-westerly to the west end of "Cumberland Lake"; thence due south to the "Saskatchewan River"; thence due south to the north-west corner of the northern limits of Treaty No. 4, including all territory within the said limits, and all islands on all lakes within the said limits, as above described; and it being also understood that in all cases where lakes form the treaty limits, ten miles from the shore of the lake should be included in the treaty.

In exchange for this, they were provided reserves for farming and the following equipment to aid them in their new occupations (Treaty Five, 1875):

> It is further agreed between Her Majesty and the said Indians that the following articles shall be supplied to any band of the said Indians who are now cultivating the soil, or who shall hereafter commence to cultivate the land, that is to say: Two

> hoes for every family actually cultivating; also one spade per family as aforesaid; one plough for every ten families as aforesaid; five harrows for every twenty families as aforesaid; one scythe for every family as aforesaid, and also one axe; and also one cross-cut saw, one hand-saw, one pit-saw, the necessary files, one grindstone, and one auger for each band; and also for each Chief, for the use of his band, one chest of ordinary carpenter's tools; also for each band enough of wheat, barley, potatoes and oats to plant the land actually broken up for cultivation by such band; also for each band one yoke of oxen, one bull and four cows all the aforesaid articles to be given once for all for the encouragement of the practice of agriculture among the Indians.

3.2.2 Treaty Six

One year later, Treaty Six was signed at Fort Carlton and Fort Pitt on August 28, 1876 and September 9, 1876 respectively by the Queen of England and the Government of the Dominion of Canada and bands from the Plains and Wood Cree tribes. The area covered by Treaty Six is delineated as the following (Treaty Six, 1876):

> Commencing at the mouth of the river emptying into the north-west angle of Cumberland Lake; thence westerly up the said river to its source; thence on a straight line in a westerly direction to the head of Green Lake; thence northerly to the elbow in the Beaver River; thence down the said river northerly to a point twenty miles from the said elbow; thence in a westerly direction, keeping on a line generally parallel with the said Beaver River (above the elbow), and about twenty miles distant therefrom, to the source of the said river; thence northerly to the north-easterly point of the south shore of Red Deer Lake, continuing westerly along the said shore to the western limit thereof; and thence due west to the Athabasca River; thence up the said river, against the stream, to the Jaspar House, in the Rocky Mountains; thence on a course south-easterly, following the easterly range of the mountains, to the source of the main branch of the Red Deer River; thence down the said river, with the stream, to the junction therewith of the outlet of the river, being the outlet of the Buffalo Lake; thence due east twenty miles; thence on a straight line south-eastwardly to the mouth of the said Red Deer River on the south branch of the Saskatchewan River; thence eastwardly and northwardly, following on the boundaries of the tracts conceded by the several treaties numbered four and five to the place of beginning.

In exchange for this land the Cree people were promised a little more than the Treaty Five bands. They got a square mile of farmland for each family of five, schooling, more annual money for supplies and equipment as follows (Treaty Six, 1876):

> It is further agreed between Her Majesty and the said Indians, that the following articles shall be supplied to any Band of the said Indians who are now cultivating the soil, or who shall hereafter commence to cultivate the land, that is to say: Four hoes for every family actually cultivating; also, two spades per family as aforesaid: one plough for every three families, as aforesaid; one harrow for every three families, as aforesaid; two scythes and one whetstone, and two hay forks and two reaping hooks, for every family as aforesaid, and also two axes; and also one cross-cut saw, one hand-saw, one pit-saw, the necessary files, one grindstone and one auger for each Band; and also for each Chief for the use of his Band, one chest of ordinary carpenter's tools; also, for each Band, enough of wheat, barley, potatoes and oats to plant the land actually broken up for cultivation by such Band; also for each Band four oxen, one bull and six cows; also, one boar and two sows, and one hand-mill when any Band shall raise sufficient grain therefor. All the aforesaid articles to be given once and for all for the encouragement of the practice of agriculture among the Indians.

In addition they were promised that a medicine chest would be kept by the Indian Agent for use in times of illness. The exact wording of the agreement leaves the First Nations to sign away "forever, all their rights, titles and privileges, whatsoever, to the lands included within the...limits" (Treaty Six, 1876).

Many of the clauses and terms of treaties are to this day contested. The meaning of treaties was not culturally appropriate or understood by either party to the agreement. It is likely that there was a misunderstanding between First Nations people and Euro-Canadians on the land surrender clauses, as these groups had differing ideas about land ownership. The treaties were an attempt at securing peaceful relations between the two parties in a cross-cultural partnership. They accomplished the first part of their goal, but failed at the second. Treaties contributed to institutionalized relationships where First Nations people are often disempowered (Dyck, 1991). Neglected in the adherence to the treaties is the intent with which the First Nations Chiefs signed, not as subjects but as equals to the Queen.

3.3 *ê-mâyahkamikahk* ("where it all went wrong" or the Northwest Resistance of 1885)

ê-mâyahkamikahk, which translates directly to "where it all went wrong", was a pivotal point in First Nations history in Canada. The term refers to the violence that erupted between some First Nations people and settlers during a transitional period in their relations. The event is otherwise known as the Northwest Rebellion of 1885 and was sparked by starvation, segregation and the fact that treaties were not working. Facing adverse conditions, a few young, First Nations men took up arms against Euro-Canadians at Frenchman's Butte, Cutknife Hill and Batoche (McCrady, 2001). They were hoping to affirm First Nations' resistance to colonialism and the conditions it was imposing on them, but in fact only served to strengthen the colonial movement. After the events of 1885, First Nations people were no longer approached by the Government of the Dominion of Canada in an open and accommodating manner, but were forced into spatial, spiritual and cultural exile while Euro-Canadian settlers depleted their land base (McLeod, 2007:5).

Current vulnerability of First Nations communities within Canada is shaped by *ê-mâyahkamikahk*, as this event further complicated treaty relationships and sovereignty matters. The manner in which colonial governments dealt with First Nations people following this event has implications for them today, as this played a major role in defining their rights, freedoms and existence in a globalized world. Many of the conditions causing the exposure or lack of adaptive capacity in First Nations communities

that are discussed later in this thesis, such as economic dependency, loss of culture and marginalisation, partially result from *ê-mâyahkamikahk*.

3.4 Current Conditions of James Smith

James Smith is located southeast of Prince Albert and northwest of Melfort (Figure 3.2). The reserve encompasses a total of 162 km^2 and the Saskatchewan River winds through the north end. The south side of the river is mostly prairie that has been cleared and used for agriculture, while the north side of the river is mostly forest. Community members mainly find their roots in the Plains Cree tribes that once hunted buffalo in the area. The reserve is on lands under the jurisdiction of Treaty Six.

3.4.1 History

The James Smith reserve was once known as Fort-à-la-Corne, a name taken from a Hudson's Bay Company post built in 1846 along the Saskatchewan River (PAGC, 2004 - Figure 3.3). Fort-à-la-Corne became linked to the Carlton trail and was a major fur trading post in the area. It was the gateway to the west and considerable amounts of trade between Europeans and indigenous populations occurred. Indigenous people used to gather in the area to acquire ammunition for their rifles and other supplies (Meyers and Thistle, 1995). Fort-à-la-Corne was situated on what is now reserve land, but few remnants of it remain.

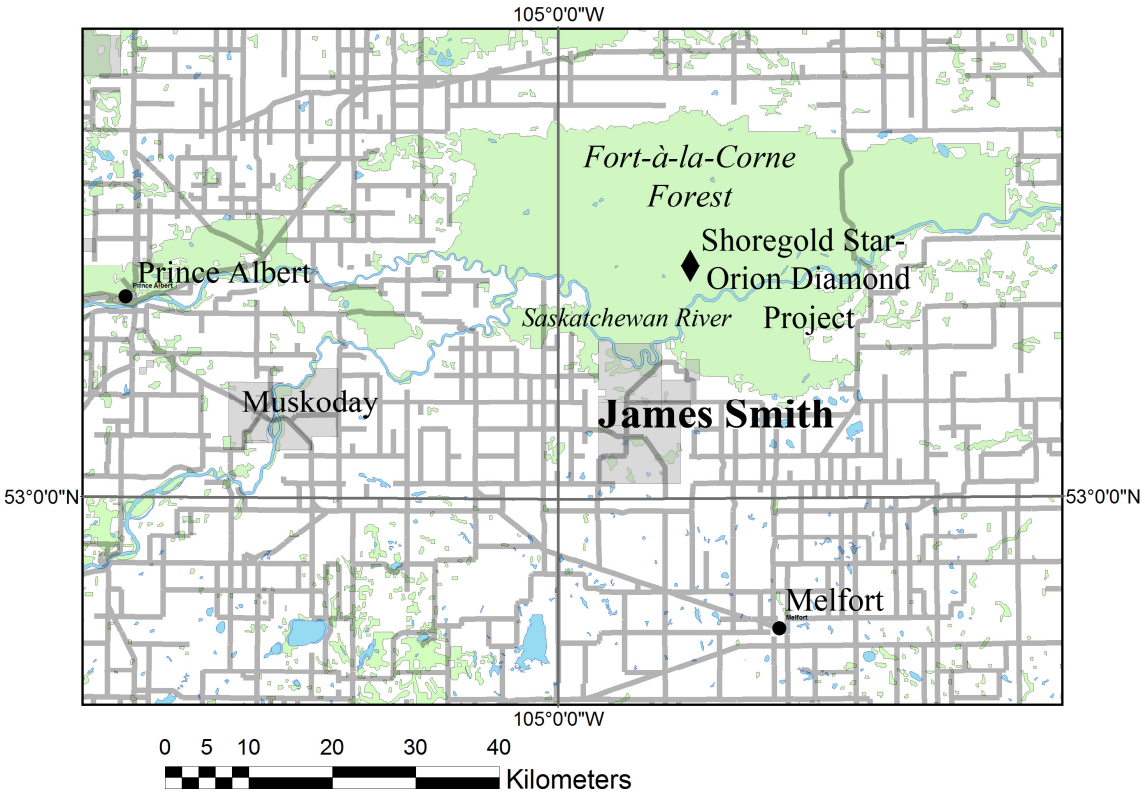


Figure 3.2 Location map of James Smith (original in colour).

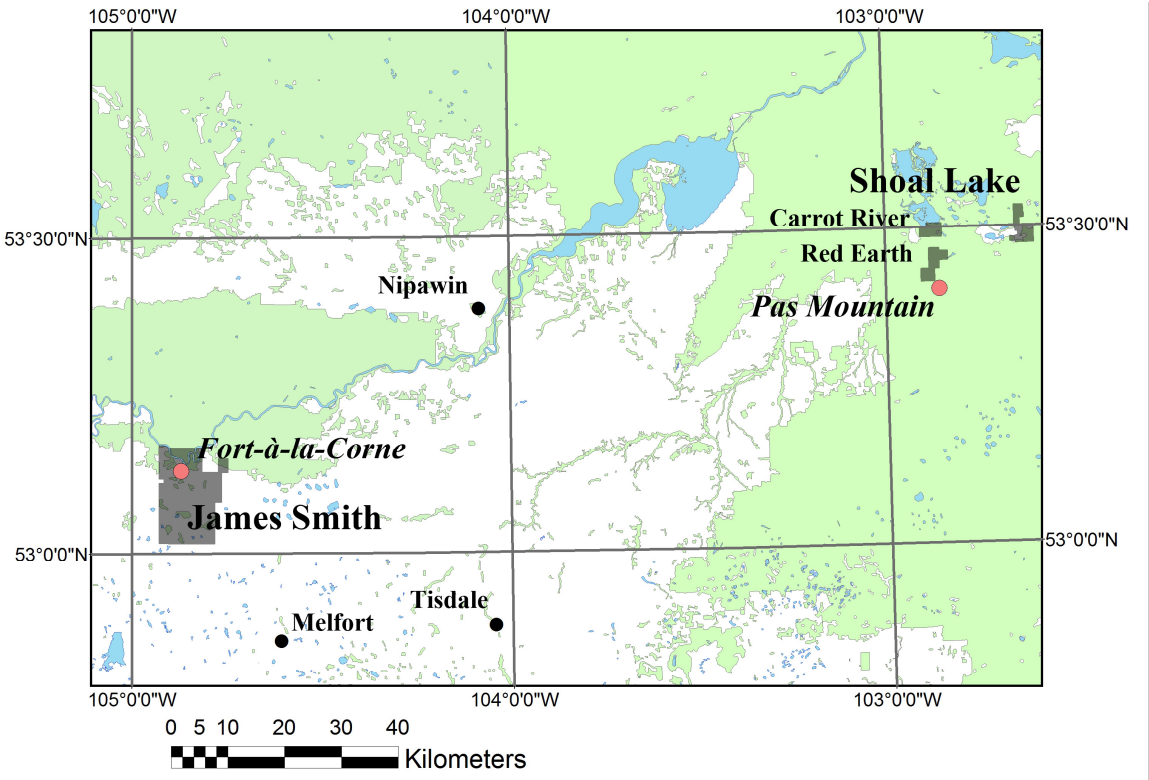


Figure 3.3 Map showing current communities and past Hudson's Bay Company forts surrounding the study communities (original in colour).

According to Elder Clifford Sanderson, James Smith was the name of a chief at the time of the creation of the reserve. His brother, John Smith, also started a reserve in the area. The latter was, however, called Muskoday; the band did not take his namesake. Originally, the community of James Smith only contained members from the James Smith band (ICC, 2005a; 2005b; 2005c; 2007). It was more homogenous in these respects than the community of today. According to Elder Mervin Burns, some members of *chakastaypasin*, a band that originally took reserve around what became Fenton, Saskatchewan, found their way to the James Smith reserve during *ê-mâyahkamikahk*, as they were displaced by the turmoil that ensued (ICC, 2005c). Their band was dispersed all over the country, with reports of members being located on the Blood Tribe and Shoal Lake reserves. The bulk of the fleeing tribe, however, found a new home on the James Smith reserve, where they were taken in as refugees (ICC, 2005a; 2005c).

Members of the Peter Chapman band also found their way to James Smith reserve under much different circumstances (ICC, 2005b). These people originally were from the Cumberland House reserve in the Treaty 5 area. The Canadian Government, in an attempt to settle a land claim with Cumberland House, awarded the people new lands that were not in their area (Raby, 1972). The new lands were located on the outskirts of the already existing James Smith reserve. A migration of people eventually followed and bands were amalgamated under the name James Smith.

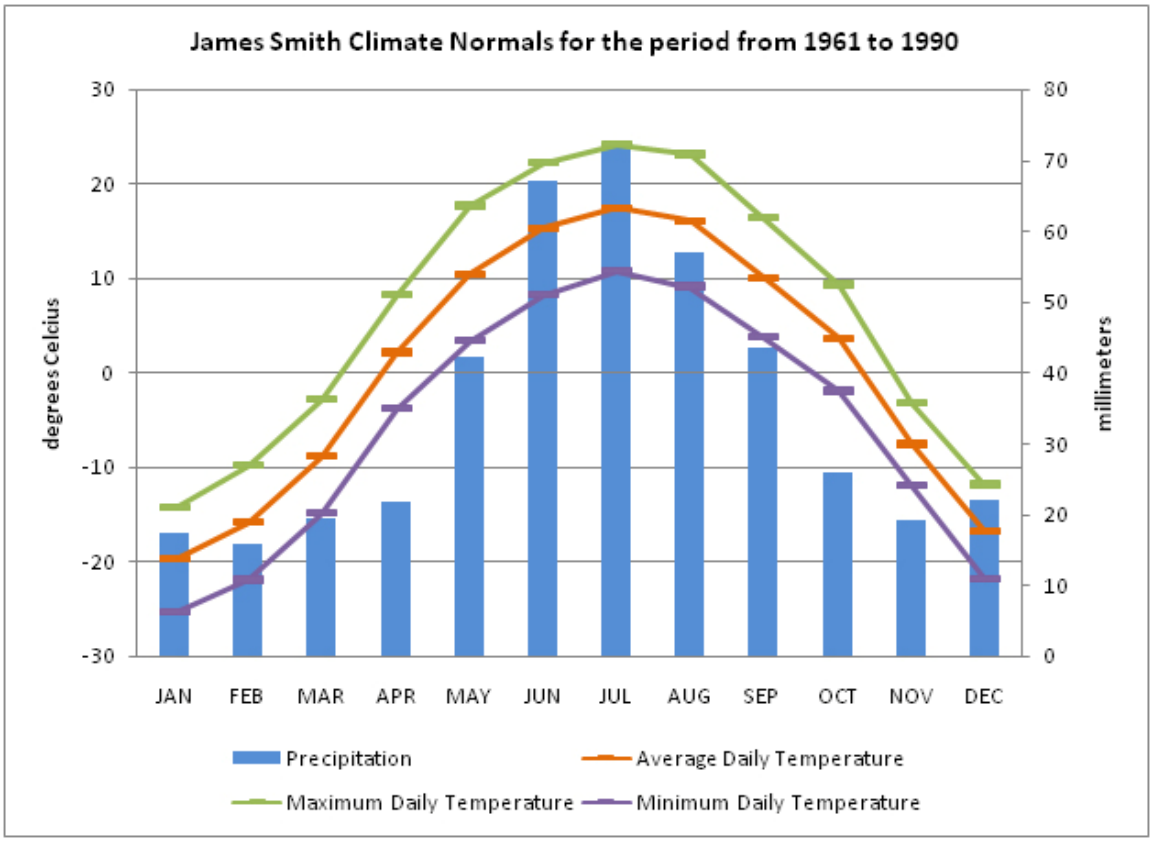
In the 1970s band members decided that it would be best to dismember the band and reform the original bands upon which the community was based (ICC, 2005a). The community was in the midst of a land claim struggle that they thought would be better pursued if each band sought their own lands individually (ICC, 2005a). Against the

advice of the Elders, the community was divided into three – James Smith, Peter Chapman and Chakastaypasin – and this revision has remained that way ever since. Throughout this thesis, the conglomeration of portions of these three bands as they currently coexist is referred to as the community of James Smith.

3.4.2 Climate and Vegetation

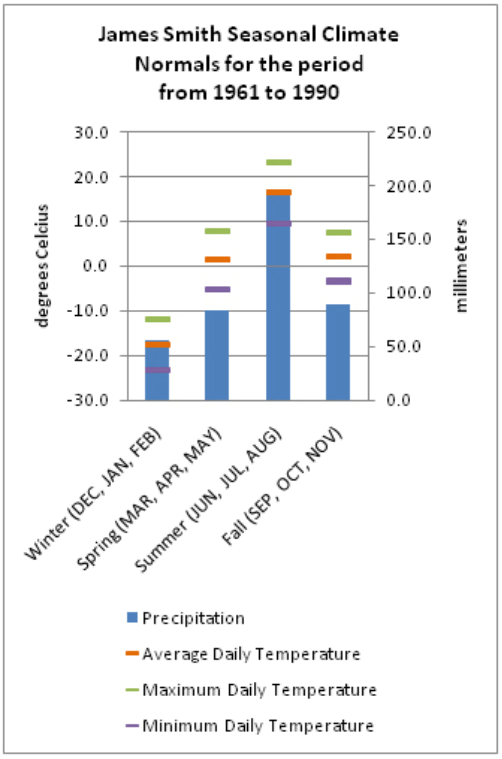
An analysis of the climate normals for the period from 1961 to 1990 for the community indicates that the average annual temperature is 0.6°C. Temperature peaks in July, averaging 17.5°C. The coldest temperatures, averaging −20.7°C, are observed in January. Average maximum daily temperature is below freezing until April, after which it remains above 0°C until November. The community receives an average of 424 mm of precipitation annually. Highest precipitation amounts are in July. The bulk of the precipitation falls in summer (Figures 3.4 and 3.5).

Vegetation on-reserve varies from prairie in the south to boreal forest, part of the Fort-à-la-Corne island forest, in the north. Vegetation cover in this area has been found to be sensitive to variations in climate moisture indices (CMIs), such as precipitation minus potential evapotranspiration (P-PET) (Hogg, 1994, 1997). The zero isoline of average P-PET falls roughly in this area (Hogg, 1994, 1997), defining it as the buffer between grasslands to the south and boreal forest to the north. This area has slightly more moisture available for plant use (hence the existence of boreal forest in the area) than more southerly parts of the province, but slightly less than more northern boreal forests.



Source: based on National Climate Archive, 2005

Figure 3.4 Climate normals for the period from 1961 to 1990 for the community of James Smith (original in colour).



Source: based on National Climate Archive, 2005

Figure 3.5 Seasonal climate normals for the period from 1961 to 1990 for the community of James Smith (original in colour).

3.4.3 Infrastructure

The community is dependent on groundwater for its potable water. Its water system consists of five interconnected wells that and are pumped through a supply line to a reservoir capable of holding 636.44 kilolitres. Four separate cells, two with 204.57 kilolitres and two with 113.65 kilolitre capacities, constitute the reservoir. Water is chlorinated here and then pumped to 87 houses in the town site and trucked to 145 households outside the town site.

There is an extensive road network in the area. However, most roads are not paved and often succumb to seasonal degradation due to rainfall and runoff. The community has a health centre responsible for minor medical treatment and community health-related functions, but the closest hospital is in Melfort approximately 30 km away by road, 15 km of which is non-paved. There is a school in the community offering classes from kindergarten to grade 12. There are 232 houses on-reserve for 1,093 people (Statistics Canada, 2008a). Nearly all of the houses require maintenance or repairs and 21% have more than one person living in the same room (Statistics Canada, 2008a). In Saskatchewan as a whole, only 12.7% of the houses require maintenance or repair and only 8% have more than one person living in the same room (Statistics Canada, 2008c).

3.4.4 Demographics

The median age of the population is 21.6 years. This is relatively low compared to a median age of 30.8 years for Saskatchewan (Statistics Canada, 2008a). The majority of the population is under 20 years of age (Figure 3.6) and people start having families relatively young. There are concerns about the ability of these young people to properly raise their family.

Of the 1,093 people on-reserve in 2006, only about 30% has any knowledge of an Aboriginal language (Statistics Canada, 2008a). Language loss is more evident in younger individuals, as 60% of adults have Cree language skills (Statistics Canada, 2008d). Even though 31% of community members hunt for food (Statistics Canada, 2008d), Elders report low levels of human capital in the form of TEK among community members since current hunting practices vary drastically from the traditional. Approximately 57% of the total population over 15 years of age does not have a high school diploma (Statistics Canada, 2008a), while 30% of individuals in Saskatchewan in the same cohort have graduated high school (Statistics Canada, 2008c). According to Statistics Canada (2008a), there are no males over 15 years of age still living on reserve with university training and 3% of females in this cohort have a university degree or diploma. There are however, 18% of males and 33% of females in this age group with trades certificates (Statistics Canada, 2008a).

There are few employment opportunities on-reserve. The unemployment rate in the community is 33.8% with a participation rate of 53.2% (Statistics Canada, 2008a). In Saskatchewan, the unemployment rate is 5.6% with a participation rate of 68.4% (Statistics Canada, 2008c). Income levels on-reserve are also low, as average income for individuals over 15 years of age that work full-time is $26,345 and median income is $25,408 (Statistics Canada, 2008a). For the total population 15 years and older, median income is only $8,296 with 64.7% of total income on-reserve coming from earnings, 32.9% from government transfers and 3.2% from other sources (Statistics Canada, 2008a). In Saskatchewan, median income for all those over 15 years of age is $23,755 with only 12.8% of this from government transfers (Statistics Canada, 2008c).

Ties between livelihood and climate are not obvious from these statistics. Recreational hunters within the community supplement their diet with wild game, but many individuals rely on the local store for imported food. The lack of involvement in industry centred on primary resources speaks to the fact that these people are not relying on climate dependent resources to earn a living as their ancestors once did. Only 35 of the 320 adults employed report involvement in agriculture and other primary resource based industries (Statistics Canada, 2008a). Livelihoods are more dependent on social assistance programs and funding for government projects, as 50 of the 320 adults employed have occupations in social sciences, education, government service and religion (Statistics Canada, 2008a). The majority of occupations are related to sales and services (33%), in particular health care and social services (17%) (Statistics Canada, 2008a).

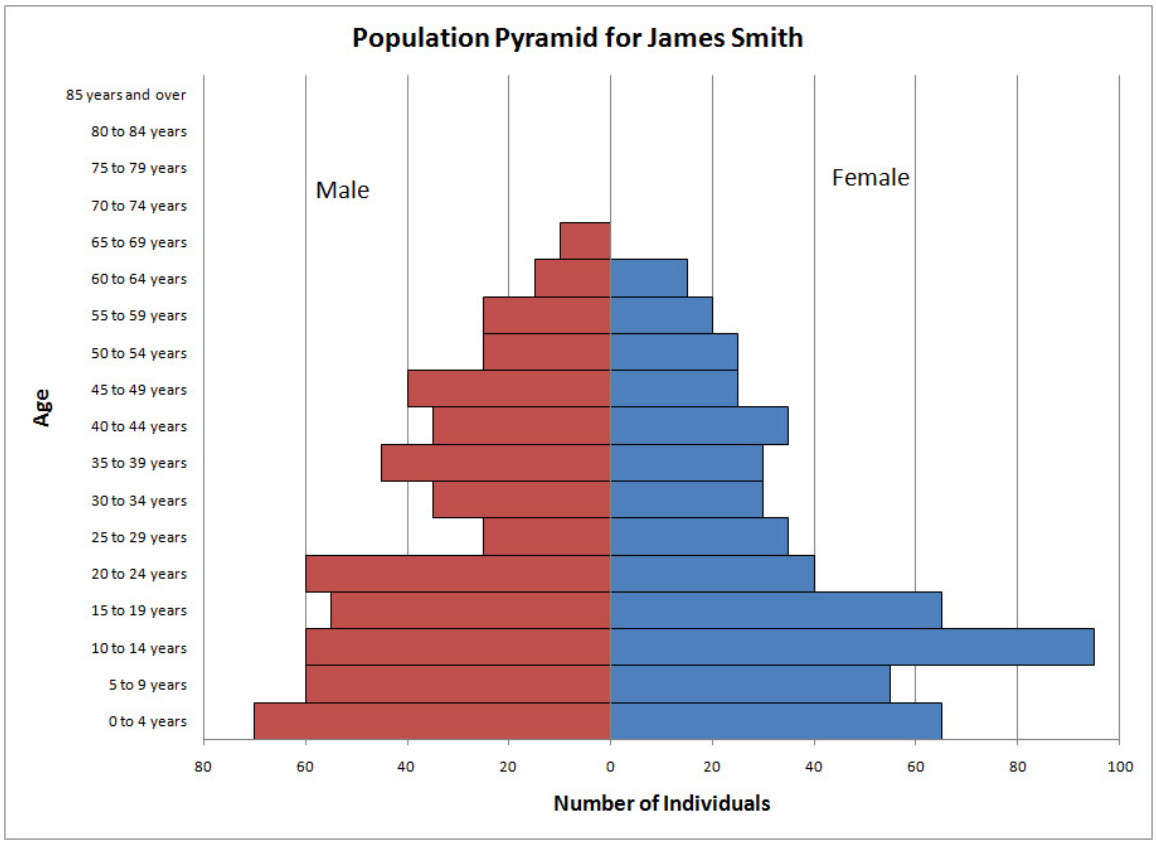
Vulnerability to climate is, however, demonstrated in the lack of employment opportunities, low income, lack of education and loss of traditional language skills as these conditions limit the ability of community members to cope with changes in climate and variability and increase their exposure to these stimuli. Many residents on the reserve live in impoverished conditions, dependent on social welfare to sustain their meagre existence. To find work, many people would be forced to leave the reserve, but the lack of education limits the opportunities off-reserve as well. On-reserve, traditional culture and language are becoming scarce. Residents are locked into a system where they are marginalized spatially, culturally and economically. Many individuals are stuck living in poverty with limited opportunities.

3.5 Current Conditions of Shoal Lake

Shoal Lake is located about an hour east of Nipawin on Highway 55. This tiny reserve encompassing 15 km^2 is located on the edges of the Pakwaw or Shoal Lake and thus adopted this name (Figure 3.7). Reserve and other lands in the area are quite swampy and wet most of the year. The area provides prime hunting grounds for moose that feed in the shallow waters and ducks that use the lake as refuge. Many species of fish are also found in the lake, providing entertainment and sustenance for community members.

3.5.1 History

Shoal Lake and its neighbouring community, Red Earth, were once the same band. They were known as the Pas Mountain, the name of a HBC trading post in the area (Figure 3.3). This band originated from people in the Pas, Manitoba, who came to the area after it was deemed suitable for reserves due to its proximity to the Pasquia Hills and greater availability of land suitable for agriculture compared to other nearby areas (Raby, 1972). This area is known as the *sipanok* and extends over 1,200 km^2. The bands have kept close ties since they split into separate reserves. Shoal Lake people speak an 'n' dialect of Cree common in the Swampy tribes, while Red Earth people speak the same dialect but pronounce certain sounds slightly different.



Source: Statistics Canada, 2008a

Figure 3.6 Community age profile for James Smith (original in colour).

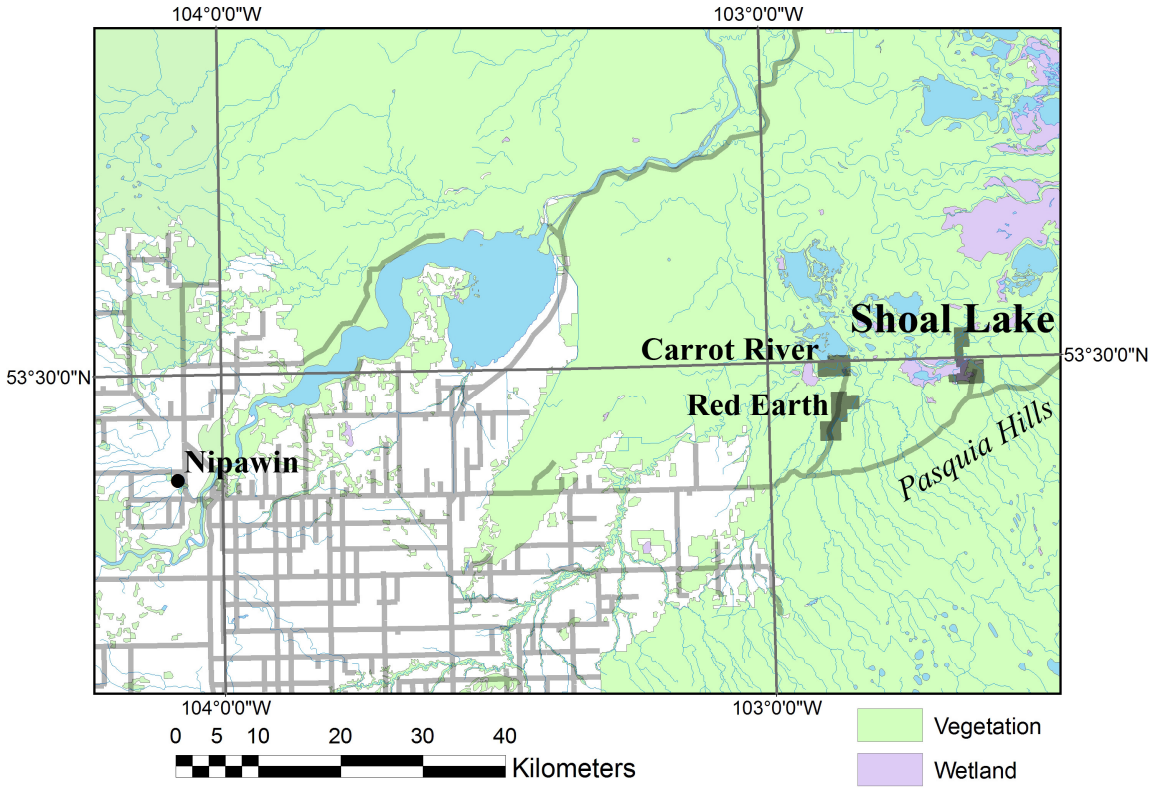


Figure 3.7 Location map of Shoal Lake (original in colour).

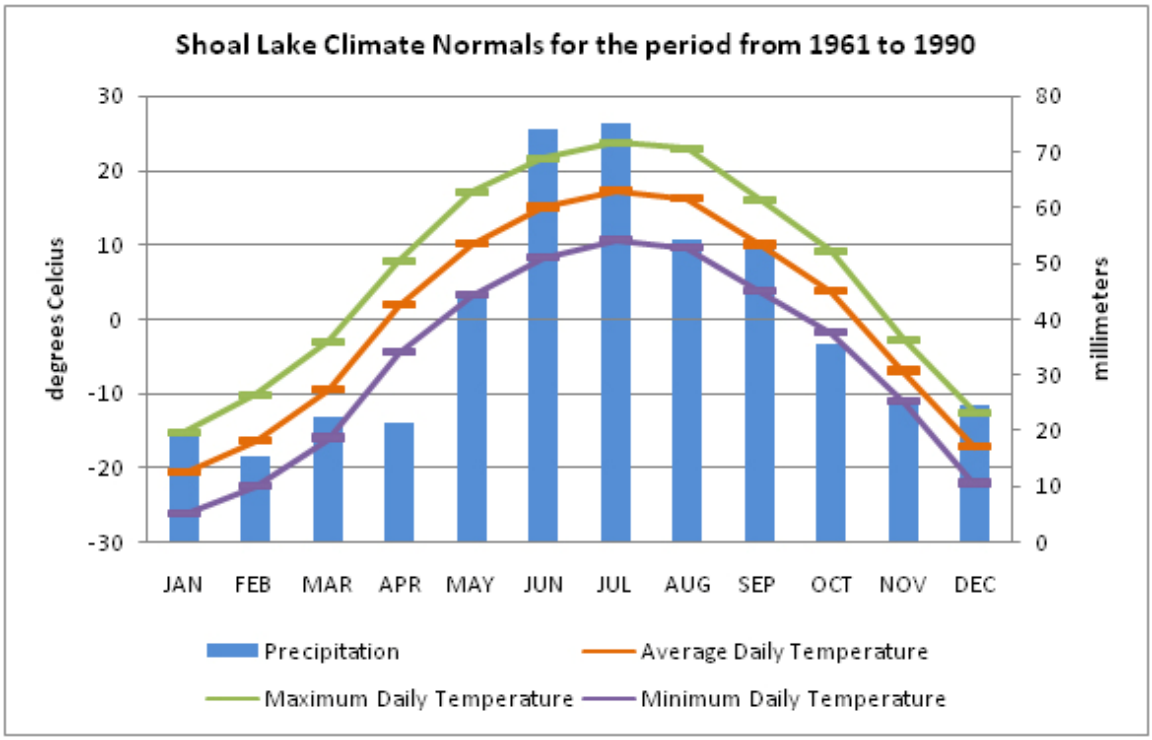
The local account of the development of the reserve is as follows[1]. There was an influential medicine man acting as chief at the time of confinement to reserves. His name was *osâwaskmuskwa* or Yellow Bear and knowledge of his many powers, both in hunting and in the supernatural, were known throughout the area. One day *osâwaskmuskwa* and his band were confronted by an Indian agent as they camped on current reserve land. The agent, armed with a double barrel shotgun, demanded that the chief mark the territory that was to be their reserve. He had been commissioned by the Government of Canada to document territories taken by First Nations people as reserves. On this day he was especially testy, and commanded Yellow Bear to walk around the bounds that he would like to take as their own. Yellow Bear showed displeasure with this task and was not about to be ordered around as he was chief in these lands. With little patience, the agent quickly aimed his shotgun at Yellow Bear and commanded him again to march around the bounds of his reserve. Yellow Bear was compelled to obey and started his hike. Being a man of many powers, Yellow Bear was able to walk with great speed around the area. The Indian agent was finding it ever increasingly difficult to match Yellow Bear's stride and at gunpoint ordered him to slow down time and time again. Yellow Bear's ability to mark territory was greatly impeded by the sluggishness of the Indian agent, and because of this, the reserve is small. This story is credited to the old people who live on the reserve today. The reserve size is also related to the population on the date of survey.

[1] This account was conveyed to the researcher by numerous individuals in the community, including Edgar Cook, Joe Bear, Betsy Head and Charlene Flett.

3.5.2 Climate and Vegetation

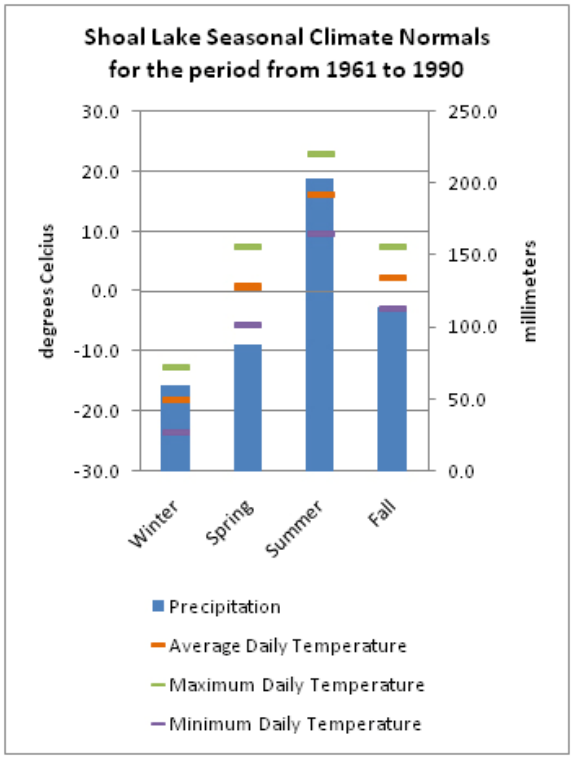
Climate normals for 1961 to 1990 show maximum precipitation in June and July (Figure 3.8 and 3.9). Temperature also is highest during these months. Average daily maximum temperatures are above 0°C during April to October. They drop below freezing once again in November and remain there until the following April (Figure 3.8 and 3.9) Seasonal variations in temperature and precipitation range from approximately -20°C in winter to +20°C in summer, and from 50 mm in winter to 200 mm in summer.

As in James Smith, vegetation in the area is sensitive to moisture availability (Hogg, 1994, 1997). There is slightly more water present in the area, as the community is found in a low lying region of Saskatchewan at the base of the Pasquia Hills (SIR, 2005), and as such, the area tends to collect water. A mix of boreal forest and wetlands are found throughout the reserve, hence the designation of the people that live here as Swampy Cree.



Source: National Climate Archive, 2005

Figure 3.8 Climate normals for the period from 1961 to 1990 for Shoal Lake, SK (original in colour).



Source: National Climate Archive, 2005

Figure 3.9 Seasonal climate normals for the period from 1961 to 1990 for the community of Shoal Lake, SK (original in colour).

3.5.3 Infrastructure

Drinking water from McVee Creek is treated with chlorine and allowed to settle for three days. Turbidity is a problem; the plant often breaks down due to its inability to keep up with the demand for water.

There are few roads in the area. The community is, however, connected to Nipawin and the Pas, Manitoba by the newly upgraded Highway 55. There is a health centre in the community, but most medical treatment must be sought at the hospital in Nipawin that is 100 km away. A school in the community offers classes from kindergarten to grade 12. There are 95 houses for 545 people and almost all of the houses require maintenance or repairs (Statistics Canada, 2008b). Poor housing conditions and crowding are concerns as 37% of dwellings have more than one person per room (Statistics Canada, 2008b).

3.5.4 Demographics

Most community members are below the age of 20 (Figure 3.10) and the median age is 16.9 years old (Statistics Canada, 2008b). Almost all residents of Shoal Lake have knowledge of an Aboriginal language (Statistics Canada, 2008b) but Elders in the community report TEK is low amongst the younger generations. Other forms of human capital are low as well, as there is 64.5% of the population over 15 years of age without a high school diploma (Statistics Canada, 2008b). Only 6.5% of the population over 15 years of age has a trades certificate and there are no members who have obtained a university degree (Statistics Canada, 2008b).

Employment opportunities on-reserve are few. The unemployment rate is 31.8% with a participation rate of 35.5% (Statistics Canada, 2008b). Income levels are extremely low, with average income for those over 15 years of age with full-time work being $17,148 and median income being $13,024 (Statistics Canada, 2008b). For the total population 15 years and over, median incomes are $5,648 with 59% of total community income coming from earnings, 40% from government transfers and 1.8% from other sources (Statistics Canada, 2008b). The most prevalent occupations are related to sales and services, with 33% of working individuals employed in these areas (Statistics Canada, 2008b). Of this 33%, 28% are in educational services (Statistics Canada, 2008b). People in Shoal Lake are poor and highly dependent on government programs to maintain their households.

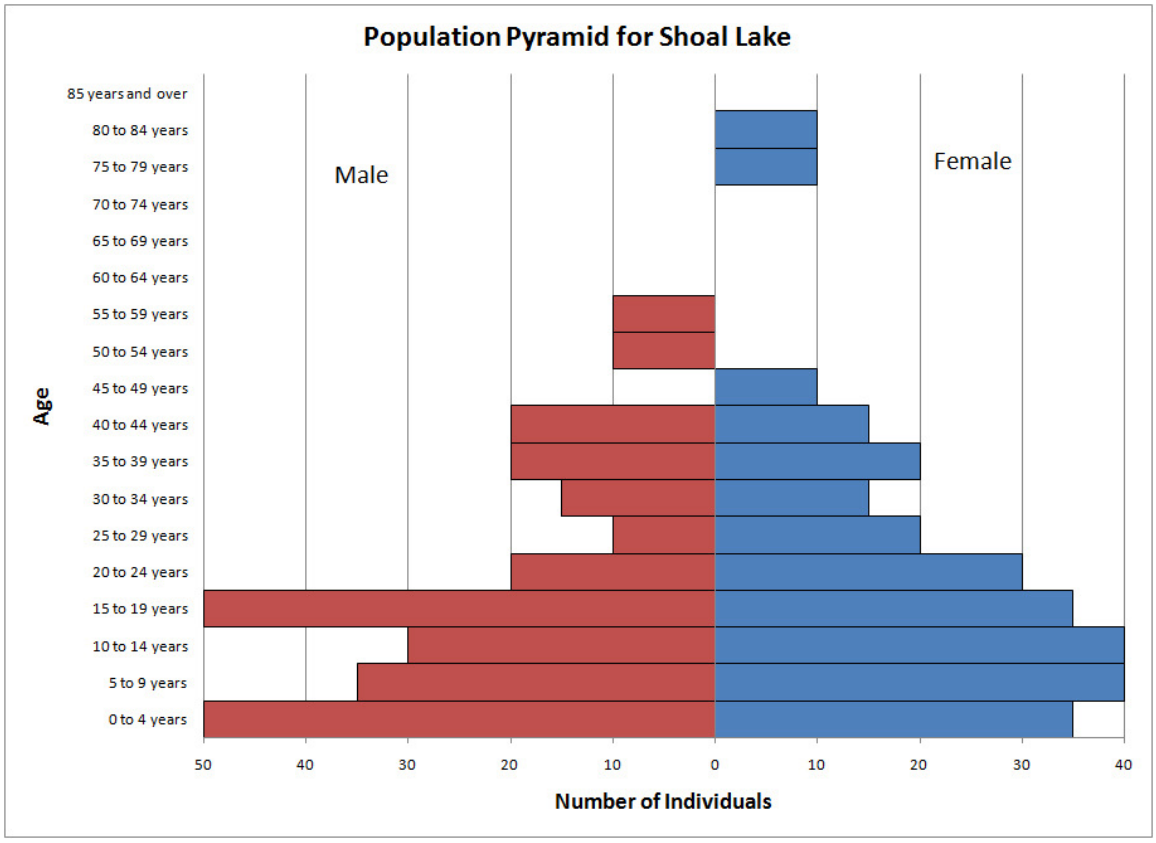
These statistics detail the lack of economic and human capital to aid in adaptation. Local livelihoods are partly supplemented by traditional harvesting practices, which complement non-traditional food sources. Changing market conditions has eliminated trapping as a viable industry and forestry employs only a few community members. Employment with projects and programs funded from outside sources and social assistance are the major means of providing for households. Vulnerability to climate change manifests through the poverty and lack of options available to residents of Shoal Lake. The current institutional framework does not allow them access to natural resources, such as forests, that they could independently develop into industries, such as forestry. Their adaptive options are largely dependent on the ability of outside funding agencies to approve programs related to community health and development. The community has however demonstrated the strength and resilience of its people in the

preservation of the Cree language and cultural attitudes amongst its people. These serve to increase pride and social capital in the community, strengths often applied to deal with problems that arise (as discussed in Chapter 5).

3.6 Important Formal Institutions Identified by Community Members

Key external institutions were identified by community members throughout the course of the research. It is important to describe these institutions, in order to fully understand their role in community vulnerability. There were six main institutions identified by community members in the both communities: (1) The *Indian Act*; (2) Indian and Northern Affairs Canada; (3) Canada Mortgage and Housing Corporation; (4) Saskatchewan Indian Gaming Association; (5) Federation of Saskatchewan Indian Nations; and (6) Prince Albert Grand Council.

The role of these institutions in affecting community vulnerability varies depending on the nature of the institution. Some, such as Indian and Northern Affairs Canada, Saskatchewan Indian Gaming Association and Canada Mortgage and Housing Corporation, provide the communities with funding to address the needs of individuals. These institutions play major roles in determining access and allocation of resources throughout First Nations communities, thus playing vital roles in adaptive capacity and also exposure, as their mandates can serve to limit the impacts of certain stimuli on the health of communities. Often local institutions, such as band governments, work together with these external institutions to provide necessary services to community residents. The exact nature of how these institutions affect the vulnerability of Shoal Lake and James Smith is further discussed in Chapter 5.



Source: Statistics Canada, 2008b

Figure 3.10 Population pyramid of Shoal Lake (original in colour).

Others within the list, such as Prince Albert Grand Council and the Federation of Saskatchewan Indian Nations, provide some administrative and organizational support to local band governments, and as such affect adaptive capacity exposure to various stimuli. These modern First Nations institutions are a means of adaptation to the Euro-Canadian system. They give testimony to the abilities of First Nations within Canada to unite and work together towards their shared goals of equality within Canada.

The final institution, the *Indian Act*, defines how the Canadian government views and interacts with First Nations peoples. The Federal Government asserts its control over First Nations people with this piece of legislation and defines their place in Canadian society. Many of the conditions detailing exposure and adaptive capacity discussed in this thesis are partly related to the *Indian Act* as it formed the basis and made legal the economic and cultural marginalization of First Nations people throughout Canadian history.

3.6.1 The *Indian Act*

The *Indian Act* (Canada, 2001) is legislation through which the Government of Canada has framed much of its interaction with First Nations people. It was originally enacted in 1850 as a means of defining and determining who was an Indian and to what band they belong. There have been many amendments to the Act over the years as the meaning of Status Indian and band membership are in constant flux with Canadian society's views on equality and the *Charter of Rights and Freedoms* (Canada, 1982).

3.6.2 Indian and Northern Affairs Canada (INAC)

Indian and Northern Affairs Canada is a federal department responsible for mandating Indian and Inuit Affairs and Northern Development, aiming to support broad economic and social development towards sustainable and healthy Aboriginal and northern communities. The Northern Development mandate deals mainly with the territories and is derived from the *Department of Indian Affairs and Northern Development Act*. The Indian and Inuit Affairs mandate is developed from the *Indian Act*.

The Indian and Inuit affairs mandate gives INAC jurisdiction over much of the interaction between the Federal government and First Nations communities. One of the major responsibilities of INAC is the negotiation of comprehensive and specific land claims. Land claims have been submitted by both communities. This topic is of utmost importance to local governments and community members, and has been for much of the last century. In addition, claim settlements are implemented and managed by INAC, making it the foremost department within the Government of Canada that interacts with First Nations people in dealing with land disputes (Canada, 1993).

The terms upon which First Nations communities seek self-governance are also regulated by INAC. INAC acts on behalf of the Government of Canada in determining how self governance initiatives can be realized. Self governance is a strategic move by many First Nations communities to maintain culture and improve conditions on-reserves. This move, in effect, removes them from the bureaucracy in which they were cast by the

Indian Act and may serve to be an adequate means of coping with current institutional exposures.

Further roles of INAC include the delivery of services to First Nations communities. Many services that would typically be delivered to non-First Nations communities by provincial governments are provided to First Nations communities by INAC. Among these services are education, housing, community infrastructure and social support. This jurisdiction includes all Status Indians on-reserves, giving INAC executive control over many necessities within the Aboriginal communities. Communities are dependent upon INAC for funding to develop the aforementioned services, which, as is the case with James Smith and Shoal Lake, often puts them at a disadvantage.

3.6.3 Canada Mortgage and Housing Corporation (CMHC)

Canada Mortgage and Housing Corporation is the national housing agency in Canada. CMHC facilitates housing projects by pursuing a number of avenues. The agency partners with various community organizations, non-profit agencies, the private sector and all levels of government in attempts to provide quality housing for all Canadians. Part of the agency's mandate is to provide adequate housing conditions for indigenous peoples on and off reserve. It does this through many programs aimed at addressing housing concerns for First Nations people (CMHC, 2008). Communities, including James Smith and Shoal Lake, rely in part on CMHC loans and funding for housing and renovation projects.

3.6.4 Saskatchewan Indian Gaming Association (SIGA)

Saskatchewan Indian Gaming Association is a non-profit charitable organization which strives to provide employment opportunities and economic growth for First Nations people and communities. SIGA is the management entity created to develop, conduct and operate on-reserve casinos. It was incorporated in January of 1996 under *The Non-Profit Corporation Act of Saskatchewan* as a direct result of the FSIN *First Nation Gaming Act* that was passed in June of 1995. The act gave First Nations people the ability to operate casinos and other forms of gaming for charitable purposes. Four casinos were opened in 1996, a fifth in 2007 and a sixth is scheduled to open in 2008. This is indicative of the ventures' success.

SIGA profits are divided three ways – 25% goes to the provincial government's general revenue fund, 25% for the Community Development Corporation and 50% to the First Nations Trust. The First Nations Trust funds are distributed directly to First Nations communities throughout the province. Both the communities of James Smith and Shoal Lake obtain and utilize SIGA funds for community projects. Community Development Corporation funds are allocated to various charities in the vicinity of casino locations. Provincial government general revenue funds are used in various aspects of the provincial budget. SIGA is regulated by the Province of Saskatchewan through the Saskatchewan Liquor and Gaming Authority. All SIGA's operations are approved and overseen by the province.

3.6.5 Federation of Saskatchewan Indian Nations (FSIN)

The Federation of Saskatchewan Indian Nations is a true federation of First Nations. The FSIN represents 74 First Nations in Saskatchewan and its mandate is to

uphold the covenant of treaties, support First Nations and facilitate intercultural relations amongst First Nations people and the rest of Canada. The FSIN finds its roots in a number of other organizations with similar goals. It was originally incorporated as a non-profit organization, but throughout time it out grew this definition. In 1982, the organization was restructured and reworked to become Canada's first Indian Legislative Assembly and was no longer constituted as a non-profit but a league of nations acting as a provincial level Indian government.

3.6.6 Prince Albert Grand Council (PAGC)

The Prince Albert Grand Council is the governing body of First Nations in Northern Saskatchewan. Both the community of James Smith and Shoal Lake are members and within its jurisdiction. It consists of 12 separate bands in total: (1)Black Lake First Nation; (2) Lac La Ronge Indian Band; (3) Fond Du Lac First Nation; (4) Peter Ballantyne Cree Nation; (5) Hatchet Lake First Nation; (6) Montreal Lake Cree Nation; (7) James Smith Cree Nation; (8) Cumberland House Cree Nation; (9) Wahpeton Dakota Nation; (10) Red Earth Cree First Nation; (11) Sturgeon Lake First Nation; (12) Shoal Lake First Nation. PAGC strives to better the situation for these First Nations communities by providing social programming, economic planning and opportunities for growth at the community level. PAGC acts as a regional level government to interface between reserves and FSIN.

CHAPTER 4 CHANGES IN SITES OF TRADITIONAL IMPORTANCE

"He thinks he was 7. He was standing there when they were unloading and they busted open some orange balls and they picked some up but some were in the water. They even dropped a sack of flour in the water. My dad picked up the flour. I picked up the orange balls and it cracked. There was water and I tasted it. And it was sweet. I tore it open and ate it. Boy it was good. They were oranges. [LAUGHTER] That was his first taste of an orange!" - Respondent

One constant in the lives of community members past and present is change. Many changes in the land have been observed and have warranted community response. Adaptability was a tried and true means of survival for traditional peoples in the area.

Documenting change in the environment is an important part of community vulnerability assessments. Traditional teachings often speak of the connection between human beings and the land. Documenting the ways in which sites of traditional use have changed and how the community has responded are integral to understanding the ways that human and environmental vulnerabilities to change manifest and interact.

Data on many sites of traditional importance were collected in both communities over the course of the research. As mentioned in Chapter 2, this database includes photographs, digital voice recordings of interviews, video footage of interviews, GPS points and GPS routes. This information was compiled into a GIS and delivered back to the communities.

4.1 James Smith

Once used for traditional harvesting and spiritual activities, the James Smith reserve has become mostly a site of agriculture, forestry and diamond mining. The south side of the Saskatchewan River was once covered by thick brush and used for hunting, trapping and other traditional activities. Now many of the larger trees are dying throughout this part of the reserve (Figure 4.1). Spiritual and cultural areas are scattered throughout this section of the reserve. Certain parts were once used as meeting grounds for the different bands in the area. Once a year all the bands would meet at this location and exchange information about medicine, animal populations and spiritual affairs, and also goods used to hunt, trap, fish and heal. With the introduction of agriculture on the prairies, most of this land was broken and used to grow cereal crops or run cattle. Originally, the reserve people were active in this industry, but have since been replaced by Euro-Canadian farmers as nearly all the land is leased to outsiders. Only one on-reserve farmer remains in the community. All residents of the reserve live on the south side of the river, either in the townsite or spread out on the land.

The north side of the Saskatchewan River is part of the Fort-a-la-Corne island forest. Traditional peoples used this area to hunt, trap and gather medicines and berries. Much of the health of the 'old people' or the ancestors of current community members is attributed to their reliance on the forest to provide food and medicines for the people. There are still some hunters and gatherers in the community, but few use the medicines for fear they have forgotten the proper techniques of applying them. Forestry is active within this area and there have been recent developments towards a full-scale open pit

Figure 4.1 Stand of dead trees (original in colour).

diamond mine, which will jeopardize local plant and animal populations. Hunting and trapping is at stake in this area as hunters, trappers and the animals themselves are pushed out by increasing developments. Ancient knowledge of medicine risks being lost as many of the medicinal plants will be dug up and displaced in search of the diamonds that lay buried beneath them. Some community members have began to work at the diamond mine. Often workers are required to stay at the mine during their shifts, placing strains on marriages and family life.

4.2 Shoal Lake

Shoal Lake reserve lands were once used for traditional harvesting practices, some of which have continued to present day. Much of the reserve is under water, with inundation along the shore dependent on the wetness of the year or particular season. Figure 4.2 shows an example of the seasonal variability of lake level. Wildlife can be found throughout reserve lands, as the swamp and forest provide food and shelter for moose, ducks, fish, beaver, muskrat, fisher, otter, mink, wolves, bears and other species of wildlife. Hunters use the water to travel by boat, making transportation around the reserve quick and easy. In days gone by, canoes were the principle means of transportation on the water, but they have since been replaced by power boats.

Figure 4.2 Seasonal variability of lake level (original in colour).

Forestry was developed on-reserve and surrounding areas. Many community members used to work in forestry camps to supplement their income from trapping. Currently, the younger generation is not as active in this industry as their grandparents were, as on-reserve forestry has ceased and much of the labour in surrounding areas has been mechanized. Employment for reserve members is scarce and reflects the lack of forestry and other industries in the area.

Agriculture was developed in the area during the time of treaties and lasted into the middle of the 20th century. Community members used the land to grow potatoes and raise a few livestock. Plenty of hay fields on-reserve used to produce quality feed for animals. Many of the hay fields and potato gardens became flooded with water after their retirement from agriculture.

4.3 Potential Use of Database

The documentation and compilation of spatial knowledge on the mapping DVD is a valuable asset to the communities. Local and traditional knowledge is captured and embedded throughout the maps in the form of video exposing youth to teachings concerning change and community response in a familiar form. Watching movies on DVD is a common pastime for youth in the community. Most DVDs are produced far from northern Saskatchewan and contain values and themes that are often at odds with traditional teachings. Local community members and Elders star in the videos found on the mapping DVD. Youth can view familiar faces discussing culturally relevant topics and conveying messages passed down for generations. The mapping DVD is a means of exploiting technology to improve continuity of knowledge and values within the communities.

Youth may gain respect for the words of their Elders when they see them on television. Deeper appreciation for the teachings of Elders can be obtained when presented in this format. The inclusion of videos captured on the land should have a similar effect. Youth may wish to visit and experience firsthand the areas and practices discussed by their Elders in the video. The importance of the land and connection to it can be better understood by youth when the landscape is presented alongside teachings.

CHAPTER 5 CURRENT VULNERABILITY

5.1 Current Exposure and Adaptive Strategies

Current exposures, adaptive capacities and vulnerabilities are related to past events. Following *ê-mâyahkamikahk*, Canadian assimilationist policy worsened (Dyck, 1991; McLeod, 2007). Although missionaries and others had been attempting to convert, or 'civilize', Indigenous people for centuries, the events of 1885 solidified their aims (Dyck, 1991; McLeod, 2007). *nêhiyawak* would then have to face residential schools and the shattering residual effects they had on family, community, and culture. During this research, residential schooling came up in conversations with the Elders, who, at times, were moved to tears when remembering all that they lost as a result of their imprisonment in the residential schooling system. Particularly significant to the Elders were the tensions within communities, disintegration of traditional family structures and the struggle to acquire the means of raising children, and erosion of cultural practices and languages that are seen resulting from residential schools. Important to note here, however, is the way in which Elders discussed the negative impacts of residential schools alongside any positive impacts they perceived, such as gaining valuable skills and knowledge while at the schools despite the sometimes harsh treatment. Their ability to stay positive is a testament to their strength, and an important capacity to cope with change. Reliance on values, beliefs, and internal human capacity to stay strong and positive in the face of change has been documented as an important coping strategy within these communities in other research as well (Ermine *et al.*, 2007).

The perceived inferiority of Indigenous peoples in Canada by Euro-Canadians is well documented and has shaped the nature of many interactions between these two groups (Dyck, 1991). When Europeans first arrived in what became Canada they sought economic partnerships with First Nations people, but also wished to teach them the 'civilized' way of life (Dyck, 1991). Many Euro-Canadians with good intentions have since attempted to lead First Nations peoples down the road to 'salvation', but have in fact helped to create many of the problematic situations in which First Nations people currently find themselves.

Coercive tutelage over the last few centuries has brought First Nations people face to face with many challenges, including cultural segregation and identity loss. The failure of Euro-Canadians to respect the beliefs and lifestyles of their hosts in the New World places First Nations people at a disadvantage within dominant Canadian culture. Euro-Canadians sought out to teach and to 'help' First Nations people to overcome their 'savage' lifestyles without recognizing the value of First Nations' knowledge and ethics. Many of the damaging programs, such as residential schooling, were a result of the will to 'teach' (Dyck, 1991.

Current exposures and adaptive strategies were documented from the perspective of community members. The summarized results are presented here. Complete tables of exposures and adaptive strategies can be found in Appendix F.

5.1.1 James Smith

Exposure in James Smith is related to a number of issues, which also serve to constrain adaptive strategies, including social problems, poverty, lack of employment opportunities, poor housing conditions, dependence on external sources of funding,

health, ineffective institutional arrangements, poor health, and threats to traditional values. The constant struggle against social problems, such as drug and alcohol abuse, violence and gangs, drastically increases exposure to climatic and other stimuli. Community members involved in unhealthy activities only serve to impede attempts to cope with other forms of stress. Poor housing conditions and overcrowding place added stress to health. Impoverished conditions and lack of employment opportunities on-reserve limit the amount of economic capital available for application in adaptation projects and lock the community into a system of dependence on the federal government. Further constraining adaptive response is the inclusion of a third party financial manager put in place by INAC to manage debts incurred by previous corrupt local governments' mismanagement of appropriated money. The manager's role is to allocate the use of INAC funding on-reserve and help reduce debts, since past local governments were misusing funding allocations that left the band in poor economic condition. Current local governments find themselves at the discretion of the third party manager, but also must cope with divisions amongst themselves and in their community. Often the band is led in three different directions by local governments, making concise and unified action difficult. Furthermore, some of the Plains Cree culture, including language, has been lost in the community and replaced with foreign attitudes and traditions that can favour unhealthy activities. Gangsters, violence and unemployment are glorified among the youth who often prefer these sorts of lifestyles over their Cree heritage. Elders are often lost before they can pass of their cultural knowledge due to poor health from diabetes and other ailments.

5.1.2 Shoal Lake

Exposure and adaptive constraints in Shoal Lake are related to poverty, dependence on external sources of funding, lack of employment opportunities, loss of traditional culture, poor health, housing conditions and social problems. One major difference between Shoal Lake and James Smith is the ability of local institutions in Shoal Lake to effectively and efficiently cope with climate- and health-related stresses by applying social capital (see Section 5.2.2). Poverty, lack of employment opportunities and dependence on outside sources of funding are still major problems in the community, but local governments are attempting to develop and manage industry in the area to ameliorate the situation (see Section 5.2.2). Social problems, including gangs, violence and substance abuse, are plaguing the community, but reliance on traditional culture and teachings has proven effective in alleviating these stresses for some individuals. Although Elders report significant losses in culture, the community has organized family camps, canoe trips and cultural exhibitions to help promote traditional lifestyles and values to youth and other members of the community and to sever their dependence on drugs and alcohol. The quality of health on-reserve is decreased by diabetes, obesity and overcrowded housing conditions, but community members have organized training and healthy activities in attempts to alleviate health problems.

An example of the changing nature of exposure in the community is illustrated in the way coping with floods has changed. Community members often had to adjust their campsites in response to flooding in the past. Houses were sometimes abandoned as well when surrounded by water, and campsites further up in the Pasquia Hills were favoured. Traditionally, Cree people were semi-nomadic and accustomed to moving in response to

many stressors, including floods. Today, the community has lost their mobility, making moving in response to flood more difficult. They are attempting to deal with floods in a more sedentary manner. Ditches were constructed to divert melt water coming from the Pasquia Hills in the spring from the community. Much flooding has been avoided with these ditches, but the high water table combined with increased amounts of moisture in the area still cause flood problems in the community.

5. 2 Discussion of Current Vulnerabilities

5.2.1 James Smith

Since this is a vulnerability assessment to climate change it is necessary, first, to characterize the community's vulnerability to climate and, then, describe the ways that these vulnerabilities interact with others. The collected data have demonstrated the community's clear vulnerability to climate. Although not necessarily the most pressing of its concerns, the community is unable to cope with certain aspects of its climatic exposures despite the mild stresses they cause. The most apparent exposure to climate results from heavy rainfall or spring runoff, which translates into an excess of surface water. This causes poor road conditions and the flooding of basements and the town site. Improving road conditions is difficult without paving the road surface. Gravel roads span the reserve and covering them with asphalt is not practical. Roads are passable for much of the year and only become treacherous when wet, during the spring, summer and fall. Paving is simply too expensive to warrant and community members have adapted to life on the muddy roads for day-to-day activities. Muddy and impassable roads, however, become a problem when a community member requires medical attention beyond the abilities of local practitioners and is forced to seek treatment in Melfort or Prince Albert.

Muddy road conditions can severely impede travel, which may result in the loss of a life. Since much drinking water delivery to households occurs via truck, poor road conditions for extended periods of time (5 to 7 days) can diminish water supplies. However, roads have usually become passable by the water truck long before the need for water in households becomes pressing.

Flooding could be largely avoided if proper drainage was constructed and maintained. The lack of functioning culverts caused most of the problems with flooding in 2007. There were two main issues contributing to this problem: (1) a lack of access to adequate funding to build drainage infrastructure capable of handling water levels; and (2) a lack of attention to maintaining existing drainage systems. The first problem relates to the band's current political and institutional framework. As mentioned earlier, INAC funding for such projects is managed by a third party manager who is reported to be less concerned with drainage in the community and more concerned with debt reduction. The money that is set aside for public works by the third party manager is also split three ways and distributed to three different public works departments to accommodate the current political state of the community. Cooperation between these departments was rarely cited during the research. Each department seeks drainage infrastructure separately with limited buying power and none is capable of acquiring such infrastructure. The second issue is the common questions of who does the work and who pays when matters such as these arise.

The community has shown great resilience with respects to its water supply. Contamination problems sometimes arise, but they are promptly and efficiently dealt with. Concerns with water availability rarely occur, and if they do, are related to the

function of infrastructure as opposed to physical quantities. The system is designed to accommodate the inoperability of certain parts by incorporating multiple parts with the same function. For example, the operation of two pumps for transporting water from the treatment centre to the reservoir avoided problems with water availability in 2007 when one pump was damaged and needed repair. The other pump was capable of supplying adequate water for the community's needs.

The community's dependence on social assistance programs to secure livelihoods presents a vulnerability to climate. The presence of such programs relieves some exposure to climate; community members are no longer dependent on the climate for securing their livelihood. On the other hand, the capacities developed over the generations to cope with climate have been lost and forgotten. In the *nikan oti* research, the example given was how community members no longer chop wood, a once necessary task in the struggle to keep warm in the harsh winters (Figure 5.1). They now have to

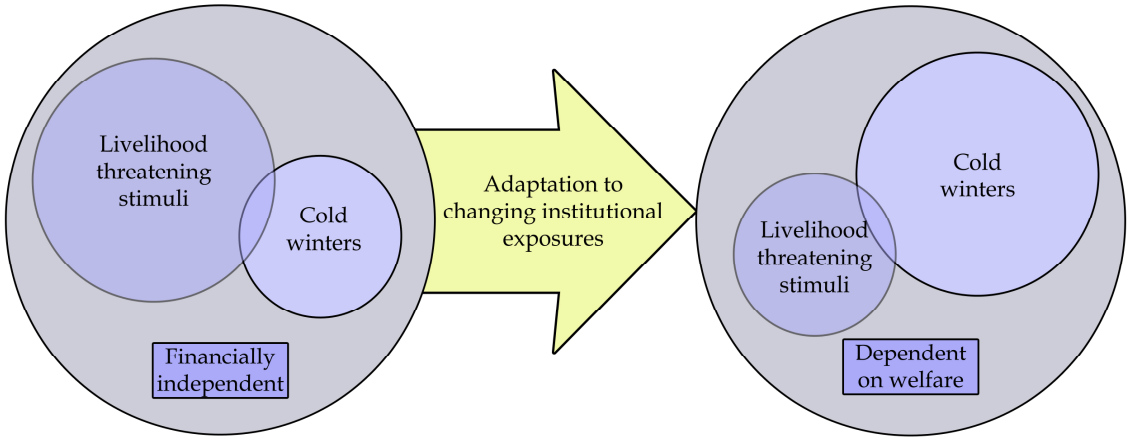


Figure 5.1 The changing nature of exposure following adaptation to the welfare system (Ermine *et al.*, 2008) (original in colour)

depend on heaters and other technologies. Changes in the natural environment no longer affect the ability of the majority of community members to make a living, but limit capacities to cope with such changes. Many of the traditional strategies, such as work ethic and spirituality, have been lost (Ermine *et al.*, 2008). Work ethic refers to the will of individuals to work hard to earn a living and was used to proactively cope with stressors (Ermine *et al.*, 2008). Spirituality refers to a set of morals that define respectful relationships with the environment and between individuals (Ermine *et al.*, 2008). Spirituality was the source of strength during difficult times and often gave individuals the will to persevere (Ermine *et al.*, 2008). The community has developed an existence based on dependency, as opposed to capacity, as their ancestors had. Social assistance programs do not produce an abundance of wealth within the community. Poverty is common amongst residents and is simply a fact of life for those who wish to stay on the reserve.

Exposure to social problems only exacerbates climate and environmental exposures. Some members are caught up in drinking, drug abuse and gangs, which translates into violence and other inhibiting atmospheres. These individuals not only do not develop their own capacities to deal with climate and environmental change, but restrain other community members from developing capacities. One respondent noted his inability to hunt following the murder of his brother during a party at a local household. He was accustomed to hunting with his brother and could no longer hunt after his brother's death. A long line of hunting and gaining knowledge of the land was stopped in this instance by this brutal crime.

Health problems are also major concerns for the community. They have been largely incapable of dealing with health-related exposures. Traditional knowledge about health is no longer functioning in the community. Many Elders remember the traditional ways, but are reluctant to practice these forms of medicine due to their dormancy for many years. There were reports of a few community members who still provide traditional treatments to individuals, but they are not widespread. Healthy lifestyles are often neglected. Obesity and diabetes are rampant and healthy food choices are difficult to find. Young children and the Elderly are the most exposed to these health risks.

5.2.2 Shoal Lake

Shoal Lake's vulnerabilities manifest very differently from those of James Smith. Climate vulnerabilities are presented first and then analyzed in light of other vulnerabilities to clearly depict the state of the community.

Flooding is a problem for Shoal Lake as well, but results from different causes than in James Smith. Exposure to floods results from proximity to the lake and characteristics of the community. Under nomadic lifestyles, people simply moved away from flooded areas during times of increased water levels. They would seek game and other resources in the Pasquia Hills or other surrounding lands. The forced cultural shift to sedentary lifestyles plays a major part in causing this problem, but is not the only culprit. Elderly respondents noted the initial ability of the people to live with the floods. Their first houses were built with higher door steps and did not have basements, and as such, were not prone to water infiltration. Some respondents remember staying in their homes while water was surrounding them. The design of houses today is partly responsible for the problem. If people did not have basements flooding in their homes

would be less likely. Also, the poor quality materials used in the construction of homes can serve to worsen mold conditions.

The community is currently coping with flooding despite exposure. They have partnered with Dalhousie University in the completion of a community development project that has identified areas less prone to flooding and more suitable for housing development. Once these areas were designated, the community was able to obtain funding for new homes in these areas from CMHC due to its good standing with this institution. Shoal Lake fostered networks and linkages with institutions to cope with climate in these respects.

Similar capacities have not been demonstrated to deal with the water quality issue. Inadequacy of the water treatment plant often causes problems with drinking water that have not been sufficiently addressed. The community lacks the resources to improve the system and is dependent on outside funding sources, mainly from INAC, to promote change. Despite efforts at creating synergy with the department there has been little headway gained with regards to water issues. According to interviewees, water protocol group meetings with INAC have proven insufficient to properly characterize the nature of this problem to the agency.

Water quality issues started affecting the community around the same time as the treatment plant was built. Before this, people relied on the lake and the Carrot River for potable water. They knew where to go to get clean water and how to prepare it for drinking. Reliance on the drinking water system is in some ways a maladaptation to urbanization as it has caused a reduction in the number of options available for obtaining

clean water. Only one respondent reported collecting water on the land as their ancestors had. Many people simply do not know the proper way to prepare water found on-reserve for drinking and are scared that if they try they will get sick. Traditional capacities for obtaining potable water have been lost and replaced with technological capacities that simply are increasing vulnerability to water quality issues.

Similar maladaptation was discussed in the *nikan oti* research. Many of the social problems that currently exist in the community are the result of the peoples' response to the shift in lifestyle. Drinking and drug abuse among the youth was of particular concern for the Elders (Figure 5.2) that see these as the direct result of unstable home conditions and their now urban lifestyle. They are concerned for the ways in which it decreases the capabilities of youth to deal with their problems. They see a lack of the capacities, such as spirituality, and intent that allowed them and their ancestors to cope with change (Ermine *et al.*, 2008) and fear that the reliance of youth on alcohol and drugs will further destroy their people.

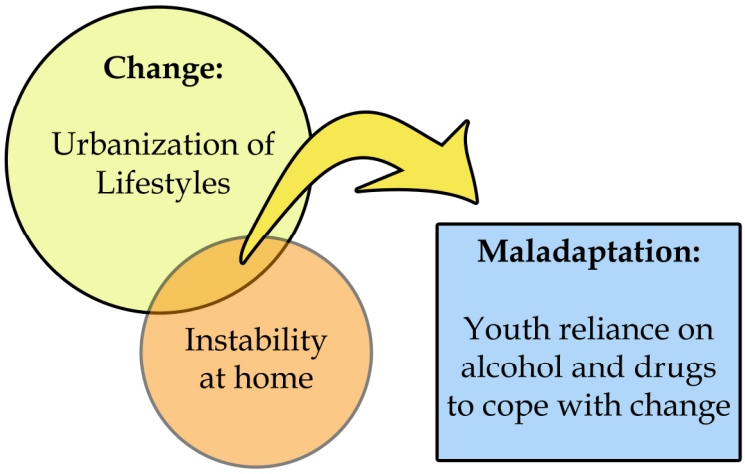


Figure 5.2 Youth reliance on drugs as a result of exposure to lifestyle change produced by instability in home life (original in colour).

Health problems affecting members of Shoal Lake arise from their sensitivities to these problems, the degree of exposure to illness, and lifestyle. Diabetes and obesity are being worsened by lack of exercise and access to healthy foods, but are also aggravated by the consumption of drugs and alcohol. The spread of community associated methicillin-resistant *Staphylococcus aureus* (CA-MRSA) is facilitated by crowded housing conditions on-reserve. Community capacities to cope with such threats have been demonstrated. Similarly as with the community development project, health research projects in conjunction with institutions have identified those that are susceptible to certain illnesses so that treatment can occur before problems develop. Studies into diabetes retnoscapy (the loss of sight due to diabetes) and MRSA have successfully identified and secured treatment for predisposed individuals. These are examples of fighting the symptoms (*i.e.,* the illnesses themselves) rather than the causes (*i.e.,* lifestyle, diet and housing issues), and demonstrate the abilities of the community to unite with various institutions to confront its problems.

CHAPTER 6 FUTURE VULNERABILITY

6.1 Future Exposure/Sensitivity

Future exposures/sensitivities were assessed through the development of future climate scenarios for the communities and a literature search on expected impacts of climate change. Climate scenarios were developed for both communities to gain insights into the sorts of climates that the communities may experience in the future. Published materials on the impacts of climate change on the Prairie Provinces were scanned for those that could potentially affect the communities. It is important to note that these scenarios provide insights into mean shifts in climatic conditions, but give little indication of the climate variability to be expected as a result of these changes. Climate variability is difficult to model using current methods, but often is important in terms of the vulnerability of human systems. The following presents the scenarios as well as the lists of potential impacts and how they could affect the communities.

6.1.1 James Smith

Future annual amounts of precipitation are expected to rise and be distributed much differently throughout the year (Figure 6.1). In the 2020s, precipitation amounts could potentially rise in all seasons. Spring rainfall amounts are expected to increase in the range of 10 mm. The strong increase in spring precipitation is expected to occur throughout the 2050s and 2080s as well, by 40 mm and 20 mm respectively. Summer precipitation is expected to decrease in the range of 20 mm in the 2050s and 40 mm in the 2080s. Precipitation amounts in the fall are expected to rise for both time periods by approximately 10 mm. Neither of the scenarios produced using the CGCM3T47 model

accurately depicted past precipitation in the area, and they were therefore not included in this portion of the study.

Potential effects on the community from predicted precipitation deal mostly with flooding. If precipitation is delivered in intense short-term events, soil infiltration is less likely and runoff will be generated that could find its way into people's homes. Road conditions are also likely to be negatively affected by the predicted precipitation levels, as the increase in precipitation will cause road surfaces to degrade and potentially become impassable during wet times. More frequent maintenance will be necessary in order to prevent deterioration.

Projected mean daily temperatures (see Figures 6.2 to 6.6) show subtle variations from the normal (1961-90) into the 2020s, and more pronounced changes in the winter and summer. Values are predicted to rise by approximately 2°C in both these seasons, with annual averages expected to increase by approximately 1°C. More severe changes are expected during winters in the 2050s, with increases of between 5° to 6°C. Annual increases are approximately 2° to 3°C for this period. Increases are more drastic throughout the year during the 2080s, with annual average values incrementing by 3° to 6°C. Analysis of climate change effects on mean maximum and minimum daily temperatures indicates that most profound changes will be exhibited in the winter, as both values are expected to increase significantly over all three time slices.

There are other likely changes in the area aside from climate. A diamond mine proposed in the Fort-à-la-Corne forest will have many impacts on the community. The destruction of large tracts of forest is imminent, but so is job creation. There will likely

be an increase in economic wealth of the community at the cost of its forest. The mine will be located in traditional lands that were used for hunting and gathering. Many respondents already note the negative effects of existing diamond mine developments on these activities (see Appendix F). These will likely only be exacerbated as development continues.

Economic capital could become less scarce in the community if the diamond mine generates as many jobs and other opportunities as is projected. Definite increases in average annual earnings of community members would occur and bring monetary prosperity to the community. There is, however another side to these developments. Elders generated discussion on the potential negative effects of the projected 'economic prosperity' showing the darker side of diamond mine developments. The Elders fear that the capacities of individuals to responsibly deal with an increase in economic wealth have not been properly developed. Increases in economic wealth could potentially exacerbate current negative conditions within the community, such as drinking, drug abuse, unstable families and violence, causing the destruction of the community. Elders wish economic affluence for their descendents, but hope that wealth does not spell out disaster for their community.

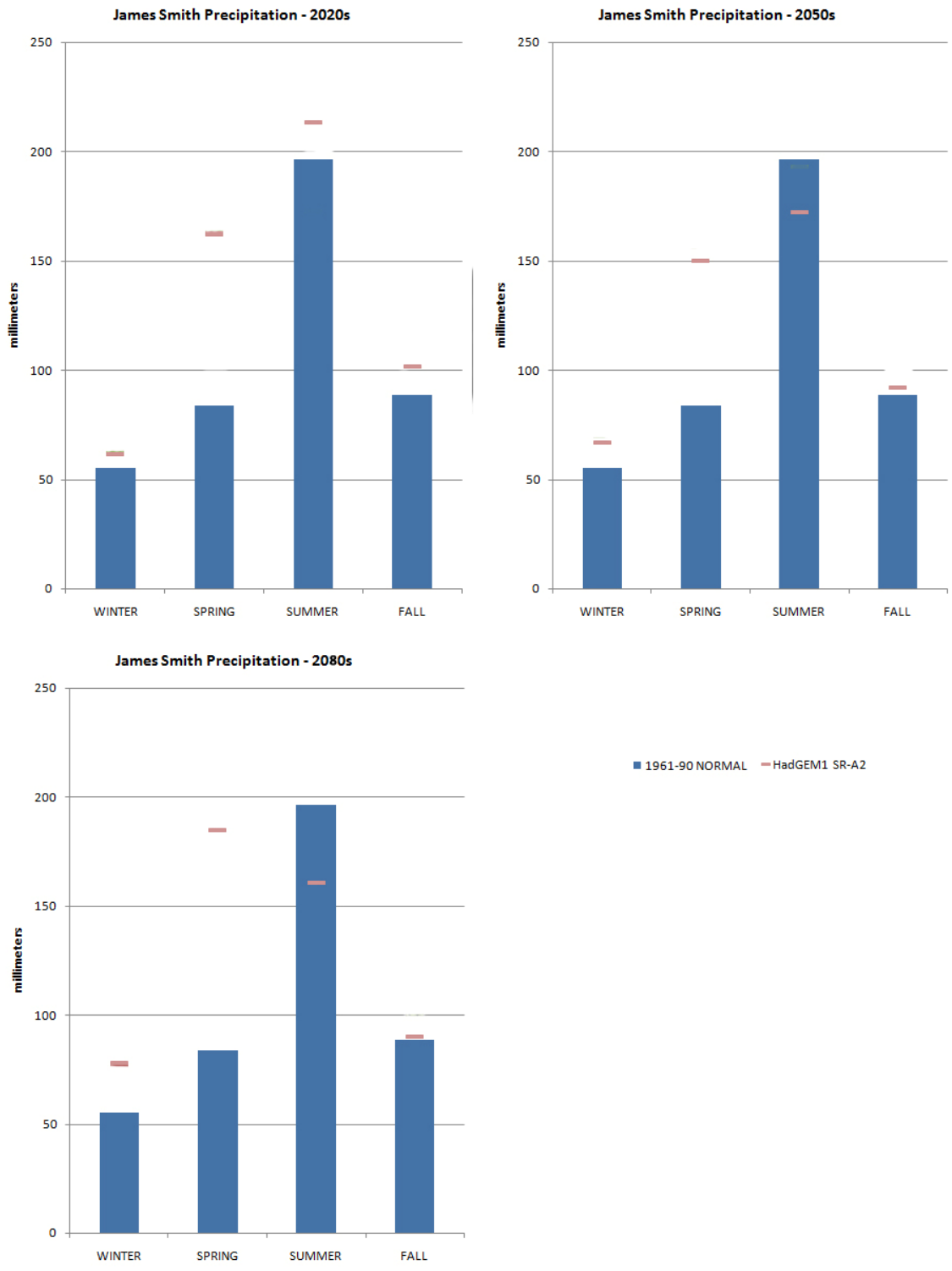


Figure 6.1 Future climate scenarios of seasonal precipitation for James Smith (CCCSN, 2007) (original in colour).

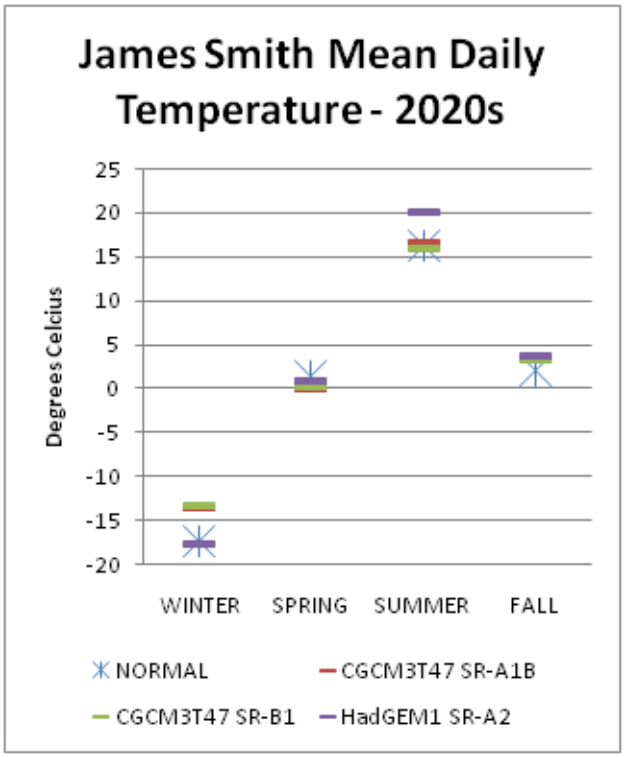


Figure 6.2 Future mean daily temperature at James Smith in the 2020s (CCCSN, 2007) (original in colour).

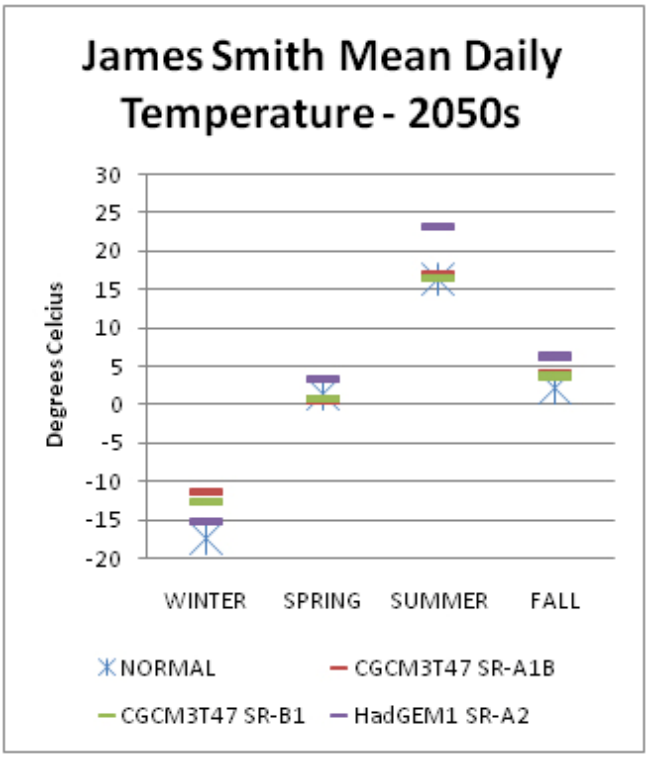


Figure 6.3 Future mean daily temperature at James Smith in the 2050s (CCCSN, 2007) (original in colour).

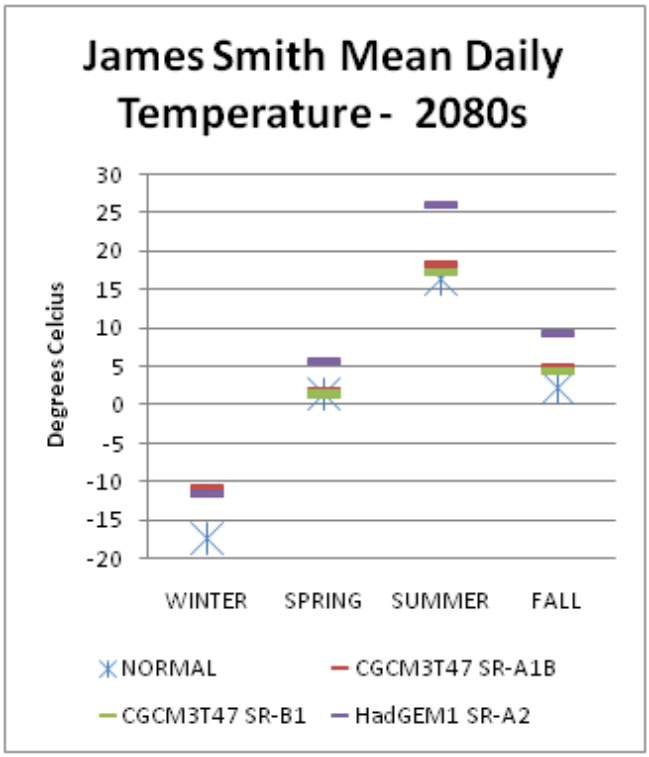


Figure 6.4 Future mean daily temperature at James Smith in the 2080s (CCCSN, 2007) (original in colour).

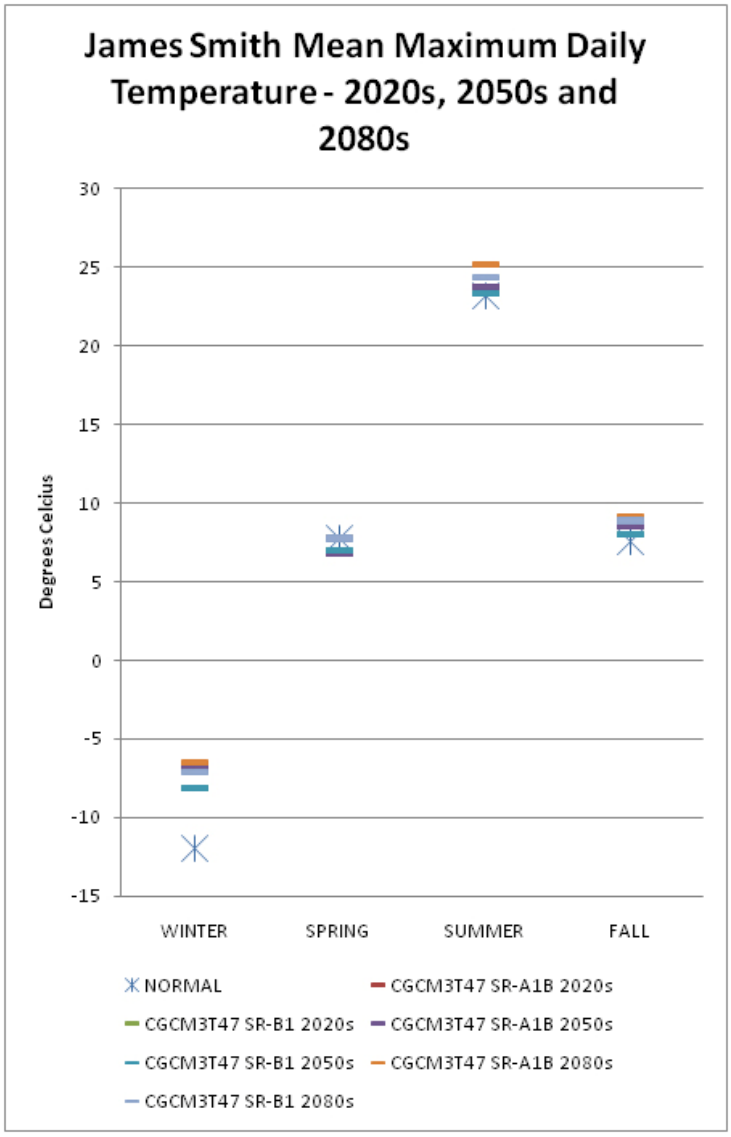


Figure 6.5 Future mean maximum daily temperature at James Smith in the 2020s, 2050s and 2080s (CCCSN, 2007) (original in colour).

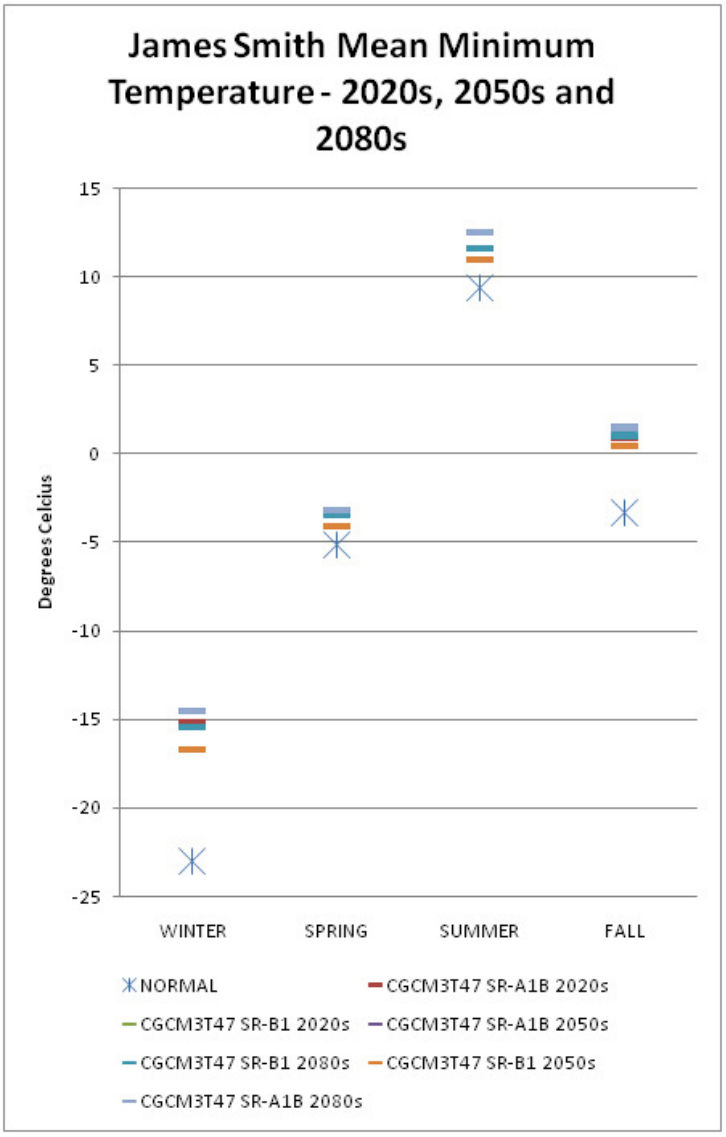


Figure 6.6 Future mean minimum daily temperature at James Smith in the 2020s, 2050s and 2080s (CCCSN, 2007) (original in colour).

6.1.2 Shoal Lake

Future climate scenarios were also produced for the community of Shoal Lake using the same variables and time periods as with James Smith. Other insights into potential future exposures were gained from community members.

By the 2020s (see Figure 6.7), precipitation is likely to be higher in the spring and lower in the summer and fall. Spring time values are projected to increase by 70 to 90 mm, while summer and fall values decrease by 30 mm and 10 mm respectively. Annual amounts may increase by 10 to 100 mm during this period. Similar seasonal changes are predicted throughout the 2050s and 2080s with only the magnitude and not the temporal distribution of change varying. Due to the wide range of precipitation values projected, it is difficult to gain any clear insights into the effects these changes may have on the community. Flooding was the most relevant exposure to water quantity-related stimuli in the past. If spring-time rainfall amounts increase as the models predict, these conditions could potentially be exacerbated.

As with James Smith, summer and winter temperature (Figures 6.8 to 6.12) are expected to rise by 1°C and 2°C respectively, from 1961-90 to the 2020s. Annual temperatures during this period are expected to increase by approximately 1°C. Annual temperatures during these periods are expected to increase by 2°C for the 2050s and 3°C for the 2080s relative to 1961-90. Warming is most pronounced during the summer and winters of the 2050s, but occurs throughout the year during the 2080s.

Potential development of the oil shale industry is another change that could impact these communities in the future. The band has already been approached by

potential developers in attempts to educate them on how they would be affected and discuss their role in such developments. As with the diamond mine in James Smith, these developments would serve to create jobs and economic wealth in the community, but possibly sacrifice the health and sustainability of the forest and wildlife in the area.

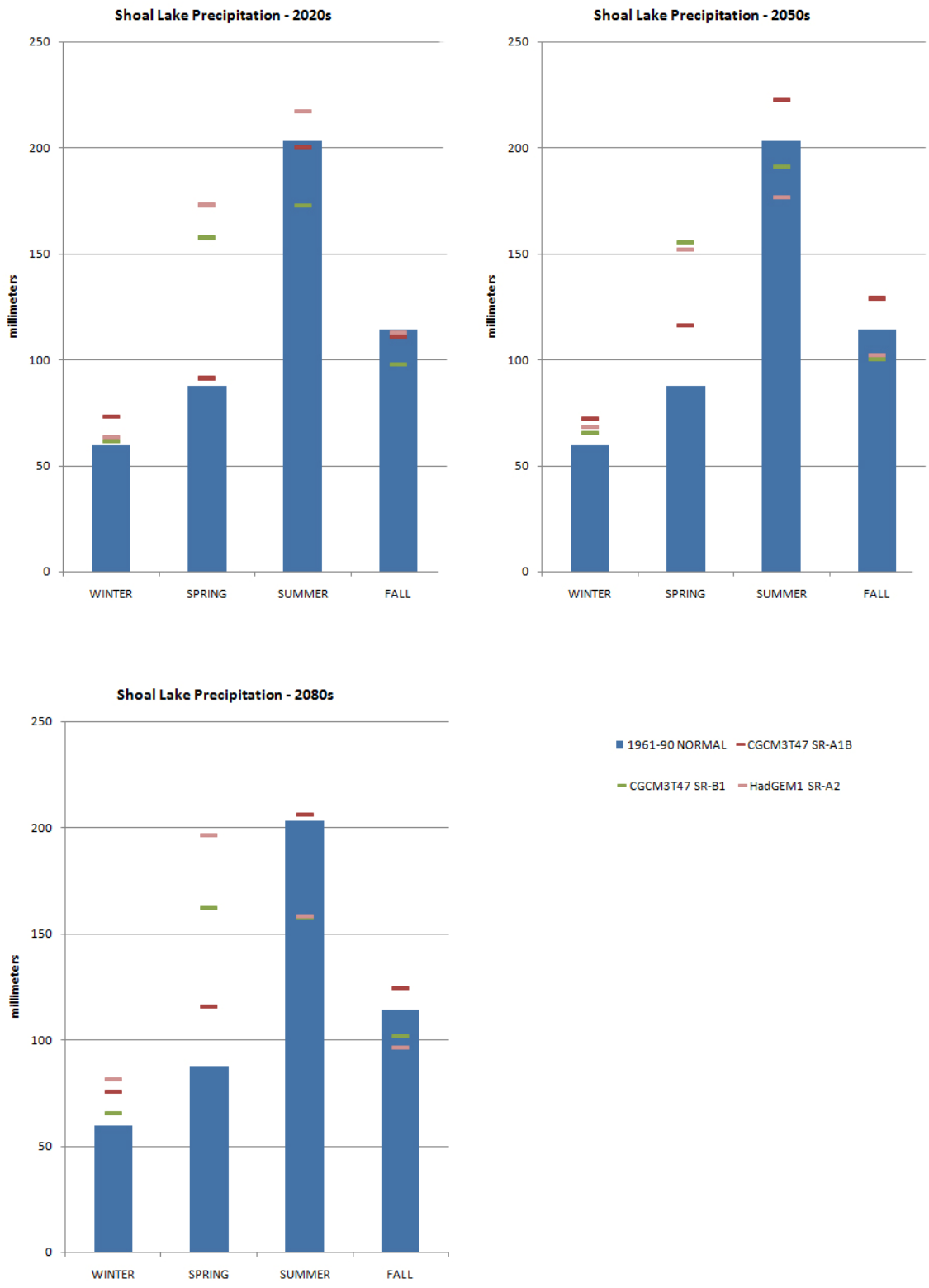


Figure 6.7 Future precipitation at Shoal Lake in the 2020s, 2050s and 2080s (CCCSN, 2007) (original in colour).

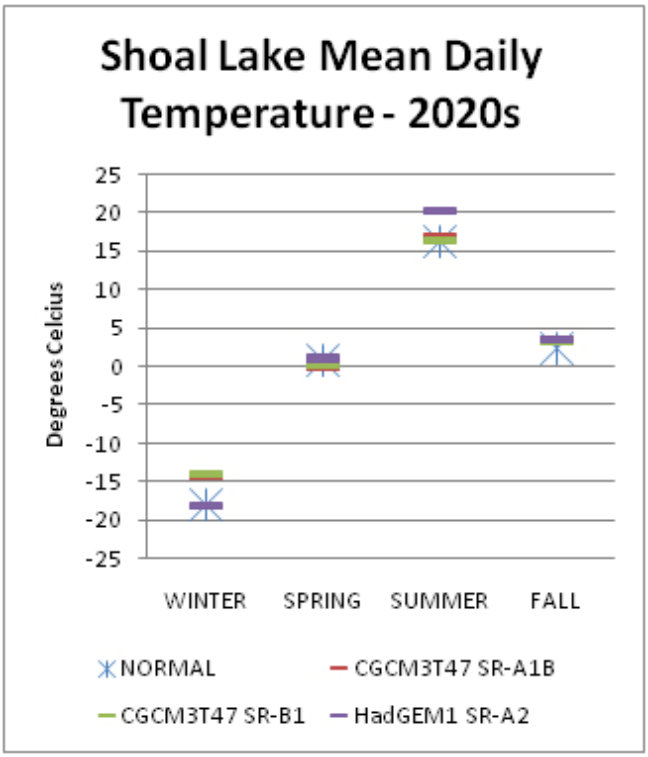


Figure 6.8 Future mean daily temperature at Shoal Lake in the 2020s (CCCSN, 2007) (original in colour).

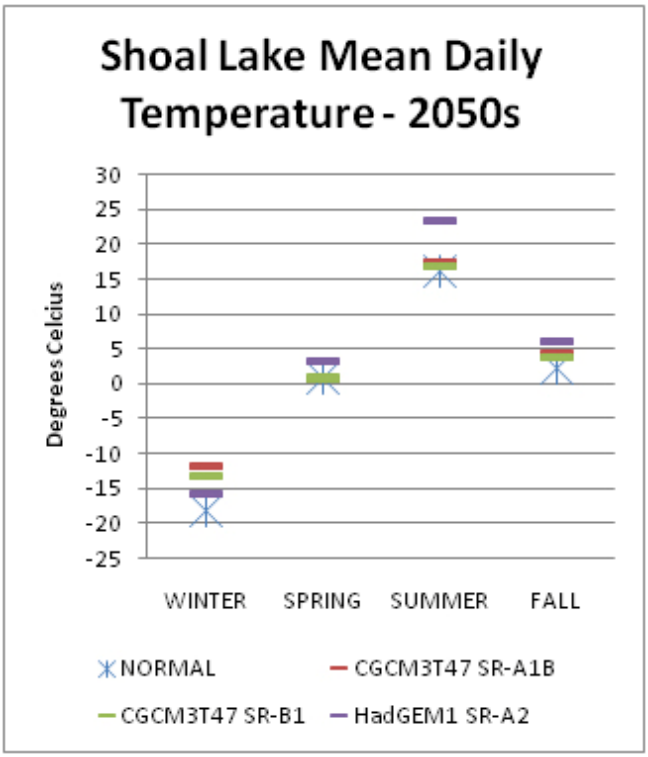


Figure 6.9 Future mean daily temperature at Shoal Lake in the 2050s (CCCSN, 2007) (original in colour).

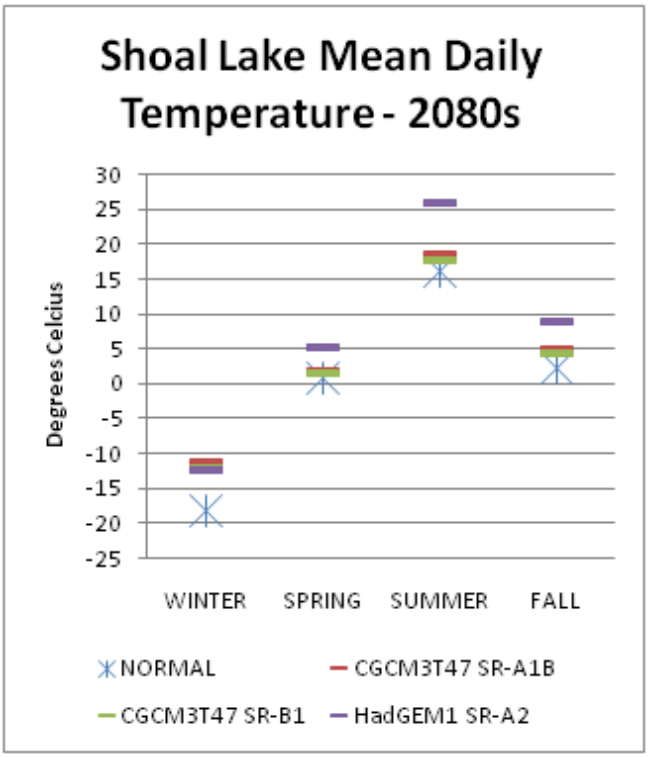


Figure 6.10 Future mean daily temperature at Shoal Lake in the 2080s (CCCSN, 2007) (original in colour).

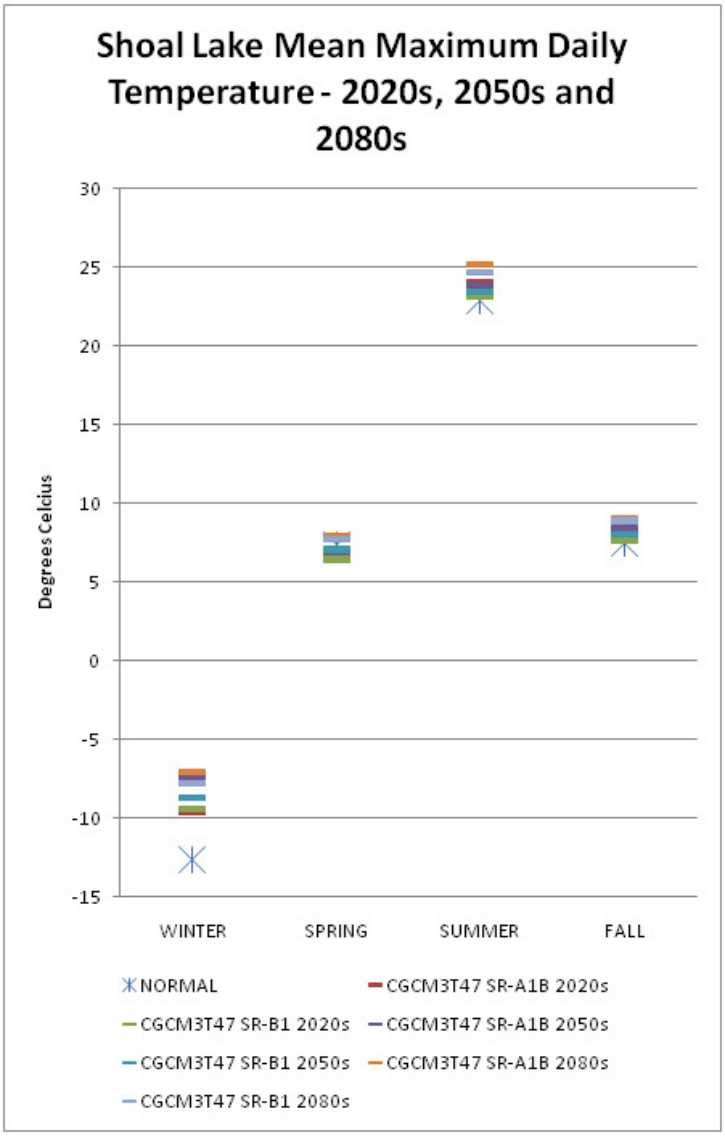


Figure 6.11 Future mean maximum daily temperature at Shoal Lake in the 2020s, 2050s and 2080s (CCCSN, 2007) (original in colour).

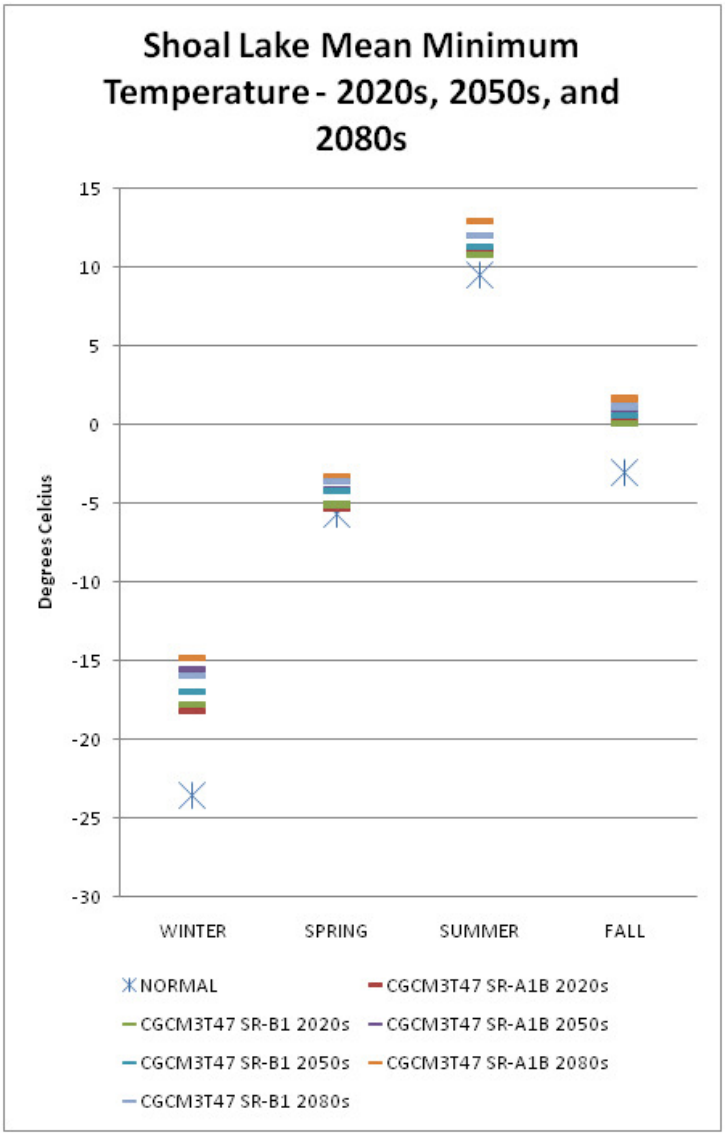


Figure 6.12 Future mean minimum daily temperature at Shoal Lake in the 2020s, 2050s and 2080s (CCCSN, 2007) (original in colour).

6.1.3 Climate Change and the Forest

The forest is important to both communities, traditionally and contemporarily. Forests were the basis of the nomadic hunter-gatherer culture of the Cree people. In conjunction with these livelihoods, deep spiritual connections were fostered with the forest environment. Forests still provide the grounds for cultural activities. Changes in the forest will cause changes in the communities, and climate change is projected to drastically affect forest in these areas. Forest cover could be lost or significantly changed in much of the area surrounding the communities due to drought, pests and an increase in forest fires (Kulshreshtha *et al.*, 2001; Johnston *et al.*, 2001; Johnston, 2008).

There are many weather- and climate-related factors that affect forest fires. The frequency, size, intensity, seasonality, type and severity of forest fires are largely dependent on climate and weather (Wheaton, 2001). Weather has been identified as one of the most important factors determining the occurrence of forest fire in western Canada (Van Wagner, 1988; Hély *et al.*, 2001). Various climatic characteristics have also been proven to affect fires, including temperature, precipitation, humidity and wind speed and direction (Flannigan *et al.,* 1998). As climate changes, so then will forest fires. Fire occurrence and severity are both expected to increase due to climate change (Bergeron and Flannigan, 1995). Fire is important in determining the vegetation composition of the forest (Suffling, 1995; Johnston, 2008).

Forest insect and pest outbreaks are also affected by climate change (Kurz *et al.*, 1995). The poikilothermic (having body temperatures that vary with ambient temperature) properties of insects make them sensitive to temperature (Flemming, 2000). Warmer temperatures increase the reproduction rate of insects (Kingsolver, 1989). Cold

winter temperatures limit populations. Winter warming will reduce the effects of this natural mechanism and insect populations will increase (Williams *et al.*, 2000) under climate change (Kingsolver, 1989; Williams *et al.*, 2000; Johnston, 2001).

Moisture stress will also produce change in the forest as higher temperatures increase evapotranspiration (Johnston *et al.*, 2001). Moisture availability determines the limits of forest (Hogg, 1994; Hogg and Hurdle 1995). The boreal transition is expected to experience moisture deficits in the future (Johnston *et al.*, 2001), reducing productivity of species and thus forest cover (Johnston, 2008).

6.1.4 Climate Change and Water

Climate change is projected to impact water availability throughout the Prairie Provinces (Sauchyn and Kulshreshtha, 2008). The flow of the Saskatchewan River will be affected by climate change as glaciers melt (Pietroniro *et al.*, 2006). Decreases in stream flow are likely under future climates, but difficult to quantify based on the complicated nature of their determinants (Pietroniro *et al.*, 2006; Sauchyn *et al.*, 2006). Shortages are likely in years with limited snowfall, but increases in spring precipitation may compensate (Sauchyn *et al.*, 2006). Communities are more sensitive to decreases in stream flow, as the rivers are used for transportation during hunting expeditions (see Appendix F).

Despite the increase in precipitation, droughts are likely to increase in intensity and duration under climate change (Herrington *et al.* 1997). Elders in Shoal Lake discussed how the last buffalo in the area died of thirst around the 1850s on account of drought (Ermine *et al.,* 2005, 2007). It is important to note the reported resilience to

drought demonstrated by the communities in the 1930s. Drought was not mentioned by any respondents as currently impacting the communities with any significance.

6.1.5 Climate Change and Human Health

First Nations peoples are expected to bear the brunt of negative health impacts due to climate change (Sauchyn and Kulshreshtha, 2008). They are not more physically susceptible to illnesses associated with climate change, but will likely be hit harder due to a lack of access to medical treatment, poorer infrastructure, lower socio-economic status and the fact that they are also faced with the deterioration of traditional lifestyles that has already produced many health problems in First Nations communities (Sauchyn and Kulshreshtha, 2008).

There are numerous projected impacts of climate change on human health in the prairies. Increases in length and severity of droughts and number of forest fires increase the occurrence of respiratory problems as they increase concentrations of dust and smoke in the air (do Pico, 1986; Rylander, 1986; do Pico, 1992; Lang, 1996; Simpson *et al*., 1998; Bowman and Johnston, 2005). Drought can also serve to increase concentrations of pathogens and other contaminants in drinking water supplies, as reduced surface water amounts are available to dilute supplies (Charron *et al*., 2003; World Health Organization, 2003). Following floods, there may also be increased occurrences of diseases, such as Hantavirus and West Nile virus, as mosquito and rodent populations related to the spread of these viruses often increase (Sauchyn and Kulshreshtha, 2008).

Most of the aforementioned health issues are more likely to harm elderly people due to their higher susceptibility, lower incomes, social isolation and higher likelihood

that they are already suffering from other health conditions (Sauchyn and Kulshreshtha, 2008). Elderly residents are the backbone of First Nations culture. Their knowledge and teachings could fill libraries if writing were to replace oral tradition. Elders in James Smith and Shoal Lake were already reported to be dying before their knowledge could be passed on. The projected impacts of climate change on health would further stress the transfer of cultural knowledge, as Elders would likely have ill health. Traditional teachings are at risk of being lost.

6.2 Future Adaptive Capacity and Resilience

There is a deep belief within Cree culture that spiritual and cultural traditions have been integral in the survival of their peoples in the past and that they are necessary for their survival in the future (FSIN, 2007). They have been protected and provided for by their beliefs and these will continue to support them. This is apparent in their ability to survive throughout Canada, in many different environments and throughout many different changes. Elders in the communities wish to prepare their grandchildren for change. They want their grandchildren to be prepared for all sorts of changes, whatever they may be. In addition to culture, the communities possess numerous other capacities and characteristics that will aid or hinder them in adapting to future changes in climate and other conditions. This section assesses the amount of preparedness that the communities exhibit.

6.2.1 James Smith

Elders circles generated discussion about the ability of the community to adjust to new conditions – specifically the proposed diamond mine. The diamond mine is seen as a blessing to most Elders, despite its impacts on the natural environment. Diamonds will

be mined through open pit methods, which will drastically modify the forest in the area. Although they would prefer less intrusive techniques of diamond extraction, they believe the mine will provide much needed economic wealth for their people. "The diamonds are a gift and we should live off them", said one Elder. They want their grandchildren to prosper in the future. The accumulation of economic wealth too quickly, however, will destroy the community according to Elders. Community members are not accustomed to wealth, and will need time to adjust to the insurgence of diamond money. Elders believe that currently the community is not capable of applying its potential fortunes effectively and that an abrupt upward shift in their income will only exacerbate current problematic conditions that exist within the community, such as drinking, drug abuse and violence. The community will have to carefully plan its strategies with respects to diamond mine development.

In an attempt to do just that, the community is striving to construct a hydroelectric dam on the Saskatchewan River to provide the mine with electricity. The mine will require a projected 50MV of power at a time when SaskPower will be trying to replace a predicted 2000MV worth of power production (Economic Development Strategy-JS, 2005). With or without the mine, the hydro dam would give James Smith a market advantage. There is also a projected 500 to 800 man-years of work involved in the dam's construction and possibly more positions available for the dam's maintenance and operation once constructed (Economic Development Strategy-JS, 2005). This is a joint venture between the three local band governments, which could forge the way for co-operation among them. The creation of the FCDC and the commencement of a feasibility study with SNC Lavalin consulting firm are major steps to making this project a reality.

6.2.2 Shoal Lake

The community of Shoal Lake is attempting to position itself to take advantage of opportunities as they are presented and build its capacities to cope with negative impacts. Their strengths lie in their ability to preserve language and culture within the community. Although much of the spirituality has been lost, there are demonstrations of the will to increase traditional capacities, such as Family Camp, that maintained the people in the past.

The demonstrated ability of the community to apply its social capital to confront problems will also aid them in the future. The community has increased its ability to deal with a wide range of exposures using its social capital and could potentially apply similar techniques when dealing with climate change.

The economic opportunities are fewer than for James Smith, requiring greater creativity to develop industry at Shoal Lake. There is potential for oil shale development, but little is known about benefits to the community. The community is prepared and poised to take advantage of opportunities in ecotourism and forestry. They have enhanced those aspects of human capital that will aid them in these industries. Lack of economic capital is currently for a constraint for the community, and there is little indication that this will change.

6.3 Discussion on Future Vulnerability

An investigation of current vulnerabilities (Chapter 5) documented the ways that vulnerability manifest from climate and weather exposures interacting with vulnerabilities to other stimuli. This knowledge can be used in conjunction with insights

into future exposures and adaptive capacities to produce a clear picture of potential future vulnerabilities to climate change in light of other factors. This section presents future vulnerability of the James Smith and Shoal Lake Cree Nations to climate change.

6.3.1 James Smith

Individuals are desperately trying to revive culture in the community of James Smith. It is difficult to say whether or not they will be successful, but climate change in light of other changes could restrict their efforts. Forest disturbance in the area by insects, drought, fire and development will potentially have severe implications, resulting in the loss of forest cover (Johnston, 2008). Culture and traditional practices are partially dependent on the forest. Future generations may not have the opportunity to see the forest as their grandparents did. Hunters will be replaced with miners, if current economic and climate projections come true.

Changes in flows down the Saskatchewan River will also have implications for the hydroelectric dam. Future stream flows are difficult to quantify, and as such, their precise effects on electricity production cannot be accurately modeled. Water storage may compensate for losses, however. There is little discussion on the water holding capacities of the dam project, but the resulting reservoir may also provide opportunities for the community, given the uncertainty surrounding water availability in the future.

On other matters concerning drinking water, the community has shown much foresight. There are plans in place to either treat river water or buy water from SaskWater in the event that the current supply of groundwater becomes unsustainable. If

these strategies are feasible, they increase the ability of the community to cope with such water shortages.

6.3.2 Shoal Lake

Flooding is currently one of most significant impacts of climate variability on the community of Shoal Lake. Less water is not necessarily beneficial to the community; flooding problems are more related to the state of the community than to the actual amount of water. Much culture and traditional practice, including hunting and fishing, depend on the high levels of water around the community. As presented in Chapter 5, flooding is more a problem of their current sedentary lifestyle than of the increased water levels. Decreased water availability in the future may have significant impacts. Shoal Lake members are descendents from Swampy Cree and depend on their wetlands for cultural well being. Loss of forest cover in the area has similar effects on culture health. The forest is integral in hunting, gathering and spirituality. With forest cover will go much tradition.

Decreases in forest cover and productivity will also impact the forestry industry in the area. Shoal Lake may be prepared for an industry that never takes off with a warmer future climate predictions come true. Ecotourism could have a similar fate. Reduction in forest and wetlands in the area will produce a reduction in wildlife. Much of the ecotourism industry would be centred on hunting. Climate change could undermine some of the efforts at economic viability already taken by the community.

CHAPTER 7 CONCLUSIONS

The two case studies have shown definite vulnerability to climate change and variability in First Nations communities. Current livelihoods are not necessarily dependent on climate, as many individuals rely on social assistance programs or employment from various band projects to secure income. Traditional harvesting practices are often impeded by variations in local climate and extreme weather events, making them treacherous at times or perhaps simply impossible. However the traditional ways of life are currently more vulnerable to the invasion of Western culture and the encroachment of industry on-reserve and traditional lands than to climate. Vulnerability to climate manifests due to the limited availability of economic resources within the community, which fosters a dependence on outside sources of funding. Community initiatives towards improving social conditions or limiting exposure to climate variability are difficult to realize independently and funding is often difficult to obtain. Partnerships between local band governments and outside institutions, such as Dalhousie University and CMHC, have had success in Shoal Lake. The community was able to identify flood prone areas and direct housing development away from them in order to reduce the likelihood of future floods destroying property, displacing families and damaging health as they have in the past. Due to past economic mismanagement issues, similar opportunities have not been employed in James Smith. The community is plagued by poor linkages with federal institutions, limiting its ability to obtain funding. Furthermore, the limited funding that is received is applied first and foremost to debt reduction by a

manager external to the community, often causing community development programs to suffer.

Traditional culture is playing a role in vulnerability reduction. Many respondents in both communities demonstrated how culture had aided in their adaptation or reduced their exposure to a particular stress within the community. Drug and alcohol abuse were often avoided or abolished by individuals who held or rediscovered their traditional beliefs. Other social problems noted by community members, such as unstable family life, violence and limited education were also confronted as individuals became aware and promoted their culture. The rekindling of traditional culture within the communities could potentially alleviate many of the social stressors currently affecting First Nations communities and prevent them from constraining adaptation to climate change and variability.

Adaptive capacity in First Nations community in Saskatchewan is greatly affected by the promotion of culture and traditional knowledge, dependence on external sources of economic capital, participation in planning projects, level of discord amongst community members, and the effects of previous mismanagement by community governments. The promotion of culture and traditional knowledge serves to build capacities by increasing social and human capital. Dependence on external sources of economic capital can serve to hinder or hold back adaptive efforts, as adequate funds are often lacking. Planning projects can allow the communities to develop in ways that can potentially reduce their exposure to various stresses. Dissent amongst community members pulls communities apart and limits their ability to act together when faced with change. Also, previous mismanagement has put some communities in a position, economically and

institutionally, that limits their ability to use external linkages and bridging ties in an effective manner.

Both communities have plans for the future. Shoal Lake is looking to develop ecotourism and forestry, while James Smith has hopes for diamond mine and hydroelectric dam development. These initiatives would bring economic prosperity to the communities and are largely grass roots attempts to relieve the economic dependence of the two communities on outside sources of funding. Climate change may hinder or help these developments. Tree cover in the area may be at risk unless specialized forest management techniques are employed, such as the introduction of foreign tree species capable of surviving in new climates. Impacts from climate change, such as increased health risks from dust, forest fires and mosquito populations, may hinder the development of ecotourism, but could potentially be managed correctly if proper safety precautions (availability of mosquito repellent/nets, forest fire monitoring, dust masks for asthmatics) are taken. In James Smith, the development of a hydroelectric dam to supply the proposed diamond mine with electricity could suffer from reduced flows in the Saskatchewan River, but the stored water could also be used for irrigation and help reduce the effects of drought. There are many constraints in both communities, however, greatly decreasing their ability to develop these industries. Loss of traditional cultures, drug and alcohol abuse, violence, overcrowding and a limited resource base greatly limit the capacities of the communities to develop locally managed industries. Funding and support for the projects is currently not in place and the communities must rely largely on external linkages to realize these goals. Shoal Lake has demonstrated the ability of local institutions to utilize their social capital with external institutions to confront problems

relating to climate variability and health. James Smith, however, showed only poor capabilities in these respects. Climate change impacts on these projects may not even be relevant, as both communities must struggle with an array of social conditions impeding their ability to develop them.

The problems contributing to vulnerability within First Nations communities cannot be easily fixed. Many of the current vulnerabilities exhibited by the Cree case study communities have been developing since the time of first contact with Europeans. This is not to say that these people would be invulnerable if it were not for European settlement of North America, but rather that current conditions producing vulnerability are related to the ways in which interaction with Europeans have taken place. The fur trade brought residents of the communities to the area in the first place, where they began to unknowingly increase exposure to drought by hunting the beaver, whose homes provide natural means of water storage throughout prairie watersheds (Daschuk, Forthcoming). As the fur trade disappeared, along with buffalo and other wildlife populations, European settlers in greater abundance began to appear in the area. Treaties were signed with the leaders of the newcomers with the hopes that they would set the stage for intercultural coexistence. The events of *ê-mâyahkamikahk* ended any hopes of this, however, and political and bureaucratic systems were developed in which Cree and other First Nations people were marginalized culturally, spatially and economically. Conditions contributing to their current vulnerability to climate stems largely from many of the policies developed following *ê-mâyahkamikahk,* such as their economic dependence, lack of empowerment for the management of local natural resources and social strife. Community vulnerability could be reduced if Canadian society were to

rethink and renegotiate relations with First Nations people in Canada and place higher value on indigenous needs and perspectives.

Other means of limiting vulnerability must come from the communities themselves. Projects aimed at increasing adaptive capacities or limiting exposures must include the community perspective in order to properly account for the needs of its members. Partnerships with outside institutions have produced successes in these respects, largely due to participatory approaches. Each community must develop its own means of managing climate change risks. Information from outside is helpful, but can only be properly applied in a community by its members. Take for example the water treatment plant in Shoal Lake. This foreign piece of technology introduced to the community to limit exposure to water quality issues has in fact increased them as local capacities and techniques of securing potable water have almost disappeared following its development. Although it may be necessary given water pollution from agricultural practices in the area, local methods may have been more efficiently applied in this case. At any rate, the task of developing community vulnerability reduction programs is better left to the community and only supported by outside institutions.

REFERENCES

Acton, D.F., Padbury, G.A. and Stushnoff, C.T. (1998) *The Ecoregions of Saskatchewan,* Canadian Plains Research Center, Regina, Saskatchewan.

Adger, N. (1996) 'Approaches to Vulnerability to Climate Change', Working Paper 96-05, Center for Social and Economic Research on the Global Environment, University of East Anglia and University College London.

Adger, N. (1999) 'Social vulnerability to climate change and extremes in coastal Vietnam', *World Development*, Vol. 27(2), pp. 249-269.

Adger, N. (2000) 'Social and ecological resilience: are they related?' *Progress in Human Geography*, Vol. 24, pp. 347-364.

Adger, N. (2001) 'Social capital and climate change', Tyndall Centre Working Paper No. 8, Norwich, England.

Adger, N. (2003) 'Social aspects of adaptive capacity to climate change', In: Huq, S., Smith, J. and Klein, R.J.T. (Eds.) *Climate change, adaptive capacity, and development,* Imperial College Press, London, pp. 29–50.

Adger, N. and Kelly, P.M. (1999) 'Social vulnerability to climate change and the architecture of entitlements', *Mitigation and Adaptation Strategies for Global Change*, Vol. 4(3-4), pp. 253-266.

Ahmad, Q.K., Warrick, A., Downing, T.E., Nishioka, S., Parikh, K.S., Parmesan, C., Schneider, S.H., Toth, F., Yohe, G., Ahmed, A.U., Ayton, P., Fitzharris, B.B., Hay, J.E., Jones, R.N., Morgan, G., Moss, R., North, W., Petschel-Held, G. and Richels, R. (2001) 'Methods and Tools', In: McCarthy, J.J., Canziani, O.F., Leary, N.A., Dokken, D.J. and White, K.S. (Eds.), *Climate Change 2001: Impacts, Adaptation, and Vulnerability*, Cambridge University Press, New York, New York. Intergovernmental Panel on Climate Change (IPCC) Working Group II, pp. 105-144.

Arrow, K. (2000) 'Observations on social capital', In: Dasgupta, P. and Serageldin, I. (Eds.) *Social Capital: A Multi-Faceted Perspective,* World Bank, Washington, DC, pp. 3-5.

Ashford, G. and Castleden, J. (2001) Inuit Observations on Climate Change: Final Report. International Institute for Sustainable Development (IISD).

Baland, J.M. and Platteau, J.P. (1996) *Halting Degradation of Natural Resources: Is There a Role for Rural Communities?*, Food and Agriculture Organization of the United Nations, Clarendon, Oxford.

Barnett, J. and Adger, W.N. (2003) 'Climate dangers and atoll countries', *Climatic Change*, Vol. 61(3), pp. 321-337.

Barrow, E.M. and Lee, R.J. (2003) *Climate Change and Environmental Assessment - Part 2: Climate Change Guidance for Environmental Assessments,* The Canadian Institute for Climate Studies, Victoria, British Columbia.

Battiste, M. and Henderson, J.Y. (2000) *Protecting Indigenous Knowledge and Heritage*, Purich Publishing, Ltd., Saskatoon, Saskatchewan.

Bell, C. and Newby, H. (1971) *Community Studies: An introduction to the sociology of the local community,* Praeger, New York, NY, USA.

Belliveau, S., Smit, B. and Bradshaw, B. (2006) 'Multiple exposures and dynamic vulnerability: evidence from the grape and wine industry in the Okanagan Valley, British Columbia, Canada', *Global Environmental Change*, Vol. 16, pp. 364-378.

Berg, B.L. (1995) *Qualitative research methods for the social sciences*, 2nd edition, A Simon and Schuster Company, Massachusetts.

Bergeron, Y. and Flannigan, M.D. (1995) 'Predicting the effects of climate change on fire frequency in the southeastern Canadian boreal forest', *Water, Air and Soil Pollution*, Vol. 82 No. 1-2, pp.437-444.

Berkes, F. (1994) 'Co-management: bridging the two solitudes', *Northern Perspectives*, Vol. 22 No. 2-3, pp. 18-21.

Berkes, F. (2008) *Sacred Ecology*, Second Edition, Routledge, New York.

Berkes, F. and Jolly, D. (2001) 'Adapting to climate change: social-ecological resilience in a Canadian western Arctic community', *Conservation Ecology*, Vol. 5 No. 2, Article 18, available online at: http://www.consecol.org/vol5/iss2/art18.

Berlin, B., Breedlove, D.E. and Ravea, P.H. (1968) 'Covert categories and folk taxonomies', *American Anthropologist*, Vol. 70, pp. 290-299.

Berlin, B. (1973) 'Folk systematics in relation to biological classification and nomenclature', *Annual Review of Ecology and Systematics*, Vol. 4, pp. 259-271.

Bowman, D.M.J.S. and Johnston, F.H. (2005) 'Wildfire smoke, fire management, and human health', *EcoHealth*, Vol. 2(1), pp. 76–80.

Bryant C.R., Smit, B., Brklacich, M., Johnston, T.R., Smithers, J., Chiotti, Q. and Singh, B. (2000) 'Adaptation in Canadian agriculture to climatic variability and change', *Climatic Change*, Vol. 45, pp. 181-201.

Canada (1982) *Canadian Charter of Rights and Freedoms*, Part 1 of the *Constitution Act,* 1982, Ottawa, ON.

Canada (1993) *Federal Policy for the Settlement of Native Claims*, Indian and Northern Affairs Canada, Ottawa, ON.

Canada (2001) *The 2001 Annotated Indian Act and Aboriginal Constitutional Provisions*, Carswell, Scarborough, ON.

Cannon, T., Twigg, J. and Rowell, J. (2003) Social Vulnerability, Sustainable Livelihoods and Disasters, Report to DFID Conflict and Humanitarian Assistance Department (CHAD) and Sustainable Livelihoods Support Office, Available online at: http://www.benfieldhrc.org/disaster_studies/projects/soc_vuln_sust_live.pdf

Cao, M. and Woodward, F.I. (1998) 'Dynamic responses of terrestrial ecosystem carbon cycling to global climate change', *Nature*, Vol. 393, pp. 249-252.

Carter, T.R., Hulme, M. and Lal, M. (1999) *Guidelines on the Use of Scenario Data for Climate Impact and Adaptation Assessment.* Intergovernmental Panel on Climate Change, Version 1.

CCCSN (Canadian Climate Change Scenarios Network) (2007) Environment Canada, see http://www.ccsn.ca/.

Charron, D.F., Waltner-Toews, D., Maarouf, A. and Stalker, M. (2003) 'A synopsis of the known and potential diseases and parasites of humans and animals associated with climate change in Ontario' In: Griefenhagen, S. and Noland, T. (Eds.) *A Synopsis of the Known and Potential Diseases and Parasites of Humans and Animals Associated with Climate Change*, Ontario Ministry of Natural Resources, Forest Research Information Report No. 154, p. 7–89.

Chiotti, Q., Johnston, T.R.R., Smit, B. and Ebel, B. (1997) 'Agricultural response to climate change: a preliminary investigation of farm-level adaptation in southern Alberta', In: Ilbery, B, Chiotti, V. and Rickard, T. (Eds.) *Agricultural Restructuring and Sustainability: A geographical perspective,* CAB International, Wallingford, pp. 167-183.

Clarkson, L., Momssette, V. and Regallet, G. (1992), *Our Responsibility to the Seventh Generation: 1ndigenou.s Peoples and Sustainable Development,* International Institute for Sustainable Development, Winnipeg, MB.

CMHC (Canada Mortgage and Housing Corporation) (2008) *Enduring Commitment: Proven Results*, Annual Report, available online: http://www.cmhc.ca/en/corp/about/anrecopl/anrecopl_001.cfm, accessed: June 15, 2009.

Cohen, S.J. (Ed.) (1997) Mackenzie Basin Impact Study (MBIS), Final Report. Environmental Adaptation Research Group, Climate and Atmospheric Research Directorate, Environment Canada.

Cramer, W., Bondeau, A., Woodward, F.I., Prentice, I.C., Betts, R.A., Brovkin, V., Cox, P.M., Fisher, V., Foley, J.A., Friend, A.D., Kucharik, C., Lomas, M.R., Ramankutty, N., Sitch, S., Smith, B., White, A. and Young-Molling, C. (2001) 'Global response of terrestrial ecosystem structure and function to CO2 and climate change: results from six dynamic global vegetation models', *Global Change Biology*, Vol. 7, pp. 357-373.

Cutter, S. (1996) 'Vulnerability to environmental hazards', *Progress in Human Geography*, Vol. 20, pp. 529-539.

Darnell, R. (2001) 'Plains Cree', in DeMallie, R.J. (Ed.) *Handbook of North American Indians: Vol. 13 (Plains)*, Smithsonian Institution Press, Washington, D.C., pp. 638-651.

Daschuk, J. (Forthcoming) 'A dry oasis: the Canadian Plains in late prehistory', Institutional Adaptations to Climate Change, prepared for the *Prairie Forum*.

Dene Nation (2003) Elder Gathering – Fort Rae, Denedeh, http://www.denenation.com/eldersrae.html, Accessed: August 2008)

DeAngelis, D.L. (1980) 'Energy flow, nutrient cycling, and ecosystem resilience', *Ecology*, Vol. 61, pp. 764-771.

Diamond, J.M. (1968) 'Zoological classification system of a primitive people', *Science*, Vol. l5l, pp. llO2-llO4.

Diaz, H.P. (2008) 'Local institutions and adaptation to climate-induced water problems', World Water Congress, Montpellier, France.

Diaz, H.P. and Gauthier, D. (2008) 'Institutional capacity for agriculture in the South Saskatchewan River Basin', In: Wall, E., Smit, B. and Wandel, J. (Eds.) *Farming in a Changing Climate*, UBC Press, Vancouver, pp. 127-141.

do Pico, G.A. (1986) 'Report on disease', *American Journal of Industrial Medicine*, Vol. 10 No. 3, pp. 261–265

do Pico, G.A. (1992) 'Hazardous exposures and lung diseases among farm workers', *Clinics in Chest Medicine*, Vol. 13 No. 2, pp. 311–328.

Downing, T.E. (2003) 'Lessons from famine early warning and food security for understanding adaptation to climate change: toward a vulnerability/adaptation science?', In: Smith, J.B., Klein, R.J.T. and Huq, S. (Eds.) *Climate Change, Adaptive Capacity and Development*, Imperial College Press, London, pp.71-100.

Downing, T.E. and Patwardhan, A. (2003) 'Vulnerability assessment for climate adaptation, adaptation policy framework: a guide for policies to facilitate adaptation to climate change', United Nations Developmental Program.

Downing, T., Aerts, J., Soussan, J., Bharwani, S., Ionescu, C., Hinkel, J., Klein, R., Mata, L., Matin, N., Moss, S., Purkey, D. and Ziervogel, G. (2006) 'Integrating social vulnerability into water management', SEI Working Paper and Newater Working Paper No. 4, Stockholm Environment Institute, Oxford.

DSD (Department of Sustainable Development) (2001) 'Inuit knowledge of climate change: a sample of Inuit experiences of climate change. Baker Lake and Arviat, Nunavut', Government of Nunavut, Department of Sustainable Development, Environmental Protection Services, Iqualuit, Nunavut.

Duerden, F. and Kuhn, R.G (1998) 'Scale, context, application of traditional knowledge of the Canadian North', *Polar Record*, Vol. 34 No. 188, pp. 31-38.

Duerden, F. (2001). State of Knowledge: Impacts of Climatic Change on Human Activity, Northern Climate Exchange Gap Analysis Project report, Available online at: http://yukon.taiga.net/knowledge/gap/.

Dwyer, P.D. (1976) 'Beetles, butterflies and bats: species transformation in a New Guinea folk classification'. *Oceania*, Vol. 46, pp. 188-205.

Dyck, N. (1991) *What is the Indian Problem?: Tutelage and Resistance in Canadian Indian Administration*, Inst. of Social and Economic Research, Memorial University, St. John's, NFLD.

Economic Development Strategy (2005) James Smith Cree Nation Profile

Environment Canada (2005) National Climate Data and Information Archive, accessed March 2008, http://climate.weatheroffice.ec.gc.ca/climate_normals/index_1961_1990_e.html

Ermine, W., Nilson, R., Sauchyn, D., Sauve, E. and Smith, R. (2005) Report Isi Askiwan – The State of the Land: Prince Albert Grand Council Elders Gathering on Climate Change, Change Impacts and Adaptation Program, Ottawa, ON.

Ermine, W., Sauchyn, D. and Pittman, J. (2008) Report Nikan Oti: The Future – Understanding adaptation and capacity in two First Nations, Climate Change Impacts and Adaptation Program, Ottawa, ON.

Ermine, W., Sauchyn, D., Vetter, M. and Hart, C. (2007) Report Isi Wipan – Climate: Identifying the impacts of climate change and capacity for adaptation in two Saskatchewan First Nation communities, Climate Change Impacts and Adaptation Program, Ottawa, ON.

Evans, P. (1996) 'Government action, social capital and development: reviewing the evidence on synergy', *World Development*, Vol. 24(6), pp. 1119-1132.

Fafchamps, M. and Minten, B. (2001) 'Social capital and agricultural trade', *American Journal of Agricultural Economics*, Vol. 83, pp. 680-685.

Feit, H. (1988) 'Self-management and state management: form of knowing and managing northern wildlife', In: Freeman, M. and Carbyn L.N. (Eds.) *Traditional Knowledge and Renewable Resource Management*, Boreal Institute for Northern Studies, Edmonton, AB. pp. 72-91.

Ferguson, M.A.D., Williamson, R.G. and Messier, F. (1998) 'Inuit knowledge of long term changes in a population of Arctic tundra caribou', *Arctic*, Vol. 51 No. 3, pp. 201-219.

Ferguson, M.A.D and Messier, F. (1997) 'Collection and analysis of traditional ecological knowledge about a population of arctic tundra caribou', *Arctic*, Vol. 50 No. 1, pp. 17-28.

Fienup-Riordan, A. (1999) 'Yaqulget qaillun pilartat [what the birds do]: Yup'ik Eskimo understanding of geese and those who study them', *Arctic*, Vol. 52, pp. 1-22.

Flannigan, M.D., Wotton, M., Richard, P., Carcaillet, C. and Bergeron, Y. (1998) 'Fire weather: past, present and future', In: *Ninth Symposium on Global Change Studies and Namias Symposium on the Status and Prospects for Climate Prediction*, Phoenix, Arizona. pp. 305-309.

Fleming, R.A. (2000) 'Climate change and insect disturbance regimes in Canada's boreal forests', *World Resource Review*, Vol. 12, pp. 521-555.

Folke, C., Carpenter, S., Elmqvist, T., Gunderson, L., Holling, C.S. and Walker, B. (2002) 'Resilience and sustainable development: building adaptive capacity in a world of transformations', *Ambio*, Vol. 31, pp. 437-440.

Folke, C., Carpenter, S., Walker, B., Scheffer, M., Elmqvist, T., Gunderson, L. and Holling, C.S. (2004) 'Regime shifts, resilience, and biodiversity in ecosystem management', *Annual Review of Ecology, Evolution, and Systematics*, Vol. 35, pp. 557-581.

Ford, J.D. and Smit, B. (2004) 'A framework for accessing the vulnerability of communities in the Canadian Arctic to risks associated with climate change', *Arctic*, Vol. 57 No. 4, pp. 389-400.

Ford, J.D., Smit, B. and Wandel, J. (2006) 'Vulnerability to climate change in the arctic: a case study from Arctic Bay, Canada,' *Global Environmental Change*, Vol. 16, pp. 145-160.

Fox, S. (1998) Inuit Knowledge of Climate and Climate Change. Masters of Environmental Studies in Geography, University of Waterloo, Ontario, Canada.

Fox, S. (2002) 'These are things that are really happening: Inuit perspectives on the evidence and impacts of climate change in Nunavut', In: Krupnik, I. and Jolly, D. (Eds.) *The earth is faster now: Indigenous observations of Arctic environmental change*, Arctic Research Consortium of the United States, Fairbanks, Alaska, pp. 12-53.

Franklin, J. (1823) *The Journey to the Polar Sea*, Project Gutenberg License, Available online at: http://www.gutenberg.com.

Fraser, E., Mabee, W. and Slaymaker, O. (2003) 'Mutual vulnerability, mutual dependence. The reflective notion between human society and the environment', *Global Environmental Change*, Vol. 13, pp. 137-144.

Freeman, M. (1976) *Inuit Land Use und Occupancy Study, Volumes I, II. III.,*Department of Indian and Northern Affairs, Ottawa, ON.

FSIN (Federation of Saskatchewan Indian Nations) (2007) Treaty Implementation Principles.

Füssel, H.M. (2005) 'Climate change vulnerability assessments: an evolution of conceptual thinking', *Climate Change,* in press.

Füssel, H.M. and Klein, R.J.T. (2002) 'Assessing vulnerability and adaptation to climate change: an evolution of conceptual thinking', Paper presented at the UNDP Expert Group Meeting in Integrating Disaster Reduction and Adaptation to Climate Change, Havana, Cuba, 17-19 June 2002.

Government of Nunavut (2003) *Nunavut climate change strategy*, Government of Nunavut, Iqualuit, Nunavut.

Gunn, A., Arlooktoo, G. and Kaomayok, D. (1988) 'The contribution of the ecological knowledge of Inuit to wildlife management in the Northwest Territories' In: Freeman, M. and Carbyn, L.N. (Eds.) *Traditional Knowledge and Renewable Resource Management*, Boreal Institute for Northern Studies, Edmonton, AB, pp. 22-30.

Grothmann, T. and Patt, A. (2005) 'Adaptive capacity and human cognition: the process of individual adaptation to climate change', *Global Environmental Change*, Vol. 15, pp. 199-213.

Handmer, J.M., Dovers, S. and Downing, T.E. (1999) 'Societal vulnerability to climate change and variability', *Mitigation and Adaptive Strategies for Global Change*, Vol. 4, pp. 267-281.

Hay, I. (2000) *Qualitative research methods in human geography*, Oxford University Press, Oxford.

Hegerl, G.C., Zwiers, F.W., Braconnot, P., Gillett, N.P., Luo, Y., Marengo Orsini, J.A., Nicholls, N., Penner, J.E. and Stott, P.A. (2007) 'Understanding and attributing climate change', In: Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K.B., Tignor, M. and Miller, H.L. (Eds.) *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change,* Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Hély, C., Flannigan, M., Bergeron, Y. and McRae, D. (2001) ' Role of vegetation and weather on fire behaviour in the Canadian mixed wood boreal forest using two fire behaviour prediction systems', *Canadian Journal of Forest Research*, Vol. 31, pp.430-441.

Hengeveld, H.G. (2000) 'Projections for Canada's climate future,' *Climate Change Digest*, CCD 00-01 (Special Edition), pp. 1-27.

Herrington, R., Johnson, B. and Hunter, F. (1997) *Responding to global climate change in the Prairies: in Volume III of the Canada Country Study: Climate Impacts and Adaptation*, Environment Canada, Ottawa, Ontario.

Hewitt, K. (1997) *Regions of Risk: A Geographical Introduction to Disasters*. Addison Wesley Longman, Essex.

Hiebert, D. and Van Wees, K. (1998) Traditional Knowledge on Forestry Issues within the Prince Albert Grand Council, Prince Albert Model Forest, Prince Albert, SK.

Hogg, E.H. (1994) 'Climate and the southern limit of the western Canadian boreal forest', *Journal of Forest Research*, Vol. 24, pp. 1835-1845.

Hogg, E.H. and Hurdle, P. (1995) 'The aspen parkland in western Canada: A dry-climate analogue for the future boreal forest?', Water, Air and Soil Pollution, Vol. 82, pp. 391-400.

Hogg, E.H. (1997) 'Temporal scaling of moisture and the forest-grassland boundary in western Canada', *Agricultural and Forest Meteorology*, Vol. 84, pp. 115-122.

Holling, C.S. (1973) 'Resilience and stability of ecological systems', Annual Review of Ecology and Systematics, Vol. 4, pp. 1-23.

Holling, C.S. (2001) 'Understanding the complexity of economic, ecological, and social systems', *Ecosystems*, Vol. 4, pp. 390-405.

Honigmann, J.J. (1981) 'West Main Cree', in Helm, J. (Ed.) *Handbook of North American Indians: Vol. 6 (Subarctic)*, Smithsonian Institution Press, Washington, D.C., pp. 217-231.

Hughes, T.P., Baird, A.H., Bellwood, D.R., Card, M., Connolly, S.R., Folke, C., Grosberg, R., Hoegh-Guldberg, O., Jackson, J.B.C., Kleypas, J., Lough, J.M., Marshall, P., Nystrom, M., Palumbi, S.R., Pandolfi, J.M., Rosen, B. and Roughgarden, J. (2003) 'Climate change, human impacts, and the resilience of coral reefs', *Science*, Vol. 301, pp. 929-933.

Huntington, H.P. (1998) 'Observations on the utility of the semi-directive interview for documenting traditional ecological knowledge', *Arctic*, Vol. 51 Iss. 3 No. 19, pp. 237 – 42.

Huntington, H.P.; Callaghan, T.; Fox, S. and Krupnik, I. (2004) 'Matching traditional and scientific observations to detect environmental change: a discussion on arctic terrestrial ecosystems', Ambio, Vol. 33 No. 7, pp. 18-23.

Hutchens, A.R. (1991) *Indian Herbology of North America,* Shambhala, Boston, MA.

IACC (Institutional Adaptations to Climate Change) (2008) SSHRC #413-2003-1001, see http://www.parc.ca/mcri/.

ICC (Indian Claims Commission) (2005a) *James Smith Cree Nation Treaty Land Entitlement Inquiry Report on Issue 9 Amalgamation*, available online at: http://indianclaims.ca/pdf/james_smith_tle.pdf

ICC (Indian Claims Commission) (2005b) *James Smith Cree Nation IR 100A Inquiry*, available online at: http://indianclaims.ca/pdf/james_smith_ir100a.pdf

ICC (Indian Claims Commission) (2005c) *James Smith Cree Nation Chakastaypasin IR 98 Inquiry*, available online at: http://indianclaims.ca/pdf/james_smith_IR98A.pdf

ICC (Indian Claims Commission) (2007) *James Smith Cree Nation Treaty Land Entitlement Inquiry*, available online at: http://indianclaims.ca/pdf/JSCN_TLE_Inquiry_en.pdf

ICC (Indian Claims Commission) (2008) *Red Earth and Shoal Lake Cree Nations Quality of Reserve Lands Inquiry*, available online at: http://indianclaims.ca/pdf/red_earth_english.pdf

Ilbery, B., Chiotti, Q. and Rickward, T. (1997). Introduction, In: Ilbery, B., Chiotti, Q. and Rickward, T. (Eds.) *Agricultural Restructuring and Sustainability: A Geographical Perspective,* CAB International, New York, pp. 1-9.

Johnston, M. (2008) Impacts of climate change on the island forests of Saskatchewan, Saskatchewan Research Council, Pub. No. 12168-1E08.

Johnston, M., Wheaton, E., Kulshreshtha, S., Wittrock, V. and Thorpe, J. (2001) Forest Ecosystem Vulnerability to Climate: An Assessment of the Western Canadian Boreal Forest, Saskatchewan Research Council, SRC Publication No. 11341-8E01.

Joss, S. and Inuktalik, B. (2000) *Effects of climate change on wildlife at Holman Island. In: Climate Change Impacts and Adaptation Strategies for Canada's Northern Territories: Final Workshop Report. February 27-29, 2000,* Explorer Hotel, Yellowknife, NWT. Prepared for Natural Resource Canada and Environment Canada, GeoNorth Ltd.

Kasperson, R.E. and Kasperson, J.X. (2001) 'Climate change, vulnerability and social justice', Stockholm Environment Institute: Risk and Vulnerability Programme.

Kearns, R. (2000). In: Hay, I. (Ed.) *Qualitative Research Methods in Human Geography*. Oxford University Press, Victoria, Australia, pp. 103-121.

Kelly, P.M. and Adger, W.N. (2000) 'Theory and practice in assessing vulnerability to climate and facilitating adaptation', *Climatic Change*, Vol. 47, pp. 325-352.

Kingsolver, J. (1989) 'Weather and population the dynamics of insects: integrating physiological and population ecology', *Physiological Zoology*, Vol. 62, pp.314-334.

Knudston, P. and Suzuki, D. (1992) *The Wisdom of the Elders,* Stoddait, Toronto, ON.

Kofinas, G., Forbes, B., Beach, H., Berkes, F., Berman, M., Chapin, T., Csonka, Y., Danell, K., Osherenko, G., Semenova, T., Tetlichi, J., Young, O. and Magness, D. (2005) ICARP II: Working Group 10. A Research Plan for the Study of Rapid Change, Resilience and Vulnerability in Social-Ecological Systems in the Arctic. Draft Science Plan.

Krupnik, I. and Jolly, D. (2002) *The earth is faster now: Indigenous observations of Arctic environmental change*, Arctic Research Consortium of the United States, Fairbanks, Alaska.

Kulshreshtha, S., Johnston, M. and Wheaton, E. (2001) Forest Ecosystem Vulnerability to Climate Change: Conceptual Framework for Economic Analysis, Prepared for the Government of Canada's Climate Change Action Fund, Presentation to Social and Economic Perspectives of Boreal Forest Ecosystem Management Conference. Heriot-Watt University, June 5 to 8, 2001, Edinburgh, Scotland. University of Saskatchewan, Saskatoon, SK, SRC Publication No. 11341-4D01.

Kurz, W.A., Apps, M.J., Stocks, B.J., and Volney, W.J.A. (1995) 'Global climate change: Disturbance regimes and biospheric feedbacks of temperate and boreal forests', In: Woodwell, G. and Mackenzie, F. (Eds.) *Biotic Feedbacks in the Global Climatic System: Will the Warming Feed the Warming?,* Oxford University Press, New York, NY, pp. 119-133.

Labrador Inuit Association, C. Brice-Bennett, (Ed.) (1977) *Our Footprints Are Everywhere: Inuit Land Use and Occupancy in Labrador,* Nain, Labrador.

Lacey, L. (1993) *Micmac Medicines, Remedies and Recollection,* Nimbus, Halifax, NS.

Lang, L. (1996) 'Danger in the dust', *Environmental Health Perspectives*, Vol. 104 No. 1, pp. 26–30.

Leichenko, R.M. and O'Brien, K.L. (2002) 'The dynamics of rural vulnerability to global change: the case of Southern Africa', Mitigation and Adaptation Strategies for Global Change, Vol. 7, pp. 1-18.

Liverman, D.M. (1994) 'Vulnerability to global environmental change,' In Cutter, S.L. (Ed.), *Environmental Risks and Hazard,* Prentice Hall, Toronto, pp. 326-42.

Mandelbaum, D.G. (1940) 'The Plains Cree', *Anthropology Papers – American Museum of Natural History*, 37(2), pp. 155-316.

McCarthy, J.J, Canziani, O.F., Leary, N.A., Dokken, D.J. and White, K.S. (2001) In: *Climate Change 2001: Impacts, Adaptation and Vulnerability- Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge.

McDonald, M., Arragutainaq, L., and Novalinga, Z. (1995) Traditional Ecological Knowledge of Environmental Changes in Hudson and James Bays, Parts 1 and 2, Canadian Arctic Resources Committee.

McLeod, N. (2007) *Cree Narrative Memory: From Treaties to Contemporary Times*, Purich Publishing, Ltd., Saskatoon, Saskatchewan.

McCrady, D. (2001) 'History of the Canadian Plains Since 1970', in DeMallie, R.J. (Ed.) *Handbook of North American Indians: Vol. 13 (Plains)*, Smithsonian Institution Press, Washington, D.C., pp. 313-328.

Melillo, J.M., Prentice, I.C., Farquhar, G.D., Schulze, E-D. and Sala, O.E. (1996) 'Terrestrial biotic responses to environmental change and feedbacks to climate' In Houghton, J.T. *et al* (Eds.) *Climate Change 1995: the Science of Climate Change,* Cambridge University Press, Cambridge, pp. 445-481.

Meyers, D. and Thistle, P. (1995) 'Saskatchewan River rendezvous centers and trading posts: continuity in a Cree social geography', *Ethnohistory*, Vol. 42 No. 3, pp. 403-444.

Mignone, J. and O'Neil, J. (2005) 'Social capital as a health determinant in First Nations communities', *Journal of Aboriginal Health*, Vol.2 No. 1, pp 26-35.

Nakicenovic, N., Davidson, O., Davis, G., Grubler, A., Kram, T., Lebre La Rovere, E., Metz, B., Morita, T., Pepper, W., Pitcher, H., Sankovski, A., Shukla, P., Swart, R., Watson, R. and Dadi, Z. (2000) *Summary for Policymakers: Emissions Scenarios*. Intergovernmental Panel on Climate Change (IPCC), Geneva Switzerland.

Næss, L.O., Bang, G., Erikson, S. and Vevatne, J. (2005) 'Institutional adaptation to climate change: flood responses at the municipal level in Norway', *Global Environmental Change*, Vol. 15(2), pp. 125-138.

National Climate Archive (2005) Canadian Climate Normals or Averages 1961 to 1990, Environment Canada, Accessed: March, 2008, Available online at: http://climate.weatheroffice.ec.gc.ca/climate_normals/index_1961_1990_e.html.

Nickels, S., Furgal, C., Castleden, J., Moss-Davies, P., Buell, M., Armstrong, B., Dillon, D. and Fonger, R. (2002) 'Putting the human face on climate change through community workshops: Inuit knowledge, partnerships, and research', In: Krupnik, I. and Jolly, D. (Eds.) *The earth is faster now: Indigenous observations of Arctic environmental change*, Arctic Research Consortium of the United States, Fairbanks, Alaska, pp. 300-333.

Nickels, S., Furgal, C., Beull, M. and Moquin, H. (2005) *Unikkaaqatigiit – Putting the Human Face on Climate Change: Perspectives from Inuit in Canada,* Joint publication of Inuit Tapiriit Kanatami, Nasivvik Center for Inuit Health and Changing Environments at University Laval and the Ajunnginiq Center at the National Aboriginal Health Organization, Ottawa.

Nuttal, M. (2005) 'Hunting, herding, fishing and gathering: Indigenous peoples and renewable resource use in the arctic', In: Arctic Climate Impact Assessment (ACIA) Scientific Report, Cambridge University Press, Cambridge, pp. 649-690.

Nystrom, M. and Folke, C. (2001) 'Spatial resilience of coral reefs', *Ecosystems*, Vol. 4, pp. 406-417.

O'Brien, K., Eriksen, S., Schjolden, A. and Nygaard, L. (2004) What's in a word? Conflicting interpretations of vulnerability in climate change research, Center for International Climate and Environmental Research (CICERO), Working Paper.

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

O'Riordan, T. and Jordan, A. (1999) 'Institutions, climate change and cultural theory: towards a common analytical framework', *Global Environmental Change*, Vol. 9, pp. 81-93.

Paavola, J. and Adger, N. (2006) 'Fair adaptation to climate change', *Ecological Economics*, Vol. 56, pp. 594-609.

PAGC (Prince Albert Grand Council) (2004) James Smith Cree Nation, Accessed: March 2008, address: http://www.pagc.sk.ca/pagc.asp?ID=5.

Parry, M. (2002) 'Scenarios for climate impact and adaptation assessment,' *Global Environmental Change*, Vol. 12, pp. 149-153.

Patton, M.Q. (1990) *Qualitative Evaluation and Research Methods,* Sage Publications, London, UK.

Pelling, M. (1998) 'Participation, social capital and vulnerability to urban flooding in Guyana', *Journal of International Development*, Vol. 10, pp. 469-486.

Pelling, M. (2002) 'Assessing urban vulnerability and social adaptation to risk- evidence from Santo Domingo', *International Development Planning Review*, Vol. 24, pp. 59-76.

Pietroniro, A., Demuth, M., Dornes, P., Toyra, J., Kouwen, N., Bingeman, A., Hopkins, C., Burn, D. and Brua, B. (2006) Stream flow shifts resulting from past and future glacier fluctuations in the eastern flowing basins of the Rocky Mountains, Climate Change Resources Users Group.

Preston, R. (1981) 'East Main Cree', in Helm, J. (Ed.) *Handbook of North American Indians: Vol. 6 (Subarctic)*, Smithsonian Institution Press, Washington, D.C., pp. 196-207.

Pretty, J.N. (1995) 'Participatory learning for sustainable agriculture', *World Development*, Vol. 23 No. 8, pp. 1247-1263.

Raby, S. (1972) 'Indian Treaty No. 5 and the Pas Agency, Saskatchewan, N.W.T', *Saskatchewan History*, Vol. 25, pp. 92-114.

Ribot, J.C. (1996) 'Climate variability, climate change and vulnerability: moving forward by looking back', In: Ribot, J. C., Magalhaes, A. R. and Panagides, S. S. (Eds.) *Climate Variability, Climate Change and Social Vulnerability in the semi-arid Tropics,* Cambridge University Press, Cambridge, pp. 1-10.

Riedlinger, D. (1999) 'Climate change and the Inuvialuit of Banks Island, NWT: Using Traditional Environmental Knowledge to Complement Western Science', *Arctic,* Vol. 52 No. 4, pp. 430-432.

Riewe, R. (Ed.) (1992) Nunavut Atlas Canadian Circumpolar Institute and the Tungavik Federation of Nunavut. Edmonton, AB.

Rylander, R. (1986) 'Lung diseases caused by organic dusts in the farm environment', *American Journal of Industrial Medicine*, Vol. 10 No. 3, pp. 221–227.

Saporta, R., Malcolm, J.R. and Martell, D.L. (1998) 'The impact of climate change on Canadian forests', In: Koshida, G. and Avis, W. (Eds.) *Responding to Global Climate Change: National Sectoral Issue*, Environment Canada, Canada Country Study: Climate Impacts and Adaptation, v. VII, pp. 319-382.

Sauchyn, D. and Kulshreshtha, S. (2008) 'Prairies', In: Lemmen, D.S., Warren, F.J., Lacroix, J. and Bush, E. (Eds.) *From Impacts to Adaptation: Canada in a Changing Climate 2007*, Government of Canada, Ottawa, ON, p. 275-328.

Sauchyn, D., Pietroniro, A. and Demuth, M. (2006) Upland Watershed Management and Global Change – Canada's Rocky Mountains and Western Plains, Proceedings, Fifth Biennial Rosenberg Forum on Water Policy, September 6-11, 2006, Banff, Alberta.

Schneiderbauer, S. and Ehrlich, D. (2006) 'Social levels and hazard (in)dependence in determining vulnerability', In: Brikmann, J. (Ed.) *Measuring Vulnerability to Natural Hazards*, United Nations University Press, New York, USA, pp. 78-102.

Semenza, J.C., Rubin, C.H., Falter, K.H., Selanikio, J.D., Flanders, W.D., Howe, H.L. and Wilhelm, J.L. (1996) 'Heat related deaths during the July 1995 heat wave in Chicago', *New England Journal of Medicine*, Vol. 335, pp. 84-90.

Sen, A. (1981) *Poverty and Famines: an essay on entitlement and deprivation,* Clarendon Press, Oxford.

Sillitoe, P. (1998) 'The development of Indigenous knowledge', *Current Anthropology*, Vol. 39 No. 2, pp. 223-252.

Simpson, J.C.G., Niven, R.M., Pickering, C.A.C., Fletcher, A.M., Oldham, L.A. and Francis, H.M. (1998) 'Prevalence and predictors of work related respiratory symptoms in workers exposed to organic dusts', *Occupational and Environmental Medicine*, Vol. 55 No. 10, pp. 668–672.

SIR (2005) *Geological Atlas of Saskatchewan*, Version 8, Saskatchewan Industry and Resources, Regina, SK.

Skinner, A. (1911) 'Notes on the Eastern Cree and Northern Saulteaux', *Anthropology Papers - American Museum of Natural History*, 9(1), Washington, D.C.

Smit, B., Burton, I., Klein, R.J.T. and Wandel, J. (2000) 'An anatomy of adaptation to climate change and variability', *Climatic Change*, Vol. 45, pp. 223-251.

Smit, B., Burton, I., Klein, R.J.T. and Street, R. (1999) 'The science of adaptation: a framework for assessment', *Mitigation and Adaptation Strategies for Global Change*, Vol. 4, pp. 199-213.

Smit, B. and Pilifosova, O. (2001) 'Adaptation to climate change in the context of sustainable development and equity', In: McCarthy, J., Canziana, O.F., Leary, N.A., Dokken, D.J., and White, K.S. (Eds.) *Climate change 2001: Impacts, Adaptation, Vulnerability,* Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, UK, pp. 876-912.

Smit, B. and Pilifosova, O. (2003) 'From adaptation to adaptive capacity and vulnerability reduction', In: Smith, J.B., Klein, R.J.T. and Huq, S. (Eds.) *Climate Change, Adaptive Capacity and Development*, Imperial College Press, London, pp. 9-28.

Smit, B. and Wandel, J. (2006) 'Adaptation, adaptive capacity and vulnerability', Global Environmental Change, Vol. 16, pp. 282–292.

Smith, J.B., Hulme, M., Jaagus, J., Keevallik, S., Mekonnen, A. and Hailemariam, K. (1998) 'Climate Change Scenarios', In: Feenstra, J.F., Burton, I., Smith, J.B. and Tol, R.S.J. (Eds.), *Handbook on Methods for Climate Change Impact Assessment and Adaptation Strategies*, United Nations Environment Programme and Institute for Environmental Studies, Version 2.0, pp. 3-1-3-40.

Smith, J.G.E. (1981) 'Western Woods Cree', in Helm, J. (Ed.) *Handbook of North American Indians: Vol. 6 (Subarctic)*, Smithsonian Institution Press, Washington, D.C., pp. 256-284.

Smithers, J. and Blay-Palmer, A. (2001) 'Technology innovation as strategy for climate adaptation in agriculture', *Applied Geography*, Vol. 21(2), pp. 175 – 197.

Smithers, J. and Smit, B. (1997) 'Human adaptation to climatic variability and change', *Global Environmental Change*, Vol. 7(2), pp. 129-146.

Statistics Canada (2008a) James Smith, Saskatchewan (table), Aboriginal Population Profile, 2006 Census, Statistics Canada Catalogue no. 92-594-XWE, Ottawa, Released January 15, 2008, http://www12.statcan.ca/english/census06/data/profiles/aboriginal/Index.cfm?Lang=E (accessed November 18, 2008).

Statistics Canada (2008b) Shoal Lake Cree Nation, Saskatchewan (table), Aboriginal Population Profile, 2006 Census, Statistics Canada Catalogue no. 92-594-XWE, Ottawa, Released January 15, 2008, http://www12.statcan.ca/english/census06/data/profiles/aboriginal/Index.cfm?Lang=E (accessed November 18, 2008).

Statistics Canada (2008c) Outlook, Saskatchewan (table), 2006 Community Profiles, 2006 Census, Statistics Canada Catalogue no. 92-591-XWE, Ottawa, Released March 13, 2007, http://www12.statcan.ca/english/census06/data/profiles/community/Index.cfm?Lang=E (accessed November 18, 2008).

Statistics Canada (2008d) James Smith, Saskatchewan (table), 2001Aboriginal Peoples Survey Community Profiles, 2001 Census, Statistics Canada, Ottawa, Released 2002, http://www12.statcan.ca/english/profil01aps/home.cfm (accessed December 17, 2008).
Stakhiv, E. Z. (1996) 'Managing water resources for climate change adaptation', In: Smith, J. B., Bhatti, N., Menzhulin, G., Benioff, R., Budyko, M. I., Campos, M., Jallow, B. and Rijsberman, F. (Eds.) *Adaptation in Climate Change: Assessment and Issues,* Springer-Verlag, New York, pp. 243-264.

Stark, R. (1992) *Guide to Indian Herbs,* Hancock House, Surrey, BC.

Suffling, R. (1995) 'Can disturbance determine vegetation distribution during climate warming? A boreal test', *Journal of Biogeography*, Vol. 22, pp. 501-508.

Svendson, G.L.H. (2006) 'Studying social capital *in situ*: A qualitative approach', *Theory and Society*, Vol. 35, pp. 39-70.

Tompkins, E.L. and Adger, W.N. (2004) 'Does adaptive management of natural resources enhance resilience to climate change?' *Ecology and Society*, Vol. 9 No. 2, 10.

Turner, B., Kasperson, R. E., Matson, P. A., McCarthy, J., Corell, R., Christensen, L., Eckley, N., Kasperson, J. X., Luers, A., Martello, M. L., Polsky, C., Pulsipher, A., and Schiller, A. (2003) 'A framework for vulnerability analysis in sustainability science', *Proceedings of the National Academy of Sciences*, Vol. 100 No. 14, pp. 8074-8079.

Treaty Five (1875) Historical Treaty Information Site, Indian and Northern Affairs Canada, Accessed: March 2008, Transcribed from: The Queen`s Printer, Ottawa, ON, Cat. No. R33-0557, IAND Publication No. QS-0573-000-EE-A-1, Available online at: http://www.ainc-inac.gc.ca/pr/trts/trty5_e.html.

Treaty Six (1876) Historical Treaty Information Site, Indian and Northern Affairs Canada, Accessed: March 2008, Transcribed from: The Queen`s Printer, Ottawa, ON, Cat. No. R33-0664, IAND Publication No. QS-0574-000-EE-A-1, Available online at: http://www.ainc-inac.gc.ca/pr/trts/trty6_e.html.

Tschakert, P. (2007) 'Views from the vulnerable: understanding climatic and other stressors in the Sahel', *Global Environmental Change*, Vol. 17, pp. 381-396.

Turner, B., Kasperson, R.E., Matson, P.A., McCarthy, J., Corell, R., Christensen, L., Eckley, N., Kasperson, J.X., Luers, A., Martello, M.L., Polsky, C., Pulsipher, A., and

Schiller, A. (2003) 'A framework for vulnerability analysis in sustainability science,' *Proceedings of the National Academy of Sciences* 100, pp. 8074–8079.

Usher, P.J. (2000) 'Traditional ecological knowledge in environmental assessment and management', *Arctic*, Vol. 3 No. 2, pp. 183-193.

Van Wagner, C.E. (1988) 'The Historical Pattern of Annual Burned Area in Canada', *The Forestry Chronicle*, Vol. 64 (June), pp.182-185.

Vogel, C. and O'Brien, K. (2004) 'Vulnerability and global environmental change: rhetoric and reality', AVISO – Information Bulletin on Global Environmental Change and Human Security, No. 13.

Watts, M.J. and Bohle, H.G. (1993). 'The space of vulnerability: the causal structure of hunger and famine', Progress in Human Geography, Vol. 17, pp. 43-67.

Wheaton, E. (1997) 'Forest ecosystems and climate', In: Herrington, R., Johnson, B., and Hunter, F., *Responding to global climate change in the Prairies: in Volume III of the Canada Country Study: Climate Impacts and Adaptation*, Environment Canada, Ottawa, Ontario, Appendix B.

Wheaton, E. (2001) Changing Fire Risk in a Changing Climate: A Literature Review and Assessment, Prepared for the Government of Canada's Climate Change Action Fund, Saskatchewan Research Council (SRC), Saskatoon, SK. SRC Publication No. 11341-2E01.

Wheaton, E.E. and MacIver, D.C. (1999) 'A framework and key questions for adapting to climate variability and change', *Mitigation and Adaptation Strategies for Global Change*, Vol. 4, pp. 215-225.

Webster, J.R., Waide, J.B., and Patten, B.C. (1975) 'Nutrient recycling and the stability of ecosystems', In: Howell, F.G., Gentry, J.B., Smith, M.H. (Eds.) *Mineral cycling in southeastern ecosystems,* National Technical Information Service, Springfield, pp. 1-27.

Williams, D.W., Long, R.P., Wargo, P.M. and Liebhold, A.M. (2000) 'Effects of climate change on forest insect and disease outbreaks', In: Mickler, R.A., Birdsey, R.A. and Hom, J. (Eds.). *Responses of Northern U.S. Forests to Environmental Change*. Ecological Studies Volume 139, Springer Verlag, NY, pp. 455-494.

Wisner, B., Blaikie, P., Cannon, T. and Davis, I. (2004) *At Risk*, 2nd Ed. Routledge, London.

Woolcock, M. (1998) 'Social capital and economic development: toward a theoretical synthesis and policy framework', *Theory and Society*, Vol. 27, pp. 151-208.

Woolcock, M. and Narayan, D. (2000) 'Social capital: implications for development theory, research and policy', *World Bank Research Observer*, Vol. 15, pp. 225-249.

World Health Organization (2003) Climate change and human health: risks and responses, World Health Organization, Geneva, Switzerland.

Yohe, G. and Tol, R.S.J. (2002) 'Indicators for social and economic coping capacity—moving toward a working definition of adaptive capacity', *Global Environmental Change*, Vol. 12, pp. 25–40.

Appendix A: Interview Guide

Section 1: Background Information

a) How old are you?
b) What do you do for a living?
c) How many people live in your household?

Section 2: Activities

a) What do you do for a living?
b) Do you hunt/trap/fish/gather berries?
c) What is your role in the community?
d) Where do you get your drinking water from?

Section 3: Current/Past Exposure

a) Are there any issues affecting your ability to earn a living?
b) Are there any issues affecting your quality of life?
c) How and why are these issues problematic to you?

Section 4: Current/Past Adaptive Strategies

a) How do you deal with the problems in your life?
b) Where do you seek help?
c) Are there any institutions that provide you with assistance?
d) Is it easy to get funding? Why? Why not?
e) Is it easy for you to talk to Elders?
f) What do you wish you could do in your community?
g) Why can't you do this?

Section 5: Current/Past Climatic/Environmental Exposures

a) Are there any problems with water quality?
b) Are there any problems with water availability/quantity?
c) Is weather problematic to you?
d) Are you always able to hunt?
e) Have you noticed any changes in the land lately?
f) How were things when you were a child?

Section 6: Current/Past Adaptive Strategies for Coping with Climatic/Environmental Exposures

a) What did you do when _____ happened?
b) How do you deal with that problem?
c) What helped you to get through that problem?
d) Do you know how your Grandfather/Grandmother dealt with that?
e) Where did you learn to do that?
f) How well did it work out for you?

Section 7: Participation in Traditional Activities

a) Do you speak Cree?
b) Do your children speak Cree? Do you try to teach them?
c) Where did you learn Cree?
d) Do you hunt/fish/etc? How do you know where to hunt/fish/etc?
e) Do you ever ask your Elders for advice? Do they offer it to you easily?
f) How do you say _____ in Cree?

Section 8: Future Vulnerability

a) What do you see for your children/grandchildren?
b) Are they prepared for this?
c) What do you hope for them?
d) Can this become true?
e) What do you need in order for this to come true?
f) What are you going to do to get this?

Section 9: Conclusion

a) Do you have anything you would like to add? Is there anything I missed?
b) Just to make sure I understand this correctly.....
c) Are there any other people that you would recommend I talk to?

Appendix B: Coding Scheme for Interview Analysis

Level 1 Node	Level 2 Node	Level 3 Node	Occurrences	
			James Smith	Shoal Lake
Age			17	17
Quotes			25	20
People in Household			12	12
Exposure				
	Health		4	12
	Climate		6	5
	Income		2	14
	Lifestyle		11	14
	Water			
		Quality	9	16
		Quantity	16	14
	Gangs		1	2
	Fear		0	3
	Violence		6	10
	Family		6	6
	Employment		7	8
	Infrastructure		3	3
	Housing		7	5
	Education		3	4
	Land		2	3
	Institutional		39	17
Adaptive Strategy				
	Health		0	7
	Social Capital		5	9
	Water		0	
		Quality	4	8
		Quantity	2	2
	Lifestyle		7	15
	Education		5	2
	Infrastructure		1	9
	Institutional		8	3
	Economic		5	9
	Housing		0	1
	Land		0	2
Adaptive Capacity				
	Research		1	6

	Health		1	2
	Institutional External		3	13
	Institutional Internal		22	17
	Social Capital			
		Bonding	8	20
		Bridging	13	20
		Linkage	2	3
	Intellectual Capital		0	2
	Cultural Capital		20	23
	Human Capital		5	19
	Natural Capital		8	9
	Technological Capital		0	1
Change				
	Wildlife		20	25
	Climate		11	8
	Community		8	2
	Economic		1	7
	Water		21	13
	Lifestyle		15	11
Future				
	Adaptive Strategy			
		Water	0	3
		Social Capital	1	3
		Income	1	1
		Institutional	0	1
		Land	0	1
		Employment	0	1
		Energy	0	1

Appendix C: Translations

Sources: McLeod, 2007; Edgar Cook, pers. comm., 2007; FSIN, 2007

ê-mâyahkamikahk: “where it all went wrong”; commonly used to refer to the Northwest Rebellion of 1885

kawatim: "cold, expose, to cold"

keesic: refers to the sun, air, sky, wind and water

mistahi: “big”

mistahi muskwa: “big bear”; a great chief in the history of Cree people was named Big Bear

môswa: “moose”

muskwa: “bear”

osâwaskmuskwa: “yellow bear”; a great chief in the history of Shoal Lake was named Yellow Bear

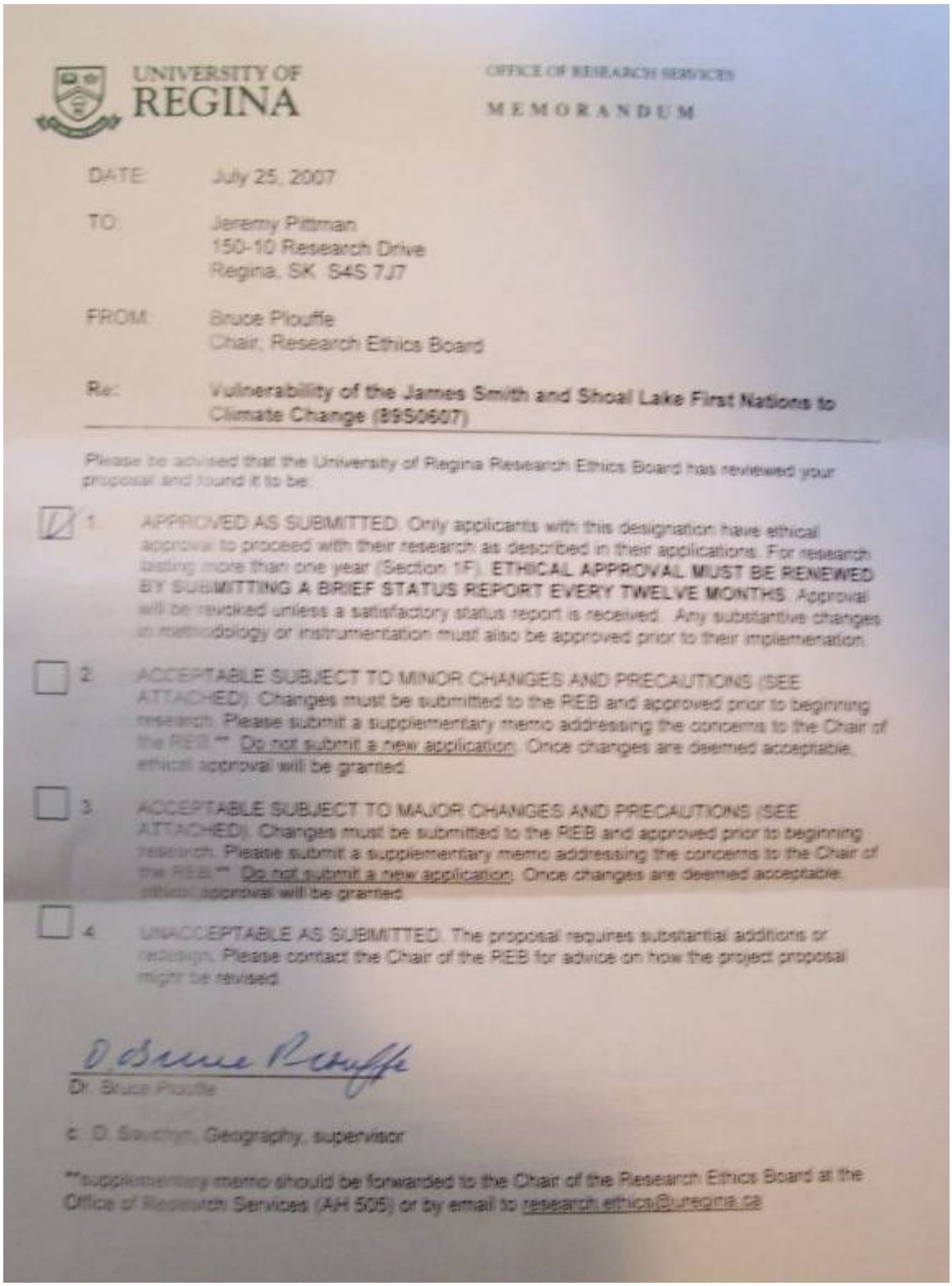
pimachihowin: “making a living”

sawanàeîcikêwin: “the destruction of”

sîsîp: “duck”

wanatapi: "sit so as to expose oneself"

Appendix D: Ethics Approval



UNIVERSITY OF REGINA

OFFICE OF RESEARCH SERVICES

MEMORANDUM

DATE: July 25, 2007

TO: Jeremy Pittman
150-10 Research Drive
Regina, SK S4S 7J7

FROM: Bruce Plouffe
Chair, Research Ethics Board

Re: Vulnerability of the James Smith and Shoal Lake First Nations to Climate Change (89S0607)

Please be advised that the University of Regina Research Ethics Board has reviewed your proposal and found it to be:

☑ 1. APPROVED AS SUBMITTED. Only applicants with this designation have ethical approval to proceed with their research as described in their applications. For research lasting more than one year (Section 1F), **ETHICAL APPROVAL MUST BE RENEWED BY SUBMITTING A BRIEF STATUS REPORT EVERY TWELVE MONTHS**. Approval will be revoked unless a satisfactory status report is received. Any substantive changes in methodology or instrumentation must also be approved prior to their implementation.

☐ 2. ACCEPTABLE SUBJECT TO MINOR CHANGES AND PRECAUTIONS (SEE ATTACHED). Changes must be submitted to the REB and approved prior to beginning research. Please submit a supplementary memo addressing the concerns to the Chair of the REB.** Do not submit a new application. Once changes are deemed acceptable, ethical approval will be granted.

☐ 3. ACCEPTABLE SUBJECT TO MAJOR CHANGES AND PRECAUTIONS (SEE ATTACHED). Changes must be submitted to the REB and approved prior to beginning research. Please submit a supplementary memo addressing the concerns to the Chair of the REB.** Do not submit a new application. Once changes are deemed acceptable, ethical approval will be granted.

☐ 4. UNACCEPTABLE AS SUBMITTED. The proposal requires substantial additions or redesign. Please contact the Chair of the REB for advice on how the project proposal might be revised.

D. Bruce Plouffe
Dr. Bruce Plouffe

c. D. Sawchyn, Geography, supervisor

**supplementary memo should be forwarded to the Chair of the Research Ethics Board at the Office of Research Services (AH 505) or by email to research.ethics@uregina.ca

Appendix E: Consent Forms

UNIVERSITY OF REGINA

CANADIAN PLAINS
RESEARCH CENTER

3737 Wascana Parkway
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Institutional Adaptation to Climate Change Project Participant Consent Sheet

We are conducting interviews of the residents of James Smith, Saskatchewan and surrounding areas. We are affiliated with the Canadian Plains Research Center of the University of Regina and we are working under the supervision of Dr. David Sauchyn and Dr. Harry Polo Diaz.

This interview is part of a study of climate-related vulnerabilities in the South Saskatchewan River Basin. The study is supported by the Social Sciences and Humanities Research Council of Canada (SSHRC). This interview deals with your impressions about climate-related vulnerabilities, with an emphasis on climate impacts on water resources in your area. The four main topics in which our questions will be focused are:

1. The conditions (exposures or stresses) that communities and households have had to deal with in the recent past, especially with regards to climate and/or water conditions.
2. The way in which communities and households have dealt with those water and/or climate conditions.
3. The roles that external institutions have played in reducing the exposures or stresses to climate and/or water conditions of communities and households.
4. The capacity of the community to deal with more serious possible changes to water and/or climate conditions in the future.

We have already informed members of the band office about this study. The interview will take approximately 60 minutes.

The University of Regina's Research Ethics Board has approved this study. If you have any questions or concerns about your rights as a participant in this study, you may contact the Chair of the Research Ethics Board (306-585-4775 or by email: research.ethics@uregina.ca).

All your answers are completely confidential – no one will know what you have said. Once we have recorded all the information, it will be impossible to identify you or any other participant. In case of any doubt you can contact the Project Director, Dr. Harry Polo Diaz (306-585-4151 or by e-mail: harry.diaz@uregina.ca) or the staff from the Canadian Plains Research Center (306-585-4758).

Participating in the study is voluntary. As well, if there is a question you would rather not answer, just say so and we will move on to the next one. You are free to discontinue your participation in the interview at any time.

We think that this is an important project and we would very much appreciate your participation. Please accept my most sincere thanks in advance for your consideration of this matter.

Participant's Name: _____

Signature _____

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We think that this is an important project and we would very much appreciate your participation. Please accept my most sincere thanks in advance for your consideration of this matter.

Participant's Name: _____

Signature _____

Appendix F: Current Exposure and Adaptive Strategy

Table F1. Climate-related exposure and adaptive strategies.

	James Smith			Shoal Lake		
	Current Exposure	**Current Adaptive Strategy**	**Importance or Severity**	**Current Exposure**	**Current Adaptive Strategy**	**Importance or Severity**
Climate	Excessive amounts of rainfall or spring runoff degrades road quality and impedes travel	None	Medium	Increasing winter temperatures impede travel on ice and snow	Hunters are more cautious, usually travel in groups, and simply go to areas that are accessible.	Medium
	Abrupt seasonal changes	None	Medium	Abrupt seasonal changes are believed to be causing health problems in infants and the elderly	None	Medium
	Drastic changes in weather in short amounts of time are difficult to predict	None - traditional methods of predicting weather have been forgotten	Medium	Drastic changes in weather in short amounts of time are difficult to predict	None - traditional methods of predicting weather have been forgotten	Medium
	Frosts in the spring kill berries	People seek berries in other areas much further from the community	Medium			

Table F2. Health-related exposure and adaptive strategies.

	James Smith			Shoal Lake		
	Current Exposure	**Current Adaptive Strategy**	**Importance or Severity**	**Current Exposure**	**Current Adaptive Strategy**	**Importance or Severity**
Health	Diabetes	None	High	Diabetes	Individuals at risk of retnoscapy were identified with help from partnering institutions. Annual walk to promote healthy lifestyles.	High
	Access to healthy foods	None	Medium	Access to healthy foods	None	Medium
	Drugs and alcohol abuse	Reliance on traditional teaching, spirituality or support meetings. Healing Circles.	High	Drugs and alcohol abuse	Reliance on traditional teachings and spirituality. Parents and band controlling youth social insurance cheques.	High
				Obesity	None	Medium
				CA-MRSA	Individuals at risk were identified and tested with help from partnering institutions.	Low
				Reduced lifespan of Elders	None	Low

Table F3. Water-related exposure and adaptive strategies.

	James Smith			Shoal Lake		
	Current Exposure	**Current Adaptive Strategy**	**Importance or Severity**	**Current Exposure**	**Current Adaptive Strategy**	**Importance or Severity**
Water	Poor quality drinking water	The band has adopted intense water quality monitoring techniques and has constructed a laboratory for conducting quality testing on-reserve. In the case of contamination, there are protocols in place to effictively and efficiently rectify the problem. Despite these efforts, some community members choose to purchase and consume bottled water.	Low	Poor quality drinking water	There is a water treatment fascility operating on-reserve, but high turbidity and over-chlorination continuously degrade the water supply. A water committee was formed that is supposed to meet yearly with INAC. To date, the water quality issue has not been resolved.	High
	Rural residents sometimes run out of water in their cisterns		Low	Flooding of peoples' homes	Areas with low risk of flooding were identified in a community development project in conjunction with Dalhousie University. New homes were built with the help of CMHC funding.	Medium
	Flooding of roads and basements	None	Low			
	Variability in the level of the South Saskatchewan River make navigation difficult	None	Medium			
	Quality of surface water on reserve has been decreasing	None	Medium			

Table F4. Exposure to social problems and adaptive strategies used to cope.

	James Smith			Shoal Lake		
	Current Exposure	**Current Adaptive Strategy**	**Importance or Severity**	**Current Exposure**	**Current Adaptive Strategy**	**Importance or Severity**
Social	Fear	None	Medium	Fear	Plan activities for youth.	Low
	Violence	None	Medium	Violence	Plan activities for youth.	Low
	Gangs	None	High	Gangs	Reliance on oneself; 'I walk alone'. Plan activities for youth.	Medium
	Poor parenting and lack of parenting skills in young mothers	None	High	Poor parenting and lack of parenting skills in young mothers	Parenting classes.	High

Table F5. Economic-related exposures and adaptive strategies.

	James Smith			Shoal Lake		
	Current Exposure	**Current Adaptive Strategy**	**Importance or Severity**	**Current Exposure**	**Current Adaptive Strategy**	**Importance or Severity**
Economic	Low high school graduation rate	None	Medium	Low high school graduation rate	None	Medium
	Lack of employment opportunities on reserve	Develop industry on reserve. Leave reserve in search of work.	Medium	Lack of employment opportunities on reserve	Develop local industries.	Medium
	Difficult to find work off reserve	Go back to reserve and seek social assistance	Medium	Difficult to achieve academically off reserve	Return to reserve.	Medium
	Attitude that glorifies dependence on welfare	Teach youth the value of work.	High			

Table F6. Infrastructure-related exposure and adaptive strategies.

	James Smith			Shoal Lake		
	Current Exposure	**Current Adaptive Strategy**	**Importance or Severity**	**Current Exposure**	**Current Adaptive Strategy**	**Importance or Severity**
Infrastructure	Lack of housing	Meet CMHC standards so that new houses can be obtained.	High	Lack of housing	Build new homes with the help of agencies, such as CMHC and INAC.	High
	Limited transportation infrastructure	None	Low	Garbage dump causes unpleasant odors in the townsite	Meetings to relocate garbage dump.	Medium
	Lack of community buildings for recreation	Community fundraising to promote pride and reduce vandalism.	Medium	Lack of commuity buildings for recreation	Use old building for community recreation; old buildings were vandalized and became useless.	Medium

Table F7. Institutional-related exposure and adaptive strategies.

	James Smith			Shoal Lake		
	Current Exposure	**Current Adaptive Strategy**	**Importance or Severity**	**Current Exposure**	**Current Adaptive Strategy**	**Importance or Severity**
Institutions	Denial of access to traditional lands	None	High	Lack of resource sharing with the province	None	Medium
	Dependency on INAC	Develop local industries, including diamond mining and power generation.	Medium	Dependency on INAC	Develop local industries, including ecotourism and forestry.	Medium
	Third party management	Meet INAC standards of band management.	Medium			
	Three band system	None	Medium			

Table F8. Cultural-related exposure and adaptive strategies.

	James Smith			Shoal Lake		
	Current Exposure	**Current Adaptive Strategy**	**Importance or Severity**	**Current Exposure**	**Current Adaptive Strategy**	**Importance or Severity**
Culture	Loss of traditional languages	None	Low	Loss of traditional knowledge	Family camp, youth camp, group canoe trips.	High
	Loss of traditional knowledge	Youth camps	Low	Lack of youth participation in traditional activities	Youth camp and cultural days	High
	Youth lack traditional skills and do not participate in traditional activities	Youth camps	Low			

Table F9. Wildlife-related exposure and adaptive strategies.

	James Smith			Shoal Lake		
	Current Exposure	**Current Adaptive Strategy**	**Importance or Severity**	**Current Exposure**	**Current Adaptive Strategy**	**Importance or Severity**
Wildlife	Animals are coming closer to the reserve	None	Low	Change in flavor of wild meat	Obtain food at store	Low
	Change in flavour of wild meat	Obtain food at store	Low	Wild meat is unhealthy	Obtain food at store	Medium
	Wild meat has become polluted and is no longer safe to consume	Obtain food at store	Medium			

Table F10. Plant-related exposure and adaptive strategies.

	James Smith			Shoal Lake		
	Current Exposure	**Current Adaptive Strategy**	**Importance or Severity**	**Current Exposure**	**Current Adaptive Strategy**	**Importance or Severity**
Plants	Berry picking sites are being destroyed by forestry and mining developments	People travelling further to pick berries.	Low	Spruce trees are no longer plentiful in the area	Plant trees.	Low
	Loss of tree cover on reserve	Plant trees; planted trees also died.	Low	Some old trees are dying	Plant trees.	Low
				Areas replanted after logging have grown in too thick to walk through	None	Low