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CONTRIBUTIONS OF CREE KNOWLEDGE: NAKATEHTAMASOYAHK OTE NEKAN NITASKENAN (Caring for the Land for the Future)

By: Karen A. Geertsema

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled *Contributions Of Cree Knowledge: Nakatehtamasoyahk Ote Nekan Nitaskenan (Caring For The Land For The Future)* submitted by Karen Geertsema in partial fulfillment of the requirements for the degree of Master of Science.

Brenda Parlee, Supervisor

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Date: August 26, 2008

Dedication

This thesis is dedicated to those very special people in my life who have taught me how to be a better person. To Bessie, who taught me that my only goal should be to become the best person that I can be, to my angel Toby, who showed me how to live from the heart, to Naomi who has taught me how to laugh, to Lance who showed me that integrity can be real, and to Shean, who has encouraged me to stand tall.

Preamble

This thesis is a testament to the warmth and support with which the people of the five Cree communities embraced me. Moreover, it is a result of the people within those communities who shared their wealth of ecological knowledge, their system of ecological monitoring, and their experiences in regard to the cumulative effects they have been experiencing as a result of land, resource and industrial development within their Traditional Territory. The most important aspect of this research for me was the opportunity to do research which would result in some applied value and benefit to these communities.

It is my sincerest hope that this research will serve to encourage and support the applied use of Traditional Ecological Knowledge (TEK) for achieving healthy sustainable socio-cultural and ecological systems. I thereby request that when this thesis is used by those other than the Cree people of this study, that it be used with a spirit of utmost respect and reciprocity for the invaluable knowledge, and expertise that the people of these communities have shared through their testimony.

The reader of this thesis is provided two caveats, both in reference to terms used throughout this document. First any reference to the term Aboriginal within this thesis is for the purpose of: 1) In some instances the inclusion of all Aboriginal peoples in Canada, including Inuit, Metis and First Nations; and 2) Adhering to the referencing of First Nations as Aboriginal people within Canadian court rulings and the *Canadian Constitution 1982.* Otherwise, the Cree of the study area insist upon being referred to as First Nations rather than Aboriginal. Second, any reference to the term Traditional Use within this thesis is for the purpose of identifying, in a colloquial manner, a set of uses and practices which the Cree people of the study area historically and currently engage in, but which are by no means fixed, in fact they are both diverse and fluid. Appropriately, by no means is it the author's intent to reproduce and reinforce the tenets of the colonial imperative.

Abstract

Aboriginal peoples in many parts of the world have developed ways of monitoring, amassing information, understanding and making associations about the local ecosystems they depend upon for subsistence resources. Appropriately, using their Traditional Ecological Knowledge (TEK), and ecosystem monitoring expertise may facilitate sustainable ecological systems. Systematic ecosystem monitoring is incidental to the sustainability of local ecosystem integrity and health. In areas disturbed by significant industrial, land and resource development, the capacity to "monitor" changing ecosystem conditions is crucial. This research demonstrates how five Aboriginal (Cree) communities in northern Alberta, Canada incorporate "systematic" ecosystem monitoring elements to assess local ecosystem condition and changes. The systematic ecosystem monitoring elements are described, including the use of "cultural keystone species" as condition indicators, the diagnostic measures used, the temporal and spatial elements, and how Cree Land Based Experts interpret and make associations about the health of fish, wildlife, plants, landscape habitat, water and air. This research reports on the observations of populations and condition of a number of cultural keystone species, hydrological yield and quality, and critical wildlife habitat affected by the cumulative effects of forestry, oil and gas, and a contaminant treatment facility development in the study area. The work also discusses the implications and ramifications to local Cree people to these changing ecological conditions. Finally, this research suggests how local Aboriginal peoples, their Traditional Ecological Knowledge (TEK), and their ecosystem monitoring expertise, can be of applied use within ecosystem management, and cumulative effects frameworks.

Acknowledgements

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I wish to extend my sincerest gratitude to the Chiefs, and community members of the Cree of Swan River, Driftpile, Sucker Creek and Kapawe'no, and the Sawridge Band who graciously shared their wealth of knowledge, wisdom and experiences with me. Special thanks to Edna Willier, Allen Willier, and Chief Leon Chalifoux.

Thank you to my advisor Dr. Brenda Parlee whose wisdom guided me around those "pitfalls" a grad student need not stumble within, for being a boundless supply of cleaver ideas, and for seeing me through the writing of this thesis.

I also wish to acknowledge three people who have inspired my passion and further study in Environmental and Aboriginal issues. To Dr. Jim Pojar, who taught me to keep my eyes grounded and upon the plants and soils beneath my feet, to Dr. Annie Booth, who introduced me to a number of struggles Aboriginal peoples have in regard to land and resources, and to Dr. Angele Smith who taught me that power is contested and embedded in landscapes.

Finally, I would like to acknowledge the author of one of my favourite quotes which is: "From whose blood are my eyes crafted" (Harraway 1989).

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Chapter One

Introduction

"The farther we get away from an individual caring for his or her own garden, the less effective planning and management decisions are" (Forman 1995: 488).

1.0 Background

In the Lesser Slave Lake region, Alberta oil and gas exploration, forestry and the development of a contaminants treatment facility have had a significant impact on the land, water, fish, wildlife and plants valued by local Cree communities. Documentation of the cumulative effects of development upon local ecosystems in Alberta has been limited, as currently, there is no applied cumulative effects framework (Toliver-Fox 2007). This situation has resulted in a certain level of risk for communities (Nagy and Gunson 1990; Allen 1994; CPAWS 1997; Timoney and Lee 2001; CPAWS 2006; NFDP 2006) and a certain level of tension between the government of Alberta, Industry and Treaty 8 First Nations (Personal Communication 2006a; 2006b; CIRL 2007).

Aboriginal peoples may be able to play a critical role in constructing our understanding of cumulative ecological effects within this landscape. Local knowledge and Traditional Ecological Knowledge (TEK) is well recognized in Canada and internationally as a valuable source of information about ecosystem conditions (Brundtland 1987; Berkes 1999). Nevertheless, this recognition has been limited to broad definition, and restricted application within ecosystem management regimes. TEK has often been framed as imprecise, subjective, constructed with methods lacking rigor, based on random investigation (anecdotal), and a knowledge system which does not make appropriate interpretations and associations about ecosystems. Whereas, Western Scientific Knowledge (WSK) is framed as precise, objective, generated by passing through a rigorous set of universally accepted methods (Cairns 1993; Cairns 2002; Dallimeier *et al.* 2002; Durell *et al.* 2005; Green *et al.* 2005

; Langor and Spence 2006; Morellet *et al.* 2007), and one which makes appropriate interpretations and associations, legitimizing it to a privileged position for applied use (Ogawa 1995; Snively and Corsiglia 2001) within ecosystem management, land and resource use, and cumulative effects frameworks. Regardless, there have been documented synergies between local TEK and conventional WSK, which have been noted previously in the TEK literature (Kofinas *et al.* 2001; Becker and Ghimire 2003; Lyver and Gunn 2004), and this study discovered many synergies as well.

The roots of the academic study of TEK date back to the mid century and the work of Levi-Strauss who studied ethnobotanical knowledge. Levi-Strauss was among the first to recognize and document the scientific nature with which local aboriginal peoples viewed and categorized the natural world. Since his work was published over a half century ago, TEK has developed into a significant area of interdisciplinary study with roots in environmental anthropology, human ecology, and a wide but limited range of application in environmental planning, management and monitoring (Duerden and Kuhn 1998; Usher 2000; Wenzel 1999; Becker and Ghimire 2003; Gill 2003; Duerden 2004; Kitson 2004; Moller *et al.* 2004; Parlee *et al.* 2005; Moller 2006; Riedlinger and Berkes 2001; Berkes *et al.* 2007). This study has aimed to increase understanding of TEK, and local Indigenous land-based expertise, which may add to the knowledge generation body of literature.

Systematic ecosystem monitoring is incidental to the sustainability of the integrity and health of local ecosystems used to procure subsistence resources. Effective ecosystem monitoring must identify and measure temporal and spatial responses or stressors upon baseline conditions or deviations from a desired trajectory. Appropriately, using Traditional Ecological Knowledge (TEK) and Indigenous Land Based Expert (LBE) ecosystem monitoring expertise for sustainability, may be appropriate. Local Indigenous peoples in many parts of the world have, over many generations, developed ways of observing, learning, understanding, generating knowledge, monitoring local ecosystems, interpreting and making associations about local ecosystem composition, structure and functioning.

Indigenous peoples who 'consistently' (regularly) engage in land-based activities (including harvesting) multiple times throughout the year for considerable lengths of time (many decades) may be considered a local "Land Based Expert". "It is important to work with experts rather than randomly selected individuals in ecological studies that incorporate local knowledge". In this way, "expert local knowledge adds value to science by providing detailed insights into the ultimate causes of change, and by contributing a rare historical perspective" (Chalmers and Fabricius 2007:1).

Appropriately, throughout this research local Cree land users are referred to as Land Based Experts (LBES) due to: a) Their substantive body of knowledge (TEK) about local ecosystem conditions; and b) The consistent and lengthy amount of time they have spent on the land observing, learning, understanding, generating knowledge, monitoring local ecosystems, interpreting and making associations about local ecosystem conditions. In this vein, I ascribe a substantial amount of mastery to their knowledge (TEK) and skills (ecosystem monitoring expertise) about the land.

Most research has focused on TEK knowledge about local endemic species, their distribution, techniques to harvest them, and combining TEK with conventional WSK to provide a rich means by which we may fill information gaps and elicit comprehensive understandings of local ecological conditions (Pinkerton and Weinstein 1995; Berkes 1998; Berkes and Folke 1998; Berkes *et al.* 2000; Mackinson 2001; Berkes and Folke 2002; Dallimeier *et al.* 2002; Berkes *et al.* 2005; Parlee *et al.* 2005a; Parlee *et al.* 2005b; Stevenson 2006). Falling out of that research were somewhat simplistic allegations of the inability of TEK, and indigenous ecosystem monitoring expertise, including that TEK and Indigenous expertise "does not allow for quantitative data" to be collected in a "synchronic manner" (Berkes 1998:10). This research has examined Cree LBEs ecosystem monitoring methods for systematic elements; and the results serve to form what may be appropriate arguments to challenge those assumptions.

1.1 Study Site

The communities of Sawridge, Swan River, Driftpile, Sucker Creek and Kapawe'no border the south and southwesterly shores of Lesser Slave Lake, Alberta. The current settlements are all reserve lands settled around the time of the signing of Treaty 8 in 1899. Geographically, (except for Kapawe'no) the reserves fall between the towns of Slave Lake to the east and High Prairie to the west on Highway 2, and are bordered to the north by Lesser Slave Lake, privately owned agricultural land, and Crown land. Kapawe'no is located slightly to the north west of Lesser Slave Lake. The study communities are located in the Athabasca River Basin, within the Dry Mixedwood (Sucker Creek and Kapawe'no) and Central Mixedwood (Sawridge, Swan River, and Driftpile) sub-regions of Alberta underlain with soft sedimentary bedrock. Low drainage rates of fine textured soils commonly results in poorly drained wetland formation, occupying a significant (20-40%) spatial area over the region (ESWG 1996; Smith *et al.* 2003; Downing and Pettapiece 2006).

The fulfillment of treaty obligations, in particular, hunting, fishing, trapping and gathering has resulted in much controversy and conflict. Treaty 8 First Nations are of the understanding that in return for signing Treaty 8 and sharing the land, their economic system was to remain fully intact and protected (Madill 1986; Halcrow 2006; T8FN 2006; Personal Communication 2008).

The extent, however, to which the provincial and federal governments have imposed restrictions on Treaty 8 Nation's access and ability to continue Traditional Use and Livelihood Practices, has been, since the signing of the treaty an issue of much debate and conflict (Madill 1986; Laboucan 2006; T8FN 2006). At the time of this study, Aboriginal, Inherent, Constitutional, and Treaty 8 Rights, and land, resource and industrial development within the study area, are a regular part of the discourse of the Cree people of these First Nation's.

1.2 Thesis Outline

In Chapter Two, I contextualize this study within the body of literature which has guided this research. Given this research is embedded in the subjects of socio-ecological relationships, and knowledge generation, theories and concepts within this thesis were drawn from the literature on Knowledge Generation. Some insights are also gained from the conceptual literature on Cumulative Impacts, Systematic Monitoring and Sustainable Development. These theories, concepts and discussions provide a foundation for this research; and it is important to understand the relationship between them.

In Chapter Three, I outline and describe the research approach and methods, including the general research methods, the methodological instruments used, and recruitment methods.

In Chapter Four, I provide some background details on the research setting (Section 4.1) by introducing the reader to the subjects of Aboriginal Peoples and Development (Section 4.1.1); Aboriginal People and Land and Resource Rights in Canada (Section 4.1.2); a Portrait of the four Cree First Nations and one Band of this Study (Section 4.2); a briefing of the three main sectors of development in the study area which are Oil and Gas, Forestry and the Contaminant Treatment Centre (Section 4.3); an introduction to the subject of development, Aboriginal peoples and the provincial government of Alberta (Section 4.4); and finally I provide a glimpse of the Bio-Physical aspects of the study area (Section 4.5).

In Chapter 5, I begin by describing the relationship of local Cree Land Based Experts (LBEs) to the local landscape. This relationship includes a diversification of land-based activities including both traditional activities such as hunting, fishing, trapping, berry and medicinal plant harvesting, and more contemporary land-based roles such as Chief, Land and Resource Managers, Commercial Fishers, Guiding, Cultural Heritage Manager, Agriculturalist, Forest Worker, and River Watch Foreman . I end by critiquing the conventional framing of TEK and land-based expertise as anecdotal and unscientific by

demonstrating how the methods used to monitor local ecosystems incorporates systematic elements; consequently the knowledge constructed is valuable and may be appropriately used within land and resource and cumulative effects frameworks.

In Chapter 6, I share interviewee observations, associations and interpretations of local ecosystem conditions and changes including: moose body condition, moose population abundance and trends, moose population dynamics, and bear body condition (Section 6.1.1); landscape fragmentation and habitat species loses (6.1.2); freshwater fish population dynamics (6.1.3); water yield (6.1.4); water quality (6.1.5); wetland water yield and water quality (6.1.6); air quality (6.1.7). This chapter also includes interviewee interpretations of associations and the causes of change. Of particular concern were increases in forestry, oil and gas exploration, and the operation of a toxic waste treatment facility. As well, this chapter attempts to demonstrate potential synergies between local Cree LBE ecological knowledge (TEK), and conventional Western Scientific Knowledge (WSK) through the weaving together of evidence from WSK studies on ecological impacts of development in other regions, with the results from this study. While the review of the WSK literature is not comprehensive, it serves as an example of how TEK and WSK can be used conjointly to better understand anthropogenic impacts on local ecological systems.

In Chapter 7 I briefly discuss how Cree Land Based Expert observations (in Chapter 6) are important to our understanding of Traditional Use impacts. This chapter presents a brief overview and not a comprehensive examination of cumulative Traditional Use impacts within the study area as experienced by Cree LBEs.

In Chapter 8, I present my synthesis, conclusions and recommendations. In Section 8.1 I re-state the study purpose, in 8.2 I divulge and discuss the three main study results which are: 1) The diversification of land-based activities and the results of the examination of ecosystem monitoring for systematic elements (Section 8.2.1); 2) The results of local ecosystem conditions which are associated with land use and development, presumed to be cumulative impacts (Section 8.2.3); and finally, 3) A number of Traditional Use

impacts (Section 8.2.3). In Section 8.3 I discuss the results and the ramifications for the results; and I present my conclusions and recommendations for further study.

1.3 Research Purpose and Objectives

The primary purpose of this study is to increase understanding of TEK as an important source of knowledge about ecosystem conditions and to reveal the potential of TEK and Land Based Expert (LBE) ecosystem monitoring methods. More specifically, I attempt to demonstrate how TEK continues to be constructed using both traditional and more contemporary opportunities, how the construction of this knowledge incorporates systematic elements, how information generated from that ecosystem knowledge construction may reveal valuable cumulative impact data, and some of the ramifications of ecosystem change for Aboriginal rights and traditional use.

This research is drawn from the literature on Knowledge Generation and there are three main objectives, those objectives are to answer the following questions:

1) How do Cree land users construct knowledge about ecological conditions, and through what kinds of specific land-based activities (Chapter 5)?
2) What kind of ecological changes are Cree land users observing within their traditional territory (Chapter 6)?
3) What are some of the ramifications upon the local Cree resulting from human induced changes to local ecosystems (Chapter 7)?

This research is significant for a number of reasons. First, the Cree of this study sought to answer ***"In what ways can Lesser Slave Lake Cree demonstrate their effective stewardship of the land"*** (Personal Communication 2006c) so that they may be engaged in equitable participation of land and resource use and cumulative effects management decisions (Personal Communication 2008) which affect them. Second, policy and decision makers have, at times, sought to practically and effectively integrate Western

Scientific Knowledge (WSK) and Traditional Ecological Knowledge (TEK) to provide a means for Aboriginal people to be meaningfully engaged in land and resource management decisions (Williams and Baines 1993; Berkes 1999; Usher 2000; Nadasdy 2003b) nonetheless, effective and meaningful participation continues to be problematic and largely unsuccessful (O'Faircheallaigh 2007) regardless of the valuable information and insight it offers (Berkes *et al.* 1991; Foreman 1995; Milich 1999; Snively and Corsiglia 2000; Martin 2001; Bradshaw 2003; Gill 2003; Kofinas *et al.* 2003; Duerden 2004; Kitson 2004; Lyver and Gunn 2004; Parlee 2005; Berkes *et al.* 2007; Chalmers and Fabricius 2007; Grant and Berkes 2007), and the synergies between TEK and WSK information towards sustaining biodiversity (Becker and Ghimire 2003).

1.4 Theoretical Significance of the Study

The link between the environment and people has long been of interest to environmental sociologists (Catton and Dunlap 1978; Schnaiberg 1980; Buttel 1986; Redclift and Woodgate 2005) with the motive of understanding how social and ecological systems constitute each other simultaneously, and in doing so, pose risks to each other in action and reaction (Redclift 2005). The framing and funding of cumulative impact research seldom uses the contributions of the social sciences in assessing and understanding the processes by which societies realize ecological threats to their well being, formulate responses, and collectively act upon them. Nonetheless, this research aims at examining the Traditional Use and ecological cumulative impacts of development upon the local Cree peoples of the study area.

This thesis may contribute to the literature on knowledge generation by the way it carves out how Traditional Ecological Knowledge (TEK) is constructed using a number of conventional scientific methods to collect local ecosystem information. More specifically, this study examines the ecosystem monitoring methods for systematic elements with the aim of illustrating how these methods used by Cree LBE are 'scientific in nature.

There tends to be a widely held assumption that WSK scientists exclusively use systematic ecosystem monitoring methods with a rational detached empiricism, and this assumption has served to facilitate the elevation of WSK to a privileged position within the dominant society. The study is somewhat unique in that it challenges the assumption that local Aboriginal people hold spurious information, constructed through the use of imprecise methods which lack rigor, based on random investigation (anecdotal), and a knowledge system which makes inappropriate subjective interpretations and associations about ecosystem conditions which is relevant only within the cultural spheres where it is embedded. The research uses direct and indirect questions to tease out nuances of Cree land-based activities, including whether Cree Land Based Experts (LBEs) systematically monitor local ecosystem conditions (Chapter 5). Recently, Palsson (1998) postulated that: 1) An increasing reliance on knowledge gleaned by monitoring and assessing at a finer spatial and wider temporal scale is essential; and 2) Orthodox theories and practices which support the highly structured and functional model through a formal institutionalized system, should be relied upon less. Accordingly, this thesis weaves together WSK and TEK results with the aim of eliciting more comprehensive understandings of: 1) Ecological impacts of industrial, land and resource development; and, 2) The synergies between local TEK and conventional WSK, which have been noted previously, to some degree, in the TEK literature (Kofinas *et al.* 2001; Becker and Ghimire 2003; Lyver and Gunn 2004). The aim of this method of knowledge system integration is to advance beyond abstract discourse around the definition and value of TEK, to a more detailed understanding and applied use of TEK and ecosystem monitoring expertise. The research may add to the TEK body of literature (Duerden and Kuhn 1998; Riedlinger and Berkes 2001; Duerden 2004; Moller *et al.* 2004; and Parlee *et al.* 2005; Moller 2006) which makes a similar appeal in that Aboriginal peoples have their own comprehensive ecosystem knowledge, generated through local ecosystem monitoring while engaged in "Traditional" land-based activities.

1.5 Research Design

This research is situated within a larger project which is being conducted in areas in Northern British Columbia, and Northern Alberta. The research has been funded by the Sustainable Forest Management Network as part of a larger cumulative effects research project initiated by Jim Frideres and Monique (University of Calgary), John Innes (University of British Columbia) and Brenda Parlee (University of Alberta).

I have engaged qualitative research with an empirical focus. An empirical focus has been actualized by engaging in twenty three qualitative interviews, which at times made use of indirect questions to determine whether the cohort's (Cree Land Based Experts) use systematic methods to monitor local ecosystem conditions. Participatory Research (PR), where the community has defined the research focus, has played a pivotal role in guiding the research questions of this study. PR has developed within a growing interest and respect for Aboriginal knowledge, and challenges top-down approaches to research, development projects and extension. In addition in-depth interviews with a total of twenty-three Cree Land Based Experts (LBEs), and a focus group mode of interviewing were used. Upon introduction to the Chiefs (see 4.2.4 for political organization) of the study area, I requested their advice and participation with the focus of this research. The response I received was that my research should address the question ***"In what ways can Lesser Slave Lake Cree demonstrate their effective stewardship of the land"*** (Personal Communication 2006c).

To this end, this research provides an example of how TEK is constructed using local Cree land-based expertise, and the potential of using that knowledge and expertise within land and resource and cumulative effects frameworks.

Chapter Two

Conceptual and Theoretical Background

2.0 Theoretical and Conceptual Background

The body of literature which grounds this research is embedded in the subjects of socio-ecological relationships, and knowledge generation. More specifically, theories are drawn from the Knowledge Generation literature which provides a starting point, while some insights are also gained from the conceptual literature on cumulative impacts, systematic monitoring and sustainable development. The theories and concepts used in this thesis provided a foundation for this research; and it is important to understand the relationship between those theories and concepts and how they relate to the Sociological body of literature. I consider the Knowledge Generation theories useful as it pertains to both how knowledge is constructed and contested within and between societies.

This thesis is important to the environmental sociological body of literature because land, resource and industrial development within the study area, sanctioned by formal governing institutions, are posing risks to the integrity and health of local ecosystems which the people of this study depend upon. Accordingly, I advance this thesis with the aim of providing an avenue for constructing more appropriate land and resource policy decisions more sensitive to the distinctive land tenure system (sometimes referred to as Traditional Territories) and the rights falling out of that distinctive tenure (hereinafter referred to as rights).

Historically, except for Marx's concepts of the metabolic rift between society and the natural environment, in *The Poverty of Philosophy* 1847 and later in *Capital* 1863-1865, sociology has given little attention to the inextricable and reactive link between the socio-cultural and ecosystem relationship until early theorists (Environmental Sociologists) in the later part of the 1970s focused on three main arguments. First, Environmental

Sociologists tended to stress the need to document the seriousness of the environmental crisis (Catton and Dunlap 1978; Schnaiberg 1980). Second, theorists discussed how and why institutions, structures and ideologies of modern industrial societies (Western) capitalist market, politics, science and socio-cultural ideologies have tended towards environmental degradation (Buttel 1986). Third, socio-environmental theorists discussed how these institutions, structures and ideologies could be mitigated through inciting changes in public values which could be acted out through environmental mobilization (Redclift and Woodgate 2005). Later, Dunlap and Catton (1994) provided more clarity by articulating how the hegemonic Western world view is re-enforced through institutional and structural policies and practices which tend to propel a very powerful momentum which often results in environmental degradation. Schnaiberg and Gould (1994) characterized the Western institutional and structural momentum as the 'treadmill of production', which they explained as the competitive nature of the capitalist economic imperative where states promote private accumulation at the ultimate expense of the environment and subaltern social groups. More recently a set of theories originating in Northern European countries have tended to build upon the view that environmental improvement strategies, including inciting changes in social values and behaviours, in individuals and industries, are more important to focus upon than documenting the existence of environmental degradation.

Inequality and social conflict may arise from the disproportionate distribution of risks created by the success of one group over another (Beck 1992). Local Aboriginal peoples may be at greater risk due to their social inequality (Szasz and Meuser 1997), and their limited political ability to participate equitably and beneficially in land and resource use and management (Baker and McLelland 2003; Personnel Communication 2006b; O'Faircheallaigh 2007) which they depend upon for healthy social, cultural, and economic (subsistence & livelihood) systems, or as Redclift (2005) describes it, ecological and human security. This research illustrates how social and ecological systems within the study area constitute each other simultaneously, and in doing so, pose risks to each other in action and reaction.

Practically speaking, more stakeholders in Alberta than ever before are vying for access, and rights to natural resources in today's landscape of finite natural resources (LUF 2007; Personal Communication 2007). Historically, Aboriginal peoples in Alberta, had very little control or information input into decisions over land and natural resources within their Traditional Territories (T8FN 2006; Treaty Commissioner 2007; Personal Communication 2006b). With various movements - arising largely out of concerns about sustainable land and resource development and Aboriginal rights, Aboriginal peoples have been invited to participate in a proliferation of potential styles and levels of land and resource management processes in Alberta (Honda-McNeil 2000; Campbell 2003; Nadasdy 2003a,b; Natcher 2005).

The point of departure for this study is to illuminate, through the results of this case study, a number of ecological cumulative impacts (Chapter 6), and Traditional Use (Chapter 7) cumulative impacts revealed through local Cree LBE's testimony. Many bureaucrats and resource managers have claimed that current land and resource use frameworks are models for partnerships between actors (stakeholders) including Aboriginal peoples who participate through land and resources consultation processes (Personal Communication 2006b). Nevertheless, Nadasdy (2003); Ross (2003); Howitt (2003); and O'Faircheallaigh (2007) have found that generally, land and resource management frameworks in Canada, are entrenched in the dominant societies existing institutions and structures which serve to foster the enhancement, re-enforcement and maintenance of political economic power for industry and the state, while disenfranchising other groups (including local Aboriginal peoples). The sociological literature is weak in covering this area of inquiry; accordingly, this thesis may provide a starting point for inquiry into: a) How local land-based ecosystem knowledge and expertise is valuable and may be appropriate for applied ecosystem management use; and b) How current land and resource management frameworks in Canada, which privilege the Western Scientific Knowledge system, more often than not, do not serve local Aboriginal people well.

2.1 Theoretical Background: Knowledge Generation

In many societies, there has been a dearth of success in drawing upon the Traditional Ecological Knowledge (TEK) and land based expertise of Aboriginal people for the purpose of augmenting ecological data and informing land and resource use decisions. Although, during certain periods there have been attempts at the integration of TEK and WSK knowledge systems which has largely resulted in the abrogation of TEK by a modernist regime for bio-economic, and political reasons rather than for applied environmental management. TEK and Aboriginal land based expertise remain contested as credible and useable within applied land and resource use frameworks. While conversely, WSK and western scientific expertise are largely regarded as the only credible and useable knowledge system with which to inform land and resource use decisions.

Karl Popper (1963: 27) contended that there are no conclusive sources of knowledge but that each are credible in their own right, although subject to critical examination. Further, he stated that the WSK empiricists insist that if we make an assertion, we must first justify it by answering the questions: a) How do you know, or what are the sources of your assertion; and b) What observations underlie your assertion? Popper (1963) stated he found these questions to be unsatisfactory in that these are politically framed questions, that there is no ultimate or higher source of knowledge, and that these questions are questions which beg the origin of knowledge "in the belief that knowledge may legitimize itself by its pedigree" (Popper 1963:25). Accordingly, unanimous testimony may well be rejected based on the reliance of spurious sources, and that "all observation involves interpretation in the light of our theoretical knowledge" Popper 1963:23).

Thus ideally it is critical: 1) That we understand and respect different knowledge systems; 2) That different knowledge, assertions and observations be regarded as the building blocks of knowledge, rather than ultimate knowledge; and 3) That the decision to acknowledge that we can learn from our own mistakes, and from other knowledge

systems which are elemental of science. In this vein, acknowledgement that both Traditional Ecological Knowledge (TEK) and Western Scientific Knowledge (WSK) are constructed within the philosophical, ideological and historical demarcations of their own respective socio-cultural systems is crucial and the only means of understanding the affray over the lack of credibility afforded TEK, and Aboriginal land-based expertise.

Local communities develop ecosystem knowledge and ecosystem monitoring expertise competency as they learn the lands unique biophysical characteristics contextualized within local temporal and spatial landscapes. Unfortunately, "there may be cultures where legitimacy and competency, as an environmental expert, are based not on learning the land, but on published papers about the land". And, "whether a community considers a person knowledgeable, is one measure of the person's legitimacy and competency" and, "the criteria for legitimacy and competency varies within each culture" (Davidson-Hunt and Berkes 2003: 20). This thesis does not seek to privilege any particular knowledge system's legitimacy; rather it attempts to illustrate how each of the WSK and TEK knowledge systems are credible 'scientific' systems in their own right. Further, through the integration of the two woven together (as done in this thesis) they may strengthen the foundation of information available for making sound land and resource use and cumulative effects management decisions.

Recently Roots (1998) asserted that, the similarities between knowledge systems are frequently construed as nebulous, while differences are emphasized. This study demonstrates that the TEK generation system may have within it elements of systematic monitoring which has often been accredited only to the WSK scientific system alone. Roots (1998: 46) argues that "both the TEK and WSK systems are scientific....but one (WSK) is mainly technical, using social and political judgment", and "assessment leads to decision", while "the other (TEK) is largely political.....brings social concerns and environmental evidence together", and "assessment and decision are not separated". The prevalent difference in Roots (1998) analysis of both systems seems to lie in the TEK system being assessed as non-technical.

The way people interact with their environment is crucial to understanding how people come to learn, re-learn, or build knowledge about their environment. These issues have increasingly been acknowledged as being essential components to ecological sustainability which is inextricably linked to the health of social, cultural and economic systems (Measham 2006; Cantrill and Senecah 2001). Knowledge generation is discussed by Davidson-Hunt and Berkes (2003:20) who argue that the TEK system integrates learning, assessment and decisions thorough knowledge and practices which are embedded in a learning feedback loop, providing for an expansive array of ecological condition indicators, and accounts of how land, resource and industrial development may be affecting ecological systems (Berkes 1999; Berkes *et al.* 2000; Berkes and Turner 2006).

To better understand knowledge generation, one may refer to Levi-Strauss (1962:23) who argued the philosophical treatise that we have a need to classify our environment to reduce the complexity of it in order to comprehend it. "To understand a real object in its totality we always tend to work from its parts....Being smaller, the object as a whole seems less formidable. By being quantitatively diminished, it seems to us qualitatively simplified". Traditional Ecological Knowledge (TEK), sometimes referred to as a quasi-science, has been restricted in credibility by the "essence" of its "results" as opposed to the achievement of credibility of the more "exact natural sciences"; nonetheless, Levi-Strauss (1962: 16) asserted that TEK is "no less scientific and its results no less genuine". To illustrate this, Levi-Strauss (1962) posited that the native species classification schemes he analyzed are antecedents of the WSK scientific method. Specifically, the Dogon of the Sudan were noted as having established a particularly extensive and systematic method of endemic species classification (Levi-Strauss 1962), as well, the Navaho Indians, the Hopi, the Zuni, and the Wik Munkan of Australia, had comprehensive understandings of ecosystems and biological taxonomic systems including some which closely resemble the Linnaean classification system where genera, species and varieties are explicitly distinguished (Thomson 1946; Levi-Strauss 1962:39-45). More recently, Berkes (1999:9) re-enforced Levi-Strauss's (1962) conclusions in

arguing that, "Both Western and Indigenous science may be considered.....the result of the same general intellectual process of creating order out of disorder".

The Knowledge Generation body of literature has assisted with my understanding of these research results and with informing my conclusions by the way it carves out how knowledge is constructed, framed, legitimized, and contested within the philosophical, ideological and temporal and spatial demarcations of all socio-cultural contexts. As well, this body of literature provides insight in regard to how a knowledge system when privileged above others, can be used to imbue power and subvert other knowledge systems. Conversely, it provides explanations around how there are no conclusive sources of knowledge, each are credible in their own right, and that all observation and interpretation is within the context of knowledge already previously constructed.

Knowledge generation is complex, often misunderstood, and political. Nevertheless, this body of literature has been useful to draw upon in that the theories tend to ground the appeal this thesis attempts to make which is that Aboriginal people have had for generations, the knowledge base and elemental 'scientific' land-based ecosystem monitoring methods necessary, to glean valuable ecosystem condition information. Others (Duerden and Kuhn 1998; Riedlinger and Berkes 2001; Duerden 2004; Moller *et al.* 2004; and Parlee *et al.* 2005; Moller 2006) have also made a similar appeal by demonstrating how Aboriginal peoples have their own systems of local ecosystem knowledge, and monitoring methods which serve to elicit comprehensive understandings of ecological systems.

2.1.1 Conceptual Background: Avenue for Locking Together Knowledge Systems

This study draws from literature which provides for an understanding of the concepts of knowledge, and the use different knowledge systems towards monitoring, assessing, planning and managing sustainable social and ecological systems through the integration of the TEK and WSK knowledge systems. Much of the literature drawn from emphasizes: a) The complexities and unpredictable anatomy and character of ecosystems

(Holling 1973; Pimm 1984; Langor and Spence 2006); and b) That governing bodies and western scientists would benefit from integrating local or other knowledge systems with WSK knowledge system expertise (Pinkerton 1995; Berkes and Folke 1998; Neis *et al.* 1999; Mackinson 2001; Berkes and Folke 2002).

2.1.2 Conceptual Background: Defining Western Scientific Knowledge (WSK)

The Latin root *scientia* means knowledge. Largely, scientific abstractions began toward the end of the nineteenth century when the theoretical propositions of evolution, natural selection and kinetic molecular theories arose, and when logically consistent rules outlining how theories could be derived from empirical statements. Historically, the demarcation of scientific knowledge, commonly known as Western Scientific Knowledge (WSK) from other systems of knowledge has been made possible by the appeal of a scientific method, and through a subtle political sanction and privileging by Western Governments and institutions (Ogawa 1995; Snively and Corsiglia 2001). For the purpose of this thesis, conventional Western Scientific Knowledge is defined as a science, with one worldview which has purposeful and rational explanations, and set of systematic methods for understanding the physical world.

2.1.3 Conceptual Background: Defining Traditional Ecological Knowledge (TEK)

For the purpose of this thesis, Traditional Ecological Knowledge (TEK), is defined as a science with one worldview which has purposeful and rational explanations, and a set of systematic methods for understanding the physical world. As well TEK has been defined as "a cumulative body of knowledge, practice and beliefs, which have evolved through adaptive processes, and handed down through generations through cultural transmission" (Berkes 1999:8). TEK is based on "learning by doing" (Moller *et al.* 2004:3), or learning the land, and TEK is a knowledge system, like any other knowledge system, not to be considered anchored in time, and a knowledge base that has been passed on and augmented through generations by family and other close personal relationships.

2.1.4 Conceptual Background: Similarities and Differences between TEK and WSK

The distinction between TEK and WSK is problematic given the political nature of the dialogue. Agrawal (1995) argues that there are three common themes in the discourse around the perceived differences between TEK and WSK. The three themes are substantive, methodological, and contextual; although, the distinctions are largely artificial and framed for political purposes. Ironically, theorists and practitioners who attempt to remove the distinctions and political boundaries, succeed only in re-enforcing the very same demarcations. Agrawal (1995) suggests that TEK knowledge is developed through a close tie to practical experience on the land, while WSK is a knowledge which is developed through abstract analysis and largely divorced from practical land-based experience. As well, he identified that: a) TEK can be equally abstract, and WSK can be utilitarian; b) Philosophers and theorists have been unable to discern any real differences between WSK 'scientific' methods and TEK 'scientific' methods; c) TEK is conceptualized as being embedded in local space and time, while WSK is purported to be universal and timeless due to its 'scientific' method; and d) WSK has been proven, in its application to be inadequate in different social, cultural and political contexts; while TEK has proven it can move beyond the constraints of space and time to be universally applied. Agrawal (1995:31) concluded that when we focus upon how these two types of knowledge are similar, rather than on perceived differences, the political lines may be removed, and the disadvantaged might have their interests safeguarded.

TEK and WSK systems are perceived to have differences in philosophies and methods. For instance, it is assumed that where WSK is based on experiment, mechanistic, analytical, reductionist (delineates and demarcates), replication of results to generate theories and laws, observation is made by separation of the observer, and it depends on recorded (especially written) information to disperse knowledge. Conversely, TEK is perceived to be based on single observation (not replication), observations which are organized informally (rather than mechanistic), observations which do not necessarily determine which subsequent observations are to be made, observations made by direct engagement with an ecosystem, and knowledge transfer dependent upon oral

transmission. TEK is also perceived to be holistic in that it considers human phenomena as integral to the ecosystem where the human, natural and spiritual systems are inextricably linked (Guanish 1998; Roots 1998).

One of the common threads between the two systems is that each of the systems is dependent upon experts, each have components of systematic observation, and each build ecosystem knowledge by accumulating information using methods which are systematic or scientific. Perhaps the only substantive difference between the two knowledge systems is that within the TEK system, the experts are those with consistent and long term experience on the land; whereas, with the WSK system, the designated experts are those who are academically educated with the technical and theoretical skills to conduct experiments to test their own hypotheses (Roots 1998).

2.2 Conceptual Background: Cumulative Effects

Over the past three decades attention has focused on the concept of cumulative effects. Cumulative effects can be defined as the incremental and interacting impacts of anthropogenic land and resource use and development stressors upon ecological, social, cultural and economic systems. Predicting and mitigating the impacts of project specific development does not adequately assess or consider the nature of: a) linear incremental effects with interacting cause and effect response relationships; b) exponential effects which result from interacting incremental effects; c) impacts resulting from exceeding response thresholds; and d) compositional, structural and functional impacts that may induce long term perturbations in systems (Roots 1986; Sonntag *et al.* 1987; Contant and Wiggins 1991; Duinker and Greig 2006). Habitat fragmentation and loss, soil degradation, fish and wildlife species decline and losses, declines in water quality, changes in water yield, and climate change are but a few of the areas where cumulative effects are considered a driving force.

Cumulative impact assessment necessitates rigorous, comprehensive examination of how land and resource use and development effects incrementally interact with one another

spatially and temporally. Dube *et al.* (2006) have defined an effect as a statistically significant difference from the desired benchmark of an indicator (i.e. size at age, organ condition, species abundance). Commencing in 1975, cumulative ecological assessment has been a part of the land and resource management discourse (Williamson 1993). Although there are disputes over typologies and conceptualizing cumulative assessment frameworks, in general, there is agreement that cumulative assessment should: a) Incorporate larger spatial scales; b) Foster longer term planning; c) Be interdisciplinary; d) Include systematic monitoring; and e) Utilize adaptive management processes. Some advocates of cumulative assessment frameworks argue it is appropriate to address ecological, socio-cultural, and economic impacts (Contant and Wiggins 1991). Further, Tollefson and Wipond (1998) posit that to understand cumulative impacts the following must be considered:

- Similar and dissimilar development produce cumulative results;
- Impacts of development accumulate temporally and spatially:
- Accumulation takes place in both incremental and synergistic ways;
- System altering effects may occur immediately or in a delayed fashion, and may be much more than a simple addition of incremental effects;
- Some development is growth inducing and thus represents a significant impetus for future development.

In Canada, a cumulative effects assessment (CEA) is a requirement under the Canadian Environmental Assessment Act of 1995, section 16 (1) which demands consideration of "any cumulative effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out" (CEAA 1999). Cumulative assessment can be considered as a process which is designed to assess the sustainability of ecological values when developments which may compromise those values are proposed. As such, in the early 1980s, the term "valued ecosystem component" (VEC) was added to the land and resource management discourse to provide a focus for CEAs. In other words, rather than assessing whether a single development project has an unacceptable level of impacts on a specific VEC, the impact can be properly understood by systematically monitoring and assessing the incremental, and

interacting impacts of development stressors upon ecosystems (Smit and Spaling 1995; Duinker and Greig 2006; Dube *et al* 2006). In this vein, CEA may have the potential to provide decision makers the information required to develop in a sustainable manner (Lawrence 1997).

There are a number of areas of concern in regard to the requirements and practice of CEA in Canada, those are: a) CEA is currently an add on to most project level Environmental Impact Assessments (EIA) and thus cumulative effects are poorly assessed and understood; b) Proponents want project approval with minimal expense towards environmental protection; c) Ecosystem impact thresholds are difficult to determine; and d) Interpretations and competencies to undertake explicit systems analysis of the interactions between land and resource use and development is daunting and vexing at best (Duinker and Greig 2005).

2.3 Conceptual Background: Systematic Monitoring

Monitoring ecosystems is essential to identifying and measuring temporal and spatial responses or stressors upon baseline conditions or deviations from a desired trajectory. Suitably, a set of measurable indicators for monitoring should be established for assessment from a desired benchmark. The knowledge of Aboriginal peoples who frequent the natural landscape, over long periods of time, is seldom effectively used within land and resource use and management frameworks regardless of the fact that they may have valuable ecosystem knowledge constructed through ecosystem monitoring in a systematic manner.

Combining Traditional Ecological Knowledge (TEK), and Cree LBE ecosystem monitoring methods (expertise) with the conventional scientific paradigm (WSK) may provide a rich means by which we may fill information gaps to elicit comprehensive understandings of ecological system changes (Berkes 1998; Berkes *et al.* 2005; Mackinson 2001). Further, emphasis should be placed upon long-term socio-ecological

benefits, by incorporating cyclical adaptive processes which can be used to generate feedback indicators for sustainable social, cultural, ecological and economic systems (Dallmeier *et al.* 2002). The following paragraphs define and distinguish what systematic monitoring should encompass allowing for a more complete examination of Cree LBEs monitoring methods to take place (Chapter 5).

Appropriate systematic monitoring should be able to provide information which can be used to assess composition, structural and functional ecosystem components within an ecosystem. Consequently, systematic ecological monitoring should: 1) Incorporation of appropriate indicators; 2) Usage of diagnostic measures; 3) Assessment at an appropriate spatial scale, with a preference for local landscape level monitoring; 4) Assessment of indicators and attributes consistently (numerous times within the course of a year) over short (up to five years) and over long (from 6 to 50 years) periods of time (Cairns 1993; Cairns 2002; Dallimeier *et al.* 2002; Durell *et al.* 2005; Green *et al.* 2005; Langor and Spence 2006; Morellet *et al.* 2007). Systematic ecological monitoring should illustrate associations and relationships using a suite of indicators (Cairns 1993; Cairns 2002; Dallimeier *et al.* 2002; Durell *et al.* 2005; Green *et al.* 2005; Langor and Spence 2006).

Direct *in situ* local observation and monitoring allows for assessment of impacts and effects of ecological or social systems, "although, it is often difficult to establish cause-effect linkages" (Cairns *et al.* 1993:14). Observation and monitoring of ecosystem condition can be assessed through: a) Species at a individual or population level; and/or b) At the community/ecosystem level. Assessments made at the individual level "will tend to be better diagnostic, consequently they may serve well as early warning indicators" (Cairns *et al.* 1993:14). Alterations to the integrity or health of individual species, or 'biomarkers', can be a strong indicator, and used as early warning signs of negative effects at higher levels of biophysical organization within an ecosystem (McCarthy and Shugart 1990). Although, Cairns *et al.* (1993:15) purport that, "a suite of indicator species may be necessary to provide a comprehensive assessment of changes in ecosystem condition related to a multitude of important stressors".

2.4 Conceptual Background: Sustainable Development

Sustainable Development was coined in the late 1980's during the World Commission on the Environment, and since then it has been used for about twenty years by governments all over the world within land and resource use planning and management frameworks. Sustainable Development was defined as "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs." by the World Commission on the Environment and Development in 1988 (Brundtland Commission Report 1988).

The Cree of the study area may have their own rendition of sustainable development, which is, NAKATEHTAMASOYAHK OTE NEKAN NITASKENAN, meaning, caring for the land for the future. The future, for the purposes of this thesis, this is for "as long as the sun shines, the rivers flow, and the grass grows". These concepts and terms come directly from the people of the study area and are formed from their understanding of local ecosystems, their own needs, and the 'Treaty Promises' of 1899 (Treaty Commissioner 2007:17; Personal Communication 2008).

Chapter Three

Research Approach and Methods

3.0 Methods: Introduction

This research aims at answering the following research questions:

1) How do Cree land users construct knowledge about ecological conditions, and through what kinds of specific land-based activities (Chapter 5)?
2) What kind of ecological changes are Cree land users observing within their traditional territory (Chapter 6)?
3) What are the Traditional Use impacts that are resulting from changes to local ecosystems (Chapter 7)?

This chapter serves to divulge the research methods the researcher used to answer these research questions.

3.1 Methods: Perspectives of the Researcher

An important consideration in any research study is the role of the researcher, and the biases and world-view he/she brings to the research project (Seale 2004). That in mind, this section will provide an introduction to my views and how I came to work with the five Cree communities of the study area.

My earliest interest in environmental issues occurred when I started working for the Ministry of Forests in northern B.C. when I was fortunate enough to find myself working in Forest Research with a number of professional scientists who inspired my passion for sustaining ecosystem health. Following my work with forestry I pursued Environmental

Anthropology with a minor in Environmental Studies. My aim was to better understand the linkages between social and environmental systems. Finally, I pursued this Masters research because of my passion for environmental justice. Specifically, I am of the belief that local ecological systems are so inextricably linked to the health and well being of rural people who depend on the land for subsistence foods that if the ecological system has been detrimentally impacted then the health and well being of those people will also be detrimentally impacted in some manner. More recently, cumulative impacts have come to the forefront of the minds of land and resource managers, academics and local peoples in Alberta. Consequently when I arrived at the University of Alberta to engage in graduate studies I quickly became very interested in conducting research which examined social and environmental impacts of development to some degree. During my initial visits to the Lesser Slave Lake area I spoke to the five Chiefs in an attempt to scope out some of their concerns with land and resources, development and the well being of their people, and this is where my focus on the interrelationship of the local ecological conditions and the sustainability of local Cree Traditional Use emerged. Since initiating this research, I have been employed with three of the Cree First Nations as their Land and Resource Consultation Manger. This position has provided me with greater insight into the current and historical challenges these communities face in regard to land, resource and industrial development, without skewing my objectivity as a researcher.

3.2 Methods: General

This research study is grounded in assessing whether the Cree Land Based Experts of this study systematically monitored local ecosystems, and documenting their local observations, experience and interpretation of ecological conditions or changes resulting from cumulative impacts of development, which may result in ramifications for traditional food harvesting, access to and management of land and resources, and overall community well-being. Accordingly, I have engaged qualitative research with an empirical focus. An empirical focus has been actualized by engaging in twenty three qualitative interviews, which at times made use of indirect questions to determine whether the cohort's (Cree Land Based Experts) use systematic methods to monitor local

ecosystem conditions. Traditional Ecological Knowledge (TEK) lies at the core of this research by identifying how TEK may be well suited to provide a foundation for local landscape level ecological assessment via its consistent and long term ecosystem monitoring which serves to augment, via a learning feedback loop, TEK. Consequently, through TEK and its complimentary ecosystem monitoring methods (expertise) key indicators of ecological conditions and/or changes in ecosystem composition, structure and functioning may be gleaned in considerable detail.

By using a number of indirect questions, the link between what the researcher's objectives are, and the question actually asked is less obvious (Singleton and Straits 1999). Nonetheless, in this case, the researcher felt it would be appropriate to use indirect questions due to the esoteric nature of the term systematic monitoring. For instance, if the researcher (interviewer) posed the question: a) Do you systematically monitor; the respondents may not have known the meaning of the term. Consequently, indirect questions worked well to investigate and retrieve information on whether the respondents systematically monitor the environment when engaged in land based activities.

The community's constructed view of reality (of ecosystem structure and functioning) has become a filter which conditions the way ecosystem changes are experienced and managed at the local level (Duerden 2004). Analysis of this aspect of socio-ecological relationships illustrates complexities in the translation of ecological changes. In that regard, it seems clear that there is a need to better understand spatially and temporally contextualized community understandings of specific socio-ecological conditions, through case study research. Accordingly, this case study may serve to augment other case study research which examines local Aboriginal perceptions and experiences of ecological change. Although generalizations cannot be made on the basis of a single case study, case study research is a means by which exemplars may be used to support broader claims. Appropriately, "it is worth repeating the insight of Thomas Kuhn that a discipline without a large number of thoroughly executed case studies is a discipline without

systematic production of exemplars, and that a discipline without exemplars is an ineffective one" (Flyvbjerg 2004:432).

During the process of this research study, I have attempted to keep in mind: a) One cannot prove a theory; and b) Facts and claims are constructed (Seale 2004). Accordingly, I have continually assessed the quality of this research by: a) Examining how relevant the research question is for the community; b) Examining whether the claims made are plausible given existing knowledge; and c) Examining whether the credibility of the claims is supported by other evidence (Seale 2004). Following consistent examination, the research is: a) Relevant to the community as the community framed the research question; b) The claims made are plausible given the existing knowledge base (Davidson-Hunt *et al.* 2003; Duerden 2004; Moller *et al.* 2004; Parlee *et al.* 2005; Berkes and Turner 2006; Stevenson 2006); and the credibility of claims is supported by other evidence (Kofinas *et al.* 2001; Davidson-Hunt *et al.* 2003; Duerden 2004; Moller *et al.* 2004; Parlee *et al.* 2005; Berkes and Turner 2006; Chapa-Vargas and Robinson 2006; Damschen *et al.* 2006; Festa-Bianchet *et al.* 2006; Stevenson 2006).

Participatory Research (PR), where the community has focused the primary research question, has played a pivotal role in guiding this study. Accordingly, the five First Nations were asked, before the research commenced, what they wished the research focus to be. The was that they sought to answer: "In what ways can Lesser Slave Lake Cree demonstrate their effective stewardship of the land" (Personal Communication 2006c) so that they may be engaged in equitable participation of land and resource use and cumulative effects management decisions (Personal Communication 2008) which affect them. PR has developed within a growing interest and respect for Aboriginal knowledge, and challenges top-down approaches to research, development projects and extension (Chambers 1992; Goebel 1998). Participation of community members in guiding the focus of research is assumed to contribute to an enhanced process of democratization and empowerment (Cleaver 2001). PR theorists have attempted to abrogate the academic researcher as a collector of knowledge and scientific analyst; rather PR has placed the researcher in a position of facilitator of diverse local knowledge collection with

methodologies which emphasize interaction between the researcher and the research subjects (Goebel 1998). Further, this methodology attempts to imbue local knowledge with respect and place it on an equal footing with outside, particularly scientific, knowledge paradigms (Chambers 1991). Paradoxically, this methodological approach sometimes adopts a hegemonic discourse and can obscure, rather than illuminate social complexity, and validate a local dominant voice as the common monolithic local knowledge (Goebel 1998). This at the forefront of my research, I sought out other voices through ad hoc and referral solicitation, rather than just the voices of the identified key participants, which were identified by the Chiefs of the five Cree communities.

The title of this thesis is a result of the First Nation's primary research focus which was, "In what ways can we demonstrate that we are effective stewards of the land". During the focus group at Swan River First Nation, Bernice Smith and Dinah Chalifoux were teaching me about how they regard the land, consequently I requested that they teach me how to write and say "Caring for our Land for the Future" in Cree, which is indicative of how Cree Land Based Expert's (LBEs) both perceive their relationship to the land, and demonstrate how they are effective stewards of the land.

> (I): "You are teaching me and I'm going to use your Cree for my title of my thesis. Yeah, and I'll have to put your name there" (12 & 14, 28 September 2007).

> (8): "That's the thing with medicinal plants.....some of the medicinal plants are so sacred that when they are disturbed they don't want to grow there again.....The grandfathers used to say that to me that you know once they're disturbed, or they're used for the wrong purposes, that they will no longer grow in that area and I, and I believe that, and I've seen that...and my dad also had told me that. He said don't ever abuse these or, or bring somebody else in there that are going to abuse them, or you will no longer find them there. So, but I, I have noticed that they're, they're, they're getting harder to find" (8, 21 September 2007).

In addition, during the course of this research I have attempted to tease out the complexities of competing local knowledge, thus ameliorating the weakness this method may have, while keeping to the fore the validity of TEK. When initiating the research, I solicited the communities research focus, which was stated as "in what way can we

indicate our effective stewardship of the land to enable future generations to exercise their treaty rights" (Personal Communication 2006c). Terms and conditions for the research were set out in a research agreement between LSLIRC, the researchers, and the funding agencies.

3.3 Methods: Methodological Instruments

In-Depth Conversation Interviews

I used in-depth interviews with a total of twenty-three Cree Land Based Experts (LBEs), and a focus group mode of interviewing with an additional four LBEs, who served to provide the researcher with an opportunity to glean information on the way in which they systematically monitor their natural environment (local ecosystems) when engaging in land based activities. An in-depth mode of interviewing was chosen because it allows an interview question guide to be constructed and used a "conversational agenda", rather than a strict question and answer format (Gubrium 1993:13). Accordingly, during the course of the interviews, I let the question guide recede to the background while encouraging respondents for their relevant experiences, observations and practices on the landscape. Thus the data presented within this thesis is a result of the interviewer being attuned to how the respondent might engage effectively in a process of articulating their knowledge and modes of expertise in ecosystem monitoring. While engaged in this research, I found that LBEs did not conceptualize distinctions between ecosystems, ecosystem monitoring, and land-based activities, rather that they were imbricate within lived experience and learning the land. As such, my aim was to tease out what the interviewees had collapsed within their memories of their own land-based experiences. A hurdle I attempted to overcome while engaged in this research was the humility these Cree LBES seemed to have in regard to their ecological knowledge and expertise, and that they considered WSK scientists more knowledgeable, and ecological experts while they considered themselves simply keepers of trivial local knowledge. For example, one of the LBES interviewed stressed that "and to do that [measure contaminants in the

environment], you'd have to be a scientist. I haven't got that far; grade nine" (7; 22 August 2006:11).

Focus Group Interview

A focus group workshop using exactly the same questions used in the other interviews was used as a milieu for people who defined themselves as sharing an interest and value in the land and wildlife. Some benefits of this form of interviewing are that "a group can provide prompts to talk, correcting or responding to others, and a plausible audience for that talk that is not just the researcher" (Macnaghten and Myers 2004:65).

Interview Guide Questions and Presentation of Results

The following outlines the manner in which the results of twenty-three in-depth conversation interviews (including the use of one small focus group) are presented in chapters throughout this thesis: Largely, the interviews focused on three themes which are: a) Land-based activities - Chapter Five; b) Observations, interpretations and associations about local ecological systems – Chapter Six; c) How changes in the local ecosystems have affected Traditional Use – Chapter Seven; and d) Analysis and results of the systematic elements of Cree LBE ecosystem monitoring methods - Chapter Eight.

Questions Used to Glean Fluid Aspects of TEK Generation, and Ecosystem Monitoring Methods (Chapter 5)

Chapter Five uses a set of research questions which made use of in-direct questions, and conversation analysis to further understand: a) The evolution of TEK generation through a broadening of diversification of land-based activities; and b) Whether, Cree LBEs systematically monitor ecosystem conditions.

More specifically, these research questions were used to examine **what** land-based activities Cree LBEs engaged in, or the variety of land-based activities (including

Traditional Use and more contemporary livelihoods); where land-based activities occurred; **when** or the consistency and length of time spent engaging in land-based activities; and d) **how** land based activities occurred, including if Cree LBEs systematically monitored. Following are the research questions used to elicit the results of Chapter Five:

1) Can you tell me about three places where you have gone harvesting/hunting more than four or five times?
2) Why is this area or these areas good for harvesting/hunting?
3) Where to you go harvesting?
4) Will you show me on a map where you go harvesting?
5) What do you harvest/hunt for?
6) How many years have you been going to the place or places where you harvest?
7) Have you consistently been going to the place you have identified that you harvest/hunt?
8) Are there certain seasons that you go harvesting every year?

In asking questions 1-13 of the interview guide (above), I was able to elicit comprehensive data to determine whether these Cree LBEs monitored local ecosystems in a systematic nature (as defined in Section 2.4 of this Thesis). This question is one of the primary research questions of this thesis. Largely descriptive, the results presented in Chapter Five on systematic monitoring were teased out from testimony (evidence in support of fact or statement or a public declaration regarding some experience) of in-depth conversation interviews but were analyzed by the use of conversation analysis techniques and using indirect questions. Teasing out the exact details of whether, a person who is not considered a scientist, systematically monitors ecosystems is problematic, to say the least. For example, if the researcher posed the question: "do you systematically monitor", it is likely the interviewee would not know what the researcher was asking because the term systematic monitoring is esoteric. Consequently, the researcher asked indirect questions, which where also used to glean other results, and

used 'conversation analysis' techniques to determine whether the Cree LBES's interviewed systematically monitored. More specifically, the researcher used the mode of indirect questions and conversation analysis in an attempt to determine whether a host of land-based activities Cree LBEs were engaging in, are systematic in nature, although rarely explicitly formulated in words.

"The features of conversation analytic theory and method imply a systematic approach" and the "organization" and "interaction" with research participants "that distinguishes it from studies that rely on educated intuition, theorizing and ethnographic inquiry and the... coding of utterances" (Maynard and Heritage 2005). For example, Maynard and Heritage (2005:429) explain how participants rarely formulate their intended activities explicitly in words. For instance, we do not say, "This is a greeting: Hello, we simply say, Hello". Similarly, the LBEs who participated in this study did not explicitly state, I systematically monitored for the health (composition, structure and functioning) of fish, animals, plants and their habitats; rather, they explained in narrative form what their observations about the health of the fish, animals, plants and habitats were, and how they determined the same when they were engaged in land based activities.

When the interviewees were asked specific questions in regard to their activities around observations of fish, wildlife, and habitat the response of interviewees was forthright and no attempt was made to conceal a particular ignorance on the subject. Where specific or indirect ecosystem indicator questions were used, which attempted to deduce whether these LBEs systematically monitored, these questions were deliberately repeated and then verified with other subsequent interviewees. Further validation provided by way of the following survey questionnaire.

Questions Used to Glean Cumulative Ecological Impacts (Chapter 6)

To determine the results of the cumulative ecological impacts of development upon local ecosystems within the study area, which are presented in Chapter Six, I used the

following questions to elicit what the participants (Cree LBEs) observed through monitoring local ecosystems, and what associations they made:

9) Are the (berries, moose, medicinal plants) still good in the area that you harvest/hunt?
10) What are the signs/signals that the (berries, moose, medicinal plants) are still good or not good anymore?
11) Do you think things have changed in the areas that you harvest?
12) What are the signs/signals that indicated to you that things were changing or not?
13) When did you start to notice these changes in the environment?

Questions Used to Glean Traditional Use Impacts (Chapter 7)

To glean the results for any Traditional Use impacts resulting from development within the study area (Chapter 7) I used the following questions from the study guide:

14) How did you respond to these changes?
15) Has forestry, oil and gas, and the waste treatment plant development affected your ability to harvest in your Traditional Area?
16) Has forestry, oil and gas, and the waste treatment plant development affected your ability to access your Traditional Area?

Use of a Survey Questionnaire

A questionnaire was developed and dispersed to each of the twenty-three participants. Data from this questionnaire are used to support each of the in-depth interviews. The questionnaires are specialized to livelihood practices, for example, there were hunter and trapper questionnaires, plants and berry harvester questionnaires, and fishing questionnaires. A total of ten questionnaires were completed and collected.

General Techniques

Interviews were tape recorded with the informed consent of the residents. Typical interview duration was two hours, although the interviews ranged from one and a half to four hours. The tapes were later transcribed and the transcripts checked for accuracy against the recordings. Later, transcripts were analyzed and coded for categories of indicators of ecological change and systematic monitoring methods.

3.4 Methods: Recruitment

The recruitment method for this sample of twenty-three interviewees included initial referrals from the respective Chiefs (key informants) of the five Cree communities, followed by contacts offered by interviewees, as well as interviewees solicited on an ad-hoc basis. Out of a total of thirty to forty potential interviewees, I interviewed twenty-three participants, which were recruited deliberately using a non-random criterion, nineteen of which are to be considered individual interviews, and four others which were part of a group interview (focus group).

The interviewees were selected on the basis that they 'consistently' (regularly engaged in land based activities, including harvesting, multiple times each year) spent 'considerable' time on the local landscape (30 to 70 years); and thus they are to be considered local "Land Based Experts" (Personal Communication 2006b). "It is important to work with experts rather than randomly selected individuals in ecological studies that incorporate local knowledge". In this way, "expert local knowledge adds value to science by providing detailed insights into the ultimate causes of change, and by contributing a rare historical perspective" (Chalmers and Fabricius 2007:1). Throughout this thesis, I refer to the participants (interviewees) as Land Based Experts (LBES) due to: a) The substantive body of knowledge (TEK) which informs their analysis and decisions about the land; and b) the lengthy and consistent amount of time they spend on the land,

observing, monitoring and analyzing ecosystems. In this vein, I ascribe a substantial amount of expertise to their knowledge about the land (ecosystems), and their ecosystem monitoring methods (expertise), consequently, throughout this thesis I will refer to their narrative about their observations of local ecosystem conditions as 'testimony'; defined as evidence in support of fact or statement or a public declaration regarding some experience (Funk and Wagnalls 1980; Dictionary.Com 2007), rather than referring to their knowledge as perception or stories as used prevalently throughout the knowledge generation literature. I do this in light of the fact that TEK knowledge is shared, and publicly debated amongst leadership of the Cree communities of the study area (Personal Communication 2007), and in full recognition that this term is often esoteric within judicial arenas, because I believe that the risk of this knowledge being perceived as spurious in referring to it as perception.

Finally, by no means do I feel it necessary to account for the meanings which are associated with Cree LBE land-based observations, processes, experiences, interpretations or associations, given the recognition that there are socio-cultural meanings inherent within Western Scientific observations, processes, experiences, interpretations, and associations. Nonetheless, it may be important to acknowledge that a few of the reasons for Cree LBEs concern with ecological system integrity and health are: 1) Protection of their Inherent, Constitutional and Treaty Rights; 2) Preservation of their Traditional way of life; and 3) Concern about their own Health and Well Being which is inextricably linked to the health of local ecosystems (Personal Communication 2006a,b,c).

There are many different ways of garnering knowledge, contextualized tacit learning and de-contextualized constructed abstractions are just two, and in most societies it is common that these two forms of learning are integrated. Neither, practical experienced based knowledge accumulation or formal institutionally based knowledge accumulation is restricted to certain groups of people, ages or cultures. Such a focuses would pre-suppose a radical separation of scientific knowledge verses traditional knowledge constructed for political purposes (Harraway 1989; Agrawal 1995, Palsson 1998; Howitt

2001; Ribot 2002). Middle-aged people can be considered competent and legitimate LBEs if they have developed competencies and experience on the land (Davidson-Hunt and Berkes 2003). For this study, the participant's knowledge is situated in and informed by immediate contextualized tacit learning and experience through consistent (regular) and long term land based use, and many were middle aged. The LBEs who were recruited for this study were of a diverse range of age groups, harvested (hunt, fish, trap, or gather plants and berries) and engaged in more contemporary livelihoods (including forestry, agriculture, recreation). As well, many of the participants had a range of multiple livelihoods, for example, one was a small scale Agriculturalist, Forestry Worker, Hunter, and River Watch Foreman, and also engaged in harvesting.

Appropriately, while this sample may not be indicative (generalizable) to the local Cree population, the researcher prognosticates that it may well be indicative of the cohort of Land Based Expert. Of the twenty-three interviewees, four were female, sixteen were male, nine were in their 50's, seven were in their 60's and four were between the ages of 70 and 90. Males and females alike partook in hunting, trapping, fishing, plant and berry harvesting. Brief field notes were taken to document recruitment methods for each interviewee.

Table 3-1 Biographical Sketch of Participants

#	Time	Location	Interview Date (day/m/year)	Gender	Approx. Age at 2006 (* exact)	Livelihood(s)
1	50/Y	Driftpile	20/10/2006	M	60 (?)	Recreation, Hunter, Fishing, Berries, Land and Resource Manger for the Band
2	45/Y	Driftpile	20/10/2006	M	55 (?)	Recreation, Hunter, Fishing, Berries, Agriculture/Farming, Land and Resource Manager for the Band
3	60/Y	Sucker Creek	12/10/2006	M	*73	Trapper, Hunter
4	70/Y	Swan River	23/08/2006	F	*86	Trapper, Hunter, Berry Picker, Medicinal Plants
5	60/Y	Driftpile	10/11/2006	M	*68	Guide, Trapper, Hunter, Elder
6	30/Y	Driftpile	22/09/2006	M	*41	Contractor, Agriculture/Farmer, Hunter, Fisherman
7	45/Y	Swan River	22/08/2006	M	55 (?)	Hunter, Fisherman, Medicinal Plants
8	45/Y	Driftpile	21/09/2006	M	*52	Hunter, Trapper, Herbalist, Cultural/Heritage Manager for the Band
9	65/Y	Driftpile	21/09/2006	M	70 (?)	Hunter, Trapper, Medicinal Plants
10	20	Driftpile	21/09/2006	F	60 (?)	Medicinal Plants, Berry Picker, Trapper
11	45/Y	Kapawe'no	11/11/2006	M	60 (?)	Hunter, Commercial Fisherman
12	40/Y	Swan River	28/09/2006	F	*62	Berry Picker, Medicinal Plants
13		Swan River	28/09/2006	M	60 (?)	Hunter
14		Swan River	28/09/2006	M	60 (?)	Medicinal Plants, Agriculture/Horses
15		Swan River	28/09/2006	F	65 (?)	Berry Picker
16	50/Y	Driftpile	22/09/2006	M	65 (?)	Agriculture/Farmer, Forestry, Hunter, River Foreman

17	45Y	Sucker Creek	16/11/2006	M	58	Agriculture/Farmer, Guide, Commercial Fisherman, Hunter, Trapper
18		Swan River	21/09/2006	M	65 (?)	Medicinal Plants
19		Sawridge	28/09/2006	M	*73	Elder, Fisherman
20		Sucker Creek	10/11/2006	M	*97	Elder, Hunter, Trapper, Fisherman, Guide, Agricultural, Forestry
21	20/Y	Sucker Creek	11/11/06	M	75 (?)	Hunter, Berry Picker, Medicinal Plant Harvester, Fisherman, Elder
22	30/Y	Swan River	08/11/2007	M	*39	Chief, Hunter, Fisherman, Plant and Berry Harvester
23	20/Y	Sucker Creek	11/11/06	F	60 (?)	Berry Picker, Medicinal Plant Harvester

Chapter 4

Background and Research Setting

4.0 Background and Research Setting: Introduction

A brief discussion in Section 4.1 follows in regard to three interrelated subjects, 1) The mosaic of Industrial and resource development within the study area; 2) Five local Cree communities, and the infringements and impacts which competition for land and resources poses for those Cree communities; and 3) the Boreal Mixwood forest which encompasses the development and people. Following is Section 4.2 which provides a portrait of the Cree people of the study area, Section 4.3 is a briefing of development within the study area, Section 4.4 discusses development and the provincial government's responsibilities to Aboriginal people's in regard to land and resources, and Section 4.5 is a portrait of the bio-geophysical environment of the study area.

4.1 Background

4.1.1 Background: Development and Aboriginal Peoples

Land and resource development and exploitation has historically, following World War II, created profound economic, social, cultural and environmental impacts upon Aboriginal people in Canada due to the intensification and interactive effects of industrialization and exploitation of natural resources. In most cases, these disruptions seem to be linked with increased stressors associated with rapid change over which an Aboriginal community has had very little control because of outside government authority (DesBrisay 1994).

Land and Resource development remains an issue with the Cree of this study area given the pace and intensity of development in the study area, and the on-going lack of participation and control over land and resources due to the entrenched regimes of the

currently governing structures and institutions (Personal Communication 2008). The Cree leadership of this study area acknowledge that the Government of Alberta has been developing a number of frameworks which seek to inform and guide land and resource use and cumulative effects management in Alberta. Like the provincial government, these Cree people have a keen interest in finding anchored, long-term solutions to land and resource issues such as:

- Land and resource use conflicts, and competing land interests;
- Affirmation and invocation of Treaty Promises and Treaty Rights which were derived from the Treaty Promises
- Comprehensive integrated resource management planning and management;
- Cumulative effects planning and management, and;
- Integration of land, wildlife, air and water planning and management.

Within the context of Aboriginal, Constitutional and Treaty rights and interests (hereinafter referred to as rights and interests), and a desire for healthy sustainable Cree futures, these Cree communities are interested in generating effective mechanisms which serve to address their rights and interests by anchoring all concepts and information used for decision making in regard to land and resources (directly bound to the health of their people) within an appropriate framework. This framework must make provisions for: a) Addressing the land and resource rights and interests of Alberta's Aboriginal peoples; and b) Equitable decision making processes between Aboriginal governments and other governments, including the Government of Alberta (Personnel Communication 2008).

4.1.2 Background: Land and Resource Rights, Interests and Consultation

There is a disparity in the understanding and interpretations of the text and obligations of *Treaty 8 1899* between the Cree of this study area and the Government of Alberta (Treaty Commissioner 2007; AFNCG 2007; Personal Communication 2008). The Cree of the study area have indicated that their Elders understanding of Treaty 8 promises and

provisions, particularly those in regard to hunting, fishing, trapping and plant harvesting rights, reserve land, social services, education and once for all expenditures differ substantially from those of the Government of Alberta, and the Government of Canada (T8FN 2006; Personal Communication 2006b; Treaty Commissioner 2007; Personal Communication 2008). In the post treaty period, and especially since the transfer of control over natural resources by the Federal Government to Alberta in 1930, there has been a steady erosion of treaty promises experienced, as a result of land and resource use, resembling that of a new settlement frontier. In 1984, the minister of Indian Affairs and Northern Development Canada, David Crombie, met with a number of Chiefs from Treaty 8 and agreed to commence negotiations for the implementation of Treaty 8 rights and promises (Madill 1986). To date, negotiations for the implementation of Treaty 8 rights and promises are still active and have achieved little success (Treaty 8 2006; Personal Communication 2008).

In September 2006, the Government of Alberta (GOA) released its *First Nations Consultation Guidelines on Land Management and Resource Development* (Consultation Guidelines) including ministry-specific guidelines for four ministries. Alberta intended the guidelines to provide administrative procedures to carry out the duty to consult and direction to all parties involved in consultation. On September 14, 2006 the Assembly of Treaty Chiefs of Alberta unanimously rejected the GOA's Consultation Guidelines (Resolution 2006). Since the rejection, the Cree of the study have developed their own Land and Resource Use Consultation Guidelines. The Cree peoples of the study area "accept that federal and provincial decision-making and economic development in Alberta will affect them in both positive and negative ways. They do not seek immunity, but do seek to be full participants in decisions around land and resource use and cumulative effects assessment and management decisions that affect them. They seek to ensure that their rights are respected, so as to mitigate harmful ecological and socio-cultural (including Traditional Use) impacts, and to maximize beneficial economic (and other) effects" (ICRCC 2007:6).

4.2 Setting: Portrait of the Lesser Slave Lake Cree Nations

The communities of Sawridge (population 60), Swan River (population 1,073), Driftpile (population 705), Sucker Creek (population 2,337) and Kapawe'no (population 91) border the south and southwesterly shores of Lesser Slave Lake, Alberta. The current settlements are all reserve lands settled around the time of the signing of Treaty 8 in 1899. Geographically, (except for Kapawe'no) the reserves fall between the towns of Slave Lake to the east and High Prairie to the west on Highway 2, and are bordered to the north by Lesser Slave Lake, privately owned agricultural land, and Crown land. Kapawe'no is located slightly to the north west of Lesser Slave Lake. Currently, there is a dearth of literature about northern Alberta's Cree people. A number of researchers Short (1989), Sinclair (1999), Candler (1999), Siegfried (1994) and Mader (1996) have examined various aspects and issues with northern Alberta Cree, nonetheless, only Pyc (1998) has explored the relationship between Traditional Use and local ecological systems in any detail. Consequently, the information I will provide in this chapter in regard to the Cree people of Lesser Slave Lake provides but a glimpse.

4.2.1 Setting: Early History

The Lesser Slave Lake Cree are Western Woods Cree who have occupied the boreal forest in Alberta since the mid eighteenth century (Smith 1978). Commencing in the 1870's there were many requests from missionaries, fur traders and Aboriginal peoples for a treaty in the Athabasca and MacKenzie regions. Nevertheless, the federal government did not proceed with northern treaties until land and mineral resources in these areas were coveted by settlers and developers, ultimately providing the catalyst for proceeding with Treaty 8. The Cree of the Lesser Slave Lake area held a meeting in January of 1890 to consider the benefits of the proposed treaty. With reports of hardships in the area at this time, a large majority of those present at the meeting had been reported to be in favour of a treaty (Madill 1986).

By 1898, when the federal government was finally preparing for a treaty, conditions had improved for the bands south of Lesser Slave Lake, thus Cree apprehension regarding the loss of hunting, fishing and trapping rights, and being restricted to reserve lands was prevalent. It was these concerns which were actively voiced by Aboriginal peoples that were debated by the treaty commissioners and departmental authorities in 1998 (Madill 1986). Nevertheless, when the terms and conditions of Treaty 8 were drafted following the Lesser Slave Lake negotiations, they largely resembled those of Treaty 7 although Treaty 8 at lease partially, reflected the recognition that the Aboriginal peoples in the area wished to continue traditional economic activities; specifically, hunting, fishing and trapping. Conversely, Treaty 7 referred to the protection of the "vocations of hunting" while Treaty 8 provided for the "right to pursue their usual vocations of hunting, trapping and fishing throughout the tract surrendered" (Canada 1966; Madill 1986). Under the terms of the treaty, many Elders of Treaty 8 agreed to share the land rather than surrender the land. It has been argued that the treaty commissioners did not explain the implications of the provision "the said Indians do hereby cede, release, surrender and yield up....all their rights, title and privileges whatsoever, to the lands..."(Daniel 1979). On June 21, 1899, the eighth treaty between the Indians of North America and the Queen of England was signed. Treaty 8 was the most comprehensive treaty, encompassing a land mass of approximately 840,000[2] kilometers, which is currently home to thirty-nine First Nation communities. Treaty 8 territory encompasses areas in Northern Alberta, Northwestern Saskatchewan, Northeastern British Columbia, and a southwest portion of the Northwest Territories (Treaty 8 2006).

In Canada, jurisdiction over land use and the exploitation of natural resources was turned over to the provincial provinces in 1930 (GOC 2006), consequently, often the fulfillment of federal treaty promises, particularly hunting, gathering, fishing and trapping rights have come into direct conflict with the provincial government's natural resource and land use development initiatives (Daniel 1979; Personal Communication).

When the Sawridge Band requested a reserve in 1911, "area settlers protested the allocation of good agricultural land,....moreover, that the Indians should be allotted a

single block of land outside the area already surveyed, leaving the good agricultural land open for settlement". Similar accounts of conflicts regarding settler's protests occurred at Swan River, resulting in the band losing sections of their reserve land (Jackson 1979; Madill 1986:84). The bands in the Lesser Slave Lake region generally selected reserve land for the adjacent areas which were known to be good hunting, trapping and fishing areas. Local bands which attempted agricultural pursuits often failed due to a lack of support from the Indian Affairs Department; following which settlers applied more pressure on the bands to "surrender their land to settlers who might put it to better use" (Madill 1986:86).

The fulfillment of treaty obligations, in particular, those regarding hunting, fishing, trapping and gathering has resulted in much controversy and conflict. Treaty 8 Aboriginal peoples are of the understanding that in return for signing Treaty 8 and sharing lands, their economic system was to remain fully intact and protected (Madill 1986; Halcrow 2006; T8FN 2006; Treaty Commissioner 2007:19), for "...as long as the sun shines, the grass grows, and the rivers flow...". These concepts and terms come directly from the people of the study area and are formed from their understanding of the 'Treaty Promises' of 1899 (Treaty Commissioner 2007:17; Personal Communication 2008). The extent, however, to which the provincial and federal governments have imposed restrictions on Treaty 8 Nation's access and ability to continue Traditional Use and Livelihood Practices, has been, since the signing of the treaty an issue of much debate (Madill 1986; Laboucan 2006; T8FN 2006).

Specifically, the discourse and text around the terms and conditions of the treaty produced a disparity in interpretations, regarding the obligations which the federal government was to incur, particularly those regarding Traditional Use and Livelihood, which differ substantially between the signatories of Treaty 8 and the government (JTT 2006).

4.2.2 Setting: Recent History

By 1898, Christian church led residential schools attempted to educate and assimilate Canada's indigenous peoples, dispossessing them of their own language's and culture and replacing it with the English language, Christian religion and other features of Euro-Canadian culture. Residential schools in Canada increased from a few in 1840 to 54 by 1898, 74 by 1920, and to a high of 81 by 1946. Operators of these schools have been charged with several offences against Aboriginal students including sexual abuse, physical abuse, and the cultural genocide (Thomas 2003). "Plaintiffs contended that the treatment students suffered in residential schools caused them extreme emotional anguish that lingered on for years, often resulting in confused personal identities, alcoholism, and the inability to engage in productive activities" (Thomas 2003:333).

Following the Second World War, the federal government commenced extending social services, technological developments, infrastructure and housing programs to the Cree and other Aboriginal peoples of northern areas. Emergency welfare became available which helped to supplement traditional subsistence foods and staples (Smith 1978).

4.2.3 Setting: Religion

Missionary work began in the mid nineteenth century, and by the twentieth century the population integrated Christianity with Cree traditional beliefs and practices (Smith 1978). Cree religious beliefs have been poorly understood. Nonetheless, it has been documented that their beliefs have included that Manitou's spirits inhabit all living and non-living things. Manitou's were revealed in dreams, providing the dreamer special powers or protection. In addition, many had their medicine bundle which contained herbs and objects imbued with spiritual power (Smith 1978). Some Cree of the Lesser Slave Lake area have a belief in the "White Buffalo Calf Woman" who will appear to emancipate them from under great burdens (Califoux 2006).

4.2.4 Setting: Political Organization

"On June 21, 1899, the eighth treaty between the Indians of North America and the Queen of England was signed and ratified by Order in Council #363. The signatories of Treaty 8 agreed to its terms for reasons of peace and friendship - ensuring what they thought would be a partnership. Treaty 8 was the most comprehensive treaty, encompassing a land mass of approximately 840,000 kilometers, and is home to 39 First Nation communities. Treaty territory covers the areas of Northern Alberta, Northwestern Saskatchewan, Northeastern British Columbia, and the Southwest portion of the Northwest Territories" (Treaty 8 2006:home).

Locally, the communities of Sawridge, Swan River, Driftpile, and Sucker Creek are governed by an elected Chief and Council, while Kapawe'no has an appointed government. Provincially, the Treaty 8 Tribal Council and the Provincial Government of Alberta (respectively), also provide some voice to political issues; while federally the Government of Canada is also politically tied.

4.2.5 Setting: Socio-Economic Organization

The Lesser Slave Lake Indian Regional Council (LSLIRC) was established in 1971. Its purpose was born out of the desire to improve economic and social conditions of the Cree people in the Lesser Slave Lake area. On the historic date of August 13th, 1979, a 'Master Agreement' was signed between the local Cree and the Department of Indian and Northern Affairs Canada (INAC). Beginning on April 1, 1980, the Lesser Slave Lake Indian regional Council (Regional Council) exercised certain powers over the administration and delivery of certain programs and services, thereby creating their own management regime (DFN 2006b).

4.2.6 Setting: Socio-Ecological Organization

The Cree people of the four nations and one band south of Lesser Slave Lake may be characterized within an inextricably integrated, complex and dynamic system of relationships amongst the people, and the land (wildlife, plants, and habitats). A tenacious commitment to maintaining a healthy and harmonious relationship with the land which "ensures utmost measures are taken to maintain her integrity", and where the people are "stewards of the land and guardians of Traditional Areas" is prominent and forms part of the frequent political leadership discourse (Laboucan 2006).

In this vein, in 2006 the LSLIRC led the movement for the five member nations of LSLIRC to establish an Environmental Protectorate Division which was formally established in 2007. The objectives outlined for this Division include accomplishing at a minimum the following: a) Integration of different knowledge systems (TEK and WSK) to accomplish sustainable management of the unique ecological challenges of the Plains Boreal forest; b) Addressing cumulative landscape level effects of land and industrial development, and resource exploitation; c) Managing natural hazards; d) Managing natural forest pests; e) Managing transitions from natural forest mosaics to fragmented landscapes which have placed stressors upon the hydrological, flora and faunal systems; f) Managing climate change; and g) Ensuring incidental water rights.(LSLIRC 2007).

4.2.7 Setting: Demographics

Following are selected demographics, including a Community Well Being Index for the Driftpile, Sucker Creek, Swan River and Kapawe'no First Nation. Information on population and well being index for the Sawridge Band was not available at the time of the writing of this thesis.

The Community Well Being index (CWB) is a product of Indian and Northern Affairs Canada's Research and Analysis Directorate. It was derived from the 2001 Census and is a means of measuring well-being in Canadian communities. It combines indications of

income, education, labour force activity, and housing conditions into a single number or "CWB" score. CWB scores may fall anywhere between zero (0) and one hundred (100). A score was generated for each community that participated in the 2001 Census, allowing an "at-a-glance" look at the relative well-being of those communities. Note that the scores are not reported for communities with fewer than 65 inhabitants or those with data quality issues (INAC 2008).

The geographic location of each of these reserves is between 55 and 60 degrees latitude, they are located within 50 Km of the nearest service centre to which it has year-round road access (INAC 2007e), and they are nestled on the south and south west edges of Lesser Slave Lake, Alberta.

Driftpile First Nation

The Driftpile First Nation is situated 30 kilometers west of Swan River. The Reserve itself is over 15,000 acres in size and sprawls along 10 kilometers of shoreline on the south side of Lesser Slave Lake (DFN 2006a). Access to the Driftpile First Nation is via a primary Highway #2 and a railway (Rail links). This community is also accessible by water (which is no longer used for transportation purposes) from the Lesser Slave Lake and Driftpile River (DFN 2006d). As of December 2002, Driftpile has approximately 2012 members affiliated with the Reserve. Approximately 35 % (705) reside on Reserve and 65 % (1,307) reside off Reserve (DFN 2006d).

Treaty Commissioner McRae visited the Lesser Slave Lake area in the summer of 1900 and laid out temporary Indian Reserve Boundaries for the Driftpile Band and other surrounding communities. The first survey of the Driftpile Indian Reserve No. 150 took place in 1901. This survey identified a landmass of approximately 13,504 acres for Chief Kinosayoo, Councilor Wechewasis and their immediate followers, at the southwest end of Lesser Slave Lake and along the Driftpile River. By Order in Council dated January 8, 1904, 21.10 square miles comprising 'Driftpile River reserve No. 150' were 'confirmed' and subjected to 'the jurisdiction of the Department of Indian Affairs' (DFN 2006c).

An additional 2,460 acres were later surveyed and allocated in 1912 for those members who were missed on the original Annuity Pay list in 1901 bringing the total to 15,964 acres.

From 1899 until 1910, the entire population of Treaty Cree around the Lesser Slave Lake area was listed initially on a single annuity pay list as members of one single band named Kinasayoo. Band Members at that time were allowed to move between Reserves freely. This situation persisted until 1929 when the Department of Indian Affairs sought to reduce the confusion and administer the five groups into their own regions separately, and the five separate groups exist today. Today, these five groups are the Kapawe'no, Sucker Creek, Driftpile and Swan River First Nation, and the Sawridge Band.

Table 4-1: Driftpile Community Well-Being Index (INAC 2006b)

Highest ALBERTA Community Score	96
ALBERTA Non-First Nations Average Score	84
Driftpile First Nation	**66**
ALBERTA First Nations Average Score	60
Lowest ALBERTA Community Score	41

Sucker Creek First Nation

The registered population of on and off reserve Sucker Creek First Nation members, as of December 2007 was 2,337.

Table 4-2: Sucker Creek Community Well Being Index (INAC 2008)

Highest ALBERTA Community Score	96
ALBERTA Non-First Nations Average Score	84
Sucker Creek First Nation	**74**
ALBERTA First Nations Average Score	60
Lowest ALBERTA Community Score	41

Swan River First Nation

The registered population of this First Nation for on and off reserve members, as of December 2007 was 1,073.

Table 4-3: Swan River Community Well Being Index (INAC 2008)

Highest ALBERTA Community Score	96
ALBERTA Non-First Nations Average Score	84
Swan River First Nation	71
ALBERTA First Nations Average Score	60
Lowest ALBERTA Community Score	41

Kapawe'no First Nation

In 1901, two years after the signing of Treaty 8, three reserves were created around Kapawe'no - Freeman to the north of town, and Halcrow and Pakeshan to the west. In 1970, these three reserves amalgamated to form Kapawe'no First Nation reserve, which today is still governed by tribal custom (Kapawe'no FN 2007), as of December 2007, Kapawe'no First Nation has a registered on and off reserve population of 304 (INAC 2008).

Table 4-4: Kapawe'no Community Well Being Index (INAC 2006d)

Highest ALBERTA Community Score	96
ALBERTA Non-First Nations Average Score	84
Kapawe'no First Nation	Unavailable
ALBERTA First Nations Average Score	60
Lowest ALBERTA FN Score	41

The Sawridge Band

The Sawridge Band "is a role model in Native self-government, self-sufficiency and entrepreneurship", and its "major objectives are to create jobs and to be self-sufficient, and to create an economic base not dependent on government contributions or depleting resources". The Sawridge Band is located within, and around Slave Lake, Alberta and its lands total 24,000 ha. (LSLIRC 2005:11).

4.3 Background: Development in the Study Area

In Alberta, the Crown holds the majority of the lands, Alberta Sustainable Resource Development manages the surface resources through fighting forest fires, managing fish and wildlife, overseeing the development of Alberta's forests, and managing the use of public lands, while Alberta Energy manages the development of sub-surface minerals and energy resources. Forestry is Alberta's third largest Industry sector next to Oil and Gas and Agriculture. For the purposes of this research study, I examined the cumulative ecological effects, which has carved out a scarred mosaic of development (Oil and Gas, Forestry and Alberta's Special Waste Treatment Centre) within the study area's Boreal Forest.

4.3.1 Oil and Gas Development

Alberta produces about 70% of Canada's crude oil and 80% of its natural gas accounting for $275 billion in direct and indirect industry employment revenues (CAPP 2008). The Swan Hills area of Alberta was pioneered by the forest and oil and gas Industries. There is currently a large area covered by oil and gas infrastructure including roads, pipelines, powerlines, well sites, risers, compressors, and seismic lines, some of which date back to the late 1950's (TAFS 2006). The Swan Hills area encompasses an oilfield which is the third largest oilfield deposit in Canada, consequently, the oil and gas industry forms the largest economic sector in the region with major industry players including Devon Canada Corporation, Penn West Energy Trust, Apache Canada Ltd., Shell and Gulf. In

1957 Home Oil (purchased by Devon Canada Corporation) was the first company to begin drilling oil in the area and since then they have produced over 530 million barrels of oil and 37 million cubic feet of natural gas per day from the field. Penn West Energy Trust is the largest land holder and leases 45% of the oil and gas field which they are currently developing (Town of Swan Hills 2008; Personal Communication 2006b).

4.3.2 Forestry

Forests cover nearly 60% of Alberta or 38 million hectares of forested land, and less than 1% is harvested in any given year, or approximately 23.1 million cubic meters is allocated for the annual allowable cut (AFPA 2008). The Forest Reserve System was implemented in the early 1900's in Alberta. Early surveys under the first *Forest Reserves Act* of 1906 designated 6.2 million acres in Alberta as Forest Reserves rather than settlement areas. The first areas in Alberta designated under the reserve systems were Cypress Hills, Cooking Lake and the entire Southeastern Slopes. Later, forest surveys were extended in 1915 to areas covering a wide band including the boreal forest from Lac La Biche west through Lesser Slave Lake and Whitecourt to the British Columbia border, and north through to Peace River.

Alberta uses three types of forest tenure systems: 1) Timber Permits; 2) Timber Quotas; and 3) Forest Management Agreements (FMA). Timber Quotas and the FMA are granted for 20 year periods with an option for renewal. The FMA is an area based agreement, while the Quota affords the holder the right to harvest a percentage of the Annual Allowable Cut (AAC). Both agreements are forged between the Province and a Forest Industry company. The FMA gives the rights to establish, grow, harvest and remove timber from an area of land which is guided by a (10 year) Detailed Forest Management Plan. The Timber Quota is based upon environmental performance and practice, managed by the province and guided by an Annual Operating Plan of the Forest Industry company (Alberta SRD 2001). Forest Industry companies currently operating in the study area are Tolko Industries, Alberta Plywood, Buchanan Lumber, and Vanderwell. The Swan Hills area was pioneered by the Forest and Oil and Gas Industries with existing forest cutblocks which date back to the historic two pass harvest system commencing

around the early 1980's. The approximate area of previous harvest is 1,940 hectares, of that roughly 56% was harvested between 1985 and 1989, 34% between 1993 and 1998, and 10% in 2002 making the most historic cutblocks approximately 22 years old. Forest stands in the area typically reach 160 years old at succession (TAFS 2006). Alberta's forest industry generates annual revenues of almost $8.4 billion, with 54,000 jobs for 50 communities where forestry is a primary industry (AFPA 2008).

The following forestry organizations operate in the study area. Millar Western which harvests north of the town of Swan Hills and harvests an annual quota of approximately 165,000 cubic meters (Town of Swan Hills 2008).

Buchanan Lumber owns and operates a dimensional stud mill and finger joint plant in the town of High Prairie with an annual quota of approximately 760,000 cubic meters (some shared with Tolko) derived from forests largely out of the study area, but with some overlap (General Development Plan 2007a).

Slave Lake Pulp Corporation (SLPC) commenced operations in 1991 where the surrounding forests provide both hardwood and softwood to sustain the mill's 210,000 air dried metric tones (ADMT) annual pulp capacity for the production of paper, board and tissue. SLPC was awarded a Forest Management Area (FMA) of approximately 630,000 ha in the upper and lower foothills, and the central Mixedwood forest with an annual quota of about 541,021 cubic meters. Alberta Plywood Ltd. Owns and operates a combination veneer plant and sawmill in Slave Lake, and quotas are derived largely from the Swan Hills region with annual quotas around 600,000 cubic meters (General Development Plan 2007b).

Tolko Industries Ltd. operates a oriented strandboard (OSB) mill located at Mitsue Industrial Park approximately 20 km. east of Slave Lake. Annual quota supplying the mill is at approximately 602,543 cubic meters of deciduous wood from stands located within the study area (General Development Plan 2004).

Vanderwell harvests approximately 520,000 cubic meters annually derived from stands within the study area to supply a sawmill located 20 km. east of Slave Lake that produces lumber, dry shavings, softwood chips and wood pellets (General Development Plan 2007c).

4.3.3 Alberta Special Waste Treatment Centre

The Alberta Special Waste Treatment Centre (ASWTC) is located on a half section of land (130 ha.), on the west half, Section 6, Township 67, Range 8, west of the fifth meridian, in Swan Hills and was developed in the late 1980's (1987) to provide hazardous and special waste treatment services for Alberta. Initial development included a variety of waste treatment processes including incineration for organic waste, chemical treatment for liquid inorganic wastes, stabilization for treatment of inorganic solids, a landfill for solid treatment residues, and a disposal well for treated liquids. The treatment centre was then expanded in 1990 and then again in 1991/92 to increase incineration capacity, and to add a furnace for Polychlorinated biphenyls (PCB) of which manufacture was banned in 1977 in the United States (US). In 1994 an application was made to accept waste from all Canadian jurisdictions, and following a public review, the facility was authorized (Bovar 1997). However, the approved expansion was fraught with "inconsistencies, defects, and issues that went unaddressed in Chem-Security's application for expansion". Specifically, the application for expansion lacked information on geo-physical bedrock fracturing, local hydrological processes, and ozone, soil and vegetation contaminant inputs, all of which has the potential to negatively affect fish, wildlife and human health (Bowal and Ingelson 1995). The ASWTC is the only stationary incinerator licensed to dispose of PCB wastes in Canada (Blais *et al.* 2003).

A mechanical failure of a transformer furnace occurred on October 16, 1996 resulted in the release of an unknown quantity of polychlorinated biphenyls (PCBs), dioxins, and furans into the airshed. Alberta Health and Alberta Environmental Protection conducted a health risk assessments that included an estimation of human population exposure (Alberta Health 1997) and the potential health risks for wildlife and human biological

tests by examining impacts on air, vegetation, soil, surface water, groundwater and wildlife within a 25 km. radius of the centre (Blais *et al.* 2003). As well, following the incident Alberta Health issued a health advisory recommending limiting the human consumption of wild fish (6 oz./week), and wild game (13 oz./month) harvested within a 30 kilometer radius of the ASWTC (Alberta Health 1997). A long term environmental and human exposure monitoring program has been ongoing since 1998 to continue to monitor PCBs, dioxins and furans in human blood, and fish and wildlife tissue samples. In June 2004 the *Swan Hills Waste Treatment Centre: Long Term Follow-Up Health Assessment Program 1997-2002* (SHWTC:LTFHAP) report was released. Final results of that report indicated that human blood contaminant concentrations were similar in 2001 to 1997, and that contaminant concentrations in deer were similar in 1999 and 2001 as they were in 1997. Recommendations from the report included that the wild game food advisory should continue (Alberta Health and Wellness 2004).

4.4 Research Setting: Development and the Provincial Government

While the economic benefits of land, resource and industrial development have undoubtedly been beneficial for non-Aboriginal people in the study area, the environmental, social and cultural risks for Aboriginal people have been the subject of some controversy since development intensified in the 50's and 60's (Personal Communication 2006b). Land, resource (forestry, oil and gas, agricultural) and industrial development (toxic waste treatment) in this region is located within the Traditional Territory of the local Cree of the Lesser Slave Lake Indian Regional Council (LSLIRC), consequently, any negative impacts caused by development substantively affect the community members of these Cree who use these lands for social, cultural and economic purposes. At present, the cumulative effects (social, cultural, economic and ecological) of development on these people, including their health and well being is not well understood. A number of efforts have been made to bring this to the attention of both the provincial and federal governments who have both fiduciary and jurisprudential responsibility to Aboriginal peoples.

The Alberta Government implemented its Aboriginal Consultation Policy in May 2005, and it's Consultation Guidelines in September of the same year. As well, after one full year in use, the provincial government has reviewed its Guidelines and will be releasing a new set of Guidelines at the end of 2007. The Government of Alberta maintains its role is: 1) To determine whether to delegate the responsibility to consult to Industry, and then to take the position of assisting in the process; 2) To review and decide on the adequacy of Industry led consultation; and 3) To inform Aboriginal peoples and Proponents about its decisions (AFNCG 2007).

First Nation people living in this region have guaranteed distinctive rights through the Treaty 8 Agreement (1899) with the Government of the Dominion of Canada, and these rights have been entrenched within subsection 35(1) of the *Constitution Act* (1982). As well, the Supreme Court of Canada (SCC) has determined that Aboriginal and Treaty Rights "can only be infringed upon by the Crown under strict conditions" (CIRL 2007:1). Nonetheless, it is the position of the majority of the Treaty 8 Aboriginal peoples of Alberta that the province of Alberta is not fulfilling its constitutional duties and jurisprudential obligations to meaningfully consult with Aboriginal peoples in regard to land, resource or industrial development within their Traditional Territories (Personal Communication 2006b; NAFA 2007). Generally, it is the contention of the Cree of the study area that the Government of Alberta is using its Consultation Guidelines as a tool to assist in land and resource decision making, and not as an instrument for protecting the distinctive rights of Aboriginal peoples. As well, the operational delegation of consultation to Industry, significantly limits addressing Alberta First Nation's rights and interests, while at the same time serving to circumvent the Alberta Government's duty to consult by inducting the Alberta Government into a neutral position (Personal Communication 2008).

Local Aboriginal communities engaging in Traditional Use (subsistence strategies) may be particularly vulnerable to ecological perturbations induced by development given development often exacerbates impacts upon fish, wildlife and habitats used for Traditional

Use activities (subsistence harvests). Engaging in subsistence practices requires the access to and use of intact healthy ecosystems for appropriating wholesome plants, berries, fish and wildlife. A number of authors (Aharonian 1994; Rode and Shephard 1994; Young 1996; Fast and Berkes 1998) have argued that communities dependent upon foods derived from local ecological systems may be exceptionally vulnerable when ecological systems are governed and managed by outside control. Supplementary to this, changes in land use and the exploitation of local resources, which are positively correlated to local ecosystem degradation, often exacerbate socio-cultural impacts, including those at the nexus of local subsistence harvests. This case study research will divulge a number of these concerns as they are embedded within the contemporary context of the study area. Specifically, I bring to the forefront the need to better evaluate the Traditional Use and ecological cumulative effects of the oil and gas, forestry and contaminant treatment industries in the region. It is my aspiration that this research will advance more appropriate and just ecosystem management policies and regulations, with a tendency for upholding the distinctive rights (see Glossary of Terms) of the local Cree people, and sustaining the integrity and health of local ecosystems.

Ecological and human health risks are interdependent because humans depend on the natural environment for food and water. Consequently, ecological degradation may result in increased human health risk due to a number of bio-chemical and physical changes to terrestrial, hydrological, and tropospheric systems (Lubchenco 1998; Suter 2007). Systematic ecological monitoring is critical to the maintenance of the integrity and health of valued ecosystems, and especially those which provide the means for procuring subsistence resources (Traditional Use). Accordingly, the use of TEK and the complimentary methods Cree LBEs use to monitor the composition, structure and functioning of local ecological systems may provide much needed critical data towards informing land and resource use decisions for advancing sustainable healthy ecosystems, and affiliated Aboriginal subsistence harvests. Local Aboriginal practices and knowledge about ecosystem dynamics are embedded in a learning feedback loop (Berkes *et al.* 2000). This process of knowledge generation provides for a variety of ecological indicators, and accounts of how industrial and resource development may be affecting

ecological integrity and health. Local Cree who have historically shared the use of Swan Hills, Alberta and area have been observing and monitoring ecosystems for generations. Consequently, these Land Based Experts have obtained and built upon their knowledge base of local ecosystem composition, structure and functioning through what appears to be systematic monitoring from which indicators of ecological integrity, health and change have been identified. Although ecological monitoring was developed for and has been embedded in TEK systems (Alcorn and Toledo 1998:239; Berkes and Folke 1998:13; Berkes 1999), it may be appropriately applied contemporaneously in serving to enhance land and resource management in a complementary manner.

4.5 Research Setting: Bio-Physical Environment

The study communities are located in the Athabasca River Basin, within the Dry Mixedwood (Sucker Creek and Kapawe'no) and Central Mixedwood (Sawridge, Swan River, and Driftpile) sub-regions of Alberta underlain with soft sedimentary bedrock. High phosphorus, calcium and magnesium phosphate content in soils originating from alkaline parent materials is a reflection of the sedimentary rock underlying much of the region. Soil genesis resulting from downward clay leaching as a dominant soil forming process results in Luvisolic soil dominance. Low drainage rates of these fine textured soils commonly results in poorly drained peatland formation, occupying a significant spatial area over the region (ESWG 1996; Smith *et al.* 2003; Downing and Pettapiece 2006).

The Central Mixedwood subregion physiography and geomorphic features consist of undulating plains, with some hummocky upland with equal proportions of morainal, lacustrine, and fluvial parent materials. Forest overstory cover is largely closed canopy mixedwood, aspen (*Populus tremuloides*) dominant in early seral stages, white spruce (*Picea* glauca) increasing with age; jack pine (*Pinus banksiana*) common on sandy sites; black spruce (*Picea mariana*), Larch (*Larix laricina*) common on extensive peatlands. The dominant understory species associated with average moisture and nutrient regimes

are low bush cranberry (*Oxycoccus mycrocarpus*), prickly rose (*Rosa acicularis*), green alder (*Alnus crispa*), Canada buffaloberry (*Shepherdia canadensis*), bunchberry (*Cornus canadensis*), wild sarsaparilla (*Aralia nudicaulis*) and dewberry (*Rubus pubescens*). Wetlands cover approximately 40% (largely bogs) and 3% lakes and streams. Major soils are Orthic Gray Luvisols, Brunisols on sands, and Mesisols, and some Fibrisols and Gleysols in wetlands (ESWG 1996; Downing and Pettapiece 2006).

The Dry Mixedwood subregion physiography and geomorphic features include undulating plains and hummocky uplands largely with morainal and lacustrine parent materials. The forest can be characterized by a co-dominance overstory of aspen (*Populus tremuloides*), balsam poplar (*Populus balsamifera*), and white spruce (*Picea glauca*). Understory dominant shrubs and forbs include low-bush cranberry (*Viburnum edule*), beaked hazelnut (*Corylus cornuta*), prickly rose (*Rosa acicularis*), red-osier dogwood (*Cornus stolonifera*), marsh reed grass (*Calamagrostis canadensis*), Canada buffalo-berry (*Shepherdia canadensis*), wild sarsaparilla (*Aralia nudicaulis*), dewberry (*Rubus pubescens*), cream-colored peavine (*Lathyrus ochroleucus*), common pink wintergreen (*Pyrola asarifolia*), and twin-flower (*Linnaea borealis*). The subregion includes 3% lakes and stream cover and is also liberally spotted with wetlands (15%) including the typical occurrence of nutrient poor acidic bogs which are dominated by black spruce (*Picea mariana*) and peat moss (*Sphagnum spp.*). Major soils in this area are Orthic and Dark Gray Luvisols with Brunisols occurring on sands, while wetland soils are Mesisols and Gleysols (Downing and Pettapiece 2006).

A list of larger mammal species likely to be found in the study area and traditionally important to local Cree include Beaver (*Castor canadensis*), Black Bear (*Ursus americanus*), Coyote (*Canis latrans*), Grey Wolf (*Canis lupus*), Grizzly Bear (*Ursus arctos*), Lynx (*Lynx canadensis*), Moose (*Alces alces*), Mule Deer (*Odocoileus hemionus*), Porcupine (*Erethizon dorsatum*), Red Fox (*Vulpes vulpes*), River Otter (*Lontra Canadensis*), Striped Skunk (*Mephitis mephitis*), White Tailed Deer (*Odocoileus virginianus*), and Wolverine (*Gulo gulo*). Two of these species, Grizzly Bear (*Ursus*

arctos), and Wolverine (*Gulo gulo*) are provincially listed as "May be at Risk", and federally they are listed as species of "Special Concern" (Downing and Pettapiece 2006).

Chapter 5

Study Results: TEK Construction

5.0 Introduction: TEK Construction

The primary purpose of this study is to increase understanding of TEK as an important source of knowledge about ecosystem conditions and to reveal the potential of TEK and Land Based Expert (LBE) ecosystem monitoring methods. Within this chapter, I demonstrate through land-based activity results: a) How TEK continues to be constructed using more diverse land-based activities, including Traditional Use and more contemporary livelihoods (Section 5.1.1); and b) How the construction of this knowledge is constructed by making use of systematic ecosystem monitoring elements (Sections 5.1.2 – 5.1.6).

In demonstrating how the generation of TEK has evolved through a diversification of land-based activities (Section 5.1.1) these results revealed that the sharing and transfer of knowledge through Elders, grandparents, and parent's wisdom has traditionally been transmitted through direct, consistent, and lengthy experience on the land, together while hunting, fishing, trapping, berry and medicinal plant harvesting and many other Traditional Use practices. As well, the testimony shared in this section by these Cree LBES has revealed, in some detail, how Traditional Use activities are now commonly integrated with more contemporary livelihood land-based activities such as Agriculture, Commercial Fishing, Guiding, and Land and Resource Managers to construct TEK. These Cree LBEs ecological knowledge is a complex process of learning the land through observations and monitoring expertise over decades is fluid and the sharing and transfer of that knowledge occurs over generations, and is shaped by socio-cultural traditions.

Appropriate systematic monitoring should be able to provide information which can be used to assess composition, structural and functional ecosystem components using indicators which highlight current conditions or changes within that ecosystem. Consequently, systematic ecological monitoring should: 1) Incorporation of appropriate indicators; 2) Usage of diagnostic measures; 3) Assessment at an appropriate spatial scale, with a preference for local landscape level monitoring; 4) Assessment of indicators and attributes consistently (numerous times within the course of a year) over short (up to five years) and over long (from 6 to 50 years) periods of time (Cairns 1993; Cairns 2002; Dallimeier *et al.* 2002; Durell *et al.* 2005; Green *et al.* 2005; Langor and Spence 2006; Morellet *et al.* 2007). Systematic ecological monitoring should illustrate associations and relationships using a suite of indicators (Cairns 1993; Cairns 2002; Dallimeier *et al.* 2002; Durell *et al.* 2005; Green *et al.* 2005; Langor and Spence 2006).

Chapter Five uses a set of research questions (below) which made use of in-direct questions, and conversation analysis to further understand: a) The evolution of TEK generation through a diversification of land-based activities; and b) Whether, Cree LBEs monitor local ecosystem conditions in a systematic manner:

1) Can you tell me about three places where you have gone harvesting/hunting more than four or five times?
2) Why is this area or these areas good for harvesting/hunting?
3) Where to you go harvesting?
4) Will you show me on a map where you go harvesting?
5) What do you harvest/hunt for?
6) How many years have you been going to the place or places where you harvest?
7) Have you consistently been going to the place you have identified that you harvest/hunt?
8) Are there certain seasons that you go harvesting every year?

Teasing out the exact details of whether, an individual, or group of individuals who are not considered scientist(s), systematically monitor ecosystems is problematic. For example, if the researcher posed the question: "do you systematically monitor", it is likely that the interviewee would not understand what the researcher is asking because the term systematic monitoring is esoteric in nature. Consequently, the researcher asked the questions about land based activities (above) which are general in nature, and made use of indirect questions to draw out whether the Cree LBE's systematically monitored. Thought provoking was that a number of the participants did not consider themselves to be a Land Based Expert (LBES), for instance, one of the LBES interviewed stressed that "and to do that, you'd have to be a scientist. I haven't got that far; only grade nine" (7, 22 August 2006); while others considered themselves local experts given they spent lengthy periods of time on the local landscape on a consistent basis "You don't have to be a specialist to know these things"..."You could see things; look at the difference between in the spring and in the fall and, you know, the trees and all that, you know. It's different..." (18, 21 September 2006:12). Nonetheless, I argue, as others (Neis *et al.* 1996; Kofinas *et al.* 2001; Mackinson 2001; Riedlinger and Berkes 2001; Gill 2003; Mackenzie River Basin Board 2003; Duerden 2004; Kitson 2004; Lyver and Gunn 2004; Moller *et al.* 2004; Parlee *et al.* 2005; Berkes *et al.* 2007) have that community level knowledge (TEK) and expertise is valuable, and can be usefully applied to inform land and resource use decisions.

In extrapolating the results from shared testimony (evidence in support of fact or statement or a public declaration regarding some experience) some of the detail and key findings may be lost; nonetheless, within this chapter the author will make every attempt to: a) Present the testimony in the voice of the LBEs to ensure that what was shared (the evidence/results) was accurately captured; and b) Provide the reader with as much detail as possible on the information the LBEs (participants) were sharing.

5.1 Results: Fluidity of TEK Construction

In this section are the results of TEK Generation which are presented in Sections 5.1 below with a discussion following in Section 5.2. This chapter presents the results under the sub-sections of: a) What types of land-based activities (including harvesting and more contemporary livelihoods) the participants engaged in (Section 5.1.1); b) Where (key areas) land-based activities occurred (Section 5.1.2); c) When (consistency and length of time) they spent engaging in land-based activities (Section 5.1.3); and d) How (including monitoring indicators) land based activities occurred (Section 5.1.4).

Chapter Six of this thesis will present the results of ecosystem conditions (cumulative effects) elicited from the research questions 9-13. In Chapter Seven, presents the results of questions 14-16 which serve to reveal how any changes in the environment, possibly resulting from development, have affected the Socio-cultural systems of the Cree LBEs. Finally, Chapter Eight is a presentation of the conclusions, some discussion of these research results and its applicability, and opportunities for further research.

5.1.1 Fluidity of TEK Construction: Diversification of Land Based Activities?

Cree Land Based Experts have engaged in Traditional Use (TU) including hunting, trapping, berry and medicinal plant harvesting and fishing, within the study area for generations. While other more contemporary livelihood activities (forestry, agriculture, and land and resource management, and archaeological and ethnobotanical protection for the Bands) have also brought many of these Cree people (about 50%) more recently onto the land. All of these land based activities, whether it is through engaging in TU, or through more contemporary livelihoods, has enabled: a) Opportunities to monitor and observe local ecosystem conditions; and b) The integration of information gathered to form new and better understandings of local ecological systems resulting in the augmentation and evolution of TEK. TEK is a knowledge system which is not to be

considered anchored in time, and one which provides a knowledge base that has been passed on through generations by family and other close personal relationships.

These results reveal that, more recently, TEK has evolved through the diversification of land-based activities by the use of more contemporary livelihoods to further learn the land (monitor ecosystems). It is through these experiences, that TEK is now also passed on, and where this form of specialized knowledge continues to evolve. While this section provides only a few glimpses of what type of land-based activities Cree LBEs now engage in through Traditional Use and contemporary livelihoods much of the data from this research supports that the evolution of TEK generation is now through a diversification of land-based activities. The following excerpts from transcribed interviews (page numbers noted) provide some accounts of **what** land based activities Cree LBEs engage in; while at the same time a number of observations of environmental change are noted.

In general, much of the information from these study results has indicated that Cree LBEs have a strong relationship to the land. This strong relationship often impels a certain approach to how Cree LBEs harvest, and in how other land based activities are conducted. For example, one of the LBEs from Swan River spoke passionately about how he and his people used to use every part of the animal they harvested, because of the respect they had for the animal (21 below); while another (18 below) LBE described the respect for the natural environment he was taught, and how it is still taught to the local Cree, and that everyone should have the same respect.

> (21): "You know, like a long time ago there was no government, everybody had a lot of things cause they shared things. You could go hunting anywhere because what you killed, you used. You used everything, the horns, you know, the hooves.... And now the government here, if they were to do something, I would say respect not only us, every Nation, but respect Mother Earth..... Mother Earth put this here for us to use, but not for destruction; that's [destruction] is getting carried away" (21, September 2006: 10).

> (18) "I would say respect not only us, every nation, respect Mother Earth. They use these things, you know. Mother Earth put this here for us to use but not for destruction. That's getting carried away....That's where everything comes from; respect that you have to give something back. You can't just take, take all the time. It's not good to do that. Even

> if I was to take, take all the time, I'd pay for it in the end but you're not supposed to do that, you know. That's how, I guess that's how we were taught long time ago to these days, it's still the same" (18, 21 September 2006:10).

A number of the participants (LBEs) provided accounts of their early childhood experiences with their grandparents, parents, siblings and friends, where they spent substantial amounts of time engaging in harvesting, and other forms of Traditional Use. For example, a LBES from Driftpile who has hunted all his life, prefers to camp out when he hunts. Early on his father taught him about wildlife behaviour, and **how** to watch for wildlife sign.

> (6): "Quite a bit of stuff my dad used to tell me too, like about the, the moose and their habits like and stuff. Like in, how they make a dry cow. Like it's a, dry cow is made, when it doesn't mate, if a cow doesn't mate when she's two years old, then she won't mate..... Like that, she'll stay that way for the rest of her life, so that's, what makes a dry cow". "There's kind of, you know, there's a lot of things I've, a lot of things I always had to watch for when I was a kid growing up, sign eh. My dad always used to call it sign. He always watched for sign, then you know there's moose in the area when there's, you could see their little nibbling on a trees. You got to watch for stuff like that and tracks". "There's a campsite in there that's actually, it's not really a good place but I mean it's a campsite, right? (I: Yeah) You camp there and you hunt around the area. That's, that's the way I do things" (6, September 22, 2006:5-6).

A hunter, a guide and an herbalist from Driftpile, who is considered a LBES, and who works for his First Nation trying to protect important cultural and heritage sites, explained how his father was a specialist in traditional medicines and very early on **how** he taught his son about local medicinal plants.

> (8): "I've gone there a lot of times to hunt and also to gather medicinal plants which I, I was taught by my father. He was a, a herbalist in, in traditional medicines and that's where we, he, he'd take me down there and he showed me how to pick them, strict plants that go in there, that only grow in that area so that's, that's where I go and gather as well" (8, September 21, 2006: 1).

An Elder and LBES from Sucker Creek and was born in 1934, by the time he was 10 years old he was learning how to live "off the land" from his father, and he explained

how "it's really a different lifestyle that we live today". His father "showed me the lifestyle of an Indian, where we would trap and hunt and, you know, our transportation at that time was by foot or, you had dogs for packers, or you had dogs for sleigh dogs". "My dad used to talk about having cabins up there but where, I don't know. The time that I used to go out with him was, you know, we slept outside. You know you got to crawl under the blanket, the blanket wasn't very big either but you know you wake up, you sleep under the blanket, you wake up in the morning, you toss a whole bunch of snow off if it snowed during the night". Later on when roads were put in for forestry and oil and gas development he explained that they no longer used sleigh dogs and horse drawn wagons "Like, you know, when, after wagon and team like in the, I guess '55 or whenever we started using trucks to go hunting where we didn't have to go by wagon, eh, cause there was lots of roads made". One of the animals he and his father used to trap was squirrels. "Actually, you know, roughly you'd bring home about five hundred squirrels in one, two weeks, yes. Anywhere from there like, we used to have pictures where, you know, after they were dried up and everything, you'd put a snare wire through their nose and then you know string them along and we had them all over the place". "Like when they go out on the trapline, you know, the mostly what they'd take is bannock, maybe a little flour and lard and sugar. The rest is from the bush, from the land. And they were healthy, eh. You walked maybe three, three, four nights before you get to the place where you're going"... "You sit in a moose lick and at night waiting for the moose come in and there's mosquitoes, holy man; no repellent, nothing. It was a tough life, but it was a good life". "You were in shape that time. This was, you know, this was part of our life". "Like to me like, you know, like the Indian way of surviving was off the land. Now to me like it's not there anymore (3, October 12, 2006: 1,2, 6, 9,11).

Another Elder, hunter and medicinal plant collector from Driftpile explained how "the only place we go to is when we're going sit in the lick, us guys, salt licks... and that's where we go and wait for our moose" (5, 10 November 2006: 8).

The most elderly [97] of the LBES who were interviewed in 2006 shared his experiences of how he hunted, trapped and fished.

> (20): "Like I'd been hunting quite a bit myself. I killed lots of moose. I've been guiding twenty-five years for Americans. Seen a lot of moose and a lot of beaver. That's what we used through the summer, us Indian people, eh. About two, three times one summer they would have to go in the bush with a family, killing the moose and drying meat there. No fridge, nothing out there now. Years ago it was nothing, eh. Now you start having the fridge, cooler, everything. You got now fridge eh. You can put your meat in it. Used to do that, some of the people used to go to the muskeg, put their, your meat in there, eh. It cold, muskeg always cold eh. Yeah. That's where they used to put their meat and that's why they had to go dry some meat through the summer, eh. That's only way you can keep the meat, dry, eh".... "I mean I'm just, I'm only 97 right now and I noticed since I was, you know, something in the, go out in the bush or a farm or go to work or I live there, I learned a lots, eh. That's where I learned quite a bit from my mother. My dad was died in 1918 of the flu. Used to be lots of stuff to eat, lots of fish. You have to go fishing, the same as my mother have to go help and in the summer used to go in a boat, rowboat and I used to go through the winter, chop the ice and put the stick just like a jigger, eh, push that, make a hole and where there's fish, when they're fishing pull the line out, used to leave a rope in there, eh. Next time you just put the, chop the ice and put it in again, eh." (20, 10 November 2006: 2).

While some LBEs continue to build upon their Traditional Ecological Knowledge (TEK) through more Traditional Use Practices (TUP), others harmonize their TUP, including moose hunting, with other more contemporary livelihoods which serve to provide additional opportunities for LBEs to build upon their knowledge of local ecosystems. TEK has provided a foundation of knowledge for Land Based Experts. As well, TEK has been augmented through greater access to other forms of environmental knowledge, including Western Scientific Knowledge (WSK); consequently, Traditional Ecological Knowledge (TEK) and Traditional Use continues to evolve through more traditional systems, but also through more contemporary mechanisms.

For example, one of the LBEs who has a position similar to a Land and Resource Manager for the Driftpile Band provided some insight as to how his more contemporary livelihood position, which brings him regularly onto the land, and which incorporates WSK, provides him with the opportunity to build upon his local ecological knowledge (TEK). Amongst the information he shared was the way in which his experiences within his Land and Resource position and his continued experiences with harvesting moose continue to enable his ability to

monitor, observe, build upon his knowledge and continue to learn about local ecosystems.

> (2): "The bear is also a concern where there used to be a lot of bear hunting in this area just south of us but we negotiated with Fish and Wildlife to try and reduce that cause they used to just shoot them right from, right beside the highway or right off the road and now we kind of, I haven't seen that in the last four or five years cause we've been campaigning to try and reduce the bear kill near the high, near the roadways"... "The people are not aware as to what they've destroyed and once it's destroyed, it's very, very seldom that it'll re-grow and I find it ironic that the province is not really accepting the traditional land studies that are taking place by First Nations and that it is an important document to our people. As well, industry should be more aware as to the importance this document is to us so that they're informed"... "My reason to hunt was to provide her with the traditional foods that she was accustomed to so that's, a lot of people still go out there and hunt, provide for their families. It hasn't changed. (2, 20 October 2006:3,8).

For example, one Cree LBE, started hunting as a child with his father, then was a guide for many years, and now has cattle and horses, and grows hay crops, near Driftpile Reserve. Through integration of Traditional Use, and a more contemporary livelihood, agriculture/farming, he was able to witness over the past 40 years that water yield (level) of Lesser Slave Lake has fluctuated substantially since he was a child while farming with his father.

> (16): "Well that, we just make hay there. We cut hay for our cows. We got cows". (I): Okay, hay. So that's gonna be yellow. (16): "I got sixty cows, well not cows, calves, a couple of bulls". (I): How long have you been in that area making hay for the, for your cattle? (16): "Since when I was a kid. I used to help my dad cause I, I was a fat chubby kid and I was the one that used to stand on top the sloop and pack the hay down when we were, cause we used to do it by hand, eh, with horses and we had, there was a thing called a sloop and it had a front, made out of wood, two skids and then there's rails like, eh. Then we just piled the hay on there and I was the one on top that shaped it and then we'd, we'd pull it to another stack and then we had a cable that put through the hay, eh, and my, my dad and my brother would hold that and we had a big crowbar like and there was a little chain on the end of that cable and they'd hold it and my mom would drive the horses or I would jump down and drive the horses away and pull that sleigh, pull that sloop out and it'd settle down. It was a lot, it was labour intensive, well there wasn't nothing else to do. Yeah. And then when we had four or five or six of them stacks lined up ,we'd get a wagon and then we'd put the hay in there and then I'd climb back up and then we'd make one long stack and

> that's how they'd stay and then we'd make a fence cause we had a bunch of horses running around loose, eh, that belonged to everybody and whoever claimed them I guess" (16, 22 September 2006: 1,2).

Another LBE who makes his home near Sucker Creek, has hunted and trapped in the area since he was about 5 years old with his grandfather in the early 50's, and later in the 60's and 70's was a commercial fisherman, and since 1979 has engaged in small scale agricultural pursuits (cattle, horses and haying).

> (17): "Well, I started hunting when I was well pretty young. About five years old I can remember going out with my grandfather setting snares, hunting squirrels, stuff like that. Well it would have been in the later 50's"..... "My grandfather had a trapline just across the highway here, Highway 2. I kind of inherited that or I bought it off an uncle and then I traded that for a trapline in the Swan Hills".... "Well I guess I hunt year round. I shouldn't say hunt year round. If I need the meat, I'll go hunting"..... (I): When did you start farming? (Ron): "Well I guess it depends on how you look at farming. I've had horses before I had cattle. I've had cattle now since 91". (I): And when did you start having horses? (17): "Mmm, in the 70's..... Like, but in the 60's and early 70's we used horses. We went south on horseback and that's where we packed our animals out there".... "I used to go commercial fishing with the guys in Joussard". (I): When did you do that? (17): "Probably the 60's and 70's, 60's and, yeah, 60's and 70's" (17, November 16, 2006: 1,2,4,8,9,11).

An Elderly woman of the age of 86, originally from between Jousard and Sucker Creek, and later Kinuso, started picking Blueberries (*Vaccinium myrtilloides* and *Vaccinium caespitosum*), Cranberries (*Oxycoccus microcarpus*), Saskatoons (*Amelanchier alnifolia*), High Bush Cranberries (*Viburnum opulus*), Choke Cherries (*Prunus virginiana*), Pin Cherries (*Prunus pensylvanica*), and Raspberries (*Rubus idaeus*) with her family, when she was a little girl, in Swan Hills. As well, she also harvested medicinal plants with her mother, including Mountain Ash (*Sorbus scopulina*), Rat Root (*Acorus calamus*) and Yarrow (*Achillea millefolium*). Later, in 1943 when she got married, she trapped and snared rabbits. Her accounts of harvesting berries and medicinal plants, and trapping provided lively narrative, and expert testimony.

> (4): "Well, around August, we used to go out and pick blueberries; like the middle part of August. We picked blueberries, cranberries, and low bush cranberries, high bush cranberries, all kinds of berries we used to pick. There

> were some choke cherries by the river, we picked them, but now you can't do that". (I): When did you start doing that? (Margaret): "We've been doing that ever since I was a little girl. I can remember picking blueberries because, my mom used to can them, but now, I don't think there are any blueberries at all in Swan Hills, they're all dead". "I used to trap too! Oh yes!! I used to be proud if I caught more squirrels than my husband". "Oh yes, one time I was snaring a rabbit, and I heard something behind me, and I looked, and there was a bear, right behind me close by, mouth and teeth. I said, Hello Mr. Bear, how is Mrs. Bear, and he just took off" (4, August 23, 2006: 1, 5, 6).

One of the Chiefs, a hunter, fisherman, and berry and plant harvester who was born and raised in Swan River, was asked; "now with your job, I will call it, do you go out on the land still? With your job, not with just hunting, but with your job, do you do that"? He responded that he does go out on the land still, and he expressed his deep concern about the amount of development in the Swan Hills area and how development is affecting his people. The Chief was quoted as saying, "I guess so, with being a Chief, it doesn't just end at the end at being 4:30 of your work day. So, anytime when I am out there hunting I'm still a Chief and I still observe what's happening out there. Especially in my main favourite hunting areas that are being logged out constantly, and with new wells, new roads and so on. Both I guess, I am out there personally, and I can't go out there as not being a Chief".

> (22): "I do mostly allot of hunting and prior to our hunting we'll sometimes fish in the creeks and rivers. Uh, where we fish and where we hunt in and around those areas where we, say if we shoot a moose, there is always berries around of some type so we always munch on some berries before we, before we dress the moose I guess. Fishing is the same thing, the odd time we'll come across some berry patches, but a majority I guess is hunting. Then again I classify hunting as hunting moose, fish, hunting for medicine, hunting for berries, so hunting is very, very general, so I can't really pin point it to that I hunt moose"
> (22, 08 November 2007: 1).

Another LBES who is approximately 60 years of age from Driftpile and is a hunter, fisherman, berry harvester, recreationalist and a Land and Resource Manager for the Band provided lengthy and spirited accounts of some of his experiences and knowledge about the land.

(1): ".... it was more of a nomadic lifestyle where our parents, grandparents lived seasonally, you know. So depending what season it was, whether it was fall, well that's when you went and hunt and gathered. (I: Right) Whether it was early fall, well then you did your berry picking, your medicine gathering cause that's when things were starting to dry and you did it before the nutrients went back into the ground, as well as a lot of the hunting that was done was at saltlicks, you know, where animals would come to get away from bugs and so then it was an area that a lot of our Elders would go and sit and do their calling and get their game, as opposed to the way it's done now. And then we also travelled in a team of horses and so we'd camp in certain areas for a length of time to cure the meat or cure the berries or give the animals a rest. So it was a lot of different sites that we'd end up being at for a short length of time and most of the time along a river. So if we were along a river, depending on the season, you could fish if the fish were spawning. They used to build weirs I think they were called for in the modern sense so you could trap the fish and basically catch them by hand if you wanted to and then you'd dress them, smoke them, you know, so that would be the reason why you'd be in one area for a long time. So really the lifestyle then was basically with the four seasons and depending on what season it is, you did different activities and most of it was camping, hunting, fishing..... "I spent a lot of time in the river swimming as a kid and it was always so nice when you could dive and it was so clear underneath, the Drift Pile River, yeah. It was so clear that you could see the different sands, the grains, the coals that grow underneath and now today it's just so silty that it's totally different, as well as the lake. I used to go and camp out at the lake with my grandfather who they used to call Joe. He used to camp by the lake and cut hay in the traditional fashion so I used to go and help him and spend a lot of time there and he'd set a net and when you set the net, you could actually see the bottom of the lake was very clear, very clean" (1, 20 October 2006: 1,4).

A Cultural and Heritage Manager for the Driftpile Band who is 52 years of age is also a hunter, trapper and Herbalist and teaches cultural camps for the youth during September of each year. This LBES seemed very adept at integrating knowledge gleaned from his professional and traditional experiences and observations on the land for more than 45 years.

(8): "I used to hunt a lot in the Swan Hills area, Freeman Lake area, and just further east, no further west in the Virginia Hills area. I've, I've gone there a lot of times to hunt and also to gather medicinal plants which I, I was taught by my father. He was a, a herbalist in, in traditional medicines and that's where we, he, he'd take me down there and he showed me how to pick them, strict plants that go in there, that only grow in that area so that's, that's where I go and gather as well"..." "I'd say since I was about eight years old [when he started]".... "So, I have my culture camps in, in September in the breeding season because the skills we pass on to the young people are, are skills that they need to know to, to, to be hunters themselves and we teach them, we teach them how to build their own

birch bark and we teach them different moose calls and techniques and stuff" (8, 21 September 2006: 1,10).

5.1.2 Fluidity of TEK Construction: The Use of Ecosystem Indicators – How?

Appropriate systematic monitoring methods should, through the use of appropriate previously identified indicators, provide data for "analysis of compositional, structural and functional attributes at various levels of biological organization" (Cairns 2002:145) and how those might change at that level, over time and space (Cairns 1993; Yoccoz *et al.* 2001; Cairns 2002; Dallimeier *et al.* 2002; Durell *et al.* 2005; Green *et al.* 2005; Langor and Spence 2006; Morellet *et al.* 2007). Using a single species to evaluate the integrity and health of an ecosystem or phenomena affecting an ecosystem can be meaningful if conducted appropriately (NRC 1981; Cairns 2002). Accordingly, using a number of species indicators, which are culturally valued (i.e. moose, various berries, or medicinal plants), to test the general conditions of integrity and health of over the landscape level, is useful. Evidence from these data, through analysis, demonstrates that these Cree LBEs systematically monitored 'cultural keystone species' (Garibaldi and Turner 2004) as key indicators, to determine the integrity and health of local ecosystems, while engaging in subsistence harvests (hunting, fishing, gathering, and harvesting medicinal plants) and other land based activities (forestry, agriculture, recreation, guide, trapper, commercial fishing, and verifying occupancy). Further, these results reveal that the primary types of ecosystem attributes (using condition indicators) monitored by Cree LBEs were: a) species abundance and trends; b) species population dynamics; c) species body condition; d) critical habitat abundance and condition; and e) water quality and yield. Interestingly, these ecosystem attributes are not dissimilar to those monitored and assessed from a Western Scientific perspective (Mackenzie River Basin Board 2003; Dube *et al.* 2006).

These results provide a number of accounts of the use of 'cultural keystone species'; coined by Garibaldi and Turner (2004); which are species of high cultural value used to identify the compositional, structural and functional condition of local ecosystems. A

number of the cultural keystone species which are identified below are moose, rabbits, squirrels, berries, and medicinal plants. These species are monitored for largely for their abundance and condition, but also for determining population dynamics. Or, as one LBE articulated, he looks for "sign".

> (6): "There's kind of, you know, there's a lot of things I've, a lot of things I always had to watch for when I was a kid growing up, sign eh. My dad always used to *call it sign.*" (6, September 22, 2006: 6).

Within the following excerpts are data which serves as evidence of '**what**' indicators, using cultural keystone species, these LBEs use when they monitor over time and space.

For example, one Elderly lady who has been harvesting many types of berries since she was a little girl, in key areas within Swan Hills, shared how over the past 70 years (approximately) she was able to monitor **blueberry abundance**. Blueberries are a cultural keystone species, and she shared that since development has intensified in the region, she had noticed a decline in the availability in blueberries, and that in the past 10 years, she has been unable to find any blueberries other than a few handfuls.

> (4): "Well, around August, we used to go out and pick blueberries; like the middle part of August. We picked blueberries, cranberries, and low bush cranberries, high bush cranberries, all kinds of berries we used to pick. There were some choke cherries by the river, we picked them, but now you can't do that. Karen: When did you start doing that? (4): We've been doing that ever since I was a little girl I can remember picking blueberries. Because, my mom used to can them, but now, I don't think there are any blueberries at all in Swan Hills" (4, 23 August, 2006:1).

Another LBE who is a hunter, specializing in the harvesting of moose (another cultural keystone species), and who uses the bones and antlers of ungulates for making implements like scrapers, is particularly attuned to the **moose health** (body condition) of moose, or more specifically, the health of the bones and antlers of the moose he harvests. In the past seven years or so, this hunter has noticed an antler and facial bone attenuating liquid in many of the moose he has harvested.

> (11): "Whenever I cut off the antlers off a bull moose, I always find in the bones some clear liquid that just eats the inside of the bone hollow in there, and it's usually always within the, where the horns and the nose and the cheekbones are cause when you cut the horns off the head, you cuts sideways..... in there, that's where I find this clear liquid....It was a clear water liquid but that liquid would just be eating that bone inside there, just hollowing it out and this has been on the increase for the last I'd say probably the last seven years, if not more". (I): Okay now before this seven years, the liquid in the bones and the antlers and the cheeks and cysts in the liver, did you notice either of those two things at all before? (11): "No, we never had them" (11, 11 November, 2006:3).

These two examples, of many, which serve provide evidence that these Cree LBEs use previously identified indicators (cultural keystone species) to assess the compositional, structural and functional condition of local ecosystems.

5.1.3 Fluidity of TEK Construction: Use Diagnostic Measures – How?

Systematic ecological monitoring should incorporate mechanisms which are capable of consistently measuring (using diagnostic measures) indicators (Cairns 1993; Cairns 2002; Dallimeier *et al.* 2002; Durell *et al.* 2005; Green *et al.* 2005; Langor and Spence 2006). Systematic monitoring methods should also include a specification of indicators which include target species or habitats to obtain appropriate estimates, and those species and habitats should be able to provide samples over large areas over time Yoccoz *et al.* 2001).

Often, detection error, occurs "because few survey methods permit the detection of all individual animals, or even all species of animals, in surveyed areas".....As well, spatial variation error occurs due to the "inability to survey large areas entirely, and the resulting need to draw inferences about large areas based on samples of locations within those areas" (Yoccoz *et al.* 2001: 448-49). For example, WSK studies use aerial survey counts, which have been imprecise and inaccurate due to large percentages of the animals being missed by observers (Samuel *et al.* 1987 cited by Morellet *et al.* 2007). Yocccoz *et al.* (2001) state that the standard capture-recapture method is somewhat effective; nonetheless, impractical and monetarily expensive; consequently most monitoring

programs rely heavily on count statistics (i.e. tracks or harvest counts) as indices which are later translated into estimates of species abundance.

Studies which re-enforce count statistics method include a number of recent studies (Neis 1992; Mackinson 2001; Kitson 2004; Grant and Berkes 2007) which reveal that count statistics, garnered through harvesting practices, can be used as credible indices to determine estimates of species abundance. In order to obtain better sampling estimates, monitoring should include target population mean abundance per plot, over the total number of potential plots in an area (Yoccoz *et al.* 2001). Catch per unit of effort has been used, fairly successfully, as an index of relative population density (Berkes 1999; Kitson 2004). Theoretically, if the success rate for harvesting a species declines, the species density rate has declined; nevertheless, if harvesters change their temporal or spatial methods of harvesting, correlating harvesting rates with species rates requires caution (Kitson 2004). The results of this study include data which uses monitoring while harvesting to estimate species abundance and health, and habitat quantity and quality which was collected throughout the year, for long periods of time (up to 70 years), over the same spatial area (Swan Hills and area). Consequently, these data may provide common indices of relative species abundance, diversity and health.

Yoccoz *et al.* (2001) consider traditional monitoring methods (how) to be imprecise, still yet others Moller *et al.* (2004) consider TEK monitoring methods used, valuable and credible in that they provide information which is collected, consistently and consecutively over long periods of time, it may be used to produce large sample sizes, and it is proven to be less expensive.

Data gleaned from this study highlighted the fact that these Cree LBEs incorporated diagnostic measures, to be used as samples of targeted species and habitat indicators, over large areas, for monitoring local ecosystem integrity and health, consistently (repeatedly multiple times a year) within each year, and over long periods of time (up to 70 years). Within the following excerpts are a couple of examples of how cultural keystone species (indicators) were monitored through the use of mechanisms which used

diagnostic measures, albeit without using an "exactness or precision" where there is "no point in trying to be more precise than ...the problem demands" (Popper 1963: 28).

An Elderly female LBE was able to vividly recall very close approximations of amounts (seven 20 gallon pails) of blueberries they would harvest in a day, from the time she was a little girl, until more recently when she was searching with a relative.

> (4) "Yes, as soon as we filled those seven 20 pound lard pails, my mom used to bring them over here to Enilda at Debbie's store, and she'd sell them for 7 cents a pound. She'd take a whole bunch of groceries home, like a hundred pound flour was only 2.50; two dollars and fifty cents. And, uh, a fifty pound flour was a dollar fifty, she'd take a whole bunch of groceries home; and when I first got married, I did the same thing. I used to sell berries here, me and my old man used to go and pick. We'd buy groceries, sometimes clothes. Geddes store used to have some clothes, you know, men's clothes and women's clothes for blueberries". (I): So, your mom, when she used to pick those seven pails, 20 pound pails, how long did it take her to pick those? (4): "About 2 or 3 days". (I): Two or three days? (4): "Yes, because all of us kids picked. Even my dad, when he'd finish whatever he'd be doing, he'd go and pick too, in the evening". (I): That was when you were about 10 or something? (4): "Oh, I was about 13, or 14, with my younger sisters". (I): That was in the Swan Hills area that you were telling me about? (4): "We'd go on that Klondike Trail"...."Yes, towards Swan Hills. There used to be blueberries all over, as soon as you go over the tracks. You know, you'd hit the bush, and you'd find blueberries all over, now there's none" (I): So how long did it take you to fill whatever pails you used, now, like when you went a few years ago? (4): Me and Rose took all day, we left at 9:00 in the morning and we got back at about 8:00 in the evening; we just filled an ice cream pail full, because we had to go here and there" (4, 23 August, 2006).

As well a middle aged female LBE picked also blueberries from the time she was a little girl, and she as well could recall very accurately approximately how many (5 gallon) pails they used to be able to pick in a day and for how many years in a row.

> (12): "I know, I'm just trying to think. If I wasn't eat so many but I got eh about maybe five pails, at least five. I would say minimum of, you know". (I): .... Okay, five 5 gallon pails. Okay so that's interesting. Now the last time you remember, like say ten years ago, how many could you have picked in that same area? Or how many did you pick? (12): "None". (I): Five gallon pails. None?! (12): "Yeah". (I): So that's quite a difference isn't it? (12): "Uhum". (I): For how many years in a row approximately, just guessing, did your family pick like close to or around five [5 gallon] pails a year .... (12): "Oh, that's good. Yeah. It would be maybe forty years" (12, September 28, 2006: 21).

Similarly, a male hunter (Cree LBE), who also participates in a number of other land based activities, was able to fairly accurately display by using his hands to indicate in inches, the size of red growths, which he finds quite regularly now in the moose that he harvests in the Swan Hills area.

> (8) ".....in the moose where I've shot a couple of them and when you go to open them up, you notice water spots or, or, or, or red spots inside their internal organs and stuff....." Some, some go quite big and, and I don't know, about [indicating with hands?].....and some, sometimes, sometimes you see them in their livers and in the tubes connecting in their livers. (I): .....So that was about I think two inches.....in diameter maybe? [observing the hand position of the LBE and extrapolating from the diameter in inches] (8): "Uhum". (I): And what organs or all organs or what organs in particular? (8): "Pretty well it affects all the internal organs". (I): Okay. (8): "The stomach, the heart, the, yeah, the heart, the liver, spot, you can, you can notice a lot of it in the liver it's up all, all the spots on there" (8, 21 September 2006).

These three examples, of many, serve to indicate that these Cree LBE incorporate mechanisms which are capable of consistently measuring (using diagnostic measures) of indicators (cultural keystone species) when they to assess the compositional, structural and functional condition of local ecosystem, and the species (and habitats) they use provide samples over large areas over time.

5.1.4 Fluidity of TEK Construction: Spatial Monitoring – Where?

Systematic monitoring should determine spatially (where) with a preference at the local landscape level (measured at an appropriate spatial scale) to measure stability or changes to ecosystem integrity and health (Cairns 1993; Cairns 2002; Dallimeier *et al.* 2002; Durell *et al.* 2005; Green *et al.* 2005; Langor and Spence 2006).

Within this thesis landscape level is loosely defined as a mosaic where a mingling of smaller scale ecosystems, or land uses is conjoined over a kilometers wide area (Forman 1995:9). The LBES of this study monitor the integrity and health of the local ecosystems at a landscape level, or more specifically, within Swan Hills, on or close to their homes

on the reserves, or near the Mitsue area. Indicators of ecological change, including those designed to monitor cervid population trends at local landscape scales (10 – 50 km^2) have proven to be reliable (Gaillard *et al.* 2000). Nevertheless, cervid populations are often monitored at a much larger spatial scale (thousands km2), or at the individual level, live visual or post mortem, when assessing morphological attributes such as body mass (Morellet *et al.* 2007).

All of these land based activities have been, for generations, been conducted broadly over an area within the Traditional Territory of the Cree communities of this study. Nonetheless, within that Traditional Territory a number of key areas have been identified, and still are commonly used for Traditional Use activities. These key areas include "the Swan Hills area in its entirety; a place we call House Mountain, Deer Mountain, up in Virginia Hills, Goose Tower Road, and the Grizzly area" (08, November 2007:1), and the confluence of the Driftpile and Little Driftpile River, Freeman Lake, Christina Lake, Mitsue, the Narrows (north shore of LSL) and the within and on the shores of the Lesser Slave Lake area.

A female LBE picked berries with her family since she was a little girl at the Narrows, which is on the north side of Lesser Slave Lake, directly across from Spruce Point Park.

> (12): "We used to pick blueberries at an area. We used to call it Sand Hills [Narrows]. We used to go by wagon, just take the whole day. Families used to go there to pick. You're lucky if you can find a blueberry now. Yeah. Across the lake there, it's called they used to pick at the Narrows" (12, September 28, 2006: 19).

A LBE who often hunts preferred to hunt at House Mountain which is south of highway 2 about 60 kilometers roughly following Swan River, and then west. He also hunted in the Moose Horn area and Virginia Hills which are east of House Mountain.

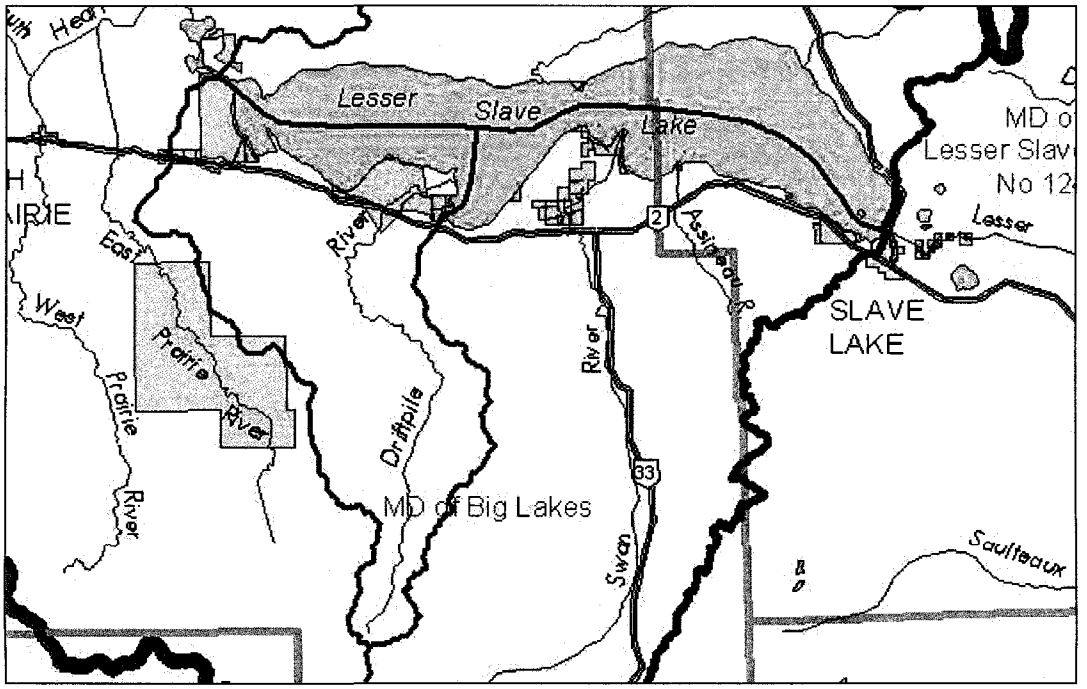
> (6): Well, see the most accessible place to us is the, the House Mountain area. So like it's, it's a, you know, half hour drive to get there and you're hunting right away. That's, that's why we go there most of the time..." (6): "Well I've been all over here. I, I usually camp here a lot, Freeman Lake because it's a beautiful place to be there. I mean that's, I camp there even it's so close to here. I usually

hunt over here in the, I'll, I'll either go from there to, to the Moose Horn over here or to the Virginia Hills" (6, September 22, 2006: 1,2).

A male LBE who largely hunts moose has hunted regularly in a number of key areas as well. The areas are north of Lesser Slave Lake, and in the Swan Hills area. Nonetheless, he had been hunting more recently in north of the lake due to the poor health of the moose in the Swan Hills area.

"....like the northern part up here, yeah. (I): All of it? (11): No, the northern part of where I was hunting before when I was younger we don't have that many oil activity going on right now, not like in all these other areas where I had said in.....Swan Hills, out in that area. ....We've been finding animals like that out there, that's where we've been taking some of these animals from.....(I): With the fluid in their?.....(11): Yeah, yeah.....(I): But did you notice any of the bulls with the fluid in their antlers, from the north? (11): Not on the northern, not yet.....and so far we haven't run across a bull yet from out there that had things like that.....Yeah. So like for the environment .....it's been having a damaging impact on the animals up here" (11, 11 November 2006).

Map 5-1 - Harvesting Area



Many of the Land Based Experts made reference to the use of key areas, and that their key areas tend to be in Swan Hills and the surrounding area (figure 5.0 above), however the "Sand Hills" [Narrows] is also used extensively. The Chief was explicit about the fact that most Cree LBEs call harvesting hunting rather than harvesting, and certain key areas for hunting are heavily used.

> (22): "Well, I guess a large portion of my area is the Swan Hills area in its entirety; a place we call House Mountain., Deer Mountain, up in Virginia Hills, Goose Tower Road, and the Grizzly area; probably hundreds of times, not just 3, 4 or 5 times. Not every place is the same, obviously because of development, so we always have to keep going place to place to place. Keep hunting and finding all these places. But a large portion I guess is in the Swan Hills [encompassing the areas mentioned above] area 08, November 2007:1).

5.1.5 Fluidity of TEK Construction: Consistency & Length of Time – When?

Most (at least 70%) of the Cree Land Based Experts (LBEs) interviewed engage in a mix of multiple land based activities (Traditional Use and other livelihoods) on a year round basis (including during different seasons) and consistently (see Glossary of Terms) over long periods of time, generally from 30 to 70 years. The participants of this study expressed sporadically throughout all the interviews, rather than at any given point, how they regularly and for long periods of time monitored local ecological systems. Consequently, in order to fully capture the time commitment, the excerpts drawing this information out tends to be lengthy. As well, given temporality is a key component of systematic monitoring I have provided many different accounts of this particular component of monitoring for the reader.

A couple of the participants experiencing some short periods of time where they could not engage in harvesting and other traditional use activities because they moved away to urban centers, attended residential school, or worked in the wage economy. For example, one LBES from Driftpile explained how several years in school served to impede upon the priority of harvesting activities.

(1): "An example for my grandparents to receive a school allowance or family allowance I had to be in school, you know. So in one hand although we lived the traditional lifestyle, we were somewhat being forced to turn into the main for lack of a better word, the mainstream society. So really the type of lifestyle I had at that time whereas my priority would have been to go snare rabbits or go hunting rabbits, I would have preferred to do that, my grandparents understood that education was becoming a priority and in order to keep the bogeyman from our door, you know, which was the government officials, they made sure I went to school, you know, cause they knew they'd get in trouble if they didn't and it was also a period when most of my older uncles and aunties and siblings were taken away from them and sent to missions, so there was always a fear to follow rules and to obey what they're being told and so for me to be able to go out and harvest rabbits which was more of a traditionally was the younger family members responsibility to do that, to go set the snares, go check them, go hunting for them, you know, that seemed to be our responsibility, our chore of the day and so cause, and my time then was focused somewhere else. The actual enjoyment of going out and hunting rabbits or snaring rabbits was being pushed to the side and had become more visible as I got older, you know, cause then school become more of a priority and that's what my grandparents pushed cause they didn't want to get into trouble with the officials and they didn't want to lose me like they lost the other siblings and family were taken away, so they abided by rules" (1, 20 October 2006:9).

Nonetheless, most of the LBEs provided lengthy accounts of the various ways in which they harvest many culturally important species, from early in childhood, through to present day, or for most of their lifetime (short of the first 5 to 8 years of their life). The concepts of length of land based activities and consistency (temporality) will be discussed in more detail later in Chapter 8 where systematic monitoring is discussed. For the purposes of this chapter, length and consistency (regularity) of time spent on the land is for the purpose of presenting the results of (when) the LBES harvest.

Following are some excerpts from the interviews which may serve to provide an understanding of the general consistency and length of time these Land Based Experts spend on the land engaging in Traditional Use activities, and in more contemporary livelihood activities.

(5): "When I started off with my dad, my late dad, he took me out about maybe when I was about four years old. He was trapping and everything south of Driftpile, and I used to go with him every winter. Most of winter we stayed all through the, we didn't come home till Christmas, then after New Years we go back until the spring, spring break up.....Summertime we'd come home and we

used to go down, live further back over here, and we used to hunt around moose in the summertime" (5, 10 November 2006).

(3): I guess my life on earth, the way I live right now is way different than the way I lived when I was a little boy living with my parents. I was born in 1934, you know, but six, seven, eight years later I used to go with my dad now and then, not all the time because I was a pest.....but the way we lived at that time, or my dad the way he lived was living off the land.....we never went to a store to get our meat or fish. I guess the main thing that was store bought was the flour, sugar and salt and little things like that, but outside of that, there was nothing we didn't have. My dad was the provider for whatever meat we needed, he was a trapper. He made his living by trapping, and lots of these Elders that have passed on now, that was their lifestyle.....their life was the trapline, home, trapline, home" (3, 12 October 2006).

One female LBE is from the Swan River area harvested berries consistently, for most of her life (40 to 50 years). In addition, she harvested and still harvests medicinal plants. In the following excerpt, she provided some detail as to the length of time she had been harvesting and what seasons she, her family and friends pick berries.

(12): "How many berries I picked? How many I ate may be easier". (I): You're just trying to get around that issue of you eating so many berries. Okay so you said forty years may be too much? (12): "I don't know.....Forty years ago last? It's been a long time, eh. Let's see. *Yeah, I'd, yeah, maybe fifty, yeah. Yeah, cause I'm too old. I was just a scrawny little kid then.....*". (I): So from fifty years ago till ten years ago, you would go up to that area and pick close to or reasonably close to five gallon pails of blueberries a year? (12): "Oh easy, yeah". (I): And is that always in the same month or season? (12): "In oh a year? Oh just the one time we go [season]. We went more than once" [in a season]. (I): And what month was that? (12): "They're usually ripe in July or August, August, in about mid-August or somewhere in there. That's the best time for picking blueberries" (12, September 28, 2006:21).

A LBE who is from Driftpile, and who started hunting when he was a small child, has hunted and fished consistently for at least 30 years. He now also engages in some agricultural pursuits with haying and raising horses. This male LBE expressed that he prefers to camp out when he goes hunting, and that his dad used to teach him "about the, the moose and their habits like and stuff". In the following excerpt, he was able to divulge the consistency and length of time he has spent on the land.

(6): My whole life. It was bred into me". "Well I'm forty-one now so". " *....Since I could start walking I was hunting and fishing already*". "*Everywhere.*

> *I hunt everywhere*"... (I): Okay. Can you tell me more about that? Like can you describe the, well first of all, how long it's been like that and, and what it was like before and what it's like now? (6): "It's getting worst anyway. *Every year* it gets worse and worse cause they keep taking more and more, see. Like it's, a couple years ago, it wasn't too bad. I mean we could still get in there and hunt". "*I just got a moose last week* on the Moose Horn River" (I): What seasons do you hunt in? (6): " *I hunt a lot*, me. I mean. Whenever. *Whenever I need the meat, I hunt. I don't, I don't need a special day. I just need to be hungry*". "I did some trapping with my dad too when I was a kid. Yeah, we used to do that. "Signed it over to Riel I think it was in '92 or something. He finally gave it [trapline] up". (I): Until '92 or something? (6): "Yeah. It was good. It was good. There was a lot of stuff out there. I mean there was; now *there's nothing.* (I): What about their [moose] hair? Like did they look healthy hair-wise when you looked at them? (6): "That depends....*It depends when we kill them, what time of the year*". (I): So you usually only fish during the spring? (6): "Yeah, when they're spawning. (I): Okay, and that's been always that way? (6): "Yeah" (I): Okay. And do you still fish every year? (6): "Yeah" (6, September 22, 2006: 1,3,7, 8,9, 14).

A male LBE from Sucker Creek is an agriculturist and he has been a hunter, fisherman, a commercial fisherman, a guide and a trapper in the study area. He used to float up and down Lesser Slave Lake when he was a kid and fish all day. He also used to guide, but since the provincial government implemented the legislation of guiding he shared that "a lot of people weren't able to compete in that so, you know, a lot of people just kind of dropped out". He was five when he started hunting with his grandfather, and later in his twenties, he was a commercial fisherman on Lesser Slave Lake. This LBE has been engaging in land based activities, including fishing in the study area consistently for about 45 years, and he described the length of time and consistency in the following manner:

> (17): "Well, I started hunting when I was well pretty young. About five years old I can remember going out with my grandfather setting snares, hunting squirrels, stuff like that....Well it would have been in the later 50's". "Well I guess I hunt year round. I shouldn't say hunt year round. *If I need the meat, I'll go hunting*"....(I): Is there anything else you noticed about the health of the moose besides those cysts? (17): "Well there are times they'll have a growth on them but it kind of looks like a *wart* you know, but what it is, I don't know.... Sometimes it's on the side, sometimes it'd be on the leg. (I): And is that something that you noticed consistently since you started hunting in that area or is it something relatively new? (17): "I'd say that it happened later. I don't remember ever seeing that when I was a kid" (Page 6). (17): "*When I was a kid* I used to float up and down the lake on a raft, kind of like a Tom Sawyer type of setting, be on the lakeshore all day long. There was a lot of perch back then. I've seen the lake change from having it, you know, populated *like it is today*.... I mean you catch *the odd perch today* but the

> numbers are not really there.... This was probably in the later 60's.... in the later 60's and early 70's when I remember those perch numbers but they're just not like that anymore.....The lake is different. It's not the same lake I used to go commercial fishing with the guys in Joussard..... Probably the 60's and 70's, 60's and, yeah, 60's and 70's" (17 16 November 2006: 9-11).

A male LBE is from Kapawe'no, who is an avid hunter, explained how he has been hunting consistently for about 45 years, mostly north of Lesser Slave Lake, and in the Swan Hills area. This LBE makes scrapers and other implements out of the antlers and long bones of ungulates so he has paid close attention to the health of the animals he harvested. He recalls his father working in the Swan Hills area, "I think it was in the 50's when they had hired my father to slash the baselines, what they call the baselines today. We never had baselines up here in this part but so they had to hire the local natives to go out there, you know, with their team of horses and their axes and saws and to just make a cut line which they call baselines so then the forestry would come in and they would start putting up their forestry towers. So they would have a general, they were actually mapping out the area to make a map. That's why the baselines still stand. So they were doing that back then. Then once they did that, then the oil and gas started coming in" (2006:8).

> (11): "Okay. I started hunting probably when I was about a little older than, and a little smaller than a rifle. The rifle was heavy and it was longer than me. So that was about probably around, see I started hunting with my dad when I was really, really young and he had took me hunting like that all the time, all through my youth. So, you know, it was when I got older then I started hunting by myself, eh, and so I've been hunting now close to I'd say about, at least a good forty years, forty to forty-five years" (11, November 11, 2006:1).

Another male LBE who is an agriculturalist has spent the past fifty years in the same area, near Driftpile. He started with his dad haying and raising animals when he was a child, and every year since then until now he spends most of his days out on the land, observing and monitoring a number of ecosystem attributes including water yield in the nearby Driftpile River.

> (16): "Since when I was a kid. I used to help my dad.....That'd be like fifty". (I): Fifty years ago? (16): "Yeah". (I): Okay, so for fifty years you've been doing that and you still do that? (16): "Yeah, Yeah...". (I): So you're still out there on

> the land? (16): "Yeah..... " (I): .....have there been any changes in that area that you've seen? (16): "Oh, lots....Before we used to get high water in the spring right say, March, April when the river thawed out, and the snow was melting, it'd all go into the river, and we'd get this high water because of the ice. Not now. I've noticed in the last ten years, maybe a little more, in....'87, yeah.....just about twenty years. Usually you get a little bit of, the, the river would go up a little bit and that's it. It seems like there's not enough ice and there's not enough water in the, in the river to create any kind of ice jam and that's from, I guess from running off the hills, pshhht and gone. Too fast.....whereas before when we had all that forest, that snow would melt and it'd gradually come into the river at a steady stream over a long period of time and that river would, by the time the ice melted, all that snow up in the hills had melted, cause the snow would melt faster than the ice, then you get all this water, all this ice and then you get all these ice dams..... and water buildup. But now it can't because there's nothing to hold the snow.....water back. It's all that clear cutting" (16, 22 September 2007: 1,2).

A male LBE who is an Elder and from Sucker Creek described how he and his family have lived off the land for his entire life until recently since he is too Elderly to engage in land based activities anymore. This Elder shared that he "used to go with my dad out on the trapline you know, that was one of the hardest things that I ever did, but it was my dad's way of living, and what he showed me was the lifestyle of an Indian.... you lived at that time, like I remember the 1930's where you get to be able to get some groceries like you know sugar, whatever. You had to have coupons cause there was a war going on, eh, which was very hard. I was the oldest in the family. There was actually, I think there was a twelve of us. I was the oldest so I was the farmhand and went in the forest and everything but I learned" (3, 12 October 2006: 1). He explained how he has been engaging in land based activities consistently (regularly) for about 60 years, he started hunting, fishing and trapping with his father around 1940 when he was about six to eight years old, that he always hunted and fished multiple times on a year round basis, and that he only stopped hunting in about the year 2000, when he became too Elderly to get around well in the forest.

> (3): "I was born in 1934, you know, but *six, seven, eight years later* I used to go with my dad now and then, not all the time because I was a pest..... but the way we lived at that time, or my dad the way he lived was *living off the land,* meaning like we, you know, we never went to a store to get our meat or fish..... my dad was the provider for whatever meat we needed. He was a trapper"..... "The last *five years*, I think five, six years ago is the last time I killed a moose. It's not because I don't want to. Because, you know, I can't, really can't walk that far. I

> can't walk in the bush like I used to. (I): When's the last, you said you went hunting five or six years ago, the last time? (3): "Yes". (I): And when you were a kid too, right? (3): Yeah. (I): And then every year pretty much or fairly consistently? (3): "Yeah, well every year, but it was a year round hunting". (I): Year round hunting for moose? (3): "Yes. Same thing with the fishing, you know. It was year round, summer or winter cause that's what we lived on, eh" (3, 12 October 2006: 1,4).

A male hunter and LBE who is from Swan River and has engaged in land based activities, including the hunting of grouse, chicken and moose for about 45 years on a regular basis and year round.

> (7): "I hunt all the way up the other side of Grand Prairie, and the other side of Grand Cache, and all the way up around Hinton, and right up to the park. (I): You mentioned that you'd been hunting since you were 15, about? (7): "Yeah, that's moose; I've hunted grouse and chicken since I was about 7". (I): What seasons did you used to go hunting when you first started hunting? (7): "Usually in the fall right before the White Man's hunting season started; and that's when the moose where the fattest. Nowadays it's mostly when you're out of meat" (7, August 22 2006: 1,2,3).

A male LBE who lives in Driftpile and has trapped, hunted, and harvested berries and medicinal plants persistently on a regular basis, year round in the Swan Hills area (except for six years when he lived in Grande Cache) for about 60 years, or since about 1947. He described his experience as follows:

> (5): "When I started off with my old man, my dad, my late dad, he took me out about maybe when I was about four year old. He was trapping and everything south of Driftpile, and I used to go with him every winter. Most of winter we stayed all through the, we don't come home till Christmas, just to come in till after New Years we go back until the spring, spring break up. (I): So you went out in the fall and came back in the spring? C: Yeah, when the fur was open, you know, late in the fall. We go, the only time we come out is when we're getting low on grub, supplies and stuff like that. We used to come back and go back. That kept on for quite a few years that I was hunting with him, like trapping, stuff like that. Summertime we'd come home and we used to go down, live further back over here, and we used to hunt around moose in the summertime"..... "I went trapping with my brother here about four years ago. *I go just for moose and stuff like that. That's about it. I take my team out".* (I): You still do? (5): "*Oh yeah"* (5, 10 November 2006: 1,2,4).

A male LBE hunter and herbalist from Driftpile has collected medicinal plants and hunted moose on a regular year round basis since he was a child with his father.

> (8): "I used to hunt a lot in the Swan Hills area, Freeman Lake area, and just further east, no further west in the Virginia Hills area. I've, I've gone there a lot of times to hunt and also to *gather medicinal plants which I, I was taught by my father. He was a, a herbalist in, in traditional medicines* and that's where we, he, he'd take me down there and he showed me how to pick them, strict plants that go in there, that only grow in that area (I: Uhum) so that's, that's where I go and gather as well. (I): So you were hunting with your dad since, since the age of what approximately, just approximately? (8): "I'd say since I was about eight years old". (I): Okay, and so that's been about, I don't mean to be personal but about how many years? Thirty-five years or something? Thirty years? (8): Ohhh *forty, about forty, forty-five years. Cause I'm fifty-two years old now.* (I): And have you hunted like consistently like every year? (8): *Pretty well every year.* (8): "*We try to get one in* say in June when the moose are good again. We try to get one in July, August, September. Not that two months when they're rutting in September and October, then again in the winter months December and January, February and not April or May cause that's when they're, we don't hunt them in those months cause they're, they're buggy. They got, they get bugs in their hairs and stuff in their hairs and they just come through a hard winter so they're not as fat and stuff so we don't hunt them in them areas and, and they carry little ones with them, so we let them have a chance to, to, to bear their little ones. (I): So *most* seasons then? That's interesting. (8, 21 September 2006:1,2).

One of the eldest male LBE who is an Elder from Sucker Creek, has been hunting, trapping, fishing, and guiding his entire life. This Elder did not explicitly say that he engaged in these land based activities on a consistent basis; nonetheless, it was implicit given the content of the entire narrative that he had. This Elder was 97 in 2006, and ceased hunting when he was 83 in 1992.

> (20): "I work on the farm thirty years and I worked in a sexton, all over, logging camps before I marry and after I married, I work all over, eh, here and there and in the wintertime I would go to the trapline. (I): So when did you stop trapping? (20): "About 1962"….. (20): I quit hunting in the 92 when I was guiding. I don't hunt like after that too much" (20, 20 November 2006: 1,7).

An agriculturalist from Driftpile, who has been haying and raising cattle starting when he was a child with his father lives near the mouth of the Driftpile River and Lesser Slave Lake; consequently he has been able to observe how the river and the lake have changed in quality and yield over his lifetime. This LBE is about 65 years of age and has been monitoring environmental conditions consistently, year round, in the area for over 50 years.

(16): "Yeah, like north here where we have our hay meadow, we go there quite often. I got sixty cows, well not cows, calves, a couple of bulls". (I): How long have you been in that area making hay for the, for your cattle? (16): "Since when I was a kid. I used to help my dad". (I): How many years ago would that be? (16): "That'd be like fifty. (I): Okay so for fifty years you've been doing that and you still do that? (16): "So we used to go, every year that, we never failed, eh. And then ah, after that '88 flood, *well in the '60 or the mid-60's,* when the oil companies start coming into Swan Hills and Ghost Mountain and all that, the *water, the lake fluctuated* ..... like it would get, soon as it rained, like, well like this rain we'd have eh, that lake would go up right, right away." (16, September 22, 2006:2-3).

An elderly male LBE who harvests medicinal plants and hunts since he was a young child in the late 1930s with his parents in the House Mountain area still collects medicinal plants over a wide area, yearly at various times during the year.

(9): "When I was small, I remember, you know, could have been three years old and about '30, 1937 I would say, we used to go by wagon trains, you know, just from Kinuso and straight up to House Mountain and that's where we, we had a few wagons, you know. People would get together, a few wagons, and then they'd all together hunt..... *I tell them that I've been hunting yearly for, in this area, all over here for years* [since he was a child], you know"
(9, 21 September 2006: 2,14).

The Chief of Swan River, who is now 39 and was born a raised in Swan River has harvested since he was a small child, like most (22/23) of the other Cree Land Based Experts of this area. This LBE regularly goes out, as Chief, and as a "hunter" [harvester] on the land monitoring the health of the ecosystems and the fish and wildlife which inhabit the local environments. He is quoted below attesting to the length of time and consistency of his land based monitoring practices.

(22): OK, so, have you always lived in this area? (22): Yes. (I): OK, so when did you start hunting? (22): Probably over 30 years ago. I started when I was six or seven or so; maybe eight years old. (I): And in those, years since you were born here have you hunted every year? (22): Yes. (I): And do you know approximately how many times a year you'd go out on the land? (22): Definitely allot, like I have never bothered to keep track of how many times I would go out there. I'd say on average probably ten to fifteen times a month on average".... "(I): So, how many times do you go out moose hunting during the year? (22): "I haven't been out that much this year because I haven't had a truck so I'd always have to wait for my step father to come out and hunt, but in the past, it was almost every day, or at least 3 to 4 times a week in the past. Not every time we were successful. In the last 2 to 3 years we're hardly seeing any

> moose out there now. In my last 15 trips I've seen moose twice in the last 15 trips out there; and that's over a span, I guess that's all this year. So they seem to be getting less out there right now. (I): So, are you saying that in the past year, you've hunted about fifteen times? (22): "Yes, fifteen times, that was basically in this entire year. Like I say, because I didn't have a truck, I didn't have a chance to get out there as much in the past year". (I): And so fifteen times is a few amount of times in a year, compared to normal for you? (22): "It's a very, very few amount of times compared to normal for me". (I): So, you said in the past, what did you say? (22): "I said at least about three to four times in a week" (22, 08 November 2007: 2)..... "I consistently do go to my favourite spots where I do know that I have always seen moose and other animals". (I): And that is since you where what? (22): "Since I have learned the territory with my uncles and my parents I guess". (I): So since you were a kid basically? (22): "Yes, since I was a kid". (I): Are there certain seasons you go harvesting? (22): "For anything"? (I): For anything! (22): "Yeah, I would say so. Springtime, I guess it would be some medicines, some roots. It has fresh growth you know, it would be a little bit stronger medicine. Summertime, late summer, early fall, there is berry picking. Not much hunting, but some hunting is done, because of the moose are calving at that time, so we generally try not to that because you can't really tell when a cow is pregnant. We don't want to really shoot a cow that has a baby. Fall time, mainly hunting. Moose we hunt at anytime, day or night. We do lots at nighttime when nobody else is out there" (22, 08 November 2007: 4).

These accounts of lengthy time spent on the land attest to how Cree LBEs can detect alterations to local ecosystems due to the fact that they have intimately engaged with the land (local ecosystems) for generations observing and monitoring, on a consistent basis (persistence in regularity throughout the year), and for long periods of time (up to 70 years).

5.1.6 Fluidity of TEK Construction: Associations – Why?

Appropriate systematic monitoring methods should be able to provide data which can be used to assess the dynamics of the composition, structural and functional attributes within an ecosystem and how those might change at the local landscape level over time and space. Systematic ecological monitoring should illustrate associations and relationships using a suite of indicators (Cairns 1993; Cairns 2002; Dallimeier *et al.* 2002; Durell *et al.* 2005; Green *et al.* 2005; Langor and Spence 2006).

The following excerpts serve to illustrate how these experts, who use a suite of indicators of local ecosystems which help associate or relate the condition of the forest or species within the forest with the compelling forces upon them.

This Elder and other Elders he knows speaks to how these LBE make associations, in this case, how they have associated moose licking contaminants near Oil and Gas wells to a change in their behaviour.

> (3): "....the moose go to these oil sites where there's a pump (I: Yeah) and that's where they go have their licks, eh. (I: Have you seen that?) Oh yes. (I): You've seen moose go lick where there's an oil well site? (3): Oh yeah, yeah. (I): And they lick what? (3): That ground.....the moose go into this, it's kind of a mucky.... sort of stuff and then they chew on that (3): and this is what's around the pumps.....We've seen quite a bit of that... Well like I couldn't say. Like, you know, when I was younger, there wasn't that much drilling going on, eh..... As soon as that drilling started, that's when the animals started to, you know, act differently..... And that's what lots of us older people talk, and you know, we tells some guys we meet, somebody that I met they talk to me how the world changes, how the animal changes, but that's how it always ends up, that drilling. Ever since that drilling started that's when the animals started..... there was something that they were eating that wasn't right. Like I said you'll see lots of moose when you go out, maybe you won't see all of them, but when you do, you know, you'll see a moose doing his moose lick in the pumps, around the pumps. Cause they always pump water out. There's always water, you know, at the site, whatever.....you know, and that's kind of a whitish yellow stuff in there" (3, 12 October, 2006).

An Elder from Sawridge, has associated the wood waste which was dumped in the Mitsue Lake many years ago to a lack of oxygenation in the lake which has caused a change of fish species.

> (19): "See that's where I realize what made that lake go like that, you know, how it's got polluted by the bark and stuff .....when they dump those sixteen foot prime timber that they took off Mitsue Hills over here.....and that's where the lake, the first part of the pollution started out because it was all on the west side, eh, where they dumped the logs. So they'd have clear water to go to the east, where the sawmill is, on the east side of the lake.....Right on the lake because that's where when the ice thawed out..... that's where they floated on that part and they had posts with the logs chained so they don't get stuck on shore.....and those are still there to this day, those logs and those chains..... Great big chains..... that's when, when I come out of the school, then I realized that's where the first pollution, that was why.....it lacked oxygen.....then the only fish

> that could live there was what they call the pike or jackfish" (19, 28 September 2006).

The Chief associated an increase in wolves (predators) to the poor physiology (body condition) and functioning (changes in behaviour) of wolves in the Swan Hills area. This association is not unwarranted given species populations have a geographical range with distributional limits determined by their physical environment and species interactions. Most species have aggregates of individuals separated by spatial areas of low density. At times, populations of species experience exponential growth rates where the size of the population is dependent upon how many more births than deaths occur. Environmental resistance, determined by carrying capacity (maximum number of individuals an environment can support) of an ecosystem places a constraint upon exponential growth rate. Consequently, when population size is small in relation to the carrying capacity, the resistance to species population growth is minimal, and the population increases exponentially. Conversely, when the population of a particular species is high and approaches the carrying capacity of the local environment, there are stressors placed on the species resulting in minimal or negative growth of the population. Factors such as weather, pests and anthropogenic induced impacts will decrease or increase species growth rates. Species density dependent factors have an interactive and increased (cumulative) effect with over-crowding which then tends to regulate or stabilize the population size. For animals such as *Canis lupus* (wolves), these factors include deteriorated body condition and overall health, increased mortality, reduced birth rate due to physiological changes, and reduced life span. The competitive exclusion principle ensures that multiple species cannot co-exist on a limited resource base. Given a limited resource base, one species will outcompete a second where the second species populations will dwindle or go extinct. Predators and prey represent two levels in the food chain, which is dissimilar to competition which involves species within a single level. When prey/predator densities fluctuate, the functional (physiological and behavioural) response of the predator changes to its rate of prey consumption. Thus, species (including *Canis lupus*) population, physiological and behavioural responses are contingent upon resource availability and health within a particular (local) environment

(Forman 1995:78-80). This LBE was cognizant of and understood the associations between anthropogenic induced changes, species (prey/predator) interactions, population dynamics and species functionality which he observed, and expressed it as follows:

> (I): Are there more wolves do you think, or less, or what do you think? (22): "I would have to say that there are probably more wolves. I do see allot of the tracks, and I have seen packs of wolves. The last one I've seen is just this side of Swan Hills; ten to fifteen kilometers. Like I say, he just stood there, I actually got a chance to just park up beside him and he didn't run away. Then a truck came up behind me and honked its horn and it ran away, I almost had a picture of him. He looked really worn down; he was not in good shape, so maybe they're starving. I guess lack of calves, or whatever, moose. Usually they are always hunting them down right. (I): Right. (22): Maybe due to lack of that, he was starving I guess. And very brave when seeing a human I guess because every other one I've seen, as soon as they see your truck or you, they're gone; they don't stick around" (22, 08 November 2007: 3-4).

5.2 Results: Diversification of Land Based Activities Discussion

This discussion focuses on the research results which aimed at understanding how Cree land users construct knowledge about ecological conditions, and what kinds of specific land-based activities facilitate TEK generation. More specifically within this section I discuss how TEK continues to be constructed using both traditional and more contemporary land-based activities. In the section which follows, I discuss how the construction of this knowledge through land-based activities, is systematic in nature.

There is a wealth of knowledge within the local Cree communities of this study area relating to fish, wildlife, habitat and water, as well as wisdom about the associations between them. The scope and scale of this knowledge can be correlated to the long intimate history of land use and occupancy over this landscape, including Traditional Use activities, and more recent contemporary livelihood pursuits which also bring these LBEs on to the land on a consistent and long term basis. Several specific themes around land based activities emerged from this research. These themes are presented in point form below:

1) Traditional land based activities generally referred to as harvesting by academics, but more commonly referred to as hunting by Cree Land Based Experts (LBEs) included hunting of moose, elk, deer (cervids), fishing, berry harvesting, medicinal plant harvesting, trapping fur bearing animals, snaring of squirrels and rabbits, and hunting of waterfowl and gamebirds (ducks, grouse and wild chickens).

2) Contemporary land based activities, generally referred to by academics as engagement in the wage economy, but more commonly referred to as livelihood activities by Cree LBEs included around Land and Resource Management, Agriculturalist/Farmer, Guiding, Cultural Heritage Management, Commercial Fishing, Forestry Work, River Foreman, and Chief.

3) Land based activities including Traditional Use and more contemporary livelihood pursuits have been and still are conducted over the shared Traditional Territory of the five communities of this study population. Nonetheless, there were heavily used areas, referred to here as key areas which include House Mountain, Deer Mountain, an area at the confluence of the Driftpile and Little Driftpile River, Virginia Hills, Freeman Lake, Christina Lake, Mitsue, the Narrows (north shore of LSL) and areas around the shores of the Lesser Slave Lake area (see figure 5.0).

4) Most (at least 70%) of these Cree Land Based Experts (LBEs) engage in a combination of a diversity of land based activities (Traditional Use and other more contemporary Livelihoods) on a year round basis (including during different seasons) and consistently (see Glossary of Terms) over long periods of time, generally from 30 to 70 years with a couple of the participants experiencing some short periods of time where they could not engage in harvesting and other traditional use activities because they moved away to urban centers, attended residential school, or worked in the non-land based wage economy. In addition,

most of the LBEs commenced their land based activities early in childhood (between the ages of 5 to 9).

5) Most of the LBEs revealed that they spent substantial amounts of time engaging in Traditional Use including harvesting with their families, but their more contemporary Livelihood land based activities are spent with largely with co-workers. Nonetheless, it is through an integration of these land based experiences, that TEK may be augmented and passed on, and how this form of specialized knowledge now continues to evolve.

6) In general, much of the information from these results has indicated that Cree LBEs have a strong relationship to the land, and that this strong relationship often impels a certain approach to how Cree LBEs harvest, and in how other land based activities are conceptualized and conducted.

7) A number of LBEs camp out when they harvest, while many prefer to make their harvesting excursions day trips.

8) Most of the participants expressed their distress about their belief that the local environment is deteriorating due to the intensity of the development in the area.

9) Many of these LBEs, especially the Elders, were lamenting about the loss of their traditional lifestyle.

5.3 Results: Analysis and Discussion on Systematic Monitoring

This discussion focuses on the research results which aimed at further understanding how the construction of TEK, through engagement in traditional and more contemporary land-based activities, incorporates empirical systematic elements, not unlike WSK, within its ecosystem monitoring methods.

The term systematic monitoring is used within the WSK literature, as a concept rather than a theory, to describe processes of gathering information, about some ecological system conditions over space and time. Monitoring of ecosystems is essential, at different points in time and space, to determine and measure responses or stressors upon baseline conditions or deviations from a desired trajectory which may shift a system from one regime to another. Initially, a suite of measurable indicators for monitoring should be identified for assessment from a desired trajectory or benchmark of desired ecological conditions (Yoccoz *et al.* 2001; Dallmeier *et al.* 2002; Morellet *et al.* 2007). Emphasis could be placed on long-term socio-ecological dynamics and conditions which can be used to generate feedback indicators for the desired integrity and health of systems. Adelman (2001) advances a concept which proposes that the sustainability of the ecological systems can only be achieved through conceptualizing a linked social and ecological system. In this vein, other authors (Cairns *et al.* 1993; Folke *et al.* 1998; Westly *et al.* 2002) as well argue that the health of the human system is contingent upon the health of the ecosystem because biogeochemical and socio-economic systems are concomitantly affected through ecological degradation. This point is mentioned in the environmental sociology literature to date, yet the value and applied use of TEK, and other less privileged knowledge systems, is glaringly absent in this literature. Accordingly, I advance this thesis as a means to provide a starting point for this body of literature to further examine the value and applied use of TEK towards effectively informing ecosystem and cumulative effects management decisions.

Appropriate systematic monitoring should be able to provide information which can be used to assess composition, structural and functional ecosystem components using indicators which highlight current conditions or changes within that ecosystem. Consequently, systematic ecological monitoring should: 1) Incorporation of appropriate indicators; 2) Usage of diagnostic measures; 3) Assessment at an appropriate spatial scale, with a preference for local landscape level monitoring; 4) Assessment of indicators and attributes consistently (numerous times within the course of a year) over short (up to five years) and over long (from 6 to 50 years) periods of time (Cairns 1993; Cairns 2002;

Dallimeier *et al.* 2002; Durell *et al.* 2005; Green *et al.* 2005; Langor and Spence 2006; Morellet *et al.* 2007). Systematic ecological monitoring should illustrate associations and relationships using a suite of indicators (Cairns 1993; Cairns 2002; Dallimeier *et al.* 2002; Durell *et al.* 2005; Green *et al.* 2005; Langor and Spence 2006).

Following are this study's results on the examination of Cree Land Based Expert (LBE) ecosystem monitoring methods for systematic elements using WSK systematic criteria (as listed above):

Cree LBE Use of Appropriate Indicators

Appropriate systematic monitoring methods should, through the use of appropriate previously identified indicators, provide data for "analysis of compositional, structural and functional attributes at various levels of biological organization" (Cairns 2002:145) and how those might change at that level, over time and space (Cairns 1993; Yoccoz *et al.* 2001; Cairns 2002; Dallimeier *et al.* 2002; Durell *et al.* 2005; Green *et al.* 2005; Langor and Spence 2006; Morellet *et al.* 2007). Using a single species to evaluate the integrity and health of an ecosystem or phenomena affecting an ecosystem can be meaningful if conducted appropriately (NRC 1981; Cairns 2002). Accordingly, using a number of species indicators, which are culturally valued (i.e. moose, various berries, or medicinal plants), to test the general conditions of integrity and health of over the landscape level, is useful. Evidence from these data (5.1.2), through analysis, demonstrates that these Cree LBEs systematically monitored 'cultural keystone species' (Garibaldi and Turner 2004) as key indicators, to determine the integrity and health of local ecosystems, while engaging in subsistence harvests (hunting, fishing, gathering, and harvesting medicinal plants) and other land based activities (forestry, agriculture, recreation, guide, trapper, commercial fishing, and verifying occupancy). Further, these results reveal that the primary types of ecosystem attributes (using condition indicators) monitored by Cree LBEs were: a) species abundance and trends; b) species population dynamics; c) species body condition; d) critical habitat abundance and condition; and e) water quality and yield. Interestingly, these ecosystem attributes are not dissimilar to

those monitored and assessed from a Western Scientific perspective (Mackenzie River Basin Board 2003; Dube *et al.* 2006).

These data, summarized in Section 5.1.2, revealed that 87% used 'cultural keystone species'; coined by Garibaldi and Turner (2004); which are species of high cultural value used to identify the compositional, structural and functional condition of local ecosystems. A number of the cultural keystone species (see Table 2) which are identified below are moose, rabbits, squirrels, berries, and medicinal plants. These species are monitored for largely for their abundance and condition, but also for determining population dynamics. As well the results revealed that there are a number of primary types of ecosystem attributes (using condition indicators) monitored by Cree LBEs were: a) species abundance and trends; b) species population dynamics; c) species body condition; d) critical habitat abundance and condition; and e) water quality and yield. Interestingly, these ecosystem attributes are not dissimilar to those monitored and assessed from a Western Scientific perspective (Mackenzie River Basin Board 2003; Dube *et al.* 2006).

Cree LBE Use of Diagnostic Measures

Systematic ecological monitoring should incorporate mechanisms which are capable of consistently measuring (using diagnostic measures) indicators (Cairns 1993; Cairns 2002; Dallimeier *et al.* 2002; Durell *et al.* 2005; Green *et al.* 2005; Langor and Spence 2006). Systematic monitoring methods should also include a specification of indicators which include target species or habitats to obtain appropriate estimates, and those species and habitats should be able to provide samples over large areas over time Yoccoz *et al.* 2001).

Often, detection error, occurs "because few survey methods permit the detection of all individual animals, or even all species of animals, in surveyed areas".....As well, spatial variation error occurs due to the "inability to survey large areas entirely, and the resulting need to draw inferences about large areas based on samples of locations within those areas" (Yoccoz *et al.* 2001: 448-49). For example, WSK studies use aerial survey counts,

which have been imprecise and inaccurate due to large percentages of the animals being missed by observers (Samuel *et al.* 1987 cited by Morellet *et al.* 2007). Yocccoz *et al.* (2001) state that the standard capture-recapture method is somewhat effective; nonetheless, impractical and monetarily expensive; consequently most monitoring programs rely heavily on count statistics (i.e. tracks or harvest counts) as indices which are later translated into estimates of species abundance.

Studies which re-enforce count statistics method include a number of recent studies (Neis 1992; Mackinson 2001; Kitson 2004; Grant and Berkes 2007) which reveal that count statistics, garnered through harvesting practices, can be used as credible indices to determine estimates of species abundance. In order to obtain better sampling estimates, monitoring should include target population mean abundance per plot, over the total number of potential plots in an area (Yoccoz *et al.* 2001). Catch per unit of effort has been used, fairly successfully, as an index of relative population density (Berkes 1999; Kitson 2004). Theoretically, if the success rate for harvesting a species declines, the species density rate has declined; nevertheless, if harvesters change their temporal or spatial methods of harvesting, correlating harvesting rates with species rates requires caution (Kitson 2004).

Yoccoz *et al.* (2001) consider traditional monitoring methods (how) to be imprecise, still yet others Moller *et al.* (2004) consider TEK monitoring methods used, valuable and credible in that they provide information which is collected, consistently and consecutively over long periods of time, it may be used to produce large sample sizes, and it is proven to be less expensive.

These data, summarized in Section 5.1.3, revealed that 61% of these Cree LBEs incorporated diagnostic measures; albeit they may be considered fuzzy diagnostic measures; for sampling targeted indicator species, and landscape attributes when monitoring local ecosystem conditions. Fuzzy logic is the logic of perception which provides for "an organized method for dealing with imprecision of data. Using fuzzy logic makes it possible to take in to account the grey areas of data, thus providing the

ability to more closely reflect the real world" (MacKinson 2001: 543). Cultural keystone species (indicators) were monitored through the use of mechanisms which used diagnostic measures, albeit without using an "exactness or precision" where there is "no point in trying to be more precise than ...the problem demands" (Popper 1963: 28).

Cree LBE Assessment at an Appropriate Spatial Scale

Systematic monitoring should determine spatially (where) with a preference at the local landscape level (measured at an appropriate spatial scale) to measure stability or changes to ecosystem integrity and health (Cairns 1993; Cairns 2002; Dallimeier *et al.* 2002; Durell *et al.* 2005; Green *et al.* 2005; Langor and Spence 2006).

Within this thesis landscape level is loosely defined as a mosaic where a mingling of smaller scale ecosystems, or land uses is conjoined over a kilometers wide area (Forman 1995:9). The LBES of this study monitor the integrity and health of the local ecosystems at a landscape level (see Section 5.1.4), or more specifically, within Swan Hills, on or close to their homes on the reserves, or near the Mitsue area.

Indicators of ecological change, including those designed to monitor cervid population trends at local landscape scales (10 – 50 km^2) have proven to be reliable (Gaillard *et al.* 2000). Nevertheless, cervid populations are often monitored at a much larger spatial scale (thousands km2), or at the individual level, live visual or post mortem, when assessing morphological attributes such as body mass (Morellet *et al.* 2007).

These data, summarized in Section 5.1.4, reveled that all (n=23) of the LBEs of this study, or 100%, have monitored ecosystem conditions at a landscape level, or more specifically, within Swan Hills, on or close to their reserves, or near the Mitsue area. Indicators of ecological change, including those designed to monitor cervid population trends at local landscape scales (10 – 50 km^2) have proven to be reliable (Gaillard *et al.* 2000). Nevertheless, cervid populations are often monitored at a much larger spatial scale (thousands km2), or at the individual level, live visual or post mortem, when assessing morphological attributes such as body mass (Morellet *et al.* 2007). All of the

LBE land-based activities have, for generations, been conducted broadly over a landscape level area (between 10 – 50 km^2) within the Traditional Territory of the Cree communities of this study. Within that Traditional Territory a number of key areas have been identified, and still are commonly used for Traditional Use activities, and monitoring ecosystem conditions. These key areas include "the Swan Hills area in its entirety; a place we call House Mountain, Deer Mountain, up in Virginia Hills, Goose Tower Road, and the Grizzly area" (08, November 2007:1), and the confluence of the Driftpile and Little Driftpile River, Freeman Lake, Christina Lake, Mitsue, the Narrows (north shore of LSL) and the within and on the shores of the Lesser Slave Lake area.

Cree LBE Assessment of Indicators and Attributes Consistently over Periods of Time

These data, summarized in Section 5.1.5, revealed that most of the participants (74%) provided many accounts as to how they measured indicators consistently (with persistence in regularity), repeatedly or multiple times a year (seasonally) over both the short term (minimum of five years) and over the long term (20 - 70 years). Although not all the participants explicitly indicated that they consistently engaged in land-based activities, all but two interviewees (Interviewee # 14 and #18) implied that they regularly and repeatedly (noted with an * in table) participated in Traditional Use, and/or more contemporary land-based activities on a regular basis. As well, although not all the participants explicitly indicated the length of time that they engaged in land-based activities, all but two (Interviewee # 14 and #18) implied that they engaged in Traditional Use, and/or more contemporary land-based activities sporadically over the course of their lifetime (noted as "Lifetime" in Table 2). For the purposes of research rigor, only the participants (74%) who explicitly stated, or acknowledged that they 'consistently' monitored ecosystems for a certain length of time.

Cree LBE Associations and Relationships

These results, summarized in Section 5.1.6, revealed how 83% of Cree LBE of this study, use a suite of indicators in associating the condition of the forest, or species within that forest, with the compelling forces upon it/them. For instance, large amounts of wood waste dumped into a lake was associated with poor oxygenation of the lake, moose consuming oil contaminated water from around oil wells was associated with poor moose health, and a greater wolf population was associated with changed wolf behaviour and body condition. Given local Cree LBEs ecosystem monitoring methods: 1) Incorporate appropriate indicators; 2) Use (approximate) diagnostic measures; 3) Assess at an appropriate spatial scale (local and landscape level); 4) Assess indicators and attributes consistently (numerous times within the course of a year) over short (up to five years) and over long (from 6 to 70 years) periods of time; 5) and illustrate associations and relationships using a suite of indicators, their ecosystem monitoring methods do incorporate systematic ecosystem monitoring elements and thus the valuable information resulting from these ecosystem monitoring observations may well be used to inform ecosystem and cumulative effects decisions within contemporary ecosystem and cumulative effects management arenas.

Chapter 6

Study Results: Environmental Effects

6.0 Introduction: Environmental Effects

The primary purpose of this study is to increase understanding of TEK as an important source of knowledge about ecosystem conditions and to reveal the potential of TEK and Land Based Expert (LBE) ecosystem monitoring methods. This chapter provides a synthesized overview of the observations, interpretations and associations of Cree Land Based Experts (LBEs) in regard to local ecosystem conditions and change within the study area. I present a number of key environmental (ecological) effects of development (forestry, oil and gas, agriculture, and toxic waste treatment development) in the study area (Swan Hills to Mitsue) as shared through testimony by the Cree Land Based Experts (LBEs). In extrapolating these results from shared testimony (evidence in support of fact or statement or a public declaration regarding some experience) some of the detail and key findings may be lost; nonetheless, within this chapter the author will aspire to: a) present the testimony in the voice of the LBEs to ensure that what was being shared (the evidence/results) was accurately captured; and b) provide the reader with as much detail on the information the LBEs (participants) were sharing.

To determine the results of the cumulative impacts of development upon local ecosystems in the study area, which are presented in this chapter, I used the following questions to elicit what the participants (Cree LBEs) observed through monitoring local ecosystems, and what interpretations and associations they made:

9) Are the (berries, moose, medicinal plants) still good in the area that you harvest/hunt?
10) What are the signs/signals that the (berries, moose, medicinal plants) are still good or not good anymore?
11) Do you think things have changed in the areas that you harvest?

12) What are the signs/signals that indicated to you that things were changing or not?
13) When did you start to notice these changes in the environment?

The observations include descriptions of different kinds of states or changes observed in wildlife, wildlife habitat, water quality, water yield, and air quality. In some cases, interviews provide some context or interpretation of the cause(s) of change. Some changes are described as caused by natural environmental change. Others are attributed to anthropogenic disturbances such as transportation corridors (highways) and other linear networks (ex. seismic), oil and gas, forestry and agriculture development, and the Alberta Waste Treatment Facility. Often, interviewees perceived these developments and associated activities, as having altered and shaped this landscape in many diverse ways resulting in a number of increases in the number of stressors upon local ecological systems.

On-going direct and regular observation and monitoring by local Aboriginal LBEs may serve to provide much needed data which can be used towards assessing ecological integrity and health, interrelationships (associations), and changes and trends over time and space (Berkes *et al.* 2000; Kofinas *et al.* 2001; Mackinson 2001; Duerden 2004; Kitson 2004; Lyver 2004; Moller *et al.* 2004; Parlee *et al.* 2005a and b; Berkes and Turner 2006; Grant and Berkes 2006; Berkes and Berkes 2007). Cree LBEs may be very knowledgeable about the components (species and habitat) and interrelationships within local ecosystems as they monitor and observe the same on a consistent (regular) basis over long periods of time. Their knowledge of the environment appears fluid in that they are able to understand variability and what can be expected as normal verses abnormal conditions in local ecosystem integrity and health. Nonetheless, observing, monitoring and assessing every possible bio-geophysical component of local ecosystems in an organized and understandable manner can be daunting. Appropriately, a suite of condition and disturbance indicators can be selected which are useful for determining the health of a species or the magnitude of stress or response to an exposure or perturbation within the system (Cairns *et al.* 1993; Cairns 2002; Milner *et al.* 2003; Jorgensen *et al.*

2005; Morellet *et al.* 2007). For example, population dynamics, distribution, densities and trends of species have been successfully used to gauge environmental integrity and health in Western Scientific Knowledge (WSK) studies some of which have concluded that the extirpation of certain indicator species from local or regional ecosystems can be used as a strong barometer that there is some level of deterioration of the ecosystem (Cairns *et al.* 1993; Cairns 2002; Jorgensen *et al.* 2005).

Over the course of this case study, Cree LBEs (the participants) indicated that they identified many key indicators which appear characteristic of the deterioration of local ecosystems, including culturally significant species of fish and wildlife, certain wildlife habitat, water quality and detrimental changes in hydrological yield. A number of those key indicators are identified within these results. Local Cree indicated that they look at the environment in a holistic manner (Personal Communication 2007), similar to an ecosystem approach. An ecosystem approach is widely recognized as a key tool which focuses on preserving the integrity and health of entire ecological systems over large spatial scales where humans are a part of that ecosystem (Cairns *et al.* 1993; MacKenzie 1996).

Within this chapter I have woven the results from the WSK literature amongst the results of this study (TEK) with the aim of illustrating how integrating these two knowledge systems may provide an avenue for building new and better understandings of local ecological systems without weakening the contribution each knowledge system has to offer independently. It is not the aim of this type presentation to evaluate the credibility of TEK contributions by measuring it against WSK results, rather, the author presents the results in this manner to exhibit how these two bodies of knowledge are credible in their own right, yet when integrated they may serve to enhance and build upon each other to inform contemporary ecosystem and cumulative effects management decisions. In this vein, TEK should be respected and preserved, and the innovations and practices (including the monitoring practices) complimentary to it may be relevant for supporting the sustainable integrity and health of local ecosystems. In placing the results from this study alongside WSK results, which examine similar ecosystem conditions due to land

and resource development in other study areas, including fish, wildlife, habitat and water changes I hope to demonstrate to the reader that these results are not just constructed perceptions in narrative form. Rather these observations are empirically generated, and serve to support previously gathered evidence of current ecological conditions and changes, which may be the result of the cumulative impacts of development within the study area. However, although the results of this study divulge many synergies with WSK results, I make no assumptions about this relationship, and strongly suggest that further research in the study area is warranted before any correlation can be determined.

One of the participants of this study expressed how problematic to the local ecosystems and to the local Cree the issue of privileging WSK and relegating TEK knowledge to the background is within the context of distinct this Aboriginal land tenure system:

> (2): "The berries have really been affected with the [development] operations, the changes that have been taking place, berry picking or even the herds [wildlife]. The people [Albertans] are not aware as to what they've destroyed and once it's destroyed, it's very, very seldom that it'll re-grow [re-habilitate itself] and I find it ironic that the province [Alberta] is not really accepting the Traditional Land Studies [TEK] that are taking place by First Nations, and the important document that it is to our people. As well Industry should be more aware... of what these sensitive areas are, and that our people are knowledgeable. That seems to be ignored... in terms of the news and the public perspective. Canada is one of the worst in terms of environmental legislation and rules, and Alberta [government and scientists] is on the top of the heap, so really we are a long ways from having any of our concerns heard or addressed" (2, October 20, 2006: 3,5).

6.1 Results: Environmental Effects

The reader will find below the results of the second group of questions (9-13 as listed above) which can be synthesized as: a) Has the environment changed; b) What are the signs and signals which indicate any changes you may have noticed; and c) When did you start to notice them?

Based on the results of this question (stated below), I was able to draw out a number of observations of key environmental (ecological) effects of development (forestry, oil and gas, agriculture, and toxic waste treatment development) in the study area (Swan Hills to Mitsue). This chapter presents a synthesized overview of the observations and interpretations (results) of Cree Land Based Experts (LBEs) in regard to some of these ecological effects which include: a) reductions in the populations of moose, squirrels, rabbits, grouse, ducks, pike, perch, and frogs; b) increases in wolves and deer; c) deterioration of the health of moose; significant declines in the abundance of blueberries and key medicinal plants; d) a reduction in water quality; e) catastrophic fluctuations in watercourses; and f) fragmentation of forests and attenuation in wildlife habitat.

6.1.1 Environmental Effects: Moose and Bear

Moose (*Alces* alces) are found in the Canadian boreal forest within a dominant overstory of white and black spruce, fir, pine and larch. The boreal forest is an approximate 1,000 kilometer wide eco-tone band residing between the tundra to the north and the more temperate forests and grasslands to the south (Karns 1997; NRC 2005). The harvesting of moose is done throughout the study area, and moose has been a staple food to the local Cree subsistence diet for many decades. A major concern frequently expressed by these study participants (LBEs) is the recent decline in the general health of local moose. A live visual assessment of moose body condition by Cree LBEs is often undertaken before they select an animal for harvest, following which a post-mortem assessment is conducted to determine whether the animal is considered healthy enough for consumption. Live visual assessment condition indicators assessed by Cree LBEs before harvesting to determine the health of an animal include: (i) colour and texture of the hair; (ii) estimate of fat content; and (iii) the manner in which the animal moves (behavior). Post-mortem condition indicators assessed have included: (i) estimate of fat content; (ii) a noting of fat colour; (iii) assessments for lumps, cysts and parasites; (iv) assessment of bone marrow and antlers; and (vi) overall assessment of the health of the internal organs.

Similarly, information on wildlife condition used for WSK studies is obtained by studying morphology, physiology and behavior condition indicators, including but not limited to: (i) subcutaneous back fat thickness; (ii) tissue sampling; (iii) bone marrow and antler assessments; and (iv) assessments for lumps, cysts and parasites (Riney 1982; Franzmann 1997; Kierdorf *et al.* 1997; Milner *et al.* 2003).

Meaningful information about the health of a wildlife population can be extrapolated from individual animal monitoring. The individual animal indicator approach potentially improves the ability of monitoring and predicting the health of a species population at the landscape or regional scale. A disease may be a result of habitat loss, reduced quality or quantity of food or water, the anthropogenic input of environmental contaminants, or other energy stressors. Northern cervids are well adapted to a wide range of variation in caloric intake availability, nevertheless, if energy stressed they can display behavioural, morphological, and physiological responses to periodic undernutrition. Consequently, condition indices or individual condition indicators can be a good measure of a wildlife population's response to its environment (Riney 1982; Franzmann 1997; Kierdorf *et al.* 1997 Milner *et al. 2003*).

In Alberta, areas where moose tend to flourish is on landscapes with fertile soils including alluvial floodplains, bogs, swamps and any boreal coniferous or mixed wood forests interspersed with deciduous shrubs (Karns 1997; MacKenzie and Moran 2004). Moose typically select open upland and aquatic areas in early summer, closed canopy areas later in the summer, open areas with a high percentage shrub cover in the late autumn and early winter, and a closed canopy forest again in the late winter (Peek 1997).

A hunter and traditional medicinal plant expert from Driftpile was well aware of moose habitat and described the same as ".... see moose diet consists of the seasons as well. In the summertime they, they eat the green vegetation, the leaves from the trees, and in the wintertime when it's harder for them, they eat the willow which grows faster in the clearcut areas, so I guess in a sense it, it's better for them to find the food in the

wintertime in the clearcut areas because it grows faster there, but they're also more easier harvest because of that" (8, 21 September 2006: 4).

While engaged in livelihood activities, Cree LBES engage in monitoring and assessing various attributes and any anomalies of culturally significant species (cultural keystone species), including numerical attributes of a population (e.g. numbers, sex and age), the health of a species, and properties of wildlife habitat (e.g. food supply, quantity and quality of water, environmental contaminants, and predator increases) this is similar information WSK scientists (Van Ballenberghe and Ballard 1997) gather for their research studies. The results of this study imply that a number of wildlife species population declines have occurred, and that moose, which is used as a dietary source of protein for local Cree people, is often full of growths and cysts, and smells, tastes, and looks different in colour. Similar reports (NRB 1999: 55) indicating that "many individuals mentioned that the number of wild animals available for hunting has been declining" and that "the appearance of some of these animals when skinned was unappetizing", and "that the poor quality of fish meant that much of it was used as food for dogs" in areas where there is intensification of land and resource development have been made.

Environmental Effects: Moose Body Condition – Lipid Content

Many of the participants (LBEs) expressed that the health of the moose in the study area is in general decline and that lipid (fat) content is substantially lower (by a roughly estimating the measurement in inches) in the past twenty five to thirty years. The measurements for fat indices they made where accomplished by roughly estimating inches of fat, comparing year to year, within moose home range, over the course of decades. Following are a number of excerpts from this study which indicate, using fat indices, that moose health in the study area is in general decline.

> (2): "Maybe just to add on some of the changes in the lifestyle and the big game, the moose, even today you find that the animal, whether it's a female or a bull moose, come late August, early September, they're not as well prepared for the

winter as they normally were ten years ago...the fat they carry at that time of the year is probably half the volume they normally would have carried ten years ago ... It's in the area in late August, September that they should have fat all over around their body, like their chest, their back and rump. That's where all the fat gathers normally and in early 70's anytime you shot a moose, whether it's a bull or a cow cause we were privileged to kill one or the other at any time... the fat was very noticeable early August. Today you kill the same cow in early August, you'd be lucky to see a trace of that fat starting to develop....Well I would say in the early 70's in mid-August you'd have at least a two inch growth, development by late August, September. Today you'd be lucky if you've got half an inch developed by the same timeframe. That's a change, a drastic change. And in a bull in late fall, say early, or mid-September that's when they're fully developed their full rutting condition, you get a five year old bull or a three year old bull, that chest is developed up to, I've seen them up to four inches [in fat] in the early 70's, 80's.....You couldn't even see the tail end of the rump of that bull it's so fat, really rounded. Today you'd be lucky at the same time, mid-September, be lucky if you got an inch and a half fat on that bull. It's a drastic change. The inner part, the body and the inner part, like the bone structure, the fat is still there. It hasn't reduced but the surface fat where it protects them from the cold has definitely reduced. The kidney portion where we always used to pick the kidney, take home, there's times you couldn't see the kidney there was so much fat there. Today same time, the kidney's quite visible. You'd have some fat portions around it but nothing to the extent it used to be..... I would say the kidneys buried within a minimum of two inch to three, four inches of fat around the kidney. That was in mid-70's; that's when I did a lot of hunting. And today you'll see the skinny, I call it skinny kidney, but the portion of that kidney itself is visible. They may, the bull let's say was in good condition might have half an inch to inch and a half of fat covering part of it, not the total kidney. As before; you couldn't see the kidney it was so fat"
(2, 20 October 2006).

(6): "I noticed too a difference in the, in the sizes of moose and the, and the amount of fat they have in them ....they're not as fat as they used to be. Like I remember killing a moose and then when you cut them open here on their on their brisket [pointing to chest area] they call it a waskut, in the Indian way.... So when you cut a moose open here, and when I was younger, the moose would be have a layer of fat like that [displays with hands about between and inch and two inches] Nowadays you're lucky if you see that much fat on them.....it used to be an inch and a half and now it's ....quarter inch, half inch....That is a lot of difference in fat..."(6, 22 September 2006).

(7): "In those animals [speaking of the moose harvested recently]; if I remember correctly there was hardly any fat" (7, 22 August 2006).

(8): "I've noticed years ago the animals were healthier, *they were a lot fatter*" (8, September 21, 2006).

Similarly, Kofinas (2003:46-47) reported that "in 2000, hunters of Lutsel Ke observed that caribou south of the community around Nonacho Lake were in better condition than

the ones towards McKinley Point and Yellowknife" and that "disturbance from hunters and traffic, pollution, and poor quality of feed were theorized as the causes for the poorer body condition of the animals".

Often WSK research results on cervid body condition are used as a critical indicator of ecological conditions Reimers *et al* 1982; Kofinas *et al.* 2003; Milner *et al.* 2003). Analogously, this studies LBEs live visual and post mortem body condition assessments seem to provide the same as WSK studies which generally include assessment of energy stores, including lipid, to reveal overall individual animal health, fecundity and nutritional status. Most regional or landscape level body condition indicial studies of a range of cervid species, often result in a correlation of body condition with deteriorated ecological health, including reduced foraging opportunities, or reduced quality of forage species (Reimers *et al.* 1983; Nilssen *et al.* 1984; Gerhart *et al.* 1996; Stephenson *et al.* 1998; Cook 2001; Green 2001). Bailey and Franzmann (1983) postulated that an increased expenditure of energy associated with pacing, lack of rest and time taken away from browsing, also compounds conditions conducive to increases in mortality.

Environmental Effects: Moose Body Condition – Lipid Colour

Many of the LBEs who hunt moose have noticed a change from a lighter to a darker fat colour over the decades. Three of those hunters are quoted below, describing this observation.

> (11): "A moose that's been living in the bush all his life and he never comes out, you will always find their fat is always white, clear....and it's just a better fat. But you get an animal that's living close to civilization; feeding off the roads ....the fat tends to be different colours" (11, 11 November 2006).

> (8): "Okay. I've noticed years ago the animals were healthier, they were a lot fatter. The fat in the moose were, was whitest, more white in colour and now today I've noticed that the moose are not as healthy. Their fat is yellowish in colour and a lot of old people have noticed that as well. (I): How long do you think that's been like that? (8): Hmm, it's been like that for the past thirty years or more" (8, 21 September 2006).

> (I): OK, and what about the colour of the fat? (22): "For the most part it seems like it is a regular colour I guess. Sometimes it's darker in colour, than I think,

> you know what I've seen before used to be really, really light in colour, almost white sometimes. Sometimes now its more reddish I guess, yes, reddish in colour"..... (I): So, when you say the fat is sometimes red, is that usual? Did you see that when you were a child? (22): "I don't think it's usual, I think it's something wrong with them; maybe". (I): So, how long have you noticed that for? (22): "I've noticed that for quite a few years now, like I can't probably pin point an exact time but I have noticed that in the last few years for sure" (22, 08 November 2007: 6).

According to wildlife biologists, changes in fat colour are normal. Crichton (1997) has explained that during a rut a bull moose will go without eating for weeks, metabolizing large amounts of their fat deposits, and reducing up to twenty percent of their body weight. When this rapid use of stored body fat occurs, the areola connective tissue associated with the fat cells often turns a dark yellow colour.

Environmental Effects: Moose Body Condition – Hair Colour

A number of observations were reported concerning the overall look of the health of moose, including the colour and texture of the hair and how it appears to be changing in colour from a darker colour and shiny texture to a lighter colour and duller texture.

There are a number of possible explanations for a change in the look of moose hair including a number of diseases which moose are typically prone to in the northern Boreal forest. These diseases include tick infestations which also contribute to moose mortality. For instance, in 1981 to 1982 in central Alberta, an estimated 50% or more of the moose died after infestations of up to 63,000 ticks per individual moose in Elk Island Park (Tefler 1984). Another possible explanation for the change in hair colour may be nutritional or environmental changes. Wildlife hair is a good indicator of mineral and toxic element exposure events; therefore, it can be used as a monitor for environmental and nutritional changes (Flynn *et al.* 1975). For example, hair samples from Pikas (*Ochatona princeps*) in Wyoming were sampled and tested for selenium deficiency. The results suggested that liver and hair mineral values were positively correlated to low selenium levels in the local geologic parent materials, supporting that wildlife hair makes a good indicator of environmental and nutritional stressors (Palmer *et al.* 2007).

The Chief from Swan River, a well known Land Based Expert, provided the most comprehensive description of the association between the changes in moose hair colour, pathologies in the liver and other organs, and a possible cause for the deteriorated body condition of local moose, using hair as a good indicator of the same. The following excerpt was taken from his testimony:

> (I): OK, so besides the ticks, do you notice anything else about the moose body condition? (22): "The fur sometimes is different. You can just tell a moose if he's healthy by the colour of the fur; whether he is shiny black, or white, or brown. You get the odd one out there, more so nowadays, they have growths on the outside. When I get a moose, I gut him, I open him up and I look at the liver, I look at the organs to see if the health of the moose. Sometimes there's a lot more spots on the liver these days. Some of them are like fatty tissue, but there are a lot that are like puss. So, I think the moose is sick, when they have that. (I): OK, so how long has that been for, since you've seen that? (22): "Probably in the last, ten to fifteen years; somewhere in there; fifteen years probably; and it's getting more. Like sometimes there is like really green gangrene. Whether it be from an old shot wound, or contamination, you just want to stay away from that, because we just don't know. We know something is wrong, but we don't' know what it is." (I): OK, so that's mostly in the liver, or not? (22): "The liver, and sometimes in the kidney, you'll see even stuff in some of the meat and hind quarters; you'll see either some discoloration. Like one moose in particular, there was really, really gangrene all over the inside of the legs and the organs, like he was just, ugh, gross! So, we actually left it out there and informed fish and game about it. Then we never heard nothing back from that about what was actually wrong with it". (I): So, say twenty years ago, did you actually see much of that or any of it or what? (22): We had no worries about that, at least twenty years ago, and prior to that waste treatment plant [Alberta Waste Treatment Plant] being open out there [Swan Hills]. We had no worries we would just go out there, and we would harvest, and we would look at the liver and it would be just perfect. Now we are constantly watching and every moose we get we, well definitely I do anyway, I am not too sure whether others do that, but I am pretty positive that they do. They check all the organs out and they check for growths and they will check even to see how the moose is just standing there, or if he's walking away if he's weak, or if he has a shiny coat. Like you can just tell by looking at them, so if there's something wrong we'll know it. But, I know a long time ago, definitely we didn't have no worries out there" ..... (I): So, you say that was in just one, but when you harvest a moose, or you go with someone who harvests a moose, do you see this phenomenon much? (22): "Well, its probably the majority of the time that you notice something different about it now. It is just not like a perfect healthy moose. Probably more than half of them have something wrong with them. We just don't know what it is; its not like we can test it, or anything like that" (22, 08 November 2007: 5-6).

Local Cree LBEs testimony, of moose hair colour changes may indicate that local moose populations are suffering from dietary deficiencies, or contaminant intake from local environmental changes. Further wildlife studies to determine the prevalence of this particular concern and how it may be related to environmental causes could be insightful.

Environmental Effects: Moose Body Condition – Growths

A more prevalent and pressing concern expressed is the abnormal growths found within moose within the study area over the last fifteen to twenty years. These growths have been found between the hide and meat, and within various internal organs of the moose. Following are a few of the excerpts from this study on these particular observations of moose body condition, and which were a re-occurring theme. I again present these excerpts unadulterated, and to be understood as evidence, which was gleaned through wildlife monitoring observations.

> (I): And what do those lumps look like? (2): "Well it's like a cyst, you, and we've cut them open some of those to check and it's just like a cyst.....On the outside between the hide and the meat itself there's the odd time we come across a moose that shows a lot more lumps and like a cyst, a growth....Just between the hide and the flesh itself....different parts of the body, mostly in the body, very seldom on top, just usually in the bottom....or up to the side..... I noticed them quiet visible when you're starting to dress, you start cutting and then you could see the lumps under here, under the arm or the front legs, or right around the back..... It just seemed like it was protected. There's a hard membrane around it and like I said there was your flesh and your skin and it seemed to be in between those". (I): And did you used to notice that when you were a kid or between the mid-70's or? (2): "No I don't remember seeing any of those before, no..... I'd say again about fifteen years ago is when I've noticed the changes in the animal's health". (I): So what colour are they? (2): "They're usually kind of a mixture of colour. It looked like there was some pus developing in there or some other hard sinew type of material". (I): And does that smell? (2): "It didn't smell....didn't have an odor at the time. The last one we opened up, don't remember any odor on it at all". (I): So in the last fifteen years what percentage of animals, of moose may you have seen that in? (2): "From...well I'd say about ten, twelve percent or fifteen percent of the moose. Say we do, we kill five, I'd say two of those probably, five or six moose that I've been involved skinning a moose, I'd say two of those would have sign of those, some kind of a lump. And again, it's just in this area" (2, 20 October 2006).

> (11): "It didn't matter if it was a male or a female, eh. They still had cysts, and the dark lungs". (I): So the females had cysts in the liver? (11): "In the liver they had big cysts" (11, 11 November 2006).

(2): "Well it's like a cyst, you, and we've cut them open some of those to check and it's just like a normal cyst that grows on even horses I've seen with cysts". (I): So what colour are they? (2): They're usually kind of a mixture of colour. *It looked like there was some pus developing in there or some other hard sinew type of material...* It just seemed like it was protected. There's a hard membrane around it and like I said there was your flesh and your skin and it seemed to be in between those. (I): So in the last fifteen years what percentage of animal, of moose, is it moose? (2): "Moose, yeah". (2): "From the ones that I've been involved with, people that I've gone hunting with, well I'd say about ten, twelve percent or fifteen percent of the moose. Say we do, we kill five, *I'd say two of those probably, five or six moose that I've been involved skinning a moose, I'd say two of those would have sign of those, some kind of a lump.* And again, it's just in this area. [Driftpile and Swan Hills] Like I've gone and killed moose up in Fox Creek area that's further, I don't know. It's further west and south, the Whitecourt area. Whitecourt, between Whitecourt and Valleyview, if you know where Valleyview is. It's south of towards Berland River. (I): And you don't see those lumps [in the moose] in that area? (2): I haven't seen those lumps in those areas (2, 20 October, 2006: 15).

(8): "I've come across a lot of sick animals as well, in the moose where I've shot a couple of them and, when you go to open them up, you notice water spots or *red spots inside their internal organs* and stuff. I don't know if that is a result of, if that's a regular disease that animals themselves get every so often or, or it's because of, of the plants or, or water that they, that they drink..... I did, I did take some samples into Fish and Game and, then I know people that, that have taken samples of sick moose and stuff to, to Edna she's the liaison for the Swan Hills waste plant [ungulate tissue sampling research to test for contaminants resulting from the Alberta Waste Treatment Plant] (I): So those red, red, did you say red spots? (8): Yeah. (I): Approximately how big are they? (8): "Some, some go quite big and, I don't know, about [indicating with hands?]... and sometimes you see them in their livers and in the tubes connecting in their livers". (I): *So that was about I think two inches* (8): "Yeah" (I): in diameter maybe? (8: "Uhum" (I): Okay, and did they smell at all did you notice or was it? (8): "*Some, some really smelled*". (I): And what organs or all organs or what organs in particular? (8): "Pretty well it affects all the internal organs. The stomach, the heart, the, yeah, the heart, the liver, spot, you can, you can notice a lot of it in the liver it's up all, all the spots on there. The blood, the blood from, seems a different color as well. It's not, *it's not bright red. It's, it's kind of brownish red.* (I): Yeah. okay, and how long has that been going on for? (8): "Oh, that's been going on for the past thirty years I guess now". (I): Okay. Interesting, and that was in just moose, or moose and elk, or moose, elk and deer, or which ones? (8): "Just the moose" (8, 21 September 2006: 5).

Similarly, Schramm (2005:156) reported from the results of her study that "local hunters, who found moose hunted in the oil rig areas near Red Earth Creek to be diseased. They described big cysts (about 3 cm in diameter) in the lungs, chests and breasts".

Growths, or cysts in moose (*Alces alces*) have been hypothesized (by the participants) to be a result of the waste treatment plant in Swan Hills, "Cause it's got to be some kind of a sickness that probably from that spillage" (5, 10 November 2006: 4), or from contaminated liquids that the moose have been licking around oil and gas wells, ".... now the moose go to these oil sites where there's a pump and that's where they go have their licks, eh.... That ground..... when there's a moose lick like, you know, the moose go into this, it's kind of a mucky sort of stuff and then they chew on that, and this is what's around the pumps. That's what they do eh; we've seen, quite a bit of that" (3, 12 October 2006).

Several causes may be implicated in the pathology within the moose in the study area, and some of those causes may be similar to those reported in other areas. For example, recent declines in moose populations in northwest Minnesota including infectious pathology associated with parasitism, some of which are associated with white-tailed deer (*Odocoileus virginianus*), infectious disease, and starvation. "Liver fluke (*Fascioloides magna*) infections apparently constituted the greatest single source of mortality and caused significant pathology to the liver, thoracic and peritoneal cavities, pericardial sac and lungs" (Murray *et al.* 2006:). In another study in Northwestern Minnesota (Custer *et al.* 2004:81), "copper deficiency, which has been associated with population declines of moose in Alaska and Sweden, may also have been a factor contributing to the decline of moose in Northwestern Minnesota". Copper deficiency can either be caused from copper deficient forage of bogs and forests, or high levels of sulfur in the diet which reduces the absorption and metabolic processes of copper (Custer *et al.* 2004).

Alternatively, toxic exposure from the Alberta Special Waste Treatment Centre has been implicated in the poor body condition of moose within the study area, including cysts, growths and overall observed poor condition, and unpublished studies which are meant to examine this association have been administered. To date, these studies are incomplete, and further studies are being contemplated (Personal Communication 2006b).

Environmental Effects: Moose Body Condition – Spots on Organs

Changes in the colour of the liver were noted by several moose hunters. This condition may be associated with the cysts and growths which were reported (above).

> (11): "They still do and the lungs are always spotted black, black spots in there...(I): That's been for seven years as well or something like that? (11): Well yeah, it's been on an increase now" (11, 11 November 2006).

> (2): Prior to that, you know, you take a liver out, it has the cover from the protective cover of the liver itself but the inside of the, like the animal, it has kind of a little fabric just like a net type of thing that's kind of wet.... "Yeah. A membrane, *but the liver itself was always to me darker in colour than what it is today but you cut the liver today, it's still kind of the same texture inside but it's just the surface area of the liver seemed to be a little tint to it*, but the taste is still the same" (2, 20 October 2006: 14).

Environmental Effects: Moose Body Condition – Antler Attenuation

Overall the many of the LBEs who were hunters, had significant concerns about the health of the moose in the region, as quite often they encountered what appeared to be moose with varying degrees of deteriorated health, including pathogens, nutritional deficiencies and changes in behaviour. A particularly interesting anomaly one participant noted appears to be a bone and antler attenuating matter in the antlers and facial bones of moose harvested from the Swan Hills area. This participant was able to note this phenomenon quite readily because he uses bones and antlers of cervids to make scrapers and other implements; consequently he was more apt to observe this condition than other hunters who likely discarded these skeletal and antler remains.

The participant (LBE) who noted this anomaly correlated the condition with the increased oil and gas activity in the region. Other studies have noted similar conditions in cervids. Hydroxyapatite is a crystalline calcium phosphate mineral compound which strengthens antlers (Muir *et al.* 1987). The ratio of the minerals within this compound is dynamic and dependent upon the effectiveness of mineralization during the growth period of the antlers, but remains stable after death (Kay *et al.* 1981). Hence, the postmortem attenuation of the internal areas of antlers from moose in the study area appears to be an

anomaly. At least two WSK studies have positively correlated contaminant inputs from industrial development, with a reduction in the density of cervid antlers. For example, Kierdorf *et al.* (1997) concluded that due to the proclivity for large amounts of fluoride to accumulate in antlers during the antlers fixed rapid growth and mineralization period, environmental pollution by fluorides, derived from a fertilizer plant, had a negative effect on the density and mineralization of Red Deer (*Cervus elaphus*) in North Bohemia (the Czech Republic). Similarly, (Jop 1979 cited by Kierdorf *et al.* 1997) correlated a decline of 32% in the average antler weight between 1922 and 1973 with environmental contaminant inputs from an industrial iron and steel plant in a forested region in Southern Poland in 1957. Although no assumptions of any correlation can be made, it may be discerning to conduct further inquiry and research into the observations, over at least seven years, of a "clear water liquid.....that would just be eating that bone inside there, just hollowing it out" (Norbert 2006).

> (11): "Whenever I cut off the antlers off a bull moose, I always find in the bones some clear liquid that just *eats the inside of the bone hollow* [attenuation] in there, and it's usually always within the, where the horns and the nose and the cheekbones are cause when you cut the horns off the head, you cut sideways.....then that's where you see it.....in there, that's where I find this clear liquid.....It was a clear water liquid but that liquid would just be eating that bone inside there, just hollowing it out and this has been on the increase for the last I'd say probably the last seven years, if not more, but I have been really noticing it within the last couple of years that it's been pretty common in moose". (I): Okay now before this seven years, the liquid in the bones and the antlers.....did you notice either of those two things at all before? (11): "No, we never had them.....It just cleans that bone clear... finally that bone is just about the thickness of this paper.....So when I cut it like I always find it in there, eh". (I): Did you notice that in any other bones in the moose other than in the head? (11): "Not in ....all the other bones. I never found them, even in the bones in the legs that we use for scrapers, the bone itself still seems the same thickness.....Swan Hills, out in that area.....We've been finding animals like that out there, when I was younger we don't have that many oil activity going on like right now, that's where we've been taking some of these animals from". (I): Did you notice any of the bulls with the fluid in there, from the north? (11): "Not on the northern, not yet.....and so far we haven't run across a bull yet from out there that had things like that. It's a clear liquid.....Yeah, a clear watery type liquid like, eh, like a gel" (11, 11 November 2006).

Environmental Effects: Moose Body Condition – Wart Growths

Moose commonly have a wart-like benign tumor protruding from the skin ranging from about half and inch to four inches called infectious cutaneous fibromas likely caused by Popova virus (Cosgrove and Fay 1981). A number of the LBEs of this study have noted this condition in moose within the study area as well; one excerpt follows:

> (11): "Okay, and I do hides. Like I make my own moose hides and we have been finding cysts on the outside of, well I guess like something like warts on some of the moose too on the bodies, and the warts are, some of them are about the size of a cup, eh, but when we scrape the hair off.....Oh yeah, they're big, like some of them are even a little smaller but about that big" [making an approximation of the cyst with hands]. (I): That's about four inches around? (11): "Uhum". (I): Where on the body is that? (11): "Anywhere or ....Yeah, usually on the sides, like I mean on the ribs like". (I): Right. And what color are those? (11): "They usually are just like a big wart that grow in there, eh, on the moose anyway, and when we cut them off, we'd cut them off but there would only be just like maybe a pin size hole that go into there.....like it's just like a little balloon there that's stuck in there.....but we would cut those off and there'd always be a little thin hole that's connected to those from the hide".

Environmental Effects: Moose – Population Abundance and Trends

Population distribution, density and trends give indications of relative species abundance population disbursal, and trends for a local area. In Alberta, moose population trends indicate a steady decline (120,000 to 100,500) from the 1960's to the 1990's (Karns 1997). Primary factors toward limiting the geographic distribution of moose in northern Alberta are food, and cover (Kelsall and Telfer 1974 cited by Karns 1997). The results of this research, through the monitoring and observations of Cree LBEs indicate that moose populations have declined somewhat in the past 20 to 30 years, or since oil and gas and forestry development has increased in the study area. This study area encompasses Swan Hills, Virginia Hills, Mitsue, the Driftpile River area, and north of Lesser Slave Lake. Following are a number of excerpts from interviews which indicate support for declining moose populations; although, not all the LBEs agreed that moose populations were in decline. The first excerpt is an account of moose still being abundant in the area, but a hunter has to make a special effort to seek them out. While the other excerpts below, are

accounts of dwindling moose populations throughout the Swan Hills area. Overall, most of the LBEs who hunt moose agreed that local moose populations have been declining since resource development, and related infrastructure, has been increasing in the area.

> (13): "The development's always there, and like now, like the last few years it's taken off again, maybe the last five years it's, another company moved in there and they've been re-drilling and doing a lot of stuff and then going into areas that they never been into before also and so they're opening that up too and going over a lot of the places that they've been already and that probably affects, you know, the game patterns but it's not really, like you just go and find them wherever they went, you know. You got to find them *so that hasn't really affected I guess that way. They're still there...*"
> (13, September 28, 2007: 19).

> (7): "Now you can drive anywhere you want. But mostly its Oil and Gas, like some areas it's affected the moose; like the moose have moved right out
> (7, 22 August 2006: 3).

> (I): Have you noticed any changes in moose pop, moose populations? (6): "Yes, there's not as many. There's not many anymore like there used to be". (I): And where is that? (6): "Like I said, now we got to go farther and farther and farther to get a moose" (6, 22 September 2006:10).

> (8): "I don't know when the clearcutting was started but I noted it about twenty years ago when, when they first started clearcutting. I, we noticed, I noticed the dramatic change setting in the moose habitat as well. Some areas were, there was less because of the clearcutting. To me the moose don't like meadows like deer do. The moose is, a woodland animal which likes to be in trees and stuff but the trees were no longer there so they, they keep moving to, to find shelter and, and, and comfort where there are trees so the impact that clearcut had on it was, is why the moose just were no longer in one area and more in other areas".....(I): Did you notice changes in the numbers of the moose in this, in these areas that you've identified on the map? (8): "It's, it's declining and to me it's, the numbers are declining" (8, 21 September 2006: 2,9).

> (I): So I'm wondering if since you were young in the north here what changes you've seen in the populations of the moose say. (11): "Yeah, the population of the moose have been, it's just been going down slowly, eh. .... So, you know, years back I used to see moose herds in the fall about anywhere from sixty-five to about a hundred and twenty animals in one herd". (I): When was that? (11): "That was probably in the 80's. It was a common sight, eh, you'll see a huge moose herds" (11, 11 November 2006: 2-3).

> (1): "Now you have to go miles back further south in order to get into any prime hunting areas" (1, 20 October 2006:2).
> (22): I haven't been out that much this year because I haven't had a truck so I'd always have to wait for my step father to come out and hunt, but in the past, it was almost every day, or at least 3 to 4 times a week in the past. Not every time

> we were successful. In the last 2 to 3 years we're hardly seeing any moose out there now. In my last 15 trips I've seen moose twice in the last 15 trips out there; and that's over a span, I guess that's all this year. So they seem to be getting less out there right now"
> (22, 08 November 2007: 2).

Environmental Effects: Moose – Population Dynamics

Population dynamics consider the demographic reactions, including sex, age, population size, natality, mortality, immigration and emigration, of one species temporally occupying a spatially explicit area. The health and availability of appropriate habitat acts as an influencing factor on fecundity at each age of a particular species; consequently, components of an environment influence an age specific survival (Krebs 1994; Van Ballenberghe and Ballard 1997). The complexity of forces acting upon population dynamics of a species is daunting including random variation, density dependent effects, seasonality, fluctuations in environmental carrying capacity, human and non-human predation, natural and anthropogenic induced parasites and diseases, landscape fragmentation, linear disturbances (i.e. roads and seismic lines) and catastrophic events. While it is beyond the scope of this research study to attempt to address the scope and scale of these complexities; a number of observations of Cree LBEs are presented with the aim of revealing that moose population dynamics are possible key indicators of detrimental ecological change in the study area, which these LBEs attributed to intensified land and resource development.

> (1): "The other big change I've seen too in terms of the big game with moose, it's very rare that you actually can find a big moose. You know, most of the game now are very young.....most of the time and most of the kills I've seen within the last ten years have been.....you're lucky to see a five year old bull that's been shot. Most of them are either three or four, so they're very young which shows that.....the game has depleted although Fish and Wildlife will tell you there's lots, plenty.....I kind of laugh because the reason why they assume there's plenty is they're exposed and you can see them a lot more, you know, because the forest isn't there but just judging from the age of the moose, it's pretty obvious that the moose's lifespan isn't very long.....I remember as a child.....my grandfather would bring home a moose, you know, and the moose was probably eight, nine, ten years old and they were really big animals. They were not small like they are now. They're not anywhere close to the way they used to be. So you can see the depletion in terms of

> the game being a lot younger, and being shot a lot earlier and maybe that's because of the way they're exposed" (1, 20 October 2006: 15).

Many larger animals, including moose, move in migration corridors, hence fences, highways, and above ground pipelines serve as potential barriers to the migratory routes of many of these species and can disrupt population dynamics (Hundertmark 1997). Many of the study participants expressed a concern that logging, oil and gas development and linear disturbances (i.e. roads and seismic lines) destroy critical habitat, food sources and safe travel corridors and cover for wildlife, as well as extirpating a number species of fish, wildlife and medicinal and food plants. These species population declines have affected the subsistence economy of the local Cree people, consequently their loss, and the loss of the habitat which support them are of special concern. For example, a number excerpts from the interviews highlight participant's expressed concern on wildlife and habitat loss in the following manner:

> (1): "You can see the major changes that have taken place in terms of the landscape, in terms of the wild game, in terms of the traditional harvesting that went on and as well as the environmental pollution that is in most of those areas now.....So there has been a lot of changes even from my time as a young person in as far as the environment is today, you know, and a lot of it I see in terms of the major culprit really is the forest industry.....although they view themselves as friends of the forest, you know, when you clearcut it does a lot of damage.....They only see the visual part of it. They don't see the damage that's actually done by clearcutting in terms of the smaller species that require the shade as well as the amount of moisture that is held and retained by the forest and the trees.....As an example of the changes that have taken place, over and above that in terms of the wild game itself, a lot of areas that we'd normally go hunting in terms of moose licks, as our grandfathers did, are very difficult now because a lot of those places tend to be hunted out cause the animals are more exposed.....Now you have to go miles back further south in order to get into any prime hunting areas" (1, 20 October 2006: 2).

The boreal forest has historically provided fire disturbed seral deciduous shrub forage considered prime moose browse (Telfer 1984). Studies have indicated that the optimal successional stages for moose browse following fire disturbance is between 11 and 30 years following a boreal forest burn. Therefore, moose population increases can be a result of optimized forage conditions within these successional burned areas. Nonetheless, moose populations at or near the protective fringes of these optimized

forage areas, where predation and increased hunting access interact, generally prevent moose population increases from occurring (Kelsall *et al.* 1977; Schwartz and Franzmann 1989). Similarly, forest clearcuts have potential for creating moose habitat through the proliferation of shrub browse following forest harvesting; nonetheless, appropriate moose habitat is also dependent on proximal relationship to protective cover including minimal distance to uncut edges, irregular lines of sight, maximum browse close to uncut edges, water, mineral licks and aquatic vegetation (Hogg 1990). Recently, moose population declines in Alberta have been attributed to the concomitant effects of fire suppression and hunter and natural predator pressures. Since the 1950's, fire suppression and predator pressures have influenced a large landscape where optimal moose seral deciduous shrub forage is limited (Telfer ES 1995).

Environmental Effects: Bear – Body Condition

Jean, a hunter, trapper and plant harvester was quite taken back once when she and her husband discovered a black bear which had fallen in a pit near oil development. Her observations and experience follow and speak for themself.

> (10): "The only problem that we have seen from oilfields was the bear, the one bear that we cut open. It was all oily. It's skin was all oily like it had fallen in one of those pits or something, and it had tried to clean itself off and when we cut it open, it's whole insides were just oily too.... The intestine, the stomach, everything was just oil. There was nothing to preserve out of it. It was just terrible" (10, 21 September 2006).

6.1.2 Environmental Effects: Fragmentation and Habitat & Species Losses

Research data needed for managing land and resources in a sustainable manner over much of the Boreal Plain study area is poor, despite the fact that the intensity, scope and scale of development activity has increased markedly over the past three decades. Few attempts have been made to develop models which correlate changes in ecosystem composition, structure and functioning, and water yield and quality with land and

resource management practices, re-enforcing concerns of a reductionist, rather than a cumulative approach to ecosystem management. New approaches are needed to tackle these complex issues (Ayensu 1999), including approaches which make use of local community knowledge about the integrity and health of local hydrological and terrestrial ecosystems.

Habitat fragmentation occurs when large contiguous areas of the landscape are divided into small, disjunct areas by land, resource, industrial and residential development resulting in a substantive loss of habitat for wildlife. For many species, this scenario typically results in concomitant decreases in populations, and fewer individuals within a species in a particular area means that the risk of local extinction within that area is high (Andren 1994; Hames *et al.* 2006).

There is ever increasing and intensifying land and resource development which encourages a suite of impacts at many scales upon ecological systems including losses in biodiversity (Barbault and Sastrapradja 1995) and habitat loss, fragmentation and degradation (Hanski *et al.* 1995; Andren 1994; McNeely *et al.* 1995; Dale 2005; Hames *et al.* 2006; O'Connell; 2006; Walters *et al.* 2006). Harvesting intensities have increased in the last three decades in some areas of Alberta at an alarming rate, increasing the volume logged over forested areas in Alberta from 3.4 to 24.4 million m^3/yr (Timoney and Lee 2001; NFDP 2006). Forest harvest effects include detrimental changes in vegetation species composition, structure and functioning, successional pathways, soil moisture, structure (compaction) and nutrient status, hydrological yield and quality (Smith *et al.* 2003). Linear development features such as forestry and oil and gas development access roads, power lines, and seismic lines can deter movements of terrestrial animals and serve as corridors which facilitate the colonization of exotic plant and animal species making a local area unsuitable for endemic species (Forman 1995; Dale *et al.* 2005).

Human caused disturbance over the study area has been largely driven by road development and other linear disturbances (i.e.: seismic and pipeline development), oil and gas exploration and development, timber harvesting, a toxic waste treatment plant,

recreation and agriculture. All of these developments seem to have had a substantial role in contributing to cumulative ecological impacts, including those resulting from forest fragmentation, over large tracts of the landscape (Schindler *et al.* 1995; Schindler *et al.* 1998; Prepas *et al.* 2001; Smith *et al.* 2003). The results of this research study serve to document the observations and associations of some of these impacts.

Many of the hunters and trappers interviewed for this study expressed solemn concern over the destruction of critical wildlife habitat over large tracts of the landscape within the study area. This level of concern may be warranted, considering under severe perturbation, restricted dispersal limits the opportunities for, and rate of, population rescue" (Peakall and Lindenmayer 2006: 531). Following are a number of excerpts of many who expressed great concern over the rate and intensity of development in the study area and its fragmenting and destructive effect on the local boreal forest.

> (6): "And here, we don't hunt here anymore. It's too, there's very seldom we go hunting here. I mean the, the deforestation they're doing back here, I mean there's no-where to hunt anymore.... it's a big field back there. (I): Where's that? (6): South of the reserve here, just south of Drift Pile here. Like where Drift Pile is there, just south of it. There's no-where to hunt there anymore; well there's no place for the animals to hide" (6, September 22, 2006: 3).

> (10): "I don't think that it's being wiped out; it's just more divisive. But, the clearcutting takes it off for a time but it comes back with the replanting and whatever, it comes back. The forest, it comes back.....but in our lifetime we'll never see, you know, we've only got another twenty years left if we're lucky, you know, and that gives you a tree this big. It doesn't give you those hundred and fifty foot tall jobs and it doesn't give you the same animals in that area" (10, 21 September 2006:12).

> (17): "You know, with all this clearcut logging there's no thought about the animals out there and I'm not saying that because I'm a trapper and I'd like to have more animals. I guess I'm speaking for the animal. You take its habitat away, it's got to go now to compete with its neighbours for habitat and then there's a competition there again for food, so there's a kind of a kill out. They don't realize they're killing the animal by taking its habitat away..... So what happens to the animal that was stripped of its habitat? It actually dies off or it has to go fight another animal for territory (17, November 16, 2006: 16).

Moose have need for sodium as evinced in their proclivity to be drawn to mineral licks and aquatic plants which are natural areas and vegetation rich with this element (Jordan

1987 cited by Franzmann and Swartz 1997). Consequently, mineral licks are critical habitat for moose in the boreal forest, which Cree LBEs have recognized and understand. Recently, since oil and gas and forestry development has increased within the study area, many of these hunters have observed critical habitat features such as mineral licks being destroyed, and in many cases completely removed as prime habitat for moose. A number of excerpts of which reveal the importance of this habitat feature, the concern for its destruction, and associations follow.

> (6): "It's usually, they usually form a, they usually, a moose, a moose will usually make them in a, in an old dried out creek bed type thing. You know what I mean? They have to have the soft mud in there that that's, that's why they call it a *saltlick*, cause a moose will, he'll go in there, like in the summertime when the bugs are bad, like I mean the horseflies and stuff, they go into the mud, roll around in the mud and it's kind of like a protection for them, you see, so they, that's why they go to the saltlicks. They get the salt, they lick the salt and they, you know, cover themselves in mud and stuff and then they have some protection from the insects. *Well actually they're all ruined.* That, that where the, where the bush line ends there, that's where that one moose lick is there, the first one, and then they're all further up into the open from there so. (I): Right. And how long has that been for, like the last how many years? (6): At least three years, four years, it's been like that cause they started working their way this way, the logging and they're working this way, eh" (6, September 22, 2006:4).

> (8): "I don't know when the clearcutting was started but I noted *it about twenty years ago* when they first started clearcutting. I noticed the dramatic change in the *moose habitat* as well. To me the moose don't like meadows like deer do. The moose is a woodland animal which likes to be inside [sheltered] trees and stuff but the trees were no longer there so they keep moving to find shelter and comfort where there are trees"... "Before when I was taught to, to hunt, I was, I was taught to, to know the moose and, and their habitat. Moose have a habit of going in the salt lick from early spring because the moose need calcium in their diet so that was an easy, easy way to go and, and harvest the moose was in salt licks. Moose or deer need privacy and shelter when they go and eat the salt from the salt licks. What clearcut logging has done is just clear cut all the shelter that the moose needs and for that reason I've seen salt licks, good salt licks out there, that were destroyed and left alone by the moose because there's no shelter and they don't feel safe going into those moose licks anymore. It's right out in the open and they don't; they just leave it alone and I've seen mostly in all these clearcut areas where moose licks were, it was regularly used by moose and elk (8, 21 September 2006: 2-3).

Fragmentation and Species Population Abundance & Trends Issue Statement

Habitat fragmentation includes a reduction of suitable composition, structure, size and functioning of critical wildlife habitat to support endemic species populations, and isolation and edge effects of suitable habitat patches resulting in increased populations of predators and resultant increased risks to endemic wildlife populations; both of which contribute to losses in biological diversity within any given area (Wilcox and Murphy 1985; Lomolino *et al.* 1989; Andren 1994; Verboom and Van Apeldoorn 1990). Wilcox and Murphy (1985:884) have stated that "habitat fragmentation is the most serious threat to biological diversity and is the primary cause of the present extinction crisis". The most prevalent large-scale cause of primary suitable wildlife habitat is land and resource development (Burgess and Sharpe 1981). And, in areas with greater than 30% suitable habitat loss, there is often a reduction in certain less resilient endemic species (Andren 1994). The results of this study support these conclusions, and indicate that habitat loss within the study area due to the intensification of development, may be associated to a reduction in certain endemic and culturally significant (cultural keystone) species, including moose, squirrels, grouse, rabbits, berries and key medicinal plants. This may be plausible, but requires further study, considering forest fragmentation imposes restrictions in dispersal mechanisms, and increases in risk of predation, both of which serve to induce situations where critical minimum population size thresholds may be breeched, with a resultant local extirpation of the species (Festa-Bianchet 2006; Peakall and Lindenmayer 2006).

The following sub-sections serve to present the results of a number of observations by Cree LBEs who are concerned by the fragmentation of the Boreal forest due to oil and gas, forestry, linear, and industrial (Alberta Special Waste Treatment Centre) development.

Environmental Effects: Fragmentation and Squirrel Population Abundance& Trends

In addition to critical habitat loss, fragmentation increases the forest edge, which often leads to decreases in endemic species and increases in predator species, including parasite recruitment (Andren 1994; Forman 1995; Donovan *et al.* 1997; Hames *et al.* 2006). For example Chalfoun *et al.* (2002) reported that the loss of forest and increase in forest edge can provide prime habitat which lends itself to increases in exotic populations of Cowbirds (*Molothrus ater*), and Red Squirrels (*Tamiasciurus hudsonius*) which increase predator pressure on boreal forest songbirds (Song and Hannon 1999). While there was no report of songbird impacts by squirrels within the results of this study, there were numerous reports of substantial declines in a number of cultural keystone species, including Red Squirrel (*Tamiasciurus hudsonius*) populations.

Many human impacts leave clear records in the paleoecological record. Paleoecology can be used to re-construct and understand historical long term anthropogenic impacts on the land, and thus it is of particular interest when considering sustainability. For instance, whole forested regions were quickly axed and essentially the entire original forest of the Midwestern United States was removed in only three decades (Forman 1994). Consequently, paleoecological records are useful for understanding and averting past resource management decisions which were detrimental to local ecosystem integrity. Lomolino *et al.* (1989) reconstructed Pleistocene distributions of mammals from forest habitats in the American Southwest. The results indicated that the patterns of occurrence of seven species of forest mammals were significantly affected by insular distribution including the extinction of some species and the introduction of competitive exotic species. In a more recent study conducted by Verboom and Van Apeldoorn (1990), on habitat requirements of red squirrel *Sciurus vulgaris*, results indicated that squirrel populations in the province of Overijssel, the Netherlands were negatively affected by the fragmentation of forested woodlots from agricultural development. Other studies also support this conclusion, for example, four species of squirrels (*Sciurus carolinensis, S.*

Niger, S. vulgaris and Tamiasciurus hudsonicus) displayed results which were more variable depending on species; however, in this study it was also concluded that squirrels are "obligates of mature forests" and "depend heavily upon mature trees", consequently they are sensitive to fragmentation of the forest and rarely found in small forested enclaves (Koprowski 2005:370). In a similar vein, a number of Cree LBEs interviewed for this study reported that red squirrel (*Tamiasciurus hudsonicus*), which has been a cultural keystone species for its fur, and for its nutritional value, have been largely removed from the boreal forest within the study area. Many of these experts associated the decline in populations of squirrel with the removal of prime habitat, including mixed spruce forests.

> (9): ".....the fur bearing animals are lesser and lesser on our trapline area because of the clearcutting..... It was just getting really good, to trap, we started, you know, when we were building it up and building it up from where they had clearcut previously and as we got to that peak of, you know, next year's going to be really good because we got all this stuff sorted out, then they went in and clearcut the whole top of House Mountain there so they took the bottom third out of our trapline and like there's no animals in there, no fur bearing animals in that area. They will re-populate as the trees come back, and stuff, but you know, we lose that for a fifteen to twenty year period" (9, 21 September 2006).

> (10): "Yeah. And when we were starting to trap when we took over this line, there had been clearcutting on the trapline just prior to when we took over that line. So I'm saying to Fred I'm going to go check all this bush because the squirrels should have just moved from where the clearcutting was to the next cutblock but I found as I went through all of those areas where the clearcutting had been that there were no squirrels, period. No nests of any kind in the next cutblock..... So, so there is a thing with animals when they are disturbed that they don't gestate, you know, they're pregnant but they don't produce.... because they get pregnant in the late fall or whatever but they don't bother with the continuation of the birth when they're disturbed and it's wintertime that they're doing that birthing process for the spring..... So when they're in there clearcutting all winter and disturbing their habitat, like they, they don't check if there's a squirrel nest there. They just go in and clearcut, you know, and that, that's all disturbed so they just don't repopulate..... And that goes for Marten and Fisher, and all of those fur bearings..... the industrialization is making a change there..... clearcutting. (I): And how long have you noticed that for? (10): Well for the twenty years that I've been here"
> 10, 21 September 2006).

> (I): "So when you trapped, what animals did you trap with your dad? (Emile): "The trapping was mostly squirrels, coyotes. At that time there were a few foxes, not too much lynx. There was a few here and there..... This was mostly what they trapped was weasel and squirrel". (I): Did you get quite a few? (3): "We

used to get lots, yes. They were gone about two weeks at a time where, it just depends how long though the weather was what happens". (I): Do you remember like how many squirrels that you used to get? (3): "Actually, you know, *roughly you'd bring home about five hundred squirrels (I): In two weeks? (3): In one, two weeks, yes....* "(I): Oh okay. I just wondered if you noticed a difference in the populations of the squirrels because you said they were lots before..... (3): I guess they're not that plentiful now (3, 12 October 2006:2).

(20): "The squirrels are all gone. There are no trees. That's why you don't see the squirrels. There's no more, eh, because the logs is gone. The squirrel, they won't go in the muskeg. There's nothing to eat, eh; same with any kind of an animal of fur. They won't go in the muskeg. That's why they left over my traplines, cause I was in muskegs, eh. All logged out. That's why they [the fur bearing animals, including squirrels] have to get out of there" (20, 10 November 2006: 4).

(6): "Yes. It's all different. There's no trees, nothing for them to hide in, nothing for them to live in cause squirrels basically live in the trees, eh or underneath them. And the martens are always after the squirrels" (6, September 22, 2006: 7).

Perhaps more complex, and thus requiring a more complex management strategy is the mutualistic community effects, including extinctions, precipitated by the symbiotic relationships between mycorrhizal (root associated) fungi, higher plants in the Pinaceae (pine), Fagaceae (beech), Salicaceae (willow), and Betulaceae (birch) families, and small mammals. Maiser *et al.* (1978:802,808) revealed that there is an "obligatory symbiotic relationship between mycorrhizal fungi and most higher plants", and that small mammals (including squirrel) contribute to the dispersal of mycorrhizal inoculum through their feeding and excrement; consequently, each forest species contributes a necessary contingent functional component to ecosystems, and it is those interrelationships which must be sustained if we are to achieve the sustainability (integrity and health) of the forests.

Environmental Effects: Fragmentation and Grouse Population Abundance & Trends

Avian nest predation is significantly greater in highly fragmented forests with greater area of edge where vegetation structure is disturbed and predation is higher, and with fewer core critical habitats where vegetation structure provides increased nest concealment (Donovan *et al.* 1997; Chapa-Vargas 2006). A number of the Cree LBEs

provided testimony which attests to a significant decline in the populations of grouse (*Tympanuchus phasianellus*), a cultural keystone species which is traditionally a part of their staple diet. Two of many descriptions of this change, follow:

> (17): "Like this fall there was quite a few chickens, not as many as there usually is when the cycle is strong" (17, 16 November 2006: 2).

> (2): "They used to be plentiful, full of wild grouse, spruce grouse even, that you could catch them out in the trees every evening. Now you don't see that anymore either. You got to go quite a ways before you can catch those in the trees in the evenings. Even out on the farms here, out in the pasture areas, used to be able to go out and shoot those prairie chickens, they're tough to get now. You don't see them in the mornings or in the evenings go up in the trees where they usually used to feed" (2, 20 October 2006: 4).

Environmental Effects: Fragmentation and Rabbit Population Abundance & Trends

Small mammal richness is heavily influenced by vegetation cover and condition. Given disturbed sites support less vegetative species biodiversity, simplified forest vegetation has detrimental impacts for native fauna in modified landscapes (Fischer and Lindenmayer 2007; Holland and Bennett 2007). Given the conditions of the anthropogenically fragmented forest within the study area which is listed as high to very high (Strittholt *et al.* 2007), it is not surprising that a number of cultural keystone species, including rabbits, which has been widely used as a staple meat for local Cree communities, may have been largely extirpated from the area. Following are a few of many accounts attesting to the extirpation of rabbit (*Lepus townsendii*) from the study area.

> (12): "Well the rabbits are just like almost extinct. You don't see them as often as they used to just going back now". (I): So how long did you used to snare rabbits for, since you were young again? (12): Oh yeah; just a little girl. (I): So that was forty, forty-five years ago at least, something like that? (12): "It was that. Yeah, it was". (I): Okay, and then did you consistently, like every year snare rabbits since you were a little girl? (12): "Yeah". (I): Until you say seven or eight years ago when now there's not any? (12): "B: There's nothing. There's none" (12, September 28, 2006: 1).

(14): "There used to be some [rabbits] all the time and then like in seven year cycles they used to come in abundance the seventh year and that hasn't happened I don't know for a long time. Now there's, you can't, you barely ever see a rabbit anymore anywhere! Even in the, a few around the isolated parts. You hardly ever see a rabbit..... (14): They were kind of, I guess you could say they're always kind of, if somebody couldn't go hunting, they're always coming to you for food. Like if somebody for some reason couldn't go out that day or that week, the rabbits would just come right by you so you could, it's kind of like having a corner store for the meat part of this table, the diet. I don't know if there's been any studies into it, or if that's has occurred in other places but it's here and I know there used to be, you'd see them all over on the road" (14, September 28, 2006: 1).

(20): "Rabbits is not coming ..... there used to be lots of rabbits, I got us lots. Now, there're no tracks. Nothing"... "Yeah, that's right, used to be lots all over. My mother used to snare through the summer and the wintertime too, eh, back here, eh. We had to eat those rabbits and they were nice and fat all the time, eh. Now, nothing".... "We used to have a lot of rabbits in 70 [1970]. I used to catch something to eat, eh. Now today, no more rabbits. I seen the wolves and the coyotes just about starve to death. There's nothing, only the mouse. There's not much but mouse now to eat, eh. No. That's why I said there're a lot of things that spoiled it. There're no more rabbits" (20, November 10, 2006: 2).

Environmental Effects: Fragmentation and Berry Plant Extirpation& Health

Land use history and the resultant disturbance to the trajectory of vegetation re-establishment on a given landscape is largely dependent upon the extent to which the ecosystem is modified, and the inherent ability of the species to survive or re-colonize (Foster 1992; Peterken and Game 1984). Mechanical damage due to forest harvesting practices such as mowing, brushing and plowing (V Plowing) treatments are undesirable for ericaceous species. Common Blueberry (*Vaccinium caespitiosum*) and Huckleberry (*Vaccinuim myrtilloides*) can be extirpated from a local area from these treatments due to the destruction of the root stock, or be prevented from rehabilitation of the species in a local area due to inherent limitations in the colonizing ability (Motzkin *et al.* 1996; Donohue *et al.* 2000). Because land disturbance history often affects canopy composition and structure (Foster 1992), and the resulting light environment, it should not be unexpected that many of the LBEs experienced an inability to procure both blueberries and huckleberries since the more recent development activities within the study area,

particularly in the last ten years. Following are a few of the many excerpts from LBEs interviewees who kindly provided testimony to this concern.

> (12): "....but there used to be so many berries there like (I: In the Swan Hills area?) up, yeah, up that way, the, not the Saskatoons, but the Blueberries. They were so big and they were just (I): When was that? (12): when I was growing up, just a kid, we used to all go down there and pick them and I think this all....Forty years ago? When I was a kid, yeah, I think so. I'm sixty-two now... 22 I was a kid. (I): And in the last how many years have you noticed that there's hardly any berries in the Swan Hills area? (12): "I haven't seen any in, oh my goodness, more than ten years now" (12): "....B: Nothing, nothing. (I: Nothing. I've heard that a few times.) I know last year there was none. This year there wasn't any there and I know there was a few, maybe the previous year but just enough to just get a taste of that" (12, September 28, 2006: 19-20).

> (10): "We usually go north of the lake for blueberries but we have years back when the clear-cuts first started happening down in Virginia Hills and south of Swan Hills we used to, we do some, did do some berries in that area but this year we stopped in Swan Hills on Goose Tower Road, there were no berries to be seen anywhere". (I): And how long have you been picking those for? (10): Well I've been here twenty years so, like we were doing it the first ten years but we haven't done it for the last ten because there's nothing there". (10): Yeah, hardy any berries. A lot of it is weather but a lot of it's the clear-cuts and the oilfield, you know. There's just so much oilfield stuff going on that. Yeah, everything's, everything's scraped and dug and roads and lease sites"
> (10, September 21, 2006: 9).

An Elderly Cree lady (LBE), who has engaged in a mix of land based harvesting activities, including trapping and berry and medicinal plant harvesting; was able to provide many accounts of ecological change, as gleaned through key indicators, including the drastic decline in blueberries in Swan Hills area. The impacts of this decline in the availability of berries has been that she was no longer able to harvest blueberries in the Swan Hills area which she had previous done for about 70 years.

> (4): "For many years, when I was living in Kinuso; for many years I used to go and pick there [Swan Hills]. Last year I went and picked there [blueberries] when my friend picked me up, I mean my cousin. But blueberries, I haven't picked blueberries for six years now I think, because we didn't find any at Swan Hills where we used to pick. We looked at that Moosehorn place there too, they had bulldozed it where we used to pick; there was a big pump there". (I): So when did you and Rose go, did you say? (4): "That was about five years ago, the last time we picked blueberries, and about two years ago, we didn't find, not even one blueberry" (4, August 23, 2006: 7,8).

A possible explanation for the extirpation and condition of blueberry and huckleberry plants within the study (although this requires further study) may be ozone (contaminant) exposure which can have deleterious effects on the physiological functioning and productivity of a wide range of plant species including conifers, deciduous species, ericacious shrubs forbs and lichens. Effects can vary depending upon the duration of exposure, concentration and presence of cumulative stresses such as drought, competition, nutrient deficiency, insects or pathogens (Smith 1990; Treshow and Anderson 1991). Injury to vascular plants may result in reduced photosynthesis, lower growth rates, accelerated senescence of foliage, and general loss of vigor clearly visible in the foliage including an overall chlorotic appearance, mottle, tip or margin burn, stipple and necrosis (Treshow and Anderson 1991; Temple *et al.* 1992). Visible symptoms in foliage resulting from ozone exposure can be considered an indicator of acute or chronic ozone exposure injury. "Chronic injury is normally induced by long-term low ozone concentrations" (Brace *et al.* 1999: 3). At least two of the Cree LBEs interviewed for this study have observed and provided testimony of plant damage which may indicate, although further research is needed, that there may be ozone injury to a number of vascular plants in the Swan Hills region, including Blueberry (*Vaccinium myrtilloides*).

> (4): "What did the plants look like; the plants that the berries were on? Margaret: They were green, and kind of, you know nowadays when you touch these plants they are kind of crispy dry. Not like years ago, if you tried to break a branch you had a hard time to break it because they were not crisp, like right now" (4, August 23, 2006: 3).

> (22): "There's allot of odour out there now, and you see allot more discoloration of the plants and trees out there as well". ... (I): What type of plants? ... What about berry plants, do you notice any kind of discoloration in any kind of berry plants? (22): "There seems to be a, I don't know what you'd call it but, you know how when a plant dies there is the change of colour, it's like that; there seems to be more of that..... (I): And how long has that been for that you've noticed that change? (22): "That's been at least 15 years at least anyway".... (I): And, that discoloration in the berry plants, that was in what area again? (22): "In the House Mountain and Deer Mountain areas, those areas for sure" (22, 08 November 2007: 12).

(I): The roots [*Acorus calamus*] you collect in the Swan Hills, Virginia Hills area, how long have you been collecting those?.....(10): We've been doing it the twenty years.....Your mother used to do it.....So since the 40's anyway. 40's or 50's.....and the Mitsue area just been recent. .....we just discovered that.....I was the one that looked for the Pitcher Plant [*Sarracenia purpurea*]..... His mother used to pick them somewhere on the highway between Slave Lake and the Athabasca River, in some of those bogs.....and then I spotted them at Mitsue because I'm from down east so I knew what a Pitcher Plant was. (I): Okay. So since you've been collecting the Rat Root [*Acorus calamus*] .....are there as many of those plants available, or are they different or are they the same? (10): .....right now it's the dryness of it might make a difference cause..... there is no water..... now that it's drying out, they're not reaching as far..... because of the lack of water. So that might make a difference..... but where I used to dig there's nothing there cause it dried up" (10, 21 September 2006: 10).

(I): So the Rat Root [*Acorus calamus*], how long have you been collecting that for? (5): "For a long time, quite awhile..... Yeah, pretty well when I was about maybe six, seven year old". (I) Okay, so since about 1952 or 50? (5): "Yeah, because they're good, they are good medicine.. It kills your cold and everything like that.....Yeah. I got a whole bunch". (I): So since about 55 or 56, 1955 or 56. (5): "Uhum. (I): Okay. Now when you collected it at that time in say the mid-50's, was there lots and where did you collect it? (5): "Down here, by the lake. There's some by the lake here.... but there's some parts that we used to go in like the Swan Hills area but not now, because it's pretty well destroyed" I: When did it get destroyed? (5): Oh, when they started logging, they'd stop everything cause, and spills [near the Alberta Waste Treatment Centre in Swan Hills], we don't want to take anything out of there. (I): Do you know when they started logging? (5): "Oh quite awhile back.... by Swan Hills its been logged for about twenty-five years. You could see the opening about twenty-five years ago.... Now it's pretty well, all the trees are out close to the Swan Hills" (5, 10 November 2006:6-7).

Environmental Effects: Fragmentation and Predator Population Abundance & Trends

"Predation by specialist predators can cause extinction of isolated populations ..... and predator-prey equilibria may only occur at large geographical and temporal scales and unlikely with increasing habitat fragmentation" Festa-Bianchet *et al.* 2006: 1537). LBEs have observed changes in predator-prey dynamics over the course of the past few decades since forestry and oil and gas development has fragmented the landscape over the study area. Following is one account of the same, although a number of other of the participants expressed increases in wolf populations.

(22): "And, I've been out on the quads, in the bush out there too and not seen one [moose] on my quad trips. So, I don't know what's happening there. I'm blaming development and those activities, that's what I blame. This is the first year too that I've seen five or seven grizzlies; and I've not really seen that in my entire lifetime; and I've seen seven, I'm pretty sure it was seven in this year alone. My brother alone, he's seen actually two more than I have so he's seen nine. I believe they are being pushed out of the bush by all the development; pushed out of their regular territories. It's quite amazing actually. Black bear; there are tones of black bears out there. So I think, I don't know what's happening, but there is something that is happening. That is allot of predators. I've seen wolves that have actually just stayed at the side of the bush and didn't run away from me, that is the first time that has ever happened" (22, 08 November 2007: 2).

6.1.3 Environmental Effects: Freshwater Fish – Population Dynamics

Certain fish populations have declined in the southern boreal region, and anthropogenic forcers are direct, including alteration of flow patterns, forest harvest practices, and discharge of eutrophying nutrients and persistent contaminants (Schindler 1998). Certain species of fish, including fresh water grayling, pike and perch populations were noted by a number of LBEs to be on the decline in Lesser Slave Lake and a number of streams and rivers in the study area. Following are two of a number of excerpts which attest to this alteration in populations of certain fish within the study area.

(6): "Well we used to catch everything when I was a kid. We used to have perch and, and white and pickerels, jackfish. Nowadays I never see any perch anymore. All we see is pickerel, jackfish and white fish. Those are the main ones that you see nowadays". (I): How long has it been since you've seen perch? (6): "A long time, eh, fifteen years.... My dad always, us guys used to always, in the spring we'd go live down there, eh. Put our camp right by the slough and we'd set a net there and we'd just stay right there for a week or so". (I): So how many fish did you used to catch in a week say twenty years ago? (6): "We'd catch four or five boxes of fish in a night" (I): How big are the boxes? (6): "Big, big boxes, like this long, this high". (I): That's about three and half, three feet by two feet. (6): "Like three feet by two feet and they're like sixteen inches high, say eighteen inches high, something like that. Would be lots. Enough to fill a freezer anyway" (I): In a week? (6): "Yeah. Well actually, you'd do that in a day but we used to, we used to camp out there and we used to eat, you know, eat our fish and stuff right there and then take so many home" (6, September 22, 2007: 12-13).

(17): "When I was a kid I used to float up and down the lake on a raft, kind of like a Tom Sawyer type of setting, be on the lakeshore all day long. There was a lot of perch back then. I've seen the lake change from having it, you know, populated like it is today... the lake was fished out by the mink ranchers to get their herring for feed. They use small mesh nets to catch their herring but then they caught everything that came along. That's what killed off all the fish and then it was polluted with suckers". (I):When was that? (17) : "That would have been in the early 70's I noticed that" (17, 16 November 2006: 9).

6.1.4 Environmental Effects: Water Yield

The results of this study provide an opportunity to better evaluate the cumulative effects of oil and gas, forestry and industrial (Alberta Waste Treatment Facility) development on water yield in the watershed encompassing Swan Hills.

Forest harvesting and Oil and Gas development can dramatically alter watershed hydrological behaviour including the promotion of snow accumulation, increased subsurface flow between basal till and the soil profile, overland flow during peak periods of precipitation, especially during spring freshet, and soil water chemistry implications, all of which affect water yield and quality (Murray and Buttle 2005). Soil compaction has been recorded in forest soils for up to 3 years after winter harvesting (Whitson *et al.* 2003) contributing to a reduction in runoff infiltration capacity, exacerbating catastrophic events in streamflow (Wissmar *et al.* 2004), forcing sediment loading (Burton 1997; Smith *et al.* 2003; Murray and Buttle 2005), and contributing to the likelihood of terrestrial slides (Geertsema 2006). A number of the participants of this study expressed a concern over the changes in the water yield, including flash flooding events of water courses, and lower water yields of both water courses (including streams and rivers), and water bodies (including lakes and wetlands). These LBEs monitored and observed a number of alterations in the hydrological systems over many decades (up to seven); nonetheless, they stressed that flooding events and lower water yields have been the most prevalent since the mid 80's which coincides with the alarming rate forests were logged in Alberta (as above). Following are excerpts from six LBEs which describe the changes

to water yield in Lesser Slave Lake and a number of rivers and streams within the study area. Water yield, including floods, is a prevalent concern with local First Nation communities in the area.

> (19): "....they were logging up here they had this new ....clear cut, you know, where they cut everything and....that's our watershed....and when they had those big rains, it all came at once. See there was nothing to hold and gradually let the water run down. That's when we had the flood, have this Sawridge Creek overflowing....so they thought because the creek couldn't handle it so they build an extra....overflow, to go this way...to Mitsue Creek....It's more likely 85....It was a sudden thing....just that year that was the first time they logged upstream of this, this creek....it was on the hill....south of here....he was doing that clear cut because they would even use the...poplar as well as the spruce....that, we got that flash flood....so it happened and it let go and it couldn't hold....that water came down" (19, 28 September 2006).
>
> (5): "The river has lots of changes, lots of changes. Driftpile River....Because of these cut blocks....Floods....More flood. We had, when they had clear cutting. There's nothing to hold it...because all the trees are gone, you know. It just caves in, caves in" (5, 10 November 2006).
>
> (10): "In the clear cutting.....in that twenty years when we've been through the trapline area....to me it's getting more profound. There's more flooding and there's more...lack of....water isn't staying with the ground. It's just rushing off and it's not sinking in.... they're in on the Drift Pile River there and Buchanan so it's just, they're coming right down over the bank, you know, right to where they, the last twenty feet or whatever. they're not supposed to be and they take everything and that water just gushes when it rains and.....and I took pictures on House Mountain, you know, like they say well if it's a watercourse then they're not supposed to be in there cutting. Well they cut. They cut those and they're watercourses. They're not watercourses in August or they're not watercourses in December but they're watercourses in April and May when the water, when the snow melts up on top and comes down, they're watercourses. (I): Right, and so how long have you noticed those, that water gushing from, from them logging too close to those streams? (10): In, in the clear cutting, that's, you know, as I say I've only been here twenty years but in that twenty years when we've been through the trapline area, it's, to me it's getting more profound. There's more flooding and there's more, you know, lack of, and the water isn't staying with the ground. It's just rushing off and it's not sinking in. It's not doing what it's supposed to do to hold the trees up. As soon as they clearcut somewhere, then all the strip of trees that they left between the clearcut and the highway all blow down....." (10, 21 September 2006).
>
> (16): "....well in the 60 or the mid 60's, when the oil companies started coming into Swan Hills....the lake fluctuated....soon as it rained....that lake would go up....right away....And before it would rain like four days, five days...steady rain....even the river would hardly go up.....there were so many trees, so much bush out there in the hills, that....they absorbed all the water....especially if it's

been dry for a long time....Like none of that water actually.....reached the river, but not much. Like the river would turn brown maybe....instead of the usual gray and that's about it, maybe a third full.....It would be in the mid 80's cause that's when we had that big flood in 88....we had a couple of...day rains and already the river just about jumped the banks.....Well some places it'd go in these old dog legs, old river beds....In 96, well in 93 we had another one. That was fairly bad cause we had to move some houses....and then 96 we had another bigger than the ones....cause I was working for housing then" (16, 22 September 2006:8-9).

(17): (I): I'm interested in changes you've seen in the land or in the water, the river, the streams, the wetlands in this area where you've been farming, if you've seen any changes at all and what they are, since you've started. (17): "Well the water level has dropped drastically. I mean... I'm talking probably the lake receding two hundred yards easy". (I): And that's since when? (17): " 79"
(17, 16 November 2006: 8-9).

(1): "You know, although they view themselves as friends of the forest, you know, when you clear cut it does a lot of damage, you know. They only see the visual part of it. They don't see the damage that's actually done by clear cutting in terms of the smaller species that require the shade as well as the amount of moisture that is held and retained by the forest.....since clear cutting and the oil and gas in terms of seismic lines.....the flooding in our community increased in terms of a rapid pace, whereas one time it was a gradual flood. You know, if there was a flood, you knew in advance because it was a slow process. Now today if you have a flood, it could happen within an hour, two hours, you know, from the river coming up over its banks, and that's because the runoff now is so fast. There's a large amount of trees that have been clear cut in our watershed areas which now increases our, the risk in terms of flash floods"
(1, 20 October 2006).

(I): OK, you mentioned something about water, around wells. Do you see anything changed in any water bodies, or streams or water courses? (22): "One particular area, when I've hunted with my uncle, he's told me that when we drive by this one area that he's never ever seen this area dried up with no water, and I've always wondered why about that. Like it's just down that Swan Hills highway a ways there and he's never ever seen that slough dry. And its dry, and I guess we are wondering why. Like is it something upstream or up in the hills, maybe some development or road building, maybe its diverted the water possibly". (I): And where is that exactly? (22): "That's just down the Swan Hills highway, south". (I): How far about? (22): "Probably around fifteen kilometers, just past the homestead there". (I): I think I know where that is. (22): "Just past the last homestead there; maybe a mile or two from there". (I): Is that the only place that you know of that has less water in it? (22): "Well, it had no water in it at the time. Other areas that; only when you are really hunting in the bush you can see because you can see all these roads they've built out there, and you see some of the natural watercourses that are now diverted by these roads so some areas where there was allot of water. We do pick some nice areas along these little creeks and along these little narrow streams; they dry up and some of these medicines need that moisture to grow. And, I don't want to be specific as to which medicines". (I): Oh, OK, I was going to ask you. Probably

> Rat Root because I know it grows by water. (22): "Wicamosimum (sp.) is another one". (I): That's a Cree name right? (22): "Yeah. It's smudge. It's a fungus, but it grows on the Red Willow; and usually right beside a stream you can find allot of that. And there're others, you'll get some moist dark areas; for Laboom (sp.). But, the rivers seem to be getting; they're always changing because we're having more floods and the whole thing changes so. But water generally speaking, most of it seems to generally be in the same places I guess. Some places I've seen water when I was young is still there". (I): That's like a wetland; that's what you're talking about? (22): "Yeah, and you look around the area and there's not much development around there too so that's probably why the water's still there". (I): What about streams, rivers, creeks? (22): "They're changing and I know there are allot more trees and willows growing up, like where the streams are. So, maybe that's what is diverting them; maybe it's because there is such low water. When we used to fish along Island Creek, that was fairly close to us and it was wide, it was a wide creek". (I): Where is Island Creek? (22): "It's down the Swan Hills highway twenty clicks maybe; somewhere around there. If you drive there now, you'll see it's narrowed right down and there are allot of trees growing up in there. It's not as wide as it used to be and fishing is not as good" ... (I): And you mentioned flooding. Like, have you seen more floods, or less floods? (22): "Well I think because our river has gotten so wide from all the floods, there's probably less, it has straightened out the river so that it flows into the lake faster. But the water is high quite often, not enough to flood but it does get way up there". (I): And has that changed at all since you were fifteen? (22): "It seems to happen more often now. I believe it is because of all the clear cuts and the water drains faster into the rivers and the creeks and the streams, all the tributaries I guess. It goes faster now; obviously if the trees were still there, they would drink up some of the water; or whatever you call that, and it would slow it down. When there are no trees, generally there is no grass too when they clear cut either, nothing really, just dirt. It takes awhile for that to come back, right. (22, 08 November 2007: 7-8).

6.1.5 Environmental Effects: Water Quality

Land, resource and industrial development can engender reduced water quality changes, including enhanced microbial populations, pathogen increases and sediment loading, all of which increase the risks to human health (Byrne *et al.* 2006). The management of aquatic ecosystems should be a critical issue to forest managers since the removal of forests and the type of harvesting treatment can have a significant influence on water quality including sediment loading in headwater systems and in wetlands (Nitschke 2005; Walters *et al.* 2006). "Few boreal waters are managed in a sustainable manner, because cumulative effects of a variety of human activities are not considered" (Schindler 1998: 181). Harvesting occurs over greater than 15% of the watershed in the study area and

sadly it has been associated with elevated phosphorous concentrations, cyanobacterial (algae) and cyanotoxin (poisons housed by algae) abundance in watercourses and waterbodies, all of which impact aquatic food webs from primary producers to vertebrates (Rask *et al.* 1998; Prepas *et al.* 2001; Smith *et al.* 2003). Overall water quality has declined in the southern boreal region, and anthropogenic forcers are direct, including alteration of flow patterns, forest harvest practices, and discharge of eutrophying nutrients and persistent contaminants (Schindler 1998).

Due to the high phosphorous content of the soils in the study area, watershed disturbances such as forestry and oil and gas development can produce "measurable changes in water quality" in the hydrological systems over this landscape (Manning *et al.* 1999). Lesser Slave Lake is a long-term repository where the effects of watershed disturbance can be measured. Bio-indicators such as the proliferation of phytoplankton species and can be sensitive indicators of deteriorating aquatic change within a watershed (Smith *et al.* 2003); accordingly, ecological response monitoring using bio-indicators, including algae, can be used to identify substantive watershed disturbance in lakes, rivers and streams (Roux *et al.* 1999). During the course of carrying out livelihood and Traditional Use activities, a number of the participants have monitored aquatic quality and a number of bio-indicators which indicate reduced water quality were noted.

> (3): "….. when I was younger you can go out in the bush and, you know, you can eat off, you can drink off of the stream…. or you can go to a muskeg, dig a hole and get fresh water. You wait a little bit till it clears, then you can drink from there. Now ….. the water just tastes bitter. It was black. Even this little creek we have here, Sucker, that's black. I mean, you know, and we used to drink from there. (I): When did you drink from Sucker Creek? (3): When I was very young, we used to get water from these little creeks. We used to get water from the, from Lesser Slave Lake to drink….. Now you can't do that unless it goes through a machine or something…." (3, 12 October, 2006).

> (2): "……You look at all the streams, they're murky or they're dirty, they're polluted. Even the muskegs….. The pollution that comes down the stream and this no doubt has affected the resource we have here in Lesser Slave Lake…… I'm familiar with *we used to be able to catch fish up say twenty miles south of the highway. Today I don't know if they even go ten, fifteen kilometres south* of the highway because of the obstructions that they have to face, they don't survive as well when they go to their spawning areas and that's due to the type of operation, the deterioration of the streams itself. I mean *it's filled with a lot of silt* so. So

those are some of the areas that ***I've seen*** the changes take place" (2, October 2, 2006: 4).

(I): What about the colour of the water? (22): "There's allot of rust coloured water in just about all the streams out there. (I): Compared to what? Like what about when you were ten, what did it look like? (22): "It was really nice back then, like it was clear. It wasn't as dirty as it is now, murky. Sometimes, not very often, the odd time its clear out there; the water's clear, you can actually see to the bottom but for the most part its not been like that. But I guess, I don't know if its from the rock, or what it's from; but it just seems like rust, a rust colour something in the water". (I): And what streams or creeks would that be in; or rivers? (22): "Just about every creek out there; even on the Swan River as well too".... Just about every place out there, even in still ponds and sloughs, you'll see this rust coloured water. It's not dirt. (I): So how long do you think that's been for? (22): "Probably at least ten years anyway, I've been noticing that; it could be longer in some areas" (22, 08 November 2007: 7).

6.1.6 Environmental Effects: Wetland Water Yield and Quality

Wetlands are of inestimable value for society, but they are threatened globally through development, climate change and invasive species. Foremost among the values of wetlands are, enhancement of water quality, erosion control and flood regulation, all of which are contingent upon the sustainability of composition, structure and functioning of wetland vegetation (Bobbink *et al.* 2006; Mitsch and Gosselink 2007). Land and resource use have pronounced effects on wetland vegetation composition, structure and functioning including the decrease of biodiversity, introduction of invasive plants, and attenuation of hydrological yield (Bobbink *et al.* 2006; Walters *et al.* 2006; Gosselink 2007). Perhaps not surprising then are the numerous observations of the LBEs of this study which attest to the attenuation of water yield within many of the local wetlands of the study area. Following are two excerpts from these study results which document this concern.

(17): "Well the wetlands have dried up..... I guess when I first moved here it was a floater. It had probably two feet of organic material floating down and there was about a three foot drop underneath it and then there was a sand base. Now it's down, but it's because the lake level's down..... Well like I said it was a floater at one point. I used to walk on top this and hold a stick so in case I fell through well I had something to grab onto.... There was a growth or there was organic material probably two feet thick like I said, and then there was water underneath that and it was about a three foot drop, down to the sand.... it's still a little bit wet but it doesn't have the water underneath.... It's basically the

organics is with the sand. The organic will still hold moisture. In the spring, the spring runoff will remain there till it drains or filters through the sand, but it'll filter to the lake level" (17, 16 November 2006: 13-14).

(2): "The wetlands, the wetlands are drying up. This problem is because it's got a lot to do with the climate as well but definitely the open land area. Like today we got a camp there that's still set up south of by where you were supposed to come and experience the wilderness yourself. There was one wet area that we had. We used to have a little detour with our quads and couldn't go through but now they opened it up, clearcut that site. Adjacent, we can drive a truck through it now, as before you couldn't even go through with a quad. You got stuck, eh, if we didn't have a four by four quad.... That's just south of Drift Pile. That's again, that's the Little Drift Pile where we go camping. That's in kilometers, about twenty-two kilometers southwest here. And again there's a little muskeg in that area adjacent. That's dried up because of the clearcut operations" (2, 20 October 2006: 17-18).

6.1.7 Environmental Effects: Air Quality

Air quality is also a concern of the local Cree communities as indicated in the following two excerpts:

(2): ".... our lifestyle has changed and how the environment has changed and that particular plant is not only affecting water and wild game, it's also affecting the air in terms of the quality of the air..." (2, October 2, 2006: 6).

(22): (I): Are there any more changes in the environment that we didn't talk about yet? (22): "The smell, there's an H2S or sour gas odour out there I guess in the Deer Mountain, House Mountain and Virginia Hills area. Allot of the times you go in a low patch; where there're low dips you'll smell that there as well too" (22, 08 November 2007:14).

6.2 Results: Environmental Effects Discussion

Land and resource use, and industrial development induce a variety of impacts upon the composition, structure and functioning of ecosystems including local extirpations of species, introductions of exotic species, changes in vegetative type composition and structure and spatial percent cover, changes in natural disturbance regimes, degradation of air, water and soil quality, and changes in water yields (Andren 1994; Kierdorf *et al.* 1997; Schindler *et al.* 1995; Schindler *et al.* 1998; Prepas *et al.* 2001; Dale *et al.* 2005; Murray and Buttle 2005; Byrne *et al.* 2006; O'Connell 2006: Walters *et al.* 2006). Currently, there are a number of somewhat effective ecosystem management tools which

link biodiversity with development plans; nonetheless, these tend to be on a small number of local land based areas and they are limited to key terrestrial vegetation and vertebrate indicator species (Doyon and Duinker 2000) which fail to consider cumulative effects.

The results of this study revealed that local Cree LBEs have observed a number of local ecosystem condition changes within the study area over the past few decades including: a) changes in water yield including catastrophic flooding events and lower water yield in watercourses; b) higher turbidity in watercourses; c) poor water quality (including a poor taste and smell) and algae blooms in the Lesser Slave Lake; d) attenuated water yield in wetlands; e) deteriorated water quality in wetlands f) landscape fragmentation causing changes in endemic species; g) a reduction in availability of medicinal plant species; h) reductions in important berry species; i) reduction in moose population; j) increase in wolf populations; k) increase in white tail deer population; l) reduction in mule deer population; m) reductions in ducks, grouse and prairie chicken populations; n) reductions in rabbits and squirrel populations; o) reductions in pike and perch populations; p) reduction in frog species population; q) deteriorated moose health including lower fat content, cysts, growths and antler attenuation; r) destruction of critical wildlife habitat including cervid mineral licks; and s) a reduction in air quality. These results illustrate the pressing importance of assessing and considering the cumulative ecological impacts of development at a local and landscape level within Alberta, and how those cumulative impacts affect Aboriginal peoples, including the potential to infringe upon their distinctive rights. In this vein, a number of Treaty 8 peoples have indicated that they expect the government of Alberta to sustain an environment conducive to upholding their rights (Personal Communication 2008).

The most prevalently associated anthropogenic forcers of observed local ecosystem disturbances identified by Cree LBEs in the study area are the Alberta Waste Treatment Centre, oil and gas development, forestry development, and transportation and other linear disturbance development (a grid work of logging roads, oil and gas roads, and seismic lines). Cree LBEs within the study area have extensive knowledge, and expertise monitoring local ecosystem conditions which may serve to reveal appropriate

information, interpretations and associations about the composition, structure and functioning of those ecosystems. Following is a table which serves to summarize the cumulative ecological impacts noted by local Cree LBEs within the study area.

Table 6-1 Results: Ecosystem Condition Indicators

Interviewee	Issue	Perceived Cause	Indicator	Species	Geographical Area
	Water Quantity				
1	Water Quantity	Forestry Practices	Flash Flooding & Low Water Levels.		Driftpile River & Little Driftpile River
1	Water Quantity	Alberta Waste Treatment			Swan Hills
5	Water Quantity	Forestry Practices	Flash Flooding & Low Water Levels.		Driftpile River & Little Driftpile River
16	Water Quantity	Forestry Practices	Flash Flooding & Low Water Levels.		Lesser Slave Lake and Local Rivers
6	Water Quantity		Low Water Levels.		Lesser Slave Lake
22		Forestry Practices	High & Low Water Levels		Swan River, Island Creek
2	Water Quality	Forestry Practices	Flash Flooding		West & East Prairie River
	Water Quality				
17	Water Quantity		Low Water Levels.		Arcadia Creek, Sucker Creek, and Lesser Slave Lake
10	Water Quantity	Forestry Practices	Flash Flooding		Swan Hills
19	Water Quantity	Forestry Practices	Flash Flooding & Turbidity.		Slave River & Sawridge Creek
16	Water Quantity	Forestry Practices	Ice Damming does not occur anymore, from rapid drainage.		Arcadia Creek
19	Water Quality	Forestry Practices	Turbidity		Mitsue Lake
1	Water Quality	Forestry Practices	Turbidity		Driftpile and the Little Driftpile River
16	Water Quality	Forestry Practices	Turbidity		Arcadia and Sucker Creek
3	Water Quality		Turbidity and Taste		Swan Hills Wetlands and Streams
22	Water Quality	Forestry Practices	Turbidity		Swan River and Others
17	Water Quality	Agriculture			Arcadia Creek
17	Water Quality		Algae Bloom		Lesser Slave Lake
1	Water Quality	Effluent Discharge	Algae Bloom		Lesser Slave Lake
6	Water Quality		Smell and Algae Bloom		Lesser Slave Lake

2	Water Quality	Forestry Practices	Flash Flooding & Turbidity		West & East Prairie River
2	Water Quality	Forestry Practices	Sediment Loading & Turbidity		Stream Courses in Swan Hills
17	Water Quality	Feedlot Practices	Turbidity, Smell, and Taste		Arcadia Creek and Lesser Slave Lake
	Wetland Attenuation				
2	Water Quantity	Forestry Practices	Attenuated Wetlands		Swan Hills
18	Water Quantity	Forestry Practices	Attenuated Wetlands		Swan Hills
17	Water Quantity		Attenuated Wetlands		Arcadia Creek and Lesser Slave Lake
7	Habitat Degradation	Forestry Practices	Wetlands/ Salt Licks Destroyed		Swan Hills
8	Habitat Degradation	Forestry Practices	Wetlands/ Salt Licks Destroyed (Forestry Development)		Swan Hills
10	Habitat Fragmentation	Forestry & Oil & Gas Practices	Fragmented Ecosystems (Oil & Gas Development)		Swan Hills
6	Habitat Degradation	Forestry Practices	Wetlands/ Salt Licks Destroyed (Forestry Development)		Swan Hills
18	Habitat Change		Plant unavailable due to fewer wetlands.	*Acorus calamus* (Rat Root)	Swan Hills
9	Habitat Change	Forestry Practices	Plant unavailable due to fewer wetlands.	*Acorus calamus* (Rat Root)	Swan Hills
8	Habitat Change		Plant unavailable due to fewer wetlands.	*Acorus calamus* (Rat Root)	Swan Hills
	Population Dynamics				
1	Population Dynamics		Age of Moose are younger; not many older moose.	*Alces alces* (Moose)	Swan Hills
	Population Distribution, Density and Trends				
7			Population Decreasing	*Alces alces* (Moose)	Swan Hills
6			Population Decreasing	*Alces alces* (Moose)	Swan Hills

8			Population Decreasing	*Alces alces* (Moose)	Swan Hills
9			No Change	*Alces alces* (Moose)	Swan Hills
11			Population Decreasing	*Alces alces* (Moose)	Swan Hills
13			**No Change**	*Alces alces* (Moose)	Swan Hills
1			Population Decreasing	*Alces alces* (Moose)	Driftpile River Watershed
22		Forestry, Oil and Gas & Linear Development	Population Decreasing	*Alces alces* (Moose)	Swan Hills
17			Population Increasing	*Alces alces* (Moose)	Swan Hills & Mitsue
2		Habitat Degradation/ Development	Population Decreasing	*Tympanuchus phasianellus* (Grouse)	Swan Hills and Driftpile
17			Population Decreasing	*Tympanuchus phasianellus* (Grouse)	Swan Hills and Driftpile
23			Population Decreasing	*Bonasa umbellus* (Chicken)	Sucker Creek
17			Population Decreasing	*Anas spp.* (Ducks)	Sucker Creek Area
7			More Wolves	*Canis lupus* (Wolf)	Swan Hills
8			More Wolves	*Canis lupus* (Wolf)	Swan Hills
19		Forestry Practices	More White Tail; Fewer Mule Deer	*Odocoileus Virginianus* (White Tail) *Odocoileus hemionus* (Mule Deer)	Swan Hills/Mitsue/ Marten Hills
1		Forestry & Agricultural Practices	Fewer Jackrabbit Population	*Lepus townsendii* (Jackrabbit)	Driftpile and Swan Hills
12		Forestry Practices	Fewer Jackrabbit	*Lepus townsendii* (Jackrabbit)	Swan River
5			Fewer Jackrabbit	*Lepus townsendii* (Jackrabbit)	Driftpile River
17			Fewer Jackrabbit	*Lepus townsendii* (Jackrabbit)	Sucker Creek
14			Fewer Jackrabbit	*Lepus townsendii* (Jackrabbit)	Swan River
20			Fewer Jackrabbit	*Lepus townsendii* (Jackrabbit)	Swan Hills & Sucker Creek Area
6		Forestry Practices	Fewer Squirrels	*Tamiasciurus hudsonicus* (Red Squirrel)	Driftpile River Area

10		Forestry Practices	Fewer Squirrels	*Tamiasciurus hudsonicus* (Red Squirrel)	Driftpile River Area
3		Forestry Practices	Fewer Squirrels	*Tamiasciurus hudsonicus* (Red Squirrel)	Swan Hills
20		Forestry Practices	Fewer Squirrels	*Tamiasciurus hudsonicus* (Red Squirrel)	Swan Hills
5		Forestry Practices	Fewer Jackrabbit	*Tamiasciurus hudsonicus* (Red Squirrel)	Driftpile River
17		Forestry Practices	Decreasing Populations	*Tamiasciurus hudsonicus* (Red Squirrel)	Sucker Creek Area
7			Decreasing Populations	*Esox lucius* (Northern Pike)	Lesser Slave Lake
17		Mink Farming	Decreasing Populations	*Perca flavescens* (Yellow Perch)	Lesser Slave Lake
6			Decreasing Populations	*Perca flavescens* (Yellow Perch)	Lesser Slave Lake
7			Increasing Populations	(Pickerel)	Lesser Slave Lake
19		Forestry Practices	Fish Populations Down	(Various)	Mitsue Lake
17			Populations Down	*Rana pipiens* (Northern Leopard Frog)	Sucker Creek Area
	Species Functioning				
1	Species Functioning Body Condition	Habitat Degradation/ Development	Lower Fat Content	*Alces alces* (Moose)	Swan Hills
7	Species Functioning Condition	Habitat Degradation/ Development	Lower Fat Content	*Alces alces* (Moose)	Swan Hills
6	Species Functioning Condition	Habitat Degradation/ Development	Lower Fat in Brisket area and around Kidneys	*Alces alces* (Moose)	Swan Hills
8	Species Functioning Condition	Habitat Degradation/ Development	Lower Fat in Brisket area and around Kidneys	*Alces alces* (Moose)	Swan Hills
17	Species Functioning Condition	Habitat Degradation/ Development	Same Fat Content	*Alces alces* (Moose)	Swan Hills and Mitsue
11	Species Functioning Condition		Clear Bone Deteriorating Liquid in Skull	*Alces alces* (Moose)	Swan Hills
11	Species Functioning Condition		Dark Spots on Lungs	*Alces alces* (Moose)	Swan Hills
11	Species Functioning Condition		Cysts in Liver	*Alces alces* (Moose)	Swan Hills

11	Species Functioning Condition		Cysts on Hide which resemble warts	*Alces alces* (Moose)	Swan Hills
17	Species Functioning Condition		Cysts on Hide which resemble warts	*Alces alces* (Moose)	Swan Hills
17	Species Functioning Condition		White Cysts throughout meat; egg type	*Alces alces* (Moose)	Swan Hills and Mitsue
2	Species Functioning Body Condition		Lumps/Cysts	*Alces alces* (Moose)	Swan Hills
8	Species Functioning Body Condition		Lumps/Cysts	*Alces alces* (Moose)	Swan Hills
9	Species Functioning Body Condition		Thousands of egg type cysts in the meat	*Alces alces* (Moose)	Swan Hills
2	Species Functioning Body Condition	Waste Treatment Plant Toxins & Oil & Gas Dev.	Liver Texture softer and greenish tinge.	*Alces alces* (Moose)	Swan Hills
6	Species Functioning Body Condition	Waste Treatment Plant Toxins & Oil & Gas Dev.	Kidney texture softer and greenish tinge.	*Alces alces* (Moose)	Swan Hills
5	Species Functioning Condition		Pusy, Green Meat and Organs	*Alces alces* (Moose)	Swan Hills
22	Species Functioning Condition	Waste Treatment Plant Toxins	Gangrene Organs and Meat	*Alces alces* (Moose)	Swan Hills
6	Species Functioning Condition		No Red Blood, Green Blood	*Alces alces* (Moose)	Driftpile
7	Species Functioning Body Condition	Waste Treatment Plant Toxins Oil &Gas	Growths	*Alces alces* (Moose)	Swan Hills
8	Species Functioning Body Condition		Fat Color Yellowish; used to be Whiter	*Alces alces* (Moose)	Swan Hills
2	Species Functioning Body Condition		Fat Color Yellowish; used to be Whiter.	*Alces alces* (Moose)	Swan Hills
7	Species Functioning Body Condition		Fat Color is Red; used to be white.	*Alces alces* (Moose)	Swan Hills
3	Species Functioning Body Condition		Fat Color Yellowish; used to be Whiter.	*Alces alces* (Moose)	Swan Hills
22	Species Functioning Body Condition		Fat Color is Red; used to be white	*Alces alces* (Moose)	Swan Hills
6	Species Functioning Body Condition		**Fat Color Same**	*Alces alces* (Moose)	Swan Hills
11	Species Functioning Body Condition		Parasites	*Coregonus clupeaformis* (White Fish)	Lesser Slave Lake

6	Species Functioning Body Condition		No Difference in Fish Health	Various	Lesser Slave Lake
2	Species Functioning	Forestry Practices	Fewer berries	*Vaccinium myrtilloides* (Blueberries)	Swan Hills
10	Species Functioning		Fewer berries	*Vaccinium myrtilloides* (Blueberries)	Swan Hills
16	Species Functioning		Fewer berries	*Vaccinium myrtilloides* (Blueberries)	Swan Hills
4	Species Functioning		Fewer berries	*Vaccinium myrtilloides* (Blueberries)	Swan Hills
9	Species Functioning		Fewer berries	*Vaccinium myrtilloides* (Blueberries)	Swan Hills
3	Species Functioning		Fewer berries	*Vaccinium myrtilloides* (Blueberries)	Swan Hills
5	Species Functioning	Forestry Practices	Fewer berries	*Vaccinium myrtilloides* (Blueberries)	Swan Hills
12	Species Functioning		Fewer berries	*Vaccinium myrtilloides* (Blueberries)	Swan Hills
23	Species Functioning		Fewer berries	*Vaccinium myrtilloides* (Blueberries)	Swan Hills
5	Population Dynamics	Forestry Practices	Plant unavailable due to fewer wetlands.	*Acorus calamus* (Rat Root)	Swan Hills
9	Species Functioning	Forestry Practices	Plant unavailable due to fewer wetlands.	*Ledum groenlandicum* (Labrador Tea)	Swan Hills
	Habitat Degradation				
17	Forest Fragmentation and Habitat Degradation	Forestry Practices			Swan Hills and Mitsue
10	Forest Fragmentation and Habitat Degradation	Forestry Practices			Swan Hills and Mitsue
6	Forest Fragmentation and Habitat Degradation	Forestry Practices			Swan Hills and Mitsue
8	Forest Fragmentation and Habitat Degradation	Forestry Practices			Swan Hills and Mitsue

	Other				
Ross Giroux	Habitat Degradation	Forestry & Oil and Gas Development	Mineral Licks Destroyed		Swan Hills
6	Habitat Degradation	Forestry & Oil and Gas Development	Mineral Licks Destroyed		Swan Hills
2			Taste and Smell Unappealing	*Alces alces* (Moose)	Driftpile Rivers & Swan Hills Area
17			Increase in Non-Endemic Species	*Cirsium arvense*	Sucker Creek Area
	Air Quality				
22		Oil and Gas	Gas Detectable in Air		Swan Hills
2			Air Quality Poor		Swan Hills and Area

Chapter 7

Study Results: Traditional Use Impacts

7.0 Traditional Use Impacts: Introduction

The primary purpose of this study is to increase understanding of TEK as an important source of knowledge about ecosystem conditions and to reveal the potential of TEK and Land Based Expert (LBE) ecosystem monitoring methods. The purpose of this chapter is to share the results of the research objective (3) which is to determine the impacts of industrial, land and resource development upon local Cree Traditional Use.rights.

To answer this question, I used the last set of questions, from the study guide, which served to draw out a number of cumulative Traditional Use impacts. Those questions are:

14) How did you respond to these changes?

15) Has forestry, oil and gas, and the waste treatment plant development affected your ability to harvest in your Traditional Area?

16) Has forestry, oil and gas, and the waste treatment plant development affected your ability to access your Traditional Area?

Based on the results of these questions (above) I was able to further understand changes to Cree Land Based Experts (LBEs) Traditional Use and other land-based activities resulting from development within the area. More specifically, this chapter presents a synthesized overview of the knowledge and experiences (results) in regard to Traditional Use impacts resulting from local ecosystem changes induced by oil and gas, forestry and a contaminant treatment facility within the study area. The preceding chapter presented information, derived from key indicators, on a number of alterations to the local ecosystems including fish and wildlife densities and distribution, population dynamics, and body condition, as well as water quality degradation, increased water yield

fluctuations, critical wildlife habitat changes, forest fragmentation, and air quality. In this chapter, the participants (LBEs) answered to the inquiry, "Has development in the area affected your Traditional Use, or other uses of the land, and how have you responded to any changes in the environment"? This chapter will present the results of that inquiry.

In extrapolating these results from shared testimony (evidence in support of fact or statement or a public declaration regarding some experience) some of the detail and key findings may be lost; nonetheless, within this chapter the author will make every attempt to: a) present the testimony in the voice of the LBEs to ensure that what was being shared (the evidence/results) was accurately captured; and b) provide the reader with as much detail on the information the LBEs (participants) were sharing.

The results of this research were pulled from the narrative of twenty-three in-depth conversation interviews (including the use of one small focus group) where a list of questions where used as a guideline (see Methods Section). Largely, the interviews focused on four themes which are: a) Land-based activities - Chapter Five; b) Observations, interpretations and associations about cumulative effects of development upon local ecological systems – Chapter Six; c) How changes in the local ecological systems have affected Traditional Use – Chapter Seven; and d) Analysis and Results of systematic nature of ecological monitoring methods of Cree LBEs Chapter Eight.

This chapter will present the results of the final theme (c above) on Traditional Use impacts. The following section, Sections 7.1, describes the Issue Statement for this chapter; Section 7.2 provides the reader with the Traditional Use Impact results as experienced and described by the participants, and Section 7.3 concludes with a summary of the impacts, and sets the stage for the following chapter where there is a discussion on the results of this study and where final conclusions are presented.

7.1 Traditional Use Impacts: Issue Statement

Any perturbations to the local Boreal Ecosystems, which may force population declines or the deterioration of the health of a number of culturally valued species or habitat is of particular concern for local Cree people as a number of freshwater fish, birds, cervids, small mammals and plants provide dietary staples, and medicinal properties. Procuring alternative sources of these staples and medicinal properties for these people tends to be limited in availability in the north, far too expensive, and disruptive to their traditional culture and lifestyle. The subsistence economy encompasses a distinctive human environment relationship where ties to the local ecosystems are a key feature, setting it widely apart from the capitalist market based economy where production and exchange can occur in the absence of social ties (Langdon 1986), and where the auspice of the individual identity and well being is often linked to the ability to procure commodities Shove and Warde (2002). Some authors (Elias 1997; Usher *et al.* 2003) posit that in Aboriginal subsistence economies, economic activity tends to be linked to the socio-cultural system and the sustainability of the natural environment which supports the subsistence economy.

For example, the Cultural Economy Model (CEM) poses that the goal of development is the holistic well being of a community, and monetary value is secondary to the sustainability of Traditional Use. Further, the CEM is distinguished from other economic models in that emphasis is placed on local history on the land, and on Traditional Ecological Knowledge (TEK), rather than Western Scientific Knowledge (WSK). Finally, the CEM proposes that the health and well being of the community is achieved through mental and physical health, modest living, deep and intimate local ecological knowledge, sustained TEK, and personal experience on the land. This model emphasizes successful political economic development is contingent upon the generation through healthy communities. That is to say, communities rife with social pathologies and loss of language, traditions and informal institutions cannot achieve any kind of appropriate economic or political development. Further, this model acknowledges that successful development is based upon respectful relations with the natural environment, and that

better governance which generates strategies to implement restitution of Aboriginal peoples with lands and resources (Elias 1997) are required. Given the author believes the Cultural Economy Model is more appropriate to the ethics of the Cree communities of the study area, it is this model which I used to inform and guide the socio-cultural impact analysis which resulted from these research data.

In this chapter, I will present a number of indicators of Traditional Use impacts experienced and shared by the study participants. Moose, Fish, Berries and a number of plants used for medicinal purposes known as 'cultural keystone species', (Garibaldi and Turner 2004) have had an important role as subsistence foods and medicines for the Cree in the study area. The deterioration of the health of these species and the extrication of keystone species populations from the local ecosystems (outlined in Chapter 6) forms the starting point for the argument that local Cree within the study area, may be at the cusp of crossing a threshold where they can no longer appropriately engage in Traditional Use activities within lands held under a distinctive tenure known as Traditional Territory.

7.1.1 Linking the Socio-cultural & Ecological Systems

There is a symbiotic relationship between social and ecological systems (Berkes and Folke 1998; Berkes *et al.* 2003); consequently, mechanisms should be identified and put in place to: a) Elicit comprehensive understandings of the complexities of human and ecosystem relationship dynamics; and b) Determine the most appropriate regimes and paradigms to govern and manage socio-ecological systems. Panarchy, as described by Holling, Gunderson and Ludwig (2002), is a conceptual theory which has, amongst other things, highlighted the notion that the WSK paradigm and reinforcement of this paradigm through governing regimes attempts to manage land and resources, often resulting in considerable degradation to ecosystems.

Regional land and resource management, through WSK efforts, generally targets the maintenance of certain valued components of an ecosystem such as timber growth and yield rates, fish and wildlife harvests and other resource exploitation variables.

Unfortunately, it has been noted that through focusing on managing for these valued components, usually because of an economic imperative, other components in the ecosystem change, which may force the degradation of the entire ecosystem, through a series of feedbacks. Sustaining any one particular variable may prompt slow alterations (over decades or more), that often go unnoticed until they manifest into an abrupt change like forest pathogen increases, hydrological turbidity, pollution and degradation, or fish and wildlife population collapses (Gunderson and Holling 2002). Currently, ecological landscapes all over the world are subjected to a barrage of forces induced by development which, over the last forty years, has been "rapid, poorly controlled, and poorly planned" (Schindler 1998:19), resulting in a loss in biological diversity (Schindler 1998; Cairns 2002), and it may be timely to recognize that changes which are "taking place in ecosystems at a range of scales are mirrored in human cultures" (Garibaldi and Turner 2004:3).

7.1.2 Understanding Cultural Keystone Species

It has been postulated that certain species within an ecosystem are keystone species which preferentially keep other species in check (Paine 1969). In a similar vein, Garibaldi and Turner (2004:4) have coined the term "cultural keystone species" for culturally salient species that shape, in a major way, the cultural identity of a people". They define cultural keystone species as species which have a defining influence on the culture and its identity, and the species may or may not be an ecologically keystone species; nonetheless, the cultural keystone species is dominant, foundational, and highly interactive with the culture (Soule *et al.* 2003; Garibaldi and Turner 2004).

7.1.3 Socio-cultural Thresholds

Holling's (1973) and May's (1977) seminal papers on resilience, and thresholds and breakpoints of ecosystems (respectively) focuses on the notion that ecosystems have multiple states which shift from one regime to another rather than maintaining an equilibrium, and that there are thresholds between the switches from one regime shift to another. Since then a number of authors have provided further analysis of ecosystem

resilience and thresholds further advancing these concepts. While yet others have convincingly argued that social and ecological systems are contingent upon each other, inextricably linked, and behave as a coherent socio-ecological system with the same inherent resilience and threshold behaviours as an ecological system. For instance, Walker and Meyers (2004) posit where there is either a social governance or paradigm shift within a social system, incited by short-term political or economic reasons, the occurrence of objectionable ecosystem degradation may occur. Berkes and Folke (1998) and Holling and Gunderson (2002) have provided the supposition that in regard to an ecosystem or a socio-ecological system, an alteration of a stable system occurs when a threshold level of a controlling variable in the system is surpassed, causing the scope and scale of feedbacks to dynamically change exacerbating an alteration in the trajectory of the system itself. These changes can be either sudden, or gradual; nevertheless, once a threshold has been surpassed, the feedbacks have changed resulting in the dynamics of the system to shift from one regime to another. As well, if a threshold has not previously been surpassed, then the regime shift resulting from the compositional, structural, or functional changes is generally unexpected, consequently alterations to the system occurs when behaviours and causes which drive the changes are profoundly unexpected. Nevertheless, Berkes and Folke (1998) point out ecological, social and cultural systems can all undergo functionally altering processes, and regime shifts resulting in different but valuable systems. Accordingly, determining what is valued, and predicting where system thresholds to those values are, before one has been exceeded, may be prudent.

These research results may assist in determining the possibility of a threshold breech, for the local Cree of this study area, where certain ecosystem components, which are cultural keystone species, are so changed or largely extirpated from the system that these communities can no longer appropriately engage in Traditional Use. This situation has been expressed rather eloquently by many of the participants of this study, including Emile, a well respected Elder from Sucker Creek:

> (3): You know in my younger days these were the kind of days that, you know, I guess the people that we, that I talked to, you know, I know we could never go back to the years where we enjoyed the country I guess, or the way we used to

live. We never can go back, but people I talk with, the older people, people my age, you know, they always talk" (3, 12 October 2006: 10).

7.2 Results: Traditional Use Impacts

Many of the participants (Cree Land Based Experts) expressed an ardent concern about the general condition, and more specific aspects of the condition of the local environment (natural ecosystems) and the fish and wildlife within those local ecosystems. For example, the Chief of Swan River articulated his general concern and how it makes him feel as follows. "Both I guess, I am out there personally, and I can't go out there as not being a Chief. Allot of my time recently being out there has been driving out there and wishing we had more control of our lands again. And, I just wonder what it would be like to be free; because I do not feel free when we are hunting now" (22, 08 November 2007: 3). More specific concerns about the condition of the local ecosystems and the Traditional Use impacts falling out of ecosystem changes are outlined in the following sub-sections of this chapter.

7.2.1 Traditional Use Impacts

The Cree communities of the study area, like other Aboriginal peoples in northern Canada, are now faced with an unprecedented increase in land and resource, and industrial development within their Traditional Territory. These communities are being challenged to address the scope and scale of development by attempting to both mitigate its impacts, and capitalize on its benefits (Personal Communication 2006b). This sub-section presents a number of Traditional Use impacts upon the Cree communities within the study area including impacts to Traditional Use (hunting, fishing, and plant and berry harvesting), and the health and well being of the local Cree people. In addition, this sub-section outlines how the participants believe that cumulative effects (environmental change) of land, resource and industrial development in the study area has resulted in a threshold being crossed, or near to being crossed, where they can no longer engage appropriately in their Traditional Use activities.

Traditional Use Impacts: Trapping

A number of the LBEs interviewed used to trap within the study area, and/or still engage in trapping activities. Nonetheless, they believe that forestry development (logging) within the region, and recreational pursuits (snowmobiling) that most of the fur bearing species they traditionally trapped are largely removed from the landscape. As well, many of those who trapped in the area were very disconcerted by the government regulation of the trapping industry as they believe that they have been afforded the right to trap through the signing of *Treaty 8* (1899), and those rights being entrenched in the *Constitution Act* (1982).

> (1): "After that I was trapping beavers and rabbits but that's just the spring, eh. You can trap rabbits and beavers but the others, there was nothing. They've logged out all the traplines. It's spoiled it, the loggers, they spoil the trapline. Now all the big trappers couldn't do nothing.....they were big trappers, used to make a lot of money. I know my dad and all my uncles used to make a lot of money through the winter. Used that money all summer till next, the wintertime they would just get some groceries from Hudson Bay Company. They paid that with his trapline..... there used to be lots of those lynx, and fox and other things, lots of that, the big trappers used to make a lot of money; now, nothing. No more trappers.... The fur is gone [fur bearing animals], yeah; yeah, the fur is gone" (1, 20 October 2006).

> (I) What about the small fur bearing animals from your trapline area that were affected by the clear cut? What did you do? (10): "We don't trap". (I): So you just stopped trapping in that area? (10) "Yeah. We didn't go at all last winter. We went for a few weeks the winter before and got nothing, absolutely nothing" (10, 21 September 2006: 12,13).

> (20): "It's not doing, it's not, there wasn't animals there because there's no trees. Took the trees out where you could trap on my trapline. Back here, up the Virginia Hills, twenty-four miles long, eh but toward the Virginia Hills that's where they have put the new town of Swan Hills. Now they've started skidoos coming into Swan Hills and go around the traplines. They drive around and play with your snares, everything. So we have to get out of there because the people there, they play with your traps. We have to trap again because after the skidoos.... That's why we have to get out of there. .... We have to go to same place but the Minister told them when the Treaty [Treaty 8] was signed, you trap already, you hunt already, take the land to trap in. Your kids and the great grandkids trap all the time. That's why he [Joe's dad] was given that trapline. Now we have to pay for our trapline. We go to Slave Lake, pay for that trapline, eh. Just to hold it, eh. Me and my brother, and then our parents pay for it a few years after I just retired. Now we have to pay our own money now to hold our trapline, eh" (20, 10 November 2006: 4).

Traditional Use Impacts: Berry Harvesting

Berries have, for generations, been a staple food for Aboriginal people in Canada. The Cree of the study area have depended upon this fruit for as long as they can remember. Many of the LBEs interviewed shared information about how they have been harvesting many species of berries including, "blueberries [*Vaccinium myrtilloides*] and [*Vaccinium caespitosum*], Cranberries [*Oxycoccus microcarpus*], Saskatoons [*Amelanchier alnifolia*], High Bush Cranberries [*Viburnum opulus*], Choke Cherries [*Prunus virginiana*], Pin Cherries [*Prunus pensylvanica*], all those, Raspberries [*Rubus idaeus*]", their entire lives "ever since I was a little girl I can remember picking blueberries because, my mom used to can them" (4, August 23, 2006: 1). Recently, however, a significant concern has been how forestry and oil and gas development in the region as seemed to largely remove some species of berries, especially blueberries, from the landscape. The following excerpts illustrate this concern, and how they "just got to do without" (9, September 21, 2006:13).

> (4): "I haven't picked blueberries for six years now I think, because we didn't find any at Swan Hills where we used to pick. We looked at that Moosehorn place there too, they had bulldozed it where we used to pick; there was a big pump [Oil Well] there" (4, August 23, 2006: 3,7).

> (9): "Well you just pick them where you can. Of course it's obvious if they're not there, you can't pick them. We did go now and then to, for blueberries and the odd huckleberry up in Mink Lake, the other side of Whitefish there and they hardly, like I, we used to go to Goose Tower, like that's the area she was talking about blueberries, there was some huckleberries in that area too. There still is, very few but it's, you know, most of it is clearcut so there's hardly anything probably now. But we pick them where we can, you know, further up but it's getting harder and harder, you know, it's that we just got to do without" (9, September 21, 2006: 13).

Traditional Use Impacts: Hunting

Moose has been a staple source of protein for generations for the local Cree. Recently reports of substantial declines in local moose populations, and that the health of the local moose is questionable have been prevalent (see Chapter 6). This has caused a great deal

of concern "worries" (see 22 below), and people have "no-where to hunt anymore" (see 6 below), resulting in health and well being effects described later in this chapter under the sections describing health and well being and economic impacts.

> (6): And here, we don't hunt here anymore. It's too, there's very seldom we go hunting here. I mean the, the deforestation they're doing back here, I mean it's, there's no-where to hunt anymore. I mean it's all like a, it's a big field back there. (I): Where's that? (6): South of the reserve here, just south of Drift Pile here. Like where Drift Pile is there, like just south of it, right here. Like you can't, there's no- where to hunt there anymore". .... It's getting worst anyway. Every year it gets worse and worse cause they keep taking more and more, see" (6, September 22, 2006: 3,5).

> (22): "The liver, and sometimes in the kidney, you'll see, even stuff in some of the meat and hind quarters; you'll see some discoloration. Like one moose in particular, there was really, really gangrene all over the inside of the legs and the organs, like he was just, ugh, gross! So, we actually left it out there and informed fish and game about it. Then we never heard anything back from that about what was actually wrong with it". (I): So, say 20 years ago, did you actually see much of that or what? (22): "We had no worries about that, at least 20 years ago, and prior to that waste treatment plant being open out there. We had no worries we would just go out there, and we would harvest, and we would look at the liver and it would be just perfect. Now we are constantly watching every moose we get....We check all the organs out and we check for growths and we will check even to see how the moose is just standing there [behaviour], or if he's walking away if he's weak, or if he has a shiny coat. Like you can just tell by looking at them, so if there's something wrong we'll know it. But, I know a long time ago, definitely we didn't have no worries out there" (22, 8 November 2007:5).

Traditional Use Impacts: Medicinal Plant Harvesting

Certain endemic plants found within the study area have been used for generations by local Cree people for various ailments, as elixirs, or for spiritual purposes. A number of the LBEs reported that many of these plants have either been largely removed from their traditional gathering areas, or, they are not as potent as they used to be.

(22): "What forests? You mean what's left out there?" (I): OK, what is left out there? (22): "Not a heck of allot". (I): What did you used to see? (22): "Oh, we used to see beautiful big spruce trees and pine. Just bush, general woods and bush and stuff like that, I don't know the exact species names, but there was allot of bush out there. Now I see clear cut block after clear cut block, and many more roads, many more leases [oil and gas wells] and just tones of them out there now compared to the past"..... "Well it seems like they are not there; and that is why we are always hunting [harvesting]. Not only in untouched areas; if we know there were medicines where there is a proposed cut block; we know they are not going to be there afterwards. They are not going to plant exactly what was there before because the way they do their assessments I don't think they get every exact species that was there. So it's changing and I guess the whole ecology of the whole area in the area that has been logged out or whatever; it really changes" (22, 08 November 2007: 8).

(6): "That's the only place that I know of.... but I checked the other places. There's some other place that we went to Swan Hills [to harvest Rat Root] and in through, you know, the House Mountain area and it seems like, I mean it's the same kind... but there was nothing there, you know, cause I checked a few places there" (18, 21 September 2006:6).

7.2.2 Traditional Use Impacts: Health and Well Being

Many of the LBEs from this study who hunted cervids provided lengthy testimony revealing observations of moose population declines. Moose is used as a dietary source of protein for the people of the study communities and recently it has been observed that it is often:

1) Full of growths and cysts:
2) Smells different;
3) Tastes different; and
4) Looks different in colour.

Given moose populations are likely in decline, and that the health of the moose is in question (see chapter six), the communities under study may be affected to the point that their health and well being are compromised. The poor health of the fish and wildlife which local Cree are harvesting within the study area is presumed to be the result of intensive oil and gas, forestry and industrial (toxic waste treatment) development. One of the LBEs interviewed, the Chief of Swan River, explained rather eloquently, a number of ways in which development has been affecting his people's health and well being.

> (22): "It's hard on your mind, and its hard on your body, because every moose you shoot you hope that it is good, and you hope you don't get sicknesses. If the moose has cancer, you hope that it is not transmitted from it to the human as well. It has affected us mentally, and health wise there seems to be more cases of cancer, and more cases of diabetes. Something is definitely happening out there, and this was not happening to us before. Recently, there are less moose for me and my brother for hunting; we have to travel allot farther, which costs us allot more money. More time is spent as well. It just seems to cause more hardship because we have to travel to other places. We have allot of our young people who do not even go into the Swan Hills area because of the waste treatment plant [Alberta Waste Treatment Centre] they just absolutely refuse to. So, not only health wise, but I guess it has also affected their spirit. It is not as strong as it would have been if specifically the waste treatment plant was not there. That seemed to have been a huge mental thing for our people is that plant being there. It's tough now I guess, it's very tough. We'd love to be able to just go out there and hunt, not have to worry about if your moose is contaminated or not, or worry about cancer down the road because it's not going to be instantly; it takes years for that stuff to kick in. And, there's no more socializing out on the land, and being in touch with nature; just having a good time out there, you know. Now it has changed as well there too. There is more alcohol and drugs now with our people because they are not actually out there socializing on the land I think; so that's part of the change. There is allot more obesity, because of the beef as opposed to the moose, is way more fatty. Moose has more enzymes in the fat than beef does, so it helps to break down the food better I guess. There has been allot of change, not only health wise; spiritually as well; mind, body, and spirit I guess. Definitely combined, like I say the young people refuse; they know its there, they don't want to get sick; so they've run out of places to hunt, and without a truck and without resources to do it, it's impossible. We're losing a culture because of that, we're losing our ways because of that as well"
> (22, 08 November 2007: 12-13).

Other hunters expressed a great deal of concern over the taste, appearance and smell of the moose they hunt of late (the past 10-20 years) in the region (study area). The following excerpt is one description of these altered and disagreeable conditions:

> (11): "Like the meat, the moose meat today now, it's so different from years back. Like years back you were able to leave your meat out, you know, after you cut a chunk of steak or something you're going to cook and you could leave it out there and you could cook that meat and it would pretty well stay like, you know, like its natural colour. Today now you take a piece of meat, you cut it up, you leave it out for awhile, the meat just turns black. Even when you cook it, you fry it, it still turns black. Like there's just the colour of the meat is so different today"
> (11, November 11, 2006:6).

The Chief of Swan River, described how the fur on moose is sometimes is different, how he could tell if a moose if is healthy or not by the colour of the fur, and how some moose

nowadays in the Swan Hills area have growths on their exterior and within their body when he opens them up. Further, he described how he looks at the liver, and other organs to see how the health, or body condition of the moose is. He expressed how there's allot more spots on the liver these days. Some of them are like fatty tissue, but there are allot that excrete a puss like substance. He believes the moose are unhealthy within about the last fifteen years, that poor health is getting more prevalent, and that sometimes there is like really green gangrene in the liver, and the kidney, and sometimes in the meat and hind quarters. Overall, he expressed a great deal of concern over the health of the moose, and he believes it poses quite a threat to the health of himself, his family and his people.

> (22): "We had no worries about that, at least 20 years ago, and prior to that waste treatment plant being open out there. We had no worries we would just go out there, and we would harvest, and we would look at the liver and it would be just perfect. Now it's that we are constantly watching and every moose we get we definitely I do anyway, I am not too sure whether others do that, but I am pretty positive that they do. They check all the organs out and they check for growths and they will check even to see how the moose is just standing there, or if he's walking away if he's weak, or if he has a shiny coat. Like you can just tell by looking at them, so if there's something wrong we'll know it. But, I know a long time ago, definitely we didn't have no worries out there" (22, 11 November 2007:5).

Others articulated that given the changes in availability and health of the cultural keystone species (moose, blueberries, rabbits, squirrels, grouse, prairie chickens and fur bearing animals) many of these communities have been forced to change their physical lifestyle and the food that they consume, consequently they are experiencing an increase in diseases.

> (1): "But it allowed us to have a large area in terms of a traditional lifestyle and we learned the basic things in terms of how to survive in that particular lifestyle, and it was a healthy lifestyle cause most of the game and this type of harvesting we did was very recreational activity as well so we were also physically fit as opposed to today where a lot of people aren't as active and aren't as mobile and don't get type the of exercise they need on a daily basis, you know, which to me is a major reason why diabetes and other illnesses are more obvious in First Nation communities and obesity is a big problem" (1, 20 October 2006:2).

7.2.3 Traditional Use and Economic Value

The economic value of the meat from a single moose has recently been estimated to be $1,320.00 (Oosenbrug *et al.* 1991). Given the decreased availability of staple foods which were traditionally harvested within the area, increased economic pressures have been imposed upon many of these communities. For example, Emile, an Elder from Sucker Creek expressed a fervid concern about the sustainability of Traditional Use subsistence food.

> (3): "I think when the development started going on in this part of the country, I think that's when everything started going haywire. To me haywire means like, you know, the way we lived was like just cutting my finger off, you know. Everything that we lived from, lived off the land was being cut off from me, from the native people". (I): Yeah, so that's changed. So now you're saying you need money to eat food? Is that what you're saying? (3): "Yes, yes".... (I): And now you can't live off the land because? (3): Because things....they're not that plentiful [populations hare declining] and yet they're not that tasty, the meat, especially moose is not that tasty as it was before" (3, 12 October 2006).

7.2.4 Traditional Use Impacts: Access

Access to harvesting areas has recently been limited given the intensification of oil and gas and forestry development in the area, and if access is available it tends to pose higher risks, "you can't even get in there, you got to risk your life to meet these logging trucks". Or, equipment has "ripped the road up so bad" many harvesters (LBEs) believe that exploration and development equipment has "damaged the roads too badly" to the point that they have to "we don't' even want to try anymore" to "search for a little old wagon trails". An excerpt follows which describes the risks from the experience of one LBE:

> (6): "That was after the spill. I haven't hunted in there since then. That was, like I said, I'm pretty sure it was in 2000....1999 maybe....So I know it was in there, close there, '99"..... "And here, we don't hunt here anymore. It's too, there's very seldom we go hunting here. I mean the, the deforestation they're doing back here, I mean it's, there's no-where to hunt anymore. I mean it's all like a, it's a big field back there". (I): Where's that? (6): "South of the reserve here, just

> south of Drift Pile here. Like where Drift Pile is there, like just south of it, right here. Like you can't, there's no-where to hunt there anymore"....."It's getting worst anyway. Every year it gets worse and worse because they keep taking more and more, see. Like it's, a couple years ago it wasn't too bad. I mean we could still get in there and hunt, but now just to get access to get in there, you can't even get in there. You got to risk your life to meet these logging trucks and all these other equipment hauling trucks. I mean it's, you can't even go back there anymore and south of Drift Pile here, we used to go back there all the time on horses, eh. Now we can't do that because there's, the quads have ripped the road up so bad that we can't even try to go in there with a, a wagon anymore, you know. So they damaged the roads too badly. I mean you search and search for a little old wagon trail but you know for us guys it was access. Now it's, we don't even want to try it anymore" (6, September 22, 2006: 2, 3, 5).

Others feel apprehension about being in their traditional territory and feeling like they are trespassing, or like they are going to be removed by oil and gas industry representatives, one LBE described his experiences and feelings about access and his traditional territory and rights in the following manner:

> (13): "There's one thing, like when I go out hunting with people or even going to Swan Hills, I'm always apprehensive are they going to kick me off or not.... although nothing has happened and I haven't really been threatened physically there is still that apprehension that they can kick us out of here, you know. Can we be here? And it's just there [in Swan Hills]. (I): How long have you been feeling that for? (13): For the past, probably since I was around sixteen, because I got kicked off a well [oil or gas well] site line, and that's our traditional hunting area..... I'm still not certain that we do have the right to go into there, and it's not mass slaughter, you know. You just go and take what you need and then you know you leave the rest. I've never seen anybody really break that law, if you will. It's the law, an unwritten law. I guess, like for me I guess the main thing is that I feel it is my territory. You know, like these guys are here and they're doing all this stuff there [development]. Is that their territory now"?
> (13, September 28, 2006: 18-19).

7.2.5 Traditional Use Impacts: Change in Harvesting Location

Almost all of the interviewees lamented about the greater and greater distance they had to travel to find plants and animals which used to be readily available and abundant. Most described this as problematic for many community members who do not have access to vehicles, as more costly, as requiring greater amounts of time, and in general as being much more difficult. Three excerpts from discussions, which describe this difficulty, follow:

(1): "As an example of the changes that have taken place, over and above that in terms of the wild game itself, a lot of areas that we'd normally go hunting in terms of moose licks as our grandfathers did are very difficult now because a lot of those places are, tend to be hunted out cause the animals are more exposed. They seem to have had to move further away from where normally we could hunt just off the highway from our community. ***Now*** you have to go miles back further south in order to get into any prime hunting areas" (1, October 20, 2006: 2).

(22): "Well, I guess a large portion of my area is the Swan Hills area in its entirety; a place we call House Mountain., Deer Mountain, up in Virginia Hills, Goose Tower Road, and the Grizzly area; probably hundreds of times, not just 3, 4 or 5 times. Not every place is the same, obviously because of development, so we always have to keep going place to place to place. Keep hunting and finding all these places. But a large portion I guess is in the Swan Hills area" (22, 08 November 2007: 1).

(6): "Yes, there's not as many. There's not many anymore like there used to be". (I): And where is that? (6): "Like I said, now we got to go farther and farther and farther to get a moose, eh" (6, September 22, 2006:10).

7.2.6 Traditional Use Impacts: People Stopped Harvesting

Many accounts of fear of contaminant inputs from the Alberta Waste Treatment Plant were articulated, and avoidance of the Swan Hills area for harvesting, especially within a 30 mile radius, is now (since the mid 1990's) common. Three accounts of this situation follows:

(I): When is the last time you went picking up by Swan Hills area? (4): "It was about four years ago I think; but not close to, just on the other side of Moosehorn. There was lots [blueberries] towards the plant [Alberta Special Waste Treatment Plant], but we didn't want to pick them. (I): Why didn't you want to pick them? (4): We were scared of that; because of the smoke [combustion of toxic waste which creates smoke released from the Waste Treatment Plant]. (I): Because of the smoke? (4): "Yes, from that plant [Alberta Toxic Waste Treatment Plant], you know" (4, August 23, 2006:3).

(1): "They could have left it [Alberta Special Waste Treatment Plant in Swan Hills] right by a city cause that's where most of the toxins come from anyway, but of course that argument didn't fly and the plant did go up in the Swan Hills area of course on the highest hill possible and to date we still have a thirty kilometer radius that there is a warning not to consume too much wild meat, let alone even try and eat the fish, you know. So to me that's an example of the type of things we've tried to avoid but in the end, we lost our battle and now we have

an area that normally used to be our traditional area to use, and of course we still use it recreationally now, but you can't drink the water, you can't eat the fish, and you can't eat too much meat within a thirty kilometer radius you know.... Maybe, the more information that's available, the better. But just, some of the examples in terms of what's happened to our region, and how our lifestyle has changed and how the environment has changed and that particular plant is not only affecting water and wild game, it's also affecting the air in terms of the quality of the air that's in that particular region because most of the toxins are burnt (2, October 2, 2006: 6).

(6): "That was after the spill [the toxic spill from the Alberta Special Waste Treatment Plant which occurred in 1996]. I haven't hunted in there since then. That was, like I said, I'm pretty sure it was in 2000....1999 maybe....So I know it was in there, close there, '99" (6, September 22, 2006: 2).

7.2.7 Traditional Use Impacts: Changes in Government Legislation

Land, resource and industrial development are not the only concerns upon the minds of these people, government regulations and licensing has also wreaked havoc to some degree. Many Elders were particularly vexed about trapline registration, and changes in fishing regulations. Due to these regulations, many trappers have been forced out of trapping, and some fishermen have been "kicked out" of areas where they traditionally fished, including some areas on the lake bordering on the reserve.

(1): ".... part of the lifestyle before provincial legislation kicked in and you had to have a registered trapline, part of the lifestyle was trapping and getting fur bearing animals such as squirrels, weasels, beaver. Whatever area you had to be in, there was always something to do in relation to harvesting and that was before legislation kicked in where you had to be a registered trapline holder to trap and so that kind of hindered our lifestyle once that occurred"
(1, October 20, 2006: 2).

(20): "Used to be lots of stuff to eat. Lot of fish....and I used to go through the winter, chop the ice and put the stick just like a jigger, eh, push that, make a hole and where there's fish, when they're fishing pull the line out, used to leave a rope in there. Next time you just chop the ice and put it in again. Used to fish just about I would say right around here. Now today can't even go, can't go even because the Fish and Wildlife is there. It's on the reserve. They got kicked out there early this spring, one Indian, John. He was going fishing, at this lake [Lesser Slave Lake], on the reserve [Sucker Creek Reserve] and I said well they can't kicked him off the reserve. Wrong. He's bringing in [got his] Treaty rights I told him it is amazing like that, two times now. They [Fish and Wildlife] haven't got no rights to come on the reserve. When the Treaty was signed, there was no Fish and Wildlife back then" (20, 10 November 2006:2).

7.2.8 Traditional Use Impacts: People Still Harvest

Not all of the LBEs who hunt and harvest plants completely avoid the Swan Hills area. One LBE described how even though he has a fairly substantial fear of using this area for Traditional Use, he still uses it because he feels he has no other viable option.

> (8): "I guess for myself it's, it's not, I don't feel as confident anymore to, to hunt in them areas, to gather medicinal plants in them areas anymore. It just, it just, because of the environment it's just too, too risky. You know I've heard a lot of stories about the water quality down there because of oil spills and leaks from the waste treatment plant and so, you know, I'm still scared to hunt and to harvest in that area [near the Alberta Special Waste Treatment Plant] but I have to. I have no choice but to go in that area because I've hunted and I feel comfortable hunting in them areas and gathering in them areas. The only other option I would have is, is to go further out to hunt outside our traditional hunting grounds and that means more gas expenses and all that stuff and to get re-familiar with other areas, it, it, it's hard" (8, 21 September 2006: 10-11).

7.2.9 Traditional Use Impacts: Other

Not all Traditional Use impacts are a result of development or land and resource regulation, there are other influencing factors. For example, the availability of food through modern retail outlets in some cases resulted in subsistence foods being less of a priority. One participant describes this phenomenon in the following manner:

> (1): "Social Services was a big factor to that, took us away from our traditional lifestyle because it was easier I guess for lack of a better word to go to the grocery store and grab commercialized foods and it was made very easy at that particular time. So really, gathering and harvesting of wild foods, berries, was all of a sudden not a priority, you know, whereas one time it was part of your daily chore and you had to get your supply and enough supply for the winter and that become kind of a, not such a priority anymore, so that also made a factor in terms of how much harvesting we did of rabbits and how much berry picking we did as well" (1, October 20, 2006: 10).

As well, although it is not prevalent (1/23), some Cree LBEs do not engage in Traditional Use or subsistence harvesting except on an ad hoc basis. One of the interviewees described himself, his level of expertise, and his engagement in the subsistence economy in the following manner:

> (14): "I don't do very many things traditionally from the land. I'm not a medicine man or gatherer of any type or a hunter but I do use them whenever it's, if you will, they're available and sometimes it only might be maybe like one or two days a month, I mean a year that I do it and it's usually either rat root and then also mint and also I guess it's a fungus on a band willow [*Salix bebbiana]* tree that's usually like if somebody goes hunting and I go along with them up in the hills, I don't hunt so if they, we see some berries or something I just stop and eat the berries"
> (14, September 28, 2006: 3).

7.3 Results: Traditional Use Impacts Discussion

White (1983) contends that the fundamental cause for the subsistence practices of Aboriginal peoples failing was the result of Euro-American attempts to bring "Indian resources, land and labour into the market economy". He maintains that understanding the changes involves understanding the reciprocal influences of the cultures, politics and the economics. Furthermore, he explains that before European colonization, the Aboriginal peoples were able to subsist with an adequate level of security and comfort. Gradually, however, they resorted to whites for European goods, which eventually led to the European control over all their land and resources and Aboriginal peoples being subject to sustained poverty and bereft of their identity.

Many models in Canada, which attempt to examine the deterioration of Aboriginal Traditional Use (including subsistence economies) and losses of Aboriginal people's culture (including traditional value systems) have fallen short given they fail to analyze the unequal relationship between the hegemonic (dominant) society and the subaltern (subordinate) societies, including Aboriginal peoples. The lack of material causes of Treaty 8 First Nation underdevelopment appears positively associated with loss of lands and resources due to broken Treaty promises and lack of addressing First Nation

struggles for political and land and resource control (Personal Communication 2006b; Treaty Commissioner 2007).

Baran (1957) examined the unequal relations between the developed and less developed nations where the dominant sustain their position by appropriate lands and resources of less developed nations or societies. In this same vein, Wallerstein and Gutkind (1976) used an example of subaltern Africa and hegemonic Europe when he argued that they were locked into the capitalist system where labour and resources from Africa supplied the markets of Europe. And similarly, Jorgenson (1978) ascertained that the Akwesasne people of the eastern United States, was brought to underdevelopment by the non-Native society which holds the political economic power. These illustrations provide what may be an appropriate rubric for analysis of contemporary socio-economic conditions between the non-Native and some of the First Nation groups in the study area where there is a "marked disparity in socio-economic well being between First Nations and other Canadian communities" (McHardy and O'Sullivan 2004:18). Appropriately, I posit that the historical appropriation of land and resources from the communities of the study area (the Sawridge Band, and Kapawe'no, Sucker Creek, Driftpile and Swan River First Nation) and the continued re-enforcement of political economic disparity between the non-Native society and these Cree people, where land and resources are at issue, serves to result in the current situation where cultural keystone species and the local ecosystems support them may be contributing to health and well being issues of these communities, placing them in a position of disproportionate risk.

These study results reveal that local Cree Land Based Experts, in general, now have a substantive concern with their inability to engage in their Traditional Use activities due to what they understand to be development induced local ecosystem changes. A number of the changes observed and communicated included local culturally significant species reductions (moose, rabbits, grouse, prairie chickens, squirrels, blueberries, rat root, pike and perch) introduction of exotic species (Canadian thistle), changes in species composition (ex. more deer, less moose) and structure (ex. moose are younger and smaller), changes in natural disturbance regimes (ex. catastrophic flooding events),

degradation of air (ex. gaseous smells), water (ex. un-potable water) and soil quality (ex. erosion), and changes in water yields (ex. attenuated water conditions in wetlands). As well, there was much concern in regard to a number of other impacts including safety on road networks, flooding of houses and hayfields, changes in the taste, appearance and smell of fish, animals and plants commonly used as subsistence foods and medicines are no longer readily available, government legislation of trapline and guiding activities, insecurity in access to harvesting areas, and angst about contaminants in the terrestrial, hydrological and atmospheric systems from the Toxic Waste Treatment Plant in Swan Hills.

Moose and berries have been critical staple diet foods of the Cree in the study area, and Sweet Flag (*Acorus calamus*), a plant for used for medicinal purposes (Personal Communication 2006a), and other local endemic species have been important staple subsistence species, 'cultural keystone species', (Garibaldi and Turner 2004). The degradation of health and the extrication of populations of a number of cultural keystone species has formed the starting point for the argument that the local Cree of this study area (Swan Hills and area), may be at the cusp of crossing a threshold where they can no longer appropriately engage in a number of Traditional Use activities within their Traditional Territory. We would do well to take precautionary measures to avoid crossing this threshold at least until more is known about the implications of perturbations to Traditional Use impacts and local ecosystem conditions as a whole.

Chapter 8

Synthesis, Conclusions and Recommendations

8.0 Study Purpose

The primary purpose of this study was to increase understanding of Traditional Ecological Knowledge (TEK) as an important source of knowledge about ecosystem conditions and to reveal the potential of TEK and Cree Land Based Expert (LBE) ecosystem monitoring methods. More specifically, I attempted to demonstrate how TEK is now constructed using both traditional and more contemporary land-based opportunities, how the construction of TEK makes use of systematic elements, how TEK may reveal valuable cumulative impact data, and the ramifications of industrial, land and resource development within the study area upon Aboriginal Traditional U and rights. This research has drawn on the Knowledge Generation literature, and has had three main objectives. Those objectives are to answer:

4) How do Cree land users construct knowledge about ecological conditions, and through what kinds of specific land-based activities (Chapter 5)?
5) What kind of ecological changes are Cree land users observing within their traditional territory (Chapter 6)?
6) What are the socio-cultural impacts that are resulting from changes to local ecosystems (Chapter 7)?

This research is significant for a number of reasons. First, the Cree of this study sought to answer *"In what ways can Lesser Slave Lake Cree demonstrate their effective stewardship of the land"* (Personal Communication 2006c). Second, policy and decision makers have, at times, sought to practically and effectively integrate Western Scientific Knowledge (WSK) and Traditional Ecological Knowledge (TEK) to provide a means for Aboriginal people to be meaningfully engaged in land and resource management decisions (Williams and Baines 1993; Berkes 1999; Usher 2000; Nadasdy 2003b)

nonetheless, effective integration and meaningful participation continues to be problematic and largely unsuccessful (O'Faircheallaigh 2007) regardless of the valuable information and insight it offers (Berkes *et al.* 1991; Foreman 1995; Milich 1999; Snively and Corsiglia 2000; Martin 2001; Bradshaw 2003; Gill 2003; Kofinas *et al.* 2003; Duerden 2004; Kitson 2004; Lyver and Gunn 2004; Parlee 2005; Berkes *et al.* 2007; Chalmers and Fabricius 2007; Grant and Berkes 2007), and the synergies between TEK and WSK information (Becker and Ghimire 2003).

8.1 Discussion of Results

The following sections provide a discussion on the three main objectives of this study which are: 1) How do Cree land users construct knowledge about local ecosystem conditions, and through what kinds of specific land-based activities (Section 8.2.1)?; 2) What kind of ecological changes are Cree LBE observing within local ecosystems within their traditional territory (Section 8.2.2)?; and, 3) What are the Traditional Use impacts resulting from changes to local ecosystems (Section 8.2.3)?

8.1.1. How do Cree Land Users Construct Knowledge about Ecological Conditions, and through what specific land-based activities (Chapter 5)?

The thesis attempted to demonstrate how Cree LBEs construct knowledge about ecological change and how they learn the land through their day to day land-based activities (Chapter 5). These land-based activities include Traditional Use activities including hunting, trapping, fishing and plant and berry harvesting, and more contemporary land-based activities such as forestry, land and resource use manager, Chief, commercial fisher, agriculturalist/farmer related livelihoods. Unlike conventional examinations and interpretations of how TEK is constructed, this work suggests that the construction of TEK makes use of systematic ecosystem monitoring methods including the use of ecosystem condition indicators, diagnostic measurements, monitoring within an appropriate spatial scale, consistently and regularly monitoring over long periods of

time, and making plausible cause and effect associations. Many simplistic allegations of the inability of TEK to be used as a systematic monitoring tool have been made, including that it does not allow for quantitative data to be collected in a synchronic manner (Berkes 1998:10), and that local experts need to be properly identified in order to sift through the heterogeneity of levels of knowledge and specialization (Davis and Wagner 2003; Ghimire *et al.* 2004). As well, Scramm (2005) has postulated that Cree hunters observe sick animals when they happen to encounter them rather than deliberately monitoring them.

These research results indicate that Cree LBEs, monitor ecosystem conditions in a deliberate and systematic manner, regardless of the fact that much of the monitoring occurs while harvesting. Similarly, results from other studies have supported the supposition that local knowledge, including TEK, is capable of contributing detailed information on biophysical conditions of local ecosystems over time and space (Neis *et al.* 1996; Kofinas *et al.* 2001; Mackinson 2001; Riedlinger and Berkes 2001; Gill 2003; Mackenzie River Basin Board 2003; Duerden 2004; Kitson 2004; Lyver and Gunn 2004; Moller *et al.* 2004; Parlee *et al.* 2005; Berkes *et al.* 2007).

Out of an imperative to procure subsistence resources, and a genuine concern for the health of the land and people (Laboucan 2006) Cree LBEs deliberately monitor local ecosystem conditions for the health of the land and wildlife. As Mackinson (2001) has noted, combining Cree LBE knowledge and expertise with conventional science (WSK) may provide a rich means by which we can fill information gaps to build on ecological knowledge. Nonetheless, this objective must be carried out using established protocols to minimize inappropriate inferences, and to test knowledge claims, not merely assert knowledge as truth (Usher 2000; Wenzel 1999; Bradshaw 2003).

Non-Aboriginal and Aboriginal peoples are increasingly aware that no knowledge system is infallible, that there are competing knowledge claims, and that each knowledge system has limitations and risks of error (Usher 2000). Given the political nature of the supposition that Cree LBEs may have ecosystem monitoring expertise capable of

collecting valuable ecosystem information, the author has employed a fairly rigorous approach to: a) Identifying those considered Land Based Experts (Section 3.4); and b) Defining and distinguishing systematic monitoring (Section 2.5); and c) Examining Cree LBE's ecosystem monitoring methods for systematic elements. WSK and TEK may each provide valuable and useful information regardless of the fact that they are based on different sets of knowledge claims, and that they use local ecosystem information through engagement in different land-based activities. Nonetheless, it is critical that both WSK and TEK use empirical systematic methods, be comprehensible, transparent, and testable, and use appropriate procedures for recording, organizing and presenting data. Bradshaw (2003:148), when reflecting on community land and resource management, has asserted that "community credibility is, understandably, a difficult subject matter; nonetheless, "it requires attention". Specifically, ecosystem monitoring methods must incorporate appropriate systematic elements (Cairns 1993; Cairns 2002; Dallimeier *et al.* 2002; Durell *et al.* 2005; Green *et al.* 2005; Langor and Spence 2006; Morellet *et al.* 2007), to be admiralty suited to inform ecosystem management decisions.

Systematic ecosystem monitoring is incidental to the sustainability of the integrity and health of local ecosystems used to procure subsistence resources. Effective ecosystem monitoring must identify and measure temporal and spatial responses or stressors upon baseline conditions or deviations from a desired trajectory. Local Indigenous peoples in many parts of the world have, over many generations, developed ways of observing, learning, understanding, constructing knowledge, monitoring local ecosystems, interpreting and making associations about local ecosystem composition, structure and functioning. Indigenous peoples who 'consistently' (regularly) engage in land-based activities (including harvesting) multiple times throughout the year for considerable lengths of time (many decades) may be considered a local "Land Based Expert". "It is important to work with experts rather than randomly selected individuals in ecological studies that incorporate local knowledge".

These research results indicate that TEK is now constructed through the integration of more diverse land-based activities, including Traditional Use and more contemporary

land-based activities. As well, these research results suggest that TEK is constructed through the use of ecosystem monitoring methods which incorporate systematic elements. Appropriately, the use of TEK knowledge and LBE ecosystem monitoring expertise to assess ecosystem conditions may provide a rich means for facilitating the sustainability of local ecosystem integrity and health.

8.1.2 What kind of ecological changes are Cree land users observing within their traditional territory (Chapter 6)?

In Chapter 6, the results of observations of Cree Land Based Experts (LBEs) local ecosystem conditions and changes within the study area are presented. Given the limited amount of WSK information on ecosystem conditions within the study area, the observations of local people, including Aboriginal people, can potentially increase our understanding of cumulative effects over this landscape.

As noted in other literature, Aboriginal land users "have a mental image of what is normal and expected, and are very adept in noting environmental conditions that fall outside of the norms" (Berkes *et al.* 2007:158), Several other studies have attested to the value of ecosystem information collected through traditional land-based activities. For example, Kofinas *et al.* (2003:49) reports that, "comparison between hunter's impressions of caribou body condition immediately after they cut up an animal in the field and in interviews at the end of the spring hunting period were not dissimilar". Kofinas *et al.* (2003), and other (Berkes and Folke 1998; Berkes *et al.* 2000; Berkes and Folke 2002; Berkes *et al.* 2005; Parlee *et al.* 2005a; Parlee *et al.* 2005b) studies reveal that the body condition assessments of fish and wildlife, and other monitoring methods of Aboriginal people from Alaska, the Northwest Territories, and the Yukon tend to provide much needed, valuable, and useful ecosystem condition information which may be appropriate for applied use within land and resource management frameworks. In summary, the results of Chapter 6 indicate that:

1) There are a number of local ecosystem condition changes within the study area over the past few decades including: a) changes in water yield including catastrophic flooding events and lower water yield in watercourses; b) higher turbidity in watercourses; c) poor water quality (including a poor taste and smell) and algae blooms in the Lesser Slave Lake; d) attenuated water yield in wetlands; e) deteriorated water quality in wetlands f) landscape fragmentation causing changes in endemic species; g) a reduction in availability of medicinal plant species; h) reductions in important berry species; i) reduction in moose population; j) increase in wolf populations; k) increase in white tail deer population; l) reduction in mule deer population; m) reductions in ducks, grouse and prairie chicken populations; n) reductions in rabbits and squirrel populations; o) reductions in pike and perch populations; p) reduction in frog species population; q) deteriorated moose health including lower fat content, cysts, growths and antler attenuation; r) destruction of critical wildlife habitat including cervid mineral licks; and s) a reduction in air quality; and,

2) There are synergies between WSK and TEK information on ecosystem conditions and associations, and how that information has potential to better inform our understanding of cumulative effects.

8.1.3. What are the Traditional Use impacts that are resulting from changes to local ecosystems (Chapter 7)?

In Chapter 7, I present and discuss the cumulative Traditional Use impact results on the Cree communities of the study area. Chapter 7 results reveal that local Cree Land Based Experts, in general, now have a substantive concern with their inability to engage in their Traditional Use activities due to what they understand to be development induced local ecosystem changes. A number of the changes observed and communicated included local culturally significant species reductions (moose, rabbits, grouse, prairie chickens,

squirrels, blueberries, rat root, pike and perch) introduction of exotic species (Canadian thistle), changes in species composition (ex. more deer, less moose) and structure (ex. moose are younger and smaller), changes in natural disturbance regimes (ex. catastrophic flooding events), degradation of air (ex. gaseous smells), water (ex. un-potable water) and soil quality (ex. erosion), and changes in water yields (ex. attenuated water conditions in wetlands). As well, there was much concern in regard to a number of other impacts including safety on road networks, flooding of houses and hayfields, changes in the taste, appearance and smell of fish, animals and plants commonly used as subsistence foods and medicines are no longer readily available, government legislation of trapline and guiding activities, insecurity in access to harvesting areas, and angst about contaminants in the terrestrial, hydrological and atmospheric systems from the Toxic Waste Treatment Plant in Swan Hills.

Highlighting the cumulative Traditional Use changes associated with land and resource development is important because of the implications for community health and well being and the ramifications for Aboriginal, Treaty, and Constitutional rights. More specifically, some literature suggests that the link between the subsistence economy and Traditional Use is positively correlated with Aboriginal people's health and well being (Rode and Shephard 1994; Young 1996). And, the provincial and federal governments may very well have an obligation to sustain an environment conducive to supporting healthy cultural keystone species used by Aboriginal peoples.

8.3 Conclusions and Recommendations

With this research I have attempted to demonstrate how Traditional Ecological Knowledge (TEK) is constructed within a contemporary context of changing Aboriginal land-based activities and within an area of significant development, and how that ecosystem knowledge may be useful within applied ecosystem management frameworks. These research results indicated that local Cree who are recognized as being Land-based Experts: a) Engage in a diversity of integrated land-based activities to construct TEK; b)

Make use of systematic ecosystem monitoring elements when monitoring local ecosystem conditions; c) Construct ecosystem knowledge which has synergies to ecosystem knowledge from other conventional scientific (WSK) studies, including valuable and useful local ecosystem information which may serve to inform ecosystem management or cumulative impact frameworks; and d) Are experiencing cumulative Traditional Use impacts which may have ramifications related to their well being and rights.

Cree Land Based Expert's (LBES) of this study provided many accounts of how they construct ecosystem knowledge about the condition and changes of local endemic species, local aquatic hydrological systems, local terrestrial bio-physical elements, and the associations between industrial, land and resource development and those ecosystem changes. TEK is constructed through lengthy and consistent time and experience on the local landscape, is passed down through many generations, and the relationship of the land to these people is a contingent one. These results have been presented, analyzed and discussed with the aim of an appropriate and meaningful level of suitability for TEK to augment the knowledge generation literature, and be applied within ecosystem management and cumulative effects frameworks.

Central to the sociology environment debate is the role of 'science' in amassing, measuring, interpreting and making associations about ecological conditions, and the framing and use of 'scientific knowledge' towards making absolute claims about ecosystem conditions. Beck (1995) posited that there is a hegemonic character to the Western Scientific Knowledge (WSK) system through the use of rhetorical and discursive mechanisms, and by elevation of this knowledge system to a privileged position above other knowledge systems with the aim of persuading the masses of the legitimacy of this science's claims to truth. More recently within the interdisciplinary literature, there has been some recognition of the benefits of integrating TEK; which is a form of science; into land and resource management frameworks (Gill 2003; Moller *et al.* 2004; Stevenson 2006). Although it has been noted that two barriers persist: a) "The reluctance to give it respect equal to that given to hard science, and b) The inability to

incorporate it in a holistic meaningful way" (MacKinson and Nottestad 1998; MacKinson 2001:541; O'Faircheallaigh 2007). While local Cree LBE ecosystem monitoring methods and ecosystem knowledge may not be embraced by all land and resource managers for absolute fish, wildlife and habitat monitoring assessments, WSK should not necessarily hold a privileged position over these knowledge claims about ecosystem conditions. Accordingly, practical and applied use of TEK for generating large samples of ecological data with meaningful results for relative assessments between years, and at a finer scale over longer periods of time may: a) Provide a more symmetrical accounting of ecosystem conditions; and, b) Allow for an opportunity to move beyond rhetoric about the value of TEK to the applied use of TEK to inform decisions within ecosystem management arenas. This study has not able to examine all aspects of TEK and Cree LBE ecosystem monitoring methods; accordingly, some limitations and unanswered questions which might be addressed in future research might include:

1) Are the diagnostic measures, incorporated within Cree LBE ecosystem monitoring methods rigorous enough to provide ecosystem composition, structure and functioning data sufficient to inform ecosystem management and cumulative effects decisions?

2) Are all of the local ecosystem changes Cree LBE observed in fact cumulative ecological impacts of local oil and gas, forestry and toxic waste treatment development, or are there other confounding factors?

3) Are the cumulative ecosystem impacts within the study area so substantive that bio-physical thresholds are at the cusp of, or past being crossed?

4) Are the ecosystem impacts experienced by local Cree communities so substantive that they have crossed a threshold where their Aboriginal, Constitutional, and Treaty rights are compromised?

5) Are *Alberta's Aboriginal Land and Resource Use Consultation Guidelines* consistent with upholding First Nation Aboriginal, Constitutional and Treaty rights?

There appears a somewhat pressing importance to considering the cumulative ecological and socio-cultural impacts of development, at the landscape level, within northern Alberta, and how those cumulative impacts affect Alberta's Aboriginal peoples including the potential to infringe upon their distinctive land tenure rights. Based on the results of this study, the applicability of Cree LBEs ecosystem monitoring methods; which incorporate systematic elements; and the TEK generated from that monitoring may be valuable and useful for producing substantial amounts of detailed information on ecosystem conditions over time and space. Accordingly, are we not behooved to recognize that there are knowledge systems, other than the WSK system appropriate for informing ecosystem management and cumulative effects frameworks? Intuitively, a less restrictive drawing upon of knowledge, which links together multiple knowledge systems, may provide the instrumental responsibility necessary to avoid "the tragedy of the commons" (Hardin 1968:1244) in northern Alberta. In closing many of the participants of this research were anxious to have the results put to an applied use which is beneficial for their communities and the local ecosystems they depend upon. One LBE expressed this by stating "Well what I'm hoping for is for you who came here, to take this message to the people, tell them it [what we have told you], you know, this is what's happening" (18, 21 September 2006: 13). This is my intent.

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APPENDIX A

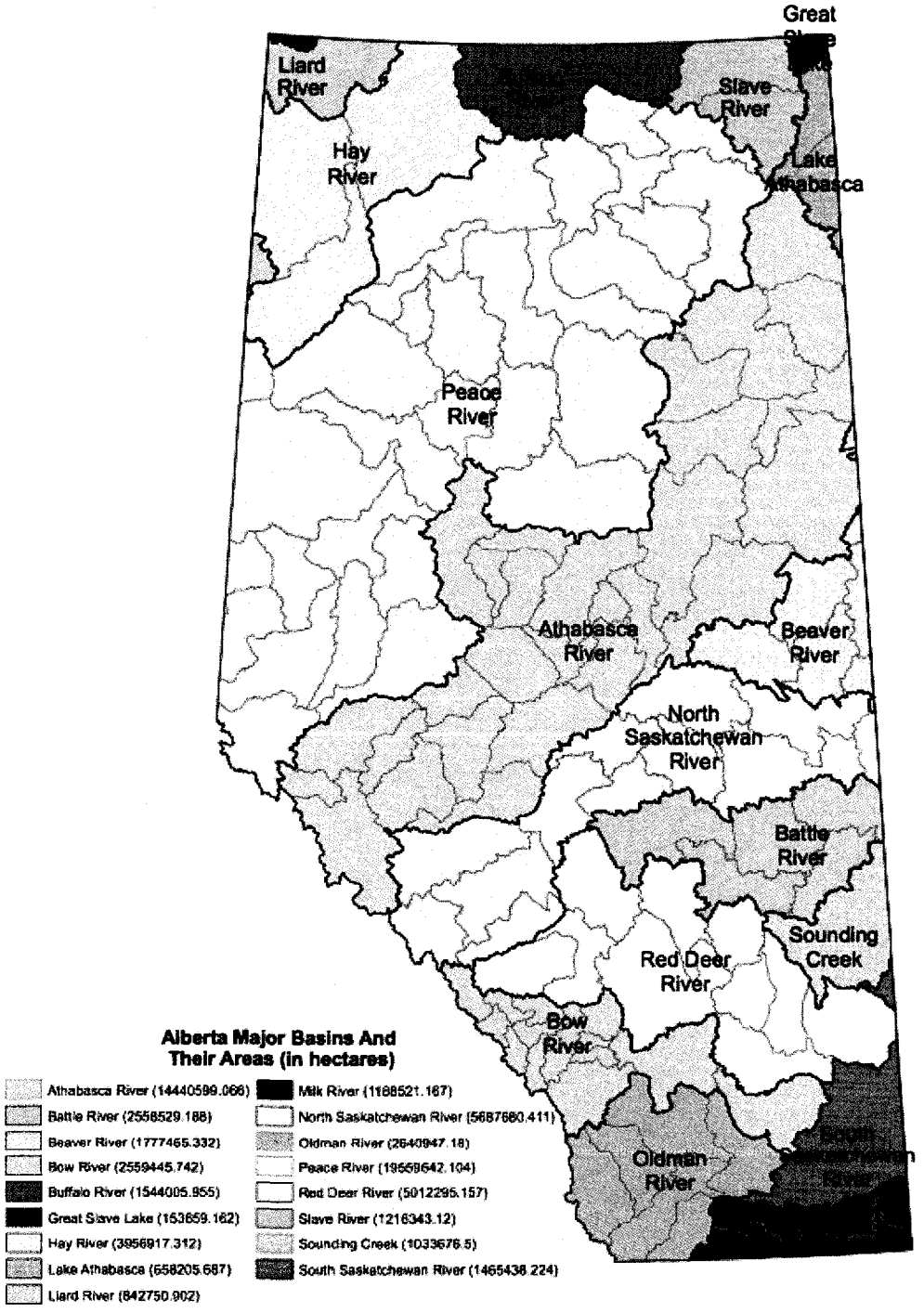

Figure A-1: ALBERTA MAJOR RIVER BASINS

APPENDIX B

Index of Plants

Berries:

Saskatoon (*Amelanchier alnifolia*)

Dwarf Blueberries (*Vaccinium myrtilloides*)

Common Blueberries (*Vaccinium caespitosum*)

Low Bush Cranberries (*Viburnum edule*)

High Bush Cranberries (*Viburnum opulus*)

Cranberries (*Oxycoccus microcarpus*)

Bog Cranberries (*Vaccinium vitis-idaea*)

Small Bog Cranberries (*Oxycoccus microcarpus*)

High Bush Cranberries (*Viburnum opulus*)

Choke Cherries (*Prunus virginiana*)

Pin Cherries (*Prunus pensylvanica*)

Raspberries (*Rubus idaeus*)

Medicinal:

Pitcher Plant (*Sarracenia purpurea*)

Rat Root (*Acorus calamus*)

Wild Peppermint (*Mentha arvensis*)

Mountain Ash (*Sorbus scopulina*)

Yarrow (*Achillea millefolium*)

Glossary of Terms:

Cultural Keystone Species: A "Cultural Keystone Species" is a culturally salient species that shapes, in a major way, the cultural identity of a people". A Cultural Keystone Species is a species which has a defining influence on a culture and its identity, and the species may or may not be an ecologically keystone species; nonetheless, the cultural keystone species is dominant, foundational, and highly interactive with the culture (Soule *et al.* 2003; Garibaldi and Turner 2004).

Consistently: For the purposes of this thesis consistently will be regarded as a consistent persistence in regularity, or more specifically, repeatedly multiple times a year, or seasonally.

Cumulative Effects: Cumulative effects can be defined as the incremental and interacting impacts of anthropogenic development stressors upon ecological, social, cultural and economic systems. Predicting and mitigating the impacts of project specific development does not adequately assess or consider the nature of: a) linear incremental effects with interacting cause and effect response relationships; b) exponential effects which result from interacting incremental effects; c) impacts resulting from exceeding response thresholds; and d) compositional, structural and functional impacts that may induce long term perturbations within ecosystems.

Distinctive Rights: Treaty peoples have distinctive rights in regard to land and resources over and above other stakeholders which arise from Section 35 of the *Constitution Act, 1982* and historical treaties (including Treaty 8). The scope of treaty rights are determined by their wording, which have been and will continue to be interpreted by Aboriginal peoples, Supreme Court of Canada and other lower courts.

Ecological Integrity and Health: The chemical, physical, hydrological and biological conditions necessary to maintain the endemic composition, structure and functioning of local ecosystems as determined by integrating and using Traditional Ecological Knowledge and Western Scientific Knowledge.

Indicator: A measurable or quantifiable feature of a valued attribute within an ecosystem which is used to calculate the status of an attribute. Each attribute is quantified using a number of condition indicators, the values which are coalesced into a performance index for the attribute. For example the combined score of a condition indicator for the health of a wildlife species (moose), with a population dynamics score, and a population distribution, density and trend score can be measured to calculate the status of moose within a geographic area during a certain time period. Appropriate indicators to assess composition, structural and functional integrity, health and/or changes should be: a) socio-ecologically relevant; b) consider stressors and resilience; c) useable at many sites; d) diagnostic; e) measurable; f) interpretable; g) summarize information from many indicators which can be used to measure a deviation from a desired trajectory; h) historical and measured continuously at the same sites over the long term; i) cause

minimal damage to an ecosystem; j) appropriately incorporate measures for the spatial scale; k) provide unique information.

Land Based Expert: The interviewees were selected on the basis that they 'consistently' (regularly engaged in land based activities, including harvesting, multiple times each year) and spent 'considerable' time on the local landscape (30 to 70 years). "It is important to work with experts rather than randomly selected individuals in ecological studies that incorporate local knowledge". In this way, "expert local knowledge adds value to science by providing detailed insights into the ultimate causes of change, and by contributing a rare historical perspective" (Chalmers and Fabricius 2007:1). Throughout this thesis, I refer to the participants (interviewees) as Land Based Experts (LBE) due to: a) The substantive body of knowledge (TEK) which informs their analysis and decisions about the land; and b) the lengthy and consistent amount of time they spend on the land, observing, monitoring and analyzing ecosystems. In this vein, I ascribe a substantial amount of expertise to their knowledge and skills about the land (ecosystems); consequently I will refer to their narrative about their observations and experiences in regard to ecosystems as 'testimony'; defined as evidence in support of fact or statement or a public declaration regarding some experience (Funk and Wagnalls 1980; Dictionary.Com 2007), rather than referring to their testaments as perception or stories.

Testimony: I present testimony, defined as evidence in support of fact or statement or a public declaration regarding some experience.

Traditional Ecological Knowledge: For the purposes of this thesis I define Traditional Ecological Knowledge as one worldview which has a purposeful and rational explanation and set of methods for understanding the physical world, and "a cumulative body of knowledge, practice and belief, evolving by adaptive processes and handed down through generations by cultural transmission" (Berkes 1999:8), and it is based on "learning by doing" (Moller *et al.* 2004:3), or learning the land. In addition, TEK, is a knowledge system, like any other knowledge system, which is not to be considered anchored in time, and it is a knowledge base that has been passed on through generations by family and other close personal relationships; nonetheless, more recently it has continued to be augmented through other more contemporary land based livelihoods (i.e. forestry, agriculture, land and resource management).

Systematic Monitoring: Appropriate systematic monitoring should be able to provide information which can be used to assess composition, structural and functional ecosystem components through indicators which highlight current conditions or changes within that ecosystem. Systematic ecological monitoring should: 1) Incorporation of appropriate indicators (what); 2) Usage of diagnostic measures (how); 3) Assessment at an appropriate spatial scale, with a preference for local landscape level monitoring (where); 4) Assessment of indicators and attributes (when) consistently (numerous times within the course of a year) over short (up to five years) and over long (from 6 to 50 years) periods of time (Cairns 1993; Cairns 2002; Dallimeier *et al.* 2002; Durell *et al.* 2005; Green *et al.* 2005; Langor and Spence 2006; Morellet *et al.* 2007).