CONTRIBUTIONS OF INUIT ECOLOGICAL KNOWLEDGE TO UNDERSTANDING THE IMPACTS OF CLIMATE CHANGE ON THE BATHURST CARIBOU HERD IN THE KITIKMEOT REGION, NUNAVUT

by

Natasha Leigh Thorpe

B.Sc. (Environmental Science and Physical Geography)

University of Toronto 1994

Research Project Submitted in Partial Fulfillment

of the Requirements for the Degree of

Master of Resource Management

in the

School of Resource and Environmental Management

Project No. 268

SIMON FRASER UNIVERSITY

July, 2000

APPROVAL

Name: **Name**

Degree:

Title of Thesis:

Examining Committee:

Chair: **Jeremy Higham**
Associate / Assistant / Professor

Dr. Evelyn Pinkerton
Senior Supervisor
Associate / Assistant / Professor

Dr. Gary Kofinas
Associate / Assistant / Professor

Date Approved: _____

ABSTRACT

Inuit ecological knowledge (IEK) can contribute new information, enhance existing knowledge, and provide hypotheses to guide further research concerning the impacts of climate change. Since time immemorial, Inuit have made links between climate, the environment and wildlife that have enabled their subsistence survival in harsh and changeable weather conditions. This paper focuses on these linkages to demonstrate the utility of IEK in contributing an understanding of climate change impacts on the Bathurst caribou herd in Nunavut, Canada.

Within these complex ecological linkages, Qitirmiut (Inuit of the Kitikmeot region) have observed increasing temperatures since the 1950s that have led to earlier spring-melt, later fall freeze-up and more variable and unpredictable weather. Other environmental impacts of a warming climate include thinner ice, lower water levels, richer vegetation, more extreme heat days and sporadic freeze-thaw cycles. Locals have linked these impacts to more incidences of caribou drowning, overheating (or "suffocating") or becoming exhausted as well as shifting their migration routes and locations of calving grounds on a local scale. Finally, Qitirmiut have observed a general increase in the quantity and quality of forage on the tundra.

With these causal relationships, IEK is shown to be a unique source of knowledge in that it is, at once, aggregating, changing, orally passed, intergenerational, multifaceted, local, iterative, adaptive and spiritual. For this paper, 27 transcripts of semi-structured and semi-directed interviews that were conducted with elders and hunters from four communities in the Kitikmeot region were reviewed. These interviews were conducted as part of a community driven research endeavour to document and communicate IEK of caribou, called the *Tuktu* (caribou) and *Nogak* (calves) Project. In conclusion, a list of 20 hypotheses generated from Qitirmiut observations are submitted as starting points to guide future scientific and Inuit ecological knowledge research on the effects of climate change.

DEDICATION

For My Grandparents

What is the true value of knowledge? That it makes our ignorance more precise.

Anne Michaels 1998, 210

ACKNOWLEDGEMENTS

Qitirmiut Elders and other community members taught me a lifetime of stories in our moments sharing *mukpauyuq* and *mipku.* *Quana* for your brilliance, patience, forgiveness, graciousness and compassion. Most of all, thanks for morning tea and laughter, even when I couldn't speak a word of Inuinnaqtun! You have shown me a glimpse of the ocean through a crack in the sea ice.

Other Northern colleagues and friends were the backbone of this work. Without the support of Grant Corey, Luke Coady, Sandra Eyegetok, Naikak Hakongak, Nancy Haniliak, Margo Kadlun-Jones, Eileen Kakolak, Mary Kaosoni, Meyok Omilgoitok, Karen Ongahak, Doug Stern, and Alex Thomson this research would have been impossible.

Members of Inuit and Nunavut Organizations were exceptionally supportive: Alex Buchan, James Eetoolook, Junna Ehaloak, Fred Elias, Keith Ferguson, Allen Maghagak, Darryl Ohokanoak, and Fred Peterson.

Others guided my academic inquiry and pushed my curiosities in new directions. Thanks to Gerry Atatahak for first planting the seed and Evelyn Pinkerton, Gary Kofinas, Chris Hanks, Mike Ferguson, Julie Cruikshank, Allice Legat and David Pelly for their cultivating advice.

For your infinite patience and ruthless review, thanks to Gord Comer, Sandra Eyegetok, Naikak Hakongak, Margo Kadlun-Jones and Leslie Tse.

I am grateful for the generous funding from the West Kitikmeot Slave Study Society, Social Science and Humanities Research Council, National Sciences and Engineering Research Council, Association of Canadian Universities for Northern Studies, Northern Scientific and Training Program, Arctic Institute of North America and Simon Fraser University. Thank you for recognizing the value of Inuit ecological knowledge.

QUANA

Quanaqqut Qitirmiut inirniit aallallu inuit ilaupkaqpangmanga ilihaqhunga unipkaanik muqpauyaqtuqatigiikhutalu mipkutuqhutalu. Quanaqquhi ayunnginaphi, huviitunnginnaphi, qanuriginginnaphinga, quyannalluaraphi, ilagiittiarniniglu ukiuni kingullini. Kihimi talvalu, qunaqquq tiituqpakkapta uplami iglaqpakhutalu tipirni uqayunngitkaluaqhunga Inuinnaqtun! Takupkaqtarma tariuryuamik ainnikkut hikumi.

Hamna qauyihainiq pipkaqtauvaktuq havaanginnit, piliriaqammaringnillu atummaringniatalu Inirnigit, angunahuaqtit, naniriaqtuqtinillu Qitirmiuni iluani. Taapkuat inuit unipkaatik, qangiqhimayatiglu qauyimayatiglu uqaqpagait ilihautikhait inulrammiit talvalu malitakhait ataniuyut tuktuliqinikkut..Amigaittut inuit kangiqhimaliqtatka talvalu kangiqhipkaqhunga nunamik aajjikkiinginnianik. Itqaumavangniaqtaphi.

Qunaqqut hapkua: John nanguyungmanga aippariumaplunga, Martha inikhaqaqpatigmat aalliangni, Bobby unipkaaliqpangmat, May iglaliqpangmat, Alonak uqaliqpangmat ima “Inuuhuktullu arnaruttillu”, Bessie havaanguyauyumut ilauvangmat, Mabel qauyimangmat unipkaanik miqhuyukhunilu, Jessie tuktuhiuqpangmat uuyuliuqhunilu, Naikak qamitpangmagu sikiituuq, Nellie auqqaaliqpangmat, Buster puiguqpangmagit iiyini, hiutini kigutinilu, Lena puhitaliuqpangmanga aullaarumaniagullu, David piksaqaqpangmat, Mary pualuliuqpangmanga mipkutuqtinmangalu aanniaqtillunga, Annie ilarananmait, Mackie unipkaaqarmat, George nunauyaliuyungmat, Charlie tiiviiqarmat nunainnarmi, Alice tun’ngahuquivangmat, Doris angunahuayungmat, Moses unaguinmat, Annie iglayungmat, Archie pittiaqhuni kangiqhipkaivangmat, George tiitangayungmat, Noah piannayungmat, Jimmy quviahuyungmat, Connie miqhiyungmat, Ella itiqtiquivangmat, Bessie piqpaginniyungmat, Paul tuniqhaiyungmat, Meyok aullariami ayuiqhaqpangmanga, Sandra nanguyungmat, Margo aliahuinnarmat, Joseph tiitangavangmat, George ayuiqhaqpangmanga iqalukhiurnimik, Nancy pulaaqpangmat unnuarni, Karen imaillilіqpangat “Natasha”. Talvalu . . . nutaqqanut quviakhuktinman’nga.

TABLE OF CONTENTS

Approval ii

Abstract iii

Dedication iv

Acknowledgements vi

Quana vii

Table of Contents viii

List of Tables xii

List of Figures xiii

1.0 INTRODUCTION 1

1.1 An Introduction to Inuit Ecological Knowledge 2

1.2 Scientific Monitoring of Arctic Climate Change 4

1.3 Problem Statement 6

1.3.1 Past Contributions from Inuit 8

1.4 Translation is not Enough: A Key to Inuinnaqtun Terms 9

1.4.1 The New Dialect of Inuinnaqtun: Phonetics for the Future of the Qitirmiut 12

1.5 Organization of this Paper 12

2.0 INUIT ECOLOGICAL KNOWLEDGE 15

2.1 Academic Definitions 16

2.1.1 A Caveat to Defining Indigenous Knowledge 18

2.2 Inuit Definitions 19

2.2.1 Wisdom Held by Elders 22
2.2.2 Select Wisdom..... 24
2.3 Acquiring IEK: Pattern-Thought..... 26
2.4 Applying IEK 27
2.5 Verifying IEK 28
2.6 Spirituality in IEK..... 31
2.7 Summary..... 31

3.0 THE TUKTU AND NOGAK PROJECT: METHODS AND DATA SOURCES 32

3.1 Background to the Tuktu and Nogak Project 33
3.1 Qualitative Methods: A Methodological Framework..... 37
3.1.1 Participant Observation 37
3.1.2 Participatory Action Research..... 37
3.1.3 Participatory Rural Appraisal 38
3.1.4 Experiential Data 39
3.2 Theory in Practice 39
3.2.1 Participant Observation 40
3.2.2 Participatory Action Research..... 40
3.2.3 Participatory Rural Appraisal 41
3.2.4 Experiential data..... 43
3.3 Reflections on Researcher Perspectives and Experiences..... 43
3.3.1 Researcher as Scientist: My Introduction to IEK 44
3.3.2 Southerner as Researcher..... 45
3.3.3 Researcher as Community Member 46
3.3.4 Coming of Age..... 46
3.4 Research Challenges..... 48
3.4.1 Cultural Differences..... 48

3.4.2 Language Barriers 50
3.4.3 Life in the Field: How Long is too Long? 50
3.4.4 Young and Female 51

4.0 METHODS: AN ADAPTIVE APPROACH 54

4.1 Deriving a Data Set: Semi-Structured Interviews about Climate 55

4.2 Personal Communication 58

4.3 Journal Entries 59

5.0 QITIRMIUT OBSERVATIONS OF CLIMATE CHANGE 60

5.1 Temperatures are Getting Warmer 60

5.1.1 Some Pros and Cons of Warm Weather to a Subsistence Way of Life 62

5.2 A Qitirmiut Explanation for Warmer Temperatures 65

5.3 Influences to Observations of a Warming Climate 66

5.4 Summary 67

6.0 THE EFFECTS OF A WARMING CLIMATE ON CARIBOU: EARLY SPRING-MELT AND LATE FREEZE-UP 68

6.1 Earlier Spring-Melt 69

6.1.1 Shift in Migration Routes: Leads Open Earlier 69

6.1.2 Migration towards Rich and Abundant Vegetation 71

6.1.2.1 Richer Vegetation provides Forage 71

6.1.2.2 Tall and Lush Vegetation provides Shade 73

6.1.2.3 Caribou as both Selective and General Foragers: A Question of Scale 74

6.2 Later Freeze-Up 75
6.2.1 Thinner Ice 76
6.2.2 Caribou Drownings 77
6.2.3 Lower Water Levels 77
6.3 Summary 80

7.0 UNPREDICTABLE WEATHER 81

7.1 Qitirmiut Seasons 81
7.2 Predicting Weather Today 83
7.2.1 Freeze Thaw Cycles 84
7.2.2 Days of Extreme Heat 85
7.2.2.1 Ways that Caribou Combat Heat 87
7.3 Unpredictable Weather across Nunavut 88
7.4 Summary 90

8.0 HYPOTHESES AND CONCLUSIONS 91

8.1 Qitirmiut Hypotheses for Further Research 92
8.2 Researcher Hypotheses 93
8.3 Conclusions 94
8.3.1 Reconciling Methodological Differences in Knowledge Systems 95
8.4 Closing Remarks 96

REFERENCES 97

Appendix A: List of Keywords for TNP 107

LIST OF TABLES

Table 1: Interviewee transcripts considered for IEK of climate change impacts 56

Table 2: List of interviewees for the Tuktu and Nogak Project. 57

Table 3: Total number of interviewees per community comparing the TNP and 699 research. 58

Table 4: Agency confidants for informal interviews 59

LIST OF FIGURES

Figure 1: Map of study area in the Kitikmeot region of Nunavut, Canada 11

Figure 2: Methods and process for the Tuktu and Nogak Project 34

Figure 3: Methods for the TNP and paper research 35

Figure 4: Relationship of 699 to the TNP 36

Figure 5: Qitirmiut observations of causal relationships resulting from warmer temperatures 61

1.0 INTRODUCTION

Climate defines the Canadian Arctic and the resolute people who live within it. Compared to other regions of the earth, the Arctic is particularly susceptible to climate changes caused by human and natural causes (Cohen 1997; Maxwell 1997). Here, a slight variation in temperature can generate both local and widespread effects that influence how much snow will fall, how cold winds will be, where plants and lichen will grow, or even whether a skidoo will start. For Inuit who must survive within the harsh Arctic climate, frequent weather observations continue to be a part of daily life. As a result, Inuit have much knowledge to contribute to our understanding of climate change in the Canadian Arctic.

Present-day Inuit depend on their understanding of climate and wildlife interactions much as their ancestors did (McGhee 1996). Around 3, 500 years ago, a worldwide cooling trend led the pre-Dorset people, ancestors of the Copper Inuit, to move from their coastal homelands southwards in search of caribou (Gordon 1975; McGhee 1996).

Despite the fact that climate has determined Inuit lifestyles, only a few written accounts (e.g. Nelson 1969, Spink 1969; Nelson 1980; Cruikshank 1984; Ferguson 1997; McDonald, Arragutainaq and Novalinga 1997; Fox 1998; Riedlinger 2000) detail Inuit ecological knowledge of prevailing weather patterns and their impact on the ecosystem. Further, “little of this information has reached the mainstream discourse on global climate change” (Cohen 1997, 302). There is a need for Inuit observations of climate to be better documented so that it can be applied in northern decision-making.

While Inuit observations of climate date back several millennia, the scientific record is just a few hundred years old (Gunn, Arlooktoo and Kaomayok 1988). Arctic explorers made notes of incidental meteorological observations starting in the 1700s, but only in the last 50 years have systematic meteorological observations been recorded through a weather station network (Maxwell 1980; Riedlinger 2000). If we do not complement recent scientific data with historical Inuit ecological knowledge, there will continue to be

significant gaps in our understanding of Arctic climate change (Ferguson 1997; Fox 1998; Ferguson, Williamson and Messier 1998; Riedlinger 2000). In this paper, I will help fill our gap in understanding by presenting Inuit ecological knowledge of climate change impacts on caribou in the Kitikmeot region of Nunavut. In doing so, I will demonstrate the utility of Inuit ecological knowledge.

1.1 An Introduction to Inuit Ecological Knowledge

Inuit ecological knowledge (IEK), the focus of Chapter Two, must be defined before I can demonstrate how Inuit can contribute to our understanding of Arctic climate. As an introduction here, based on my years of living in Nunavut and working with Inuit, I understand IEK to encompass:

> the intergenerational survival skills, insights, spirituality and experiences of people who demonstrate an acute awareness of dynamic interactions between themselves, lands and resources.

In the words of Sandra Eyegetok, community researcher for an Inuit ecological knowledge project, “we are talking about that which we’ve always known” (pers. comm. 1999). This definition speaks to the intergenerational nature of IEK whereby environmental observations are told through stories and passed from one generation to the next.

There are nine characteristics of IEK that I discuss in this paper. IEK is aggregating, changing, orally passed, intergenerational, multifaceted, local, iterative, adaptive and spiritual. I introduce each of these points below and further discuss them in the next chapter.

A key strength of IEK is that it is based on local observations. These observations may or may not have relevance on a regional scale or global scale, but they do contribute significantly at a local scale. Based on ideas put forth by Cunnison (1951), Cohen suggests that “in everyday life, common folk produce and maintain histories of their own little collectivities and resist the construction of more universal historical compositions

(Cohen 1989, 10). In my experience, Inuit make their climate observations on a local scale and do not apply these outside a spatial area with which they are familiar. I perceive this to be partially because of a cultural norm whereby people are not comfortable speaking about that which they have not seen.

IEK is continuously expanding and changing depending on the person making observations or hearing stories from elders and hunters. That is, "the knowledge of the . . .past is not simply given or handed down but is continuously and actively gathered and dissected" (Cohen 1989, 10). It has been suggested that IEK withstands the test of time, as it is passed from one generation to the next.

> There could be no better measure of intelligence than the ability to thrive in the Arctic with a technology limited to what could be made with ivory and bone, antler, soapstone, slate, animal skins and bits of driftwood that were as precious as cold. The Inuit did not endure the cold. (Davis 1998, 39)

As always, knowledge that is passed down is filtered through the receiver and categorically understood within that receivers' experience. IEK changes with each new listener in a way that is iterative and adaptive. Consequently, knowledge of the present is contributed.

Past knowledge is not "lodged in…a series of texts" in the way a written tradition such as western scientific knowledge may be, but instead, it is "engaged in and derives from arrays of social activity" (Cohen 1989, 11). IEK is not fixed in one period of time. Instead, IEK is continuously updated and enhanced by contemporary observations before being passed from one generation to the next. In this way, it is aggregating. At the same time, much information within this knowledge can be lost when it is not orally carried from one generation to the next or if it is not recorded. Like all knowledge, IEK changes over time.

One of the strengths of IEK is that it is multifaceted. Inuit recognize complexities within the ecosystem, particularly the linkages between ecological variables. Further, these complexities are viewed through an Inuit paradigm that is rich in cultural, spiritual and

social elements. Accordingly, each of these elements contributes to IEK.

In my experience, another key element of Inuit ecological knowledge is that it is infused with spiritual underpinnings related to animism as well as other traditions, for example, Anglican and Catholic. Ecological phenomena are often explained within the context of these beliefs, especially when no obvious or tangible reason exists. I provide an example of this in Chapter Seven.

Unlike other knowledge systems that inform our understanding of climate change, IEK is local in scale, changing, aggregating, iterative, adaptive, based on oral tradition, intergenerational, multifaceted, and permeated with spiritualism.

1.2 Scientific Monitoring of Arctic Climate Change

IEK can enrich our relatively nascent scientific understanding of climate change and enhance current climate monitoring programs. As earlier mentioned, scientific monitoring of Arctic climate began in the 1950s when an expansive meteorological network was established (Maxwell 1980). In the 1960s and 1970s General Circulation Models (GCM) were used to predict global climate responses to scenarios of change, for example, in the levels of greenhouse gases (Cohen 1997; Riedlinger 2000). In the 1980s, GCM results and instrumental data indicated that fluctuations in global temperatures might lead to global warming. In fact, data were showing that global warming had already begun and that an anthropogenically manufactured hole in the ozone layer existed over the poles. Results from research in the Mackenzie Delta of the Western Arctic show that temperatures have warmed an average of 1.5 degrees Celsius over the last 100 years (Dyke and Jasper 2000). Further, recent GCM predictions are that by the year 2100, global annual temperatures will increase by 1–3.5 degrees Celsius with Arctic temperatures increasing by 5-7 degrees Celsius in the winter and as much as to 5 degrees Celsius in the summer (Dyke and Jasper 2000). Information such as this, recently led governments, industries, universities and nongovernmental organizations to seriously consider global change and act to curb human causes of global warming through domestic and international policies to reduce greenhouse gases.

Canada is a signatory on several international agreements to decrease human causes of atmospheric and climate change. Starting in 1987 with the international Montreal Protocol on Substances that Deplete the Ozone Layer, Canada committed to working towards reducing the production and consumption of compounds that deplete stratospheric ozone by 2000. Canada also participated in the 1992 Earth Summit where it joined other countries in becoming bound by international law to reduce human causes of global warming. This was followed by the Kyoto Convention in 1997 where Canada agreed to reduce greenhouse gas emissions to 6% below 1990 levels before 2012. This commitment necessarily entails continued climate change monitoring and research and represents an opportunity to consider both scientific and IEK knowledge of climate.

In response to international commitments to combat climate change, Canadian governments have increased funding for climate studies to assist scientists in researching and predicting global change. Scientific theory and research confirms that global temperatures have warmed since the industrial revolution, particularly since the 1920s (Overpeck et al. 1997). Natural causes (e.g. increased solar irradiance and decreased volcanic activity) and human activities (e.g. intensive agriculture, deforestation, burning fossil fuels and releasing industrial waste gases) have led to this recent warming trend (Kane et al. 1992; Svoboda and Nabert 1994; Overpeck et al. 1997; Walsh 1993).

Recently, human activities have contributed to a warming trend, but looking farther back in the climatological record, increased temperatures have been experienced before (Kane et al. 1992; Koihok pers. comm. 1998; Omilgoitok, M. pers. comm. 1998; Overpeck et al. 1997). McGhee (1996) describes a general warming trend about 2, 600 years ago. More recently, Inuit elders Annie and Mackie Kaosoni recalled to me their grandparents' stories about a cool period in the late 1800s and early 1900s when temperatures never increased enough for the lakes to melt during the summer (Kaosoni, A. pers. comm. 1999; Kaosoni, M. pers. comm. 1999). From scientific and Inuit observations we know that climate changes, but how, how much and why are questions of time scale. Many Inuit elders suggest that climate changes are common. Predicting the periodicities of climate changes is a function of how long you have lived, the stories

you have heard, and the condition of your memory (Kuptana pers. comm. 1998; Koihok pers. comm. 1998). To improve predictions of future climatic trends and assess patterns of the last 100 years (the period when humans have had the greatest impact on global change), we must look towards both Inuit and scientific knowledge.

1.3 Problem Statement

One reason that IEK can contribute to the current western scientific understanding of climate is because it offers detailed local observations rather than the generalities common to scientific thought and models. The following section elaborates on how IEK can provide localized observations. Next I discuss the skepticism that surrounds both IEK and western scientific knowledge. In doing so, I present the current context faced by people who are trying to have IEK recognized as useful.

Since Inuit observations are localized and detailed, they can enrich known observations, enhance existing data, or contribute new insights to complement scientific research, particularly since the current scientific climate change paradigm is typically applied broadly across the Arctic and does not account for specific regional phenomena observed by Inuit (Ferguson 1997; Ferguson, Williamson and Messier 1998). For example, a hunter may be able to discuss annual variations of ice thickness for a particular region. These observations may support scientific theories on how temperature fluctuations influence freeze-thaw cycles. Further, IEK can help scientists ask the right questions and follow meaningful lines of inquiry.

IEK can enrich current western scientific understanding of weather at a local scale. For example, Freeman (1994) recalls that her:

> father and grandfather and uncles could not go out hunting unless the weather was right for them. The right weather also depended on what kinds of animals were to be hunted. Some animals can only be hunted in some types of 'bad' weather, for example, on a windy day,". (Freeman 1994, 3)

Inuit can describe what makes "right", "good" and "bad" weather in a detailed way owing

to the centrality of weather to Inuit life. These localized observations can contribute to an account of climatic phenomena that are more generally understood across Nunavut.

The product of this research is a series of local observations of climate change that can contribute to understanding the effects of a changing climate on vegetation and caribou that will add to the current debate concerning the utility of IEK (Cruikshank 1981; Bielawski 1984; Winkelaar 1990; Wolfe et al. 1991; Johnson 1992; Nahanni 1992; Inglis 1993; Freeman 1994; Sallenave 1994; Gombay 1995; Stevenson 1996; Howard and Widdowson 1996; Wolfley 1998; Berkes 1999; Freeman 1999). Although I elaborate on this debate in Chapter Three, at this stage it is important to introduce the skepticism that surrounds IEK. One anonymous government official, now legally and politically required to integrate IEK into his work, regards IEK as "hearsay and folklore" (Anonymous A pers. comm. 1994). While these may be components of IEK, they do not necessarily render all IEK as invalid. Others view IEK as merely religion and spiritualism (Howard and Widdowson 1996). Certainly these are important qualities of IEK that should be considered, but they do not necessarily detract from the utility of IEK.

People may recognize the value of IEK, but avoid it in their research because of the political, social and practical difficulties associated with integrating IEK and western scientific knowledge (Cruikshank 1981; Bielawski 1984; Gombay 1995; Cohen 1997). These difficulties are not surprising given that Northerners are in transition between a time when IEK was disregarded and an era of tentative acceptance. To change status quo is a gradual process and only in the late 1990s has government policy required that IEK be considered in various Northern decision-making processes.

Another obvious reason why many western scientists are skeptical of IEK stems from

the fact that their research opportunities and dollars are potentially threatened[1]. It is understandable that many scientists may not support *any* system that upsets their research monopoly, especially one that directly competes for funding. Dollars are finite and budget cuts to western scientific research will continue to be made, particularly now that the Nunavut Land Claims Agreement (1993) (NLCA) is in place. Instead of feeling threatened, western scientists might see collaborating with Inuit as an opportunity to produce *more* comprehensive research and ironically, in doing so, be more competitive for funding opportunities.

1.3.1 Past Contributions from Inuit

It is not known how much Inuit have contributed to our current scientific understanding of the relationship between climate, vegetation and caribou primarily because indigenous people were not given credit for their contributions of knowledge in the past. As a result, these contributions typically went unrecorded even though they likely informed many scientists' hypotheses, collection of data and results. Now that local knowledge is deemed valuable by legislation, such as the NLCA, it is more common to see informants given due consideration either in the acknowledgements or within the text of published materials.

[1] The West Kitikmeot Slave Study Society of Yellowknife, NWT, was established in 1995 to fund environmental baseline research in the Slave Geological Province -- a mineral rich area that spans from Yellowknife Northwards to the Coronation Gulf. Competition for funds between scientific and local knowledge researchers can be fierce. As an example, I am an IEK researcher funded by the WKSS and I submitted a request for additional funds recently. To my surprise, a western scientific researcher told me that the request would be granted simply because I was conducting IEK and not scientific research. His frustration stemmed from the fact that WKSS has cut budgets for some western scientific projects, but not for IEK projects. For the funding agency, the political reality is that failing to fund a sound indigenous ecological knowledge project would be highly condemned by aboriginal groups. WKSS must seek a balance in funding both scientific and indigenous knowledge projects in order to continue receiving support from all funders.

Inuit ecological knowledge of climate has been documented throughout the North by several researchers (Spink 1969; Nelson 1980; Cruikshank 1984; McDonald, Arragutainaq and Novalinga 1996; Ferguson 1997; Fox 1998; Riedlinger 2000) but their work is just the beginning of what could be recorded and contributed to an understanding of climate. Since IEK can offer insight on a regional and local scale, as will be demonstrated in this paper, it is important to document Inuit observations from many locations across Nunavut. This paper meets this challenge by focussing on the Kitikmeot region, an area where few climatic observations have been gathered from Inuit.

Prior to 1950, most scientific climatic observations were incidental and unsystematic (Riedlinger 2000). Several Arctic expeditions contributed to the climatic record in the Kitikmeot region, for example, those run by Amundsen (1903-1906), Stefansson and Anderson (1908-1912; 1914-1918)[2], and Rasmussen (1921-1924). Most recorded observations appear to have been made by explorers (Ferguson pers. comm. 2000). This does not necessarily mean that Inuit did not contribute to these observations, only that Inuit were not given credit.

1.4 Translation is not Enough: A Key to Inuinnaqtun Terms

Before moving into the next chapters of this paper, I discuss why the Inuit dialect of Inuinnaqtun is precise for terms related to weather. In this section, I also describe why I use some Inuinnaqtun rather than English terms.

Inuinnaqtun is a dialect of Inuktitut spoken in the Kitikmeot region of western Nunavut (Figure 1). Since Inuinnaqtun evolved in the Kitikmeot, it abounds with terms specific to

[2] Diamond Jenness served as the ethnologist for the Canadian Arctic Expedition run by Stefansson between 1913-16. His diaries have provided valuable historical information and demonstrate the breadth and depth of Inuit ecological knowledge.

environmental features of this particular area. As a result, the dialect is precise for those ecological features (e.g. climatic variables) that are central to Inuit ways of living.

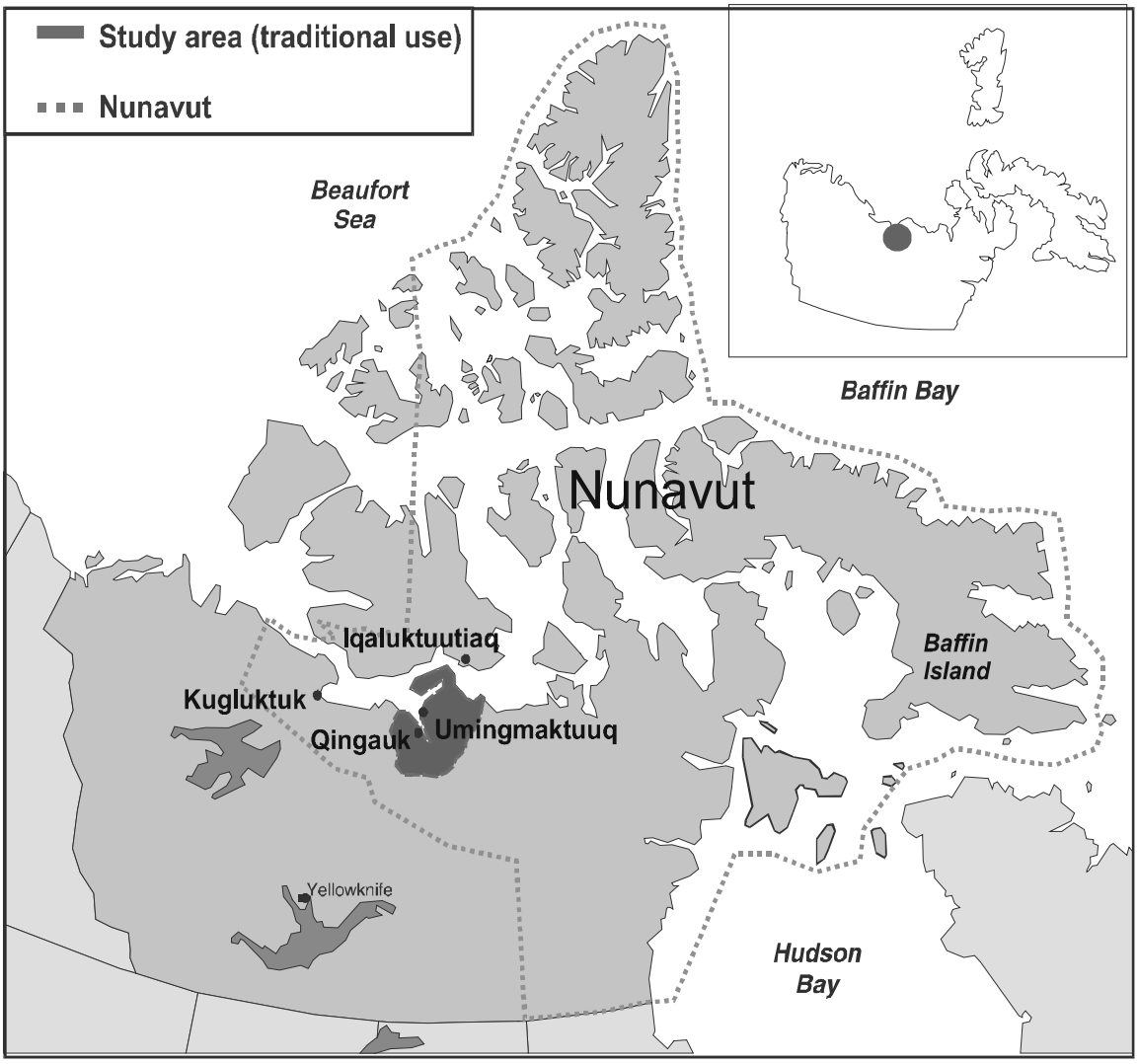
The precise nature of Inuinnaqtun (and, for that matter, Inuktitut) can be illustrated through the fact that there are many words for snow depending on its texture, age, depth, density, grain, consistency, or surface wind pattern (Kadlun-Jones pers. comm 1999; Omilgoitok, M. pers. comm.1999). Snow covers the ground for 10-11 months of the year in the Kitikmeot and is central to peoples' lives. Personal safety and hunting success can often depend upon whether one has a good understanding of the different types of snow. Consequently, many terms were developed to differentiate between disparate ice and snow conditions.

On the contrary, throughout my research, I noticed that many middle-aged and younger Inuit do not distinguish between different types of tundra vegetation because they have little use for such specific and technical language for this particular subject. Instead, people often broadly refer to the tundra and the plants living upon it as *nuna* (land) rather than categorizing the land into different vegetation types[3]. People know who to ask in order to find out exact names, but, in most cases, they are content with categorizing all vegetation under one term used to mean tundra or land: *nuna* (Kadlun-Jones pers. comm. 1999) Elders Lena Kamoayok, Mary Kaniak and Ella Panegyuk remembered names for tundra vegetation that Inuit used for food (e.g. berries and mountain sorrel), cooking fuel (willow, birch and heather), and as material to make mattresses (birch), but they classified other vegetation under one heading: *nuna* (Kamoayok 1998; Kaniak 1998; Panegyuk, E. 1998).

[3] Since "nuna" means "land" and "vut" means "our" then the name of the territory of "Nunavut" means "our land".

Figure 1:

Map of study area in the Kitikmeot region of Nunavut, Canada



Many elder men and hunters knew names for different plants better than did the elder women. This is probably because they travel and hunt on the land often and therefore have more opportunity to note vegetation. Further, they have observed the vegetative remains in caribou stomachs while butchering. Men also look for grazing signs on plants to see how recently an animal has passed by which again forces them to focus on

tundra vegetation. However, even though elders and hunters are usually best at identifying different types of tundra vegetation, many still refer collectively to all plants as *nuna*. From my experience working with elders, it appears that even when people know the different names, they do not think differentiating between them is important. Alternatively, people may not think that it is important for me to know the different names.

1.4.1 The New Dialect of Inuinnaqtun: Phonetics for the Future of the Qitirmiut

There are two language systems for Inuinnaqtun: the old and the new. In this paper, have used the new system because it is phonetic and therefore easier for non-Inuinnaqtun speakers to learn. Implementing the new system throughout the Kitikmeot region is important since English is often the first, or only, language spoken by Inuit youth. Many elders are resistant to change or unaware of the importance of phonetic spelling and therefore reject the new system. Still, the new system is slowly gaining acceptance and is being taught throughout Nunavut schools and colleges (Kadlun-Jones pers. comm. 1999; Ohokak pers. comm. 1999).

This paper is focused on observations made by a specific group of Inuit from the Kitikmeot region of western Nunavut (Figure 1). This group is known to historians and ethnologists as the Copper Inuit and to themselves as the Qitirmiut or “people of the Kitikmeot (Qitirmiut) region”. Throughout this paper I have adopted the term Qitirmiut when referring to Inuit of the Kitikmeot (Qitirmiut) region and Inuit to mean all people living across Nunavut. Note that I have retained the old system for given names and established geographical names, for example, the region Kitikmeot retains the old spelling rather than becoming Qitirmiut.

1.5 Organization of this Paper

This chapter introduces the research, including the research objectives, and a short definition for Inuit ecological knowledge. It presents a brief background of scientific and

Inuit research on climate change. Finally, a discussion of the Inuinnaqtun terms used in the paper follows.

Chapter Two provides a detailed discussion of Inuit ecological knowledge, including what it comprises and how it is acquired, applied and verified. The concept of patterned thought is introduced and followed by a discussion of why elders are considered to be experts.

In Chapters Three and Four, the methods for this research are presented. This includes a detailed discussion of how participant observation, participatory action research, participatory rural appraisal and experiential data were used in an Inuit ecological knowledge study called the Tuktu and Nogak Project (TNP). It is from the TNP that the research materials were derived for this paper. Chapter Three closes with a discussion of research challenges. Chapter Four details the methods of how interview transcripts from the TNP were considered for this research paper in combination with consultations with key informants.

Chapters Five, Six and Seven present the research results. Chapter Five describes Qitirmiut observations of a warming climate. Chapter Six presents the impacts of a warming climate on the environment and how these, in turn, influence caribou according to elders and hunters. Chapter Seven details local comments about the weather becoming increasingly more variable and difficult to predict. These examples of IEK held by the *Qitirmiut* (Copper Inuit) fill information gaps, contribute useful forms of knowledge, and enhance our current scientific and collective understanding of the effects of climatic changes on vegetation and caribou in the Kitikmeot region of western Nunavut. This adds to other research concerning the utility of IEK in our understanding of climatic change.

Chapter Eight presents a list of hypotheses generated by Qitirmiut observations detailed in this paper and suggests that these are starting points for future research. Taking these hypotheses one step further, additional hypotheses are presented based on Qitirmiut knowledge as well as my research and experience. Finally, a call is made to integrate local knowledge and western scientific knowledge to further our understanding

of climate change. In presenting these hypotheses, the results of this research paper contribute new information and enhance existing information about the effects of climate change.

2.0 INUIT ECOLOGICAL KNOWLEDGE

Inuit and non-Inuit organizations across Nunavut are currently discussing how to define Inuit ecological knowledge as the first step in any formal process that involves the application of Inuit ecological knowledge (Irlbacher 1997; Ferguson pers. comm. 2000; Tigguluraq pers. comm. 2000). This discussion runs parallel to a thirty-year old academic debate concerning how to term ecological knowledge held by indigenous peoples (Wenzel 1999; Neis and Felt in press). Perhaps the most commonly used term within academic and Inuit circles is traditional ecological knowledge (TEK) although local knowledge, indigenous knowledge and *Inuit Qaujimanituqangit* are also used.

Through the evolution of ideas about ethnoscience, cultural ecology and oral history and the current process of finding a working definition for Inuit ecological knowledge (IEK), members of Inuit and Nunavut organizations and academia are understanding better the intricacies of this complex way of knowing (Berkes 1999; Anderson 2000;Tigalluraq pers. comm. 2000). In this process, these disparate communities are converging in their definition of IEK. Academics and Inuit alike cite the same nine properties of Inuit ecological knowledge that render this way of knowing unique. As introduced in Chapter One, IEK is commonly understood to be:

- aggregating
- changing
- orally passed
- intergenerational
- multifaceted
- local
- iterative
- adaptive and
- spiritual.

In this chapter, I elaborate on how these above qualities characterize IEK in presenting both scholarly and Inuit definitions. Next, I provide a background as to how IEK is

acquired, applied and verified. First, I introduce the concept of sensory pattern-thought as a way that Inuit acquire and apply their ecological knowledge based on Ross (1992). Finally, in order to illustrate that IEK undergoes a rich review process, I present examples of how IEK is verified between and among communities. By introducing the way that IEK is defined, acquired, applied and verified, I provide an overall context for how and why IEK is useful in contributing to our understanding of climate change effects.

2.1 Academic Definitions

Most scholars use the broad terms "traditional ecological knowledge" or "indigenous ecological knowledge*"* even when they are referring to knowledge held specifically by Inuit. Although I choose to not delve into this nomenclature debate within this brief paper, I reject both terms and prefer to be more precise by using "Inuit ecological knowledge" (IEK)[4]. I understand this to mean knowledge held by Inuit across Nunavut and "Qitirmiut ecological knowledge" (QEK) to mean knowledge held by Inuit living in the Qitirmiut region of Nunavut. Of course, QEK is a type or subset of IEK.

In presenting the following academic definitions for IEK as the first step in demonstrating the utility of IEK, I include definitions applied to both traditional and indigenous ecological knowledge. I take this liberty because most authors use these broad terms even if it is only knowledge held by Inuit that they are discussing. Further, these broad terms encompass Inuit ecological knowledge and their definition therefore applies.

Several academics highlight the nine properties of IEK mentioned in the previous section. As Neis and Felt explain, IEK is "cumulative over generations, empirical in that it must continuously face the test of experience, and dynamic in that it changes in response to socioeconomic, technological, physical or other changes"(Neis and Felt in

[4] Please see Berkes (1999) and Wenzel (1999) for further discussions of the nomenclature debate.

press, 3). Further, Wenzel highlights that IEK encompasses an understanding of non-static ecological components in suggesting that IEK is knowledge of "the dynamic interactions that occur among all the elements, cultural as well as biophysical, within the Northern ecosystem," (Wenzel 1999, 114). Berkes puts forth a comparable working definition for TEK as "a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission about the relationship of living beings (including humans) with one another and with their environment" (Berkes 1999, 8).

Others provide similar definitions that suggest that this knowledge embodies adaptive and self-management practices through a relationship of respectful reciprocity with the environment (Nakashima 1986; Feit 1988; Gunn, Arlooktoo, and Kaomayok 1988; Nakashima 1993; Pinkerton 1994; Gombay 1995; Davis 1998; Fox 1998). In other words, living on the land and depending on ecological resources for survival, forced Inuit to be iterative in their approach to "managing" themselves within their local environment. A valuable asset of this knowledge is that it has been applied and revised over the course of generations. Accordingly, Pinkerton argues for continued inclusion and application of local knowledge in co-management regimes because the "loss of the traditional management regimes often entails the loss of the resources as well" (Pinkerton 1994, 51). However, the inclusion and application of local knowledge in co-management regimes should occur in a way that maintains the integrity of local knowledge. This can present a challenge given that western terms like co-management, sustainable development and ecological crisis have no analogues in indigenous languages (Cruikshank 1998).

Building upon the ideas put forth by other scholars and my personal experience, I define IEK as

> an accumulated and evolving body of knowledge that comprises the intergenerational survival skills, beliefs, practices, wisdom and experiences of Inuit as people who demonstrate an acute awareness of dynamic interactions between people, lands and resources.

IEK includes an understanding of ecosystems and relationships between ecological as

well as social, cultural, and spiritual values.

2.1.1 A Caveat to Defining Indigenous Knowledge

Critics caution that ecological knowledge held by indigenous peoples should not be romanticized to be more than it really is or taken out of context (Howard and Widdowson 1997; Cruikshank 1998; Krech 1999). In the 1990s, backlash resulting from government abuse of indigenous people in Canada (e.g. residential schools, stolen lands) may have swung the pendulum in the opposite direction so that some people consider all indigenous ecological knowledge as valuable (Irlbacher 1997). Acceptance of local knowledge without a critical eye can be more damaging or disempowering to indigenous people than if it were not accepted in the first place. One key criticism, elaborated below, is the claim that indigenous knowledge is not based on conservation any more than it is on economy.

Shepard Krech in his controversial book entitled *The Ecological Indian*, critiques the knowledge of indigenous peoples by suggesting that it has not always been the product of a conservationist ethic whereby ecological limits are understood or respected (Krech 1999). In fact, he argues that indigenous peoples may have contributed to mass extinctions for the last 11, 000 years. He presents recent cases where North American Indians (i.e. the Creek, Choctaw, Chickasaw) over-hunted and trapped deer, buffalo and beaver in order to trade their pelts for modern amenities such as guns, bullets, kettles, axes, knives, duffel, flannel, linen, cotton and silk.

Krech provides two explanations for indigenous people, in this case, Indians, to over-hunt. First, Indians may have abandoned their traditional conservation measures and been corrupted by their want for new technology and alcohol:

> Indians sacrificed harmony, balance, and conservation on the altar of chaos, commodities, and accumulation. Formerly restrained by traditional ideas from overexploiting animals, they abandoned tradition in the face of consumer temptations. (Krech 1999, 152)

Alternatively, Indians may have

> actively created choices for themselves, defined new roles, found paths in the new order in myriad and sometimes contradictory ways, and did not become dependent either rapidly or predictably. (Krech 1999, 152)

In both explanations, Krech suggests that Indians consciously decided to abandon a conservationist ethic. However, I would propose that since the European industrial economy was a new paradigm, the consequences to wildlife, the environment and social order were unknown. The ecological balance understood by locals was upset and a new equilibrium had to be reached, but the speed at which changes occurred was too fast for people to adapt. While it is true that prior to European contact, indigenous peoples were trading pelts for important social and political reasons, the difference was that these exchanges were more sustainable prior to the consumptive pressures brought forth by a European industrial economy.

Cruikshank (1998) points out that deeming the indigenous person or hunter a "noble savage" and suggesting that s/he lived in harmony with the environment prior to European contact is problematic in part because it can be "used as a weapon when indigenous people fail to pass arbitrary test of authenticity," (Cruikshank 1998: 60). Indeed, all contemporary ecological knowledge may be discarded because of the actions of a few indigenous people who do not conform to the noble savage stereotype. Wenzel (1991) provides an example of suggesting that the anti-sealing and harvesting campaigns first embraced Inuit conservation ethics and philosophies and later turned these against Inuit who have adopted modern hunting techniques. The same could be said of the controversy surrounding the bowhead hunt in Nunavut in 1998.

To summarize, while IEK should be understood as useful, as will be demonstrated in this paper, one should not unconditionally accepted any form of knowledge without placing it within a context and recognizing both it's strengths and limitations.

2.2 Inuit Definitions

The previous sections have highlighted how academics and non-Inuit define and critique Inuit ecological knowledge. In this section, I provide Inuit definitions for their ecological

knowledge. In particular, I emphasize how Inuit differentiate between knowledge and wisdom and why wisdom is of more value as a commodity and contribution to an understanding of climate change impacts.

When I asked Inuit to define IEK, I was told often that it was difficult because many Inuinnaqtun terms do not translate accurately into English (Atatahak pers. comm. 1999; Maghagak pers. comm. 1999). Even if they do, many concepts do not fit easily into a western framework.

The complexity, interconnectedness and wealth of information that characterize IEK can be lost when it is translated and written down rather than explained, demonstrated or acquired through experience. As Berkes asserts, writing a definition down "will never be an adequate format for the teaching of indigenous knowledge," (Berkes 1999, 28). In other words, a young boy will learn more from watching and listening to his grandfather hunt a caribou and then experiencing the hunt himself, rather than by reading a book about hunting. This was the case for Alootook Ipellie, an academic Inuk who speaks to IEK as a unique way of knowing:

> I was often in awe of the extraordinary abilities of my elders to understand the season, in knowing the behaviour of all Arctic animals species and to co-exist with their fellow Inuit in a common goal to survive as a collective. In the Arctic's harsh environment, one mistake or a lapse in judgement could spell certain disaster. By observing, listening and practising what my elders did, I was instilled with the will to survive for the moment and go on for another day. (Ipellie 1997, 98)

Gerry Atatahak provided a definition for IEK based on his experience running the *Naonayaotit* Traditional Knowledge Study (NTKS), a project to document IEK in the Kitikmeot region: IEK is *engilgaat* (long ago) *elihimayaghait* (what they should know) (pers. comm. 2000). Margo Kadlun-Jones (pers. comm. 2000), in reviewing this definition (and paper), added that the word *elihimayaghait* is stronger and is more accurately translated as "what they must or have to know". In fact, she suggests that the Inuinnaqtun word *pitquhiit* would be better in that it encompasses what is known, what has always been known and what must be in a holistic sense. This word does not translate easily into English.

Atatahak further explained that “this information has been passed down through the generations as what [Inuit] know from their fore fathers or mothers and it is a way of still doing things (i.e. beliefs, tradition, art of surviving etc…” (Atatahak pers. comm. 2000). In this way, the spiritual connection of Inuit ecological knowledge was emphasized as “beliefs”. Gerry also spoke to “the art” of surviving which implied that certain talents or skills are acquired in order to endure the harsh Arctic climate.

Another key component of IEK that was emphasized by Gerry is longevity that makes IEK an accumulated knowledge that is revised, enhanced and then passed down from one generation to the next. In the Arctic, the western scientific record of wildlife dates back approximately 200 years (Gunn, Arlooktoo and Kaomayok 1988) whereas Inuit ecological knowledge can be traced for millennia (Gunn, Arlooktoo and Kaomayok 1988; Fox 1998; Gordon 1996; Berkes 1999; Eyegetok pers. comm 1999; Atatahak pers. comm. 2000; Hakongak pers. comm. 2000; Riedlinger 2000; Tigullaraq pers. comm. 2000). The fact that IEK spans generations is one attribute that distinguishes it from other ways of knowing and makes it valuable as a contribution to our understanding of climate change.

Inuit recognize the importance of first defining their knowledge before integrating it into everyday policies, procedures, and educational programs. Leading the way in this regard is the *Inuit Qaujimanituqangit* Working Group (IQWG), a small association of people working for the Department of Sustainable Development (DSD) in the Government of Nunavut (GN). Joe Tigalluraq, member of the IQWG, explained that the group rejected an earlier definition of *Inuit Qaujimajatugangit* which “refers to objects ideas, ways of doing things, songs, beliefs etc…that were originally known by Inuit” (Tigalluraq pers. comm. 2000). Instead, members of the group preferred *Inuit Qaujimanituqangit* (IQ) which “refers to the wisdom of Inuit (Elders) rather than what they (Inuit or Elders) know” (Tigalluraq pers. comm. email 2000). In this revised definition for IQ, people have specified wisdom as a higher level of knowledge or a special form of expertise.

While all people have knowledge, not all knowledge is wisdom. Members of the working group sought to emphasize that the IEK based on wisdom is most valuable and that

knowledge is not valuable simply because it is Inuit. Instead, knowledge is valuable when it is based on wisdom. In my experience working with Inuit, I understand knowledge to become wisdom when it has undergone both personal and public scrutiny over time. This renders wisdom closer to "the truth". With a definition of IEK that emphasizes wisdom, *Inuit Qaujimanituqangit* can be more easily made into a commodity, applied and recognized. When this occurs, IEK can be shown as useful in contributing ot an understanding of climate change.

2.2.1 Wisdom Held by Elders

In earlier times, Inuit elders were critical to the survival of a nomadic group because of their wisdom, particularly in the areas of anticipating and preparing for ecological events such as weather changes and caribou migrations. Older people continue to be highly respected in Inuit and other indigenous cultures because of their expertise:

> You must never reveal what you know, for knowledge is power. If you step forward, you show yourself to your enemies…This is something the whites have never understood. The only time you can reveal your stories is when you no longer have the power: in old age. (*In* Davis 1998, 36).

The older an Inuk is, the more "secrets" to survival he/she can share. Since most elders can no longer hunt, their contribution to survival of the group is to educate.

Elders are critical to survival and commonly consulted for their ecological knowledge (Ross 1992; Wolfley 1998). As Ross (1992) explains,

> Even when their powers of observation began to fail, [elders] possessed two things younger people lacked: a reservoir of experience…and sophisticated skills in pattern-thought which others were only developing. (Ross 1992, 80).

Raymond de Coccola, missionary and explorer, speaks to this when he writes about Manerathiak, a Copper Inuit (Qitirmiut) elder:

> 'The wind is rising,' she reported. 'The sky is cloudy. Drifting snow is blanketing the dogs.'. . . Manerathiak, like a reliable, old-fashioned

> barometer, had correctly forecast an approaching blizzard.' (de Coccola and King 1989, 22-3).

As in the past, Inuit elders today continue to be considered experts because of their years of experience and ability to assess ecological phenomena.

In Inuit culture, youths' knowledge is not considered as valuable or reliable as elders' knowledge. Of thirty–four community members that I interviewed, the three youngest interviewees were the only people who wanted to remain anonymous. In contrast, all of the elders were adamant that their names be used: they were proud and wanted recognition. When I asked George Kuptana, eighty-two years old, if he had any questions or concerns about our interview, his only worry was that we be sure to air the interview on CBC radio!

My interpretation of the younger peoples' apprehension in providing their names was that they believed they were too young to be experts. I spent months at a time over several consecutive years living with these particular three people. Although all were parents in their twenties with at least a decade of experience hunting, fishing and providing for their families, they thought of themselves as young not only in years, but also in experience. As a result, when I asked questions they were hesitant to provide information and commonly responded "I do not know", "How should I know?", "Somebody would know that" or "You should ask an elder that".

While Qitirmiut can hesitate to take responsibility, often it is not because people are incapable of a task or without relevant knowledge. My research partner, Sandra Eyegetok, explained that people might know the answer or how to do something, but they fear having to take responsibility in case something goes wrong (Eyegetok pers. comm. 1999). During my five years of partnerships with Sandra and other community research partners, people often wanted me to take responsibility for actions that may be judged. For example, I was often asked to write letters or ask contentious questions during a meeting. This was primarily because people wanted to avoid confrontation, a practice that has always been part of Inuit culture. In fact, avoiding confrontation is a key component in keeping harmony and surviving in a nomadic group (Ross 1992).

A good example of Qitirmiut wanting to avoid responsibility was when my Inuit partners were hesitant to ask a question about traditional Inuit ways for fear that their elders would scorn them for not knowing the answer. In this case, they wouldn't be wrong, only forgetful of their heritage. To ameliorate this situation, my partners often said that it was me, the *qaplunaaq* (literally the one with bushy eyebrows, or the white person), who was asking the question. This happened during an Inuinnaqtun interview with an elder woman when I asked about how caribou are used for *kamiks* (fur slippers). My co-researcher, Sandra, listened to the answer but wanted to know more about how to traditionally sew them. She was afraid to admit she had forgotten what her mother had taught her so she said that I was the one wanting to know. This freed him to ask more "silly" as well as probing questions.

Another reason why these interviewees wanted to remain anonymous is that being wrong is particularly difficult to accept within Inuit culture. As a result, they preferred to remain anonymous in the event that what they shared was incongruent with that reported by the expert Inuit: elders.

2.2.2 Select Wisdom

Although elders are considered experts on account of their aged experience, not every elder has identical wisdom. Like any culture, experts contribute best depending on their particular life experience and expertise. Just as a scientific expert on tropical plants may not contribute much to a dialogue on Arctic vegetation, an expert from western Nunavut may not add to an understanding about caribou migrations in eastern Nunavut. Only experts with relevant knowledge should be consulted to further our understanding of any ecological phenomenon. As discussed earlier, not all Inuit are expert historians and while all Inuit "have knowledge … not everybody has wisdom," (McMullen pers. comm. 1998). Certain people have had access to more stories and have had more personal experience that renders them experts in different disciplines (Cohen 1989). It may be true that elders are experts, but, like scientists, their expertise differs and is relevant depending on the issue considered.

In my experience, the topic at hand determines which elder is consulted as an expert.

For the issue of climate change, elders in *Iqaluktuuttiaq* pointed me towards Frank Analok[5]. At eighty-two years old, Frank was particularly wise and explained how Inuit used the moon and animals to chart the annual cycle. With ease, he recalled years that were particularly warm and others that were cold. I elaborate on his recollections in Chapters Five through Seven, but for now, there are two processes that Inuit undergo when documenting or seeking ecological knowledge from elders or hunters. All experts must be identified first. In accordance with the IQWG definition, these would be the wise elders. Next, the right experts for the pertinent issue must be consulted. In this way, counsel is sought from the most appropriate people.

To summarize, in the first two sections of this chapter I provided academic and Inuit definitions for IEK. Academics and Inuit recognize nine unique qualities of Inuit ecological knowledge, specifically, that it is aggregating, changing, orally passed, intergenerational, multifaceted, iterative, adaptive and spiritual. Although all wisdom is knowledge, not all knowledge is wisdom. Elders or experienced hunters are more likely to have wisdom that is valuable, for example, in contributing to an understanding of climate change impacts. Inuit recognize the importance of wisdom in using the term *Inuit Qaujimanituqangit*.

Regardless of how IEK is characterized, before examining how Inuit can contribute their knowledge to the current western scientific knowledge of climate change, first one must realize how IEK is both generated, implemented and compared. Gombay suggests that to "understand the nature of [Inuit] ecological knowledge one cannot concentrate solely on what is understood; one must also consider how it is understood and why," (Gombay 1995, 8). This observation speaks to the importance of how IEK is acquired, applied and verified within and among Inuit communities. These three processes are the topics of

[5] Frank Analok is often consulted as an expert for a variety of topics. He was one of five elders who had their stories published in *Uvajuq*, a book compiled by the Kitikmeot Heritage Society (1999) that recounts the tale about how Mount Pelly (near Cambridge Bay) was formed.

the following sections.

2.3 Acquiring IEK: Pattern-Thought

Since time immemorial, travelling throughout the Arctic and depending on this environment for subsistence has enabled Inuit to acquire types of knowledge through a way of thinking unique to their experience. The Inuit thought process has roots in hunter-gatherer times and continues to evolve today. Ross (1992) explains that the success of the hunter-gatherer

> depended upon [an] ability to accurately read the innumerable variables which each season, day and hour presented. Those variables, however, presented patterns which, over time and with great attention, one could learn to recognize . . .[I]t constituted . . . a very specialized form of thought. (Ross 1992, 70)

Ross terms this way of thinking "pattern-thought" and suggests that it develops at a sensory level whereby repeated feelings and observations comprise a "complex and compacted form of reasoning" (Ross 1992, 74). Pattern-thought undergoes a filtration process whereby information is sorted and links between variables are made. For example, Inuit may observe cracks in the sea ice, link these with the influx of seals basking in the sun, and further connect this with an increase in the number of polar bears. Chaos in the environment is broken into smaller components and relationships and in different patterns defined by culture and experience. For the Inuit, an intricate thought process was established whereby subconscious sensory perceptions, developed over years of observation, guided their actions.

While everybody, scientists and indigenous people alike, have pattern-thought, Inuit are particularly sensory in their interpretations. Minnie Freeman of Cape Hope Island in James Bay wrote:

> I have witnessed many of [my grandfathers] predictions that have happened in some parts of the world. Not only have I witnessed them with my eyes but have also *felt* (emphasis added) them… (Freeman 1994, 4).

More than just intuition or feelings, Inuit *sense* ecological phenomena and categorize them within their extant understanding. For example, an Inuit hunter may explain that he is certain where the best hunting grounds are located because they are what "he has always known" (Eyegetok pers. comm. 1999). This subjective explanation appears incongruent with the scientific method, yet "what has always been known" is not simply subjective intuition. It has been developed through observations that are, at once, frequent, systematic, sensory and objective.

The Inuit thought process is distinct, yet it shares many properties with western scientific thinking. For example, an expert physicist understands the law of gravity and so he or she builds a conduit such that water will drain downhill. While the physicist deliberates about at the exact angle the conduit must be built, he or she knows it must be more than 180 degrees so that the water will flow downhill. The physicist learned the academics behind the law of gravity, but this was after he or she already had the experiential knowledge of gravitational pull on water, the applied knowledge, that is first learned in a sandbox. The physicist has "always known" about the law of gravity and, even without the academic training that provided context to the principle, this knowledge is acquired through sensory pattern-thought. Although the way sensory pattern-thought is acquired and used differs, it occurs in both western scientific and Inuit cultures.

2.4 Applying IEK

Inuit have successfully applied their sensory pattern-thought to survive severe Arctic conditions. Before modern times, peoples' knowledge of how climate influenced local wildlife often dictated whether an Inuit family would perish or persevere. A particularly harsh winter might cause wildlife populations to diminish because of reduced nutrients in tundra vegetation. Alternatively, a warm summer could lead animals to shift habitats thereby moving them farther away from traditional hunting grounds. In order to predict or respond to population cycles and shifts in migration, hunters had to be attuned to climate. In the 1930s, Nokadlak, a Copper Inuk, reported that

> the last time, the caribou didn't come in the spring. *Hila*, the Weather spirit, took over. Storm after storm chased the caribou away. We nearly

starved to death. (*In* de Coccola and King 1989, 28)

Since caribou were more critical than any other wildlife species to the survival of the Inuit they had to understand, explain and predict climatic influences on caribou in order to survive. In this case, the spiritual aspect of IEK is highlighted in the explanation of why the caribou were scarce. In predicting caribou movements, based on my discussions with local Qitirmiut, people might go to hunting grounds where caribou were most plentiful during previous summers or falls that were characterized by similar weather conditions. For example, an early spring-melt might mean caribou go to the west side of Bathurst Inlet to calve while a late spring-melt might suggest that caribou will go to the east side of the Inlet.

Inuit success in enduring harsh conditions was because they applied sensory pattern-thought to daily routines and dilemmas. Through years of experience on the land and listening to ancestors' stories, Inuit acquired adaptive management strategies and skills based on a relationship of respect and reciprocity with the environment. These skills were grouped into manageable categories, often linked with the spiritual world, according to an Inuit way of identifying patterns. For example, weather conditions were, and continue to be, repeatedly observed and linked with caribou hunting conditions. What is "sensed" (warming spring temperatures) is associated (with poor travel conditions for hunting) in a patterned process. What is unique is the *way* in which thoughts are patterned by Inuit versus other cultural groups.

2.5 Verifying IEK

It is common for Inuit to corroborate their observations with others both within and among communities. Traditionally, Inuit culture was based on oral communication. Today, people continue to rely on discussions with others in order to learn from one another and compare and verify observations.

Visiting or "having tea" has always been a central part of Inuit culture in order to exchange information and to foster closer relationships by simply being together (de

Coccola and King 1989). In my experience, the frequency that people visit one another is astounding. In *Umingmaktuuq*, a community of thirty, it is not uncommon for community members to meet for tea up to fifteen times per day in various households. I was told that frequently "having tea" has always been an important fabric of community relations and served as an important forum for information exchange (Coady pers. comm. 1996; Hakongak pers. comm. 2000). During these meetings, Inuit talk about the environment, often repeating and comparing observations from one household to the next. In my experience, sometimes there will be no discussions during a visit, but the simple act of being together brings people and family members closer. Meeting regularly is an important tradition that fosters close personal relations, improves memory, and ensures that critical information is shared.

Travelling to other communities remains a part of daily life for many Qitirmiut, especially for those from *Umingmaktuuq* and *Qingauk*, and serves as an important way to share and compare observations. Frequently, people do not hesitate to travel great distances even though a journey by skidoo or boat can take days or entail grueling discomfort. Upon arrival at a new destination, particularly a small community, the first priority is to start visiting. This consists of going from house to house over the course of several hours and repeating discussions of travel conditions, for example, ice and snow quality and wildlife availability. Communicating regularly is an important tradition that fosters close personal relations, conserves food resources, improves memory, and ensures that information about the environment, such as weather and hunting conditions, is shared.

Inuit have been conditioned to verbally communicate which is why repetition and memorization are critical for a hunter who depends heavily on his/her memory on a daily basis for hunting and survival. Memorization is made easier through the process of repetition. Qitirmiut repeated a phrase or concept up to four or five times in one conversation. For example, when I asked Bobby Algona (1999) of *Qurluqtuq* about the annual caribou cycle, he repeated the time of year (fall time) that he was talking about several times:

> I'll start out with the *fall time* I guess. *Fall time*. I like the *fall time* better than all the other seasons. You can walk around, you can skidoo a little

> bit. Do stuff with a skidoo a little bit, but you still walk around on soft snow. Go shoot a caribou. Before the winter's coming, stock up on caribou. (emphasis added)

Later in the interview, he emphasized how tame some caribou are:

> They're one of the *tamest* animals too. The *tamest*. That Bathurst caribou, one of the *tamest* animals. You can call them right up to you. (emphasis added)

Another example of repetition was when Frank Analok (1998) described how Inuit used the moon to tell the seasons:

> Oh yeah, they used the *moon* only, the *moon*. The *moon*, the *moon* was used *to tell the seasons*. Like it's June right now. They used the *moon* as a way *to tell seasons* long ago. It was a way *to tell the seasons*. When the moon would come during the spring thaw, when there's water, the caribou are calving and the birds are nesting. That's how it was used, in the month of June. (emphasis added)

At eighty-two, Analok was one of the eldest people that I interviewed. He also repeated himself more than any other person. This is telling, considering that he has little experience with the written world and he was talking in his own language.

Another reason for repetition is that Inuit traditionally maintained an oral rather than written tradition. It is my perception that since things weren't written down, they had to be remembered. As a result, I propose that people had to repeat important information to ensure it would be passed down from one generation to the next.

Repetition gives the listener time to digest key information and the opportunity to ask probing questions. It provides numerous chances for the listener to offer his/her knowledge to be compared and verified with that of the speaker. As any parent or teacher well knows, repetition serves as an educational tool in that a person is less likely to forget what s/he has been told time and time again.

Although people commonly used repetition as a learning tool, Qitirmiut are not renowned

for talking about happenings outside their experience nor are they comfortable speaking on another person's behalf (Briggs 1970; Eyegetok pers. comm. 1999; Kadlun-Jones pers. comm. 1999; Thomson pers. comm. 1999; Stern pers. comm. 2000). It is more common for hunters to share their personal observations and experiences and compare these with other hunters directly. This ensures that IEK is verified on a first person level.

2.6 Spirituality in IEK

IEK is infused with spiritual underpinnings that are closely linked with an ethic and respect for the natural world and often used to help Inuit explain uncertainty associated with ecological phenomena. In my experience, Inuit extend the same or greater respect to caribou as they do people in a way that contributes to a precautionary approach and conservation ethic. The ecosystem is viewed to have integrity and balance in a holistic way. Although spirituality is integral to IEK as a worldview, this dimension of IEK is too broad to address in this paper. Instead, I focus exclusively on the ecological dimensions of IEK. The role of spirituality in local knowledge has been debated in other work (Inglis 1993; Kofinas 1998; Berkes 1999; Krech 1999).

2.7 Summary

Nine properties of IEK are recognized by academics and Inuit alike and together render IEK valuable as a contribution to our understanding of ecology, in general, and climate change impacts, in particular. Specifically, IEK is aggregating, changing, orally passed, intergenerational, multifaceted, iterative, adaptive and spiritual. Inuit distinguish wisdom from all other knowledge and understand this to be most valuable. As elders are particularly wise, they are equipped to contribute by educating others about ecology.

Inuit acquire knowledge (and ultimately, wisdom) through a pattern-thought process particular to their culture and environment. Since time immemorial, this knowledge has been applied and Inuit have persevered despite harsh climatic conditions. In the process of applying this knowledge, Inuit continuously verify and revise their knowledge through frequent discussions with community members.

3.0 THE TUKTU AND NOGAK PROJECT: METHODS AND DATA SOURCES

I lived with *Qitirmiut* for an average of five months per year during the last five years. The opportunity to spend these concentrated, intermittent periods in *Iqaluktuuttiaq* (Cambridge Bay), *Qingauk* (Bathurst Inlet), *Umingmaktuuq* (Bay Chimo), and *Qurluqtuq* (Coppermine) came through my role as principal researcher for an Inuit ecological knowledge study known as the *Tuktu* (caribou) and *Nogak* (calving) Project (TNP). The TNP is funded by the West Kitikmeot/Slave Study Society,[6] a multistakeholder alliance that sponsors projects to develop baseline environmental information for the Slave Geological Province (Figure 1). Roughly, the West Kitikmeot region spans Northwards from Yellowknife to the Coronation Gulf and from the Back River westwards to the Coppermine River (300,000 km^2) (Kakolak pers. comm. 2000).

My research on Inuit ecological knowledge of climate change for this paper evolved from my role as principal researcher for the TNP. As a result, the TNP methods are relevant to this paper as they provided the materials on which this analysis is based. In the sections below, I clarify how the research was carried out and how interviews were developed, conducted, verified and assessed. The TNP and this paper are separate yet related. This chapter focuses on the methods for the TNP whereas Chapter Four details research methods for this paper.

[6] The West Kitikmeot/Slave Study Society is a partnership of aboriginal and environmental organizations, government and industry. In late 1995, these partners united to ensure that the effects of development on the environment, wildlife and people in the Slave Geological Province region are minimal and that Northern people get the maximum benefits. Since the WKSS was initiated, it has funded 20 scientific and Dogrib, Inuit and Dene ecological knowledge projects. For more information, see www.wkss.nt.ca.

In Section 3.1, I present a theoretical background for qualitative research methods. I discuss how these methods relate to both the TNP and this analysis in Section 3.2. Participatory action research (PAR) was my main method, but I also incorporated components of participant observation (PO) and participatory rural appraisal (PRA). As a researcher, my cultural and experiential framework informed the manner in which I conducted this qualitative research. Accordingly, I discuss the nature of my experiential data as a central component of my methods.

In Section 3.3, I outline some of my research challenges that impacted the way in which I collected primary data for the TNP. These are important to my analysis of the interview transcripts for the purposes of this research. These challenges included managing for age, gender, language and cultural differences.

3.1 Background to the Tuktu and Nogak Project

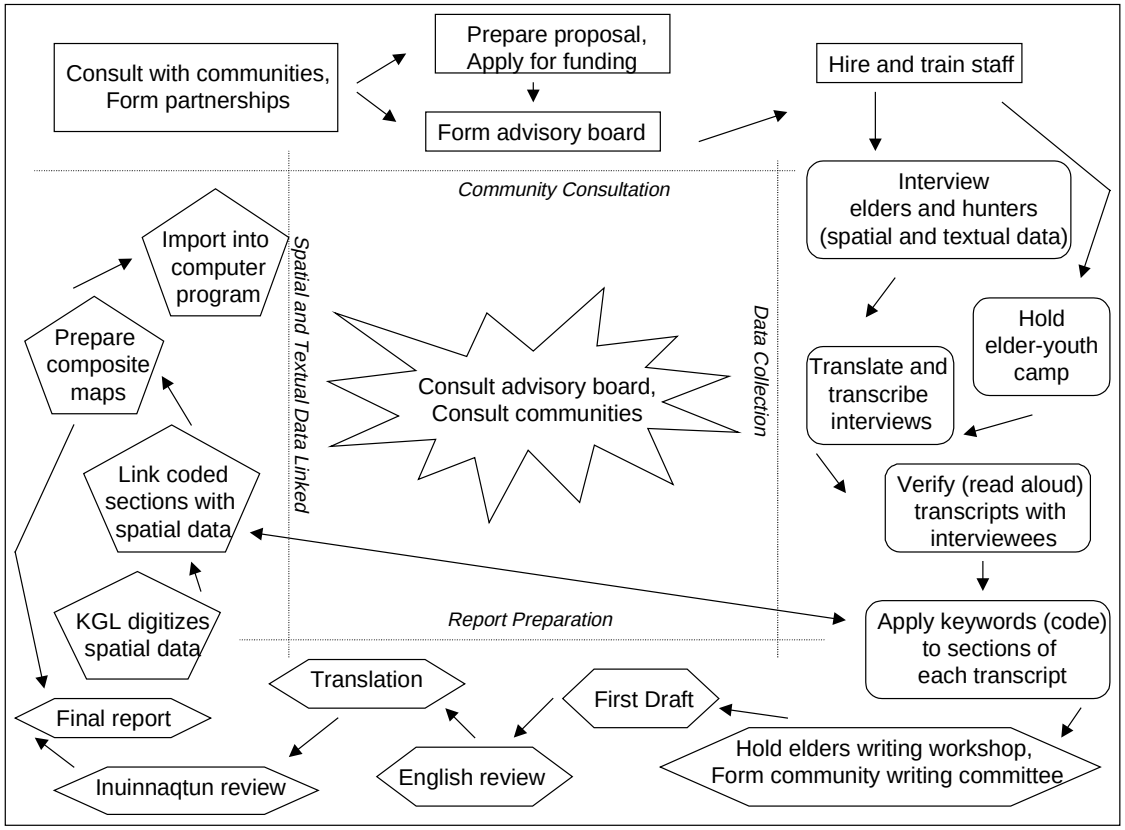
Figure 2 summarizes each stage of the TNP given that it is not prudent to expand upon these within this paper. Instead, I provide a brief synopsis in the following section so that the reader can understand the evolution of the interview transcripts that I considered.

Community consultation for the TNP began in 1995 which resulted in a project goal: to chronicle hunters' and elders' knowledge of caribou and calving grounds for the Bathurst herd of barrenland caribou. The study area is the historical and current hunting grounds for the communities of *Umingmaktuuq* and *Qingauk* (Figure 1).

I am the principal researcher for this community endeavour. I work with several community research partners, Sandra Eyegetok, Margo Kadlun-Jones and Naikak Hakongak. We are guided by and accountable to elders from a community advisory board. As researchers, we report to the board members who decide how the information is collected, documented, and shared. This is shown in Figure 2 and further discussed in Section 3.1.

Figure 2:

Methods and process for the Tuktu and Nogak Project

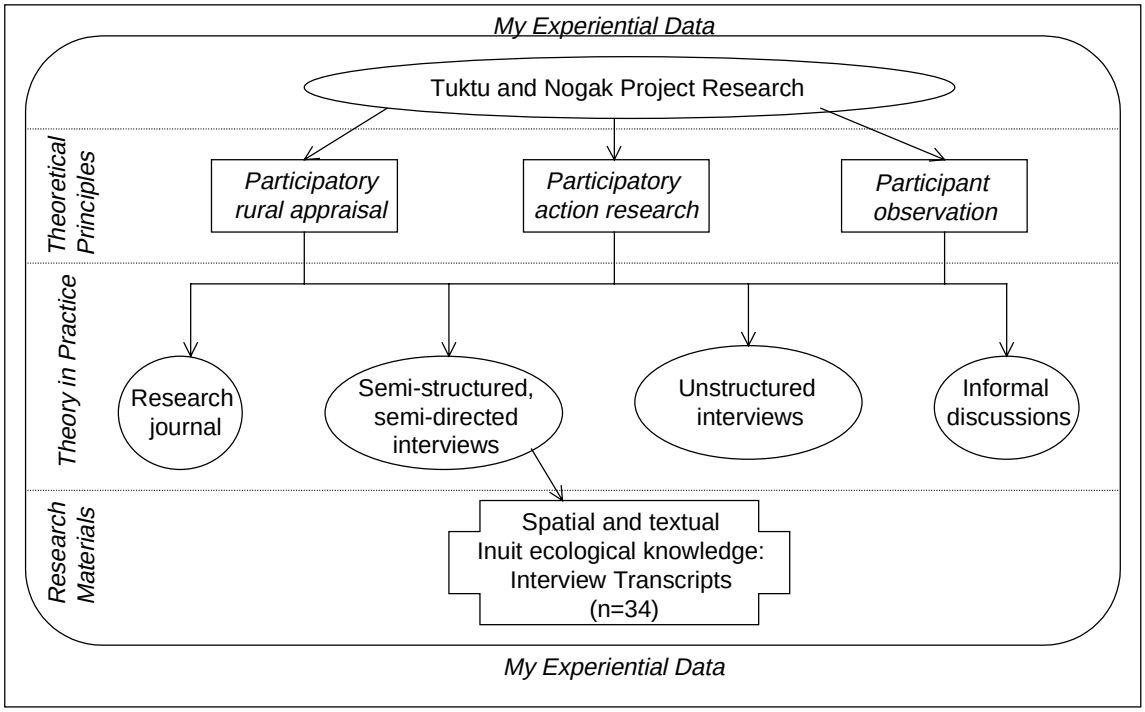


The advisory board suggested and I agreed, that conducting interviews in communities and "out on the land" was an ideal way to collect Inuit ecological knowledge from elders and hunters. Elders could better share their knowledge in this natural setting because they were comfortable. In addition, they seemed to be flooded with memories when they returned to places of their past.

Next, we worked with four community members to draft an interview questionnaire and have it reviewed by several elders. Once the interview questionnaire was revised, we conducted semi-structured and semi-directed interviews with 34 people to document both spatial and textual information (see Figure 3) (Huntington 1998). Unstructured interviews, informal discussions and my research journals complemented the semi-structured and

Figure 3:

Methods for the TNP and paper research



semi-directed interviews to inform my research. This process is elaborated in Chapter Four.

The semi-structured and semi-directed interviews were transcribed then translated from Inuinnaqtun to English (or vice versa) by my research partners. Next, the transcripts (n=34) were read aloud to each interviewee so that every word could be verified. Accordingly, I revised transcripts and then divided them into discrete sections. Finally, each section was coded according to caribou-related keywords derived from my research partner and my understanding of caribou ecology, for example, changes to population, foraging habits, body fat, and habitat preferences (see Appendix A).

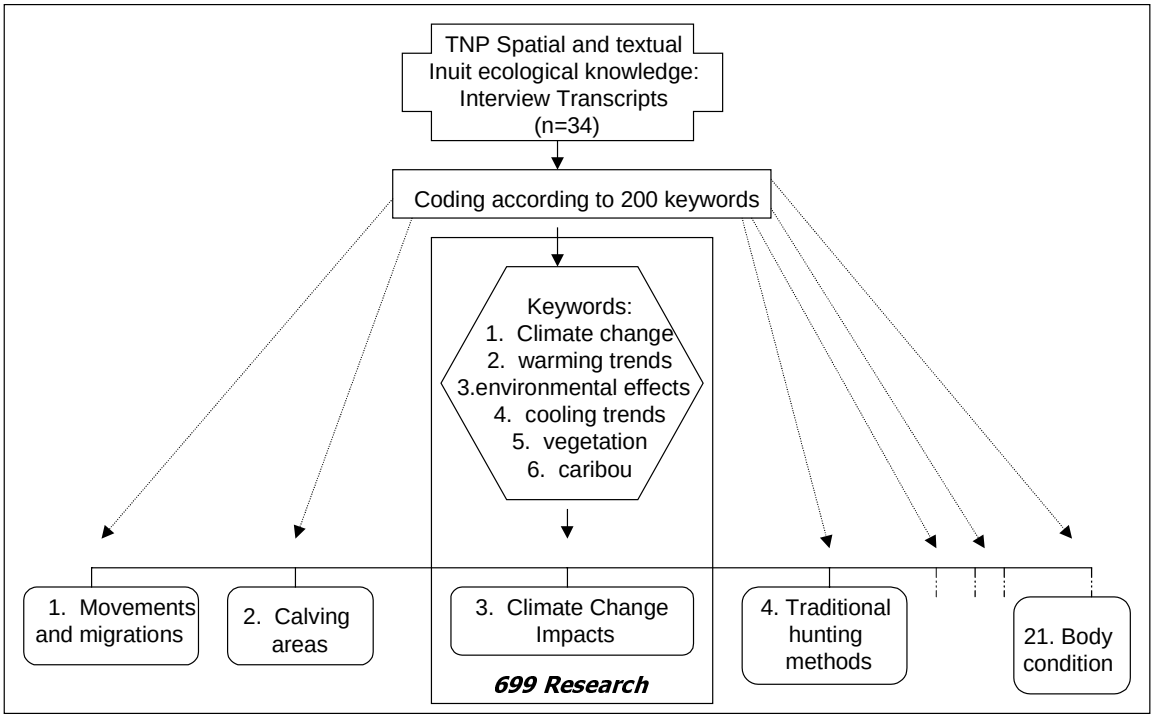
In the next step, we clustered together keywords to form twenty–one categories and then sorted coded sections into appropriate categories, for example, caribou movements and

migrations, calving areas, traditional hunting techniques, and body condition (see Figure 4). Each category formed chapters within the TNP report. For this paper, I analyze the climate category. For more information on the TNP, consult the webpage: www.polarnet.ca/tuktu.

In order to be considered as climate-relevant, the transcripts had to have a combination of any two of the six keywords (e.g. climate change and vegetation or warming trends and caribou).

Figure 4:

Relationship of 699 to the TNP



This figure illustrates the process of selecting climate-relevant transcripts (n=27) from the TNP transcripts (n=34) according to 6 keywords. Note that there were 21 categories of chapters that evolved from the TNP and that only one chapter, namely, that about climate, is examined in the 699.

3.1 Qualitative Methods: A Methodological Framework

In the following sections, I present a theoretical background for qualitative research methods, namely, participant observation, participatory action research, and participatory rural appraisal. In doing so, I provide a background for the following sections in which I explain how I implemented each of these methods for this paper.

3.1.1 Participant Observation

Participant observation is defined as fieldwork where the researcher "participates as well as observes by developing relationships with informants" (Burgess 1984, 81). This model of participant observation matured into participatory action research as social scientists realized that the researcher is an actor and not merely an observer (Spradley 1980). In this way, the researcher alters happenings within a given situation.

Early social scientists tried to mask their insider perspectives by minimizing the influences of one becoming an active participant in community life. In contrast, contemporary researchers work to become more integrated into communities while at the same time documenting how they are influential actors in the research process (Whyte 1991; Greenwood, Whyte and Harkavy 1993).

3.1.2 Participatory Action Research

Participatory action research is "a form of action research in which professional social researchers operate as full collaborators with members of organizations in studying and transforming those organizations" (Greenwood, Whyte and Harkavy 1993, 177) through the process of "mutual inquiry and local ownership" (Chataway 1997, 747). Important components of PAR include the following between community members and outside researchers:

- collaboration
- incorporation of local knowledge
- eclecticism and diversity
- case orientation

- emergent process; and
- linking scientific understanding to social action (Greenwood, Whyte and Harkavy 1993, 179).

More than just a methodology, PAR is “an important scientific and moral goal for social research to achieve” (Greenwood, Whyte and Harkavy 1993, 175). Most contemporary community research is no longer characterized by an expert academic descending upon a community. Instead, it is a “cooperative research venture” between researchers and community members (Dene Cultural Institute 1994). Although cooperative, the venture should empower community members through their capacity building and control over most stages in the research process.

3.1.3 Participatory Rural Appraisal

One form that PAR has taken recently is participatory rural appraisal (PRA) which includes results from community research relationships between Northern and southern countries in the field of agricultural development (Holden and Joseph 1991; Webber and Ison 1994). More recently, PRA has broadened it’s applications into other development fields, for example, in the Yukon, Northwest Territories and Alaska where the Arctic Borderlands Ecological Monitoring Co-Op and the Sustainability of Arctic Community Project are linking members from communities and science (Kofinas et al., 1997). The Project runs an extensive monitoring program that involves both community members and scientists. Inuvialuit like Billy Archie of the Aklavik Hunters & Trappers Committee have been involved since the onset of the program and have taken lead roles in ecological monitoring (Archie pers. comm. 2000). It is empowering for community members to be associated with this successful project by building relations with researchers, having local knowledge recognized as legitimate and learning to sustain common pool resources (Kofinas pers. comm. 2000).

Participatory rural appraisal is an “intensive, systematic but semi-structured learning experience carried out in a community by a multidisciplinary team which includes community members” (Theis and Grady 1991, 23). Further to this, Webber and Ison (1994) suggest that an interdisciplinary team is preferable to a multidisciplinary team.

An interdisciplinary team "seeks to value and understand diversity within a group rather than being limited in the way a multidisciplinary team is because disciplinary 'experts' often experience what they see and experience through their particular lens on the world" (Webber and Ison 1994, 109). In PRA, community empowerment is a critical outcome that depends upon the level at which community members participate in and facilitate the process (Webber and Ison 1994).

3.1.4 Experiential Data

While people recognize that they influence the research process by being active participants in community life, the background, worldview, and character of a researcher may influence *how* the research process is altered. Many qualitative social scientists realize that they bring their background and identity to their research and see this as a valuable component of their work rather than a bias that needs to be masked (Glesne and Peshkin 1992; Maxwell 1996). Glesne and Peshkin suggest that "subjectivity is…a strength on which I build. It makes me who I am as a person and as a researcher, equipping me with the perspective and insights that shape all that I do as a researcher" (Glesne and Peshkin 1992, 104). Strauss (1987) terms this "experiential data" and suggests that they include researchers' technical knowledge, research background, and personal history. In the context of my research, I perceive my experiential data to also include my worldview, theoretical frameworks and paradigms that underlie and encompass the research process, as illustrated in Figure 3. I explain how my experiential data contributed to some of my research challenges in Section 3.3.

Most social scientists bring experiential data and subjectivity to their research with a critical eye (Strauss 1987; Glesne and Peshkin 1992; Maxwell 1996). The role of social scientists is to recognize that they are subjective and allow for their perspective to be known as an important component of the research process.

3.2 Theory in Practice

Now that I have introduced participant observation, participatory action research,

participatory rural appraisal and experiential data, in this section I described how I implemented these methods in my research. For the TNP, I began with participant observation then moved towards participatory action research as my guiding methods. Insofar as I continue to conduct qualitative research in partnership with community members, I adopt elements of participatory rural appraisal also. Participant observation, participatory action research and participatory rural appraisal are all closely related and are inevitable in a social science situation. They are, at once, modes, tools, techniques and methods.

3.2.1 Participant Observation

I was a participant observer early in the research process for the TNP. This occurred before I was comfortable working with Inuit and thus, before community members had confidence in me. In addition, later in the research process I switched between being more of an observer versus participant during times when I did not want to get entrenched in a community situation. Like Kofinas, I oscillated between"…offering support in various activities where solicited; and at other times purposefully avoiding direct intervention in a process where I felt that intervention would dramatically alter the course of events" (Kofinas 1998, 53). With time I was able to periodically distance myself in order to gain objectivity. This was particularly important when voicing my opinion would have been consequential.

As I became heavily involved in community life, my methodology shifted towards participatory action research. In this way, I started to recognize that I was an actor in the research process and that the Inuit world was not a fishbowl to be viewed from a distance.

3.2.2 Participatory Action Research

There are two reasons why participatory action research was my primary method for the TNP. First, although community members and I collaborated, they ultimately drove and directed the research process. Research agreements I signed with the community advisory board specified the various ways in which community members and I would

contribute to the research process. An important clause of the agreements was that community members ultimately held the veto power for any decision related to the research.

Another reason that PAR was my main method was my intense level of community involvement. As earlier mentioned, I spent many extended periods living in communities and partaking in daily life over the course of the last five years. In *Umingmaktuuq*, I felt a sense of belonging once the newness of my presence faded and people learned that I was committed to staying for weeks, months and years. I further explain these events in Section 3.3.

PAR was my central methodology because of my personal investments and changing roles in community life. A turning point in my sense of belonging in communities was when people began to feel comfortable both criticizing and complimenting me. For example, I was chided for being cheap if I didn't contribute enough gas money for a boat or skidoo trip. On the other hand, people started to call me *Tuktu* (caribou) and teasingly encouraged me to become a girlfriend to an elder bachelor. Given my experiences over the years, I could not help but become strongly connected with these people. However, the more I became both physically and emotionally involved with community members, the more I influenced the research process.

3.2.3 Participatory Rural Appraisal

Closely related to participatory action research, many concepts of participatory rural appraisal were relevant to my research since I was an outsider working with community members to document IEK. For example, I was part of a team that included community researchers, advisory board members, elders, hunters, wildlife officers, and people from hunters and trappers organizations.

Working as part of this team, I followed two key principles of PRA. The first was a readiness to "maintain collaboration over a longer time frame than the initial appraisal, in which local capacity to be responsible [was] fostered rather than the PRA team merely returning with their new understandings" (Webber and Ison 1994, 109). For the TNP,

elders chose research partners with whom I was to work. These partners, Margo Kadlun-Jones and Sandra Eyegetok, were paid well and charged with the responsibilities of maintaining community consultation, running home offices, conducting interviews, analysing interview transcripts and writing reports. In this way, skills were transferred and capacity was built.

The second key concept of PRA that I implemented was a preparedness to "accept that the team . . . merely provided a 'trigger' for local action and that no particular outcomes [were] guaranteed," (Webber and Ison 1994, 109). Working together, one of our team roles was to provide impetus and respond to inspiration for community research on caribou and calving areas. At times this was difficult given the uncertainty in the nature of the results. We did not know how we would package the interview transcripts, for example, how they would be sorted or what relevant categories would emerge. Further, we were unsure of which caribou-related issues would be most important or whether the results would be conveyed through video documentaries or reports. One important outcome that evolved from the research process was the abundance of knowledge of the effects of climate change. As a result, I pursued this line of inquiry for this paper.

In accordance with one of the goals of PRA, community members were empowered as researchers, consultants and educators through their roles in the research process for the TNP. The fact that I was absent periodically from the study communities facilitated empowerment because it forced community members to direct the project.

Another way that people were empowered was through the process of receiving credit for their contributions of knowledge. Credit came in the form of attention from media and other community members, publications and financial compensation. One example of this was when Moses Koihok proudly delivered his interview tapes to the school in *Iqaluktuuttiaq* and instructed the teachers to incorporate them into the curriculum. The teachers were excited with this contribution and honoured him at a school ceremony (Koihok pers. comm. 1999).

Another important example of empowerment was that Sandra Eyegetok received media attention in the region for her role in the TNP. This came from her writing several

articles, presenting at an international conference, and being interviewed for newspaper articles, television documentaries, and radio shows. For the first time in her life, she delivered several public speeches in front of Inuit and non-Inuit crowds of over 300 people. People in her community congratulated her after TNP milestones had been publicized. These positive experiences built tremendous confidence and pride (Eyegetok pers. comm. 2000).

3.2.4 Experiential data

As a researcher, my scientific training contributed to my experiential data and influenced my research process in that I brought certain scientific framework to my research that enabled me to ask probing scientific questions (Maxwell 1996). Of course, I do not know every scientific theory about climate, caribou and vegetation, but I hold a general understanding of climate change, plant physiology, and caribou biology, population dynamics, and migrations and movements. It is likely that this knowledge was significant in guiding the data collection and analyses.

Without my scientific training, pertinent material could have slipped by unnoticed. For example, I may not have realized that inflamed joints in caribou legs were due to brucellosis. Instead, I might have thought this was a common disease. I would not have understood that willows prefer moist growing conditions and therefore missed the link between caribou habitat preferences and willow foraging. My scientific training was a starting point and continues to be an ongoing framework as part of my experiential data while conducting qualitative research. My experiential data also includes my training, heritage and experiences inform how my research is documented, presented and analyzed throughout this paper

3.3 Reflections on Researcher Perspectives and Experiences

I see through the eyes of a white, middle-class, educated, and non-religious woman from southern Canada. In conducting my analysis, I realize that “as in any anthropological encounter, [I am] keenly aware that boundary battles about what to include and what to

exclude are often arbitrary, rarely neutral, and always powerful" (Nader 1996, 4). I hope to make these as transparent as possible in providing the reader with information about my background in this chapter as well being explicit about my methods in the next chapter.

I am an environmental scientist trained in the physical and biological sciences. For most of my life I have resided in Vancouver, but for the last six years I have also resided in Yellowknife, *Umingmaktuuq*, and *Iqaluktuuttiaq*. For the last five years I have documented Inuit ecological knowledge of caribou for the TNP. In contrast, during my first years in the North I worked as a scientist for the federal government, environmental consulting companies, and mining corporations. These jobs required me to travel throughout the Kitikmeot region conducting water quality and quantity studies, wildlife research, and environmental assessments.

My interest in the social sciences, and ultimately this research, was sparked when I was working for the Ekati diamond mine located 400 kilometres Northeast of Yellowknife. This was the first time I was exposed to IEK and it caused me to be more aware of the limitations of western scientific paradigm.

3.3.1 Researcher as Scientist: My Introduction to IEK

At Ekati I was informed that I had to meet with an Inuit elder, Jack Kaodluak, and his grandson, Colin Kaodluak, from *Qurluqtuq* (Coppermine) so that we could incorporate their observations into baseline wildlife data. At the time, I resented the inconvenience and disruption to my schedule. I was dubious of the elder's ability to recount his experiences not only because he had not travelled to the region for over 30 years, but also because at that time, he had come by skidoo and dogteam rather than by helicopter. Viewing the land from the air is an entirely different perspective than from the land and I wondered if he would be able to adjust since he had never been in a helicopter before.

Within the first few hours of Jack and Colin wandering around the claims block, I was proven wrong. Jack helped us to locate important denning habitats and landmarks near

traditional camp locations, caribou crossings or other important sites. I had been working for the mine for 3 months, out in the helicopter every day, yet still I could not easily decipher specific lakes, boulder fields and eskers. I had trouble adjusting my southern lenses to see more than just an endless expanse of nondescript tundra. After spending time with Jack I realized that for me to shift my observation skills from rugged mountains to intricate tundra was a far bigger challenge than for him to change from a terrestrial to aerial viewpoint.

This pivotal experience inspired me to open my mind to conducting research in ways other than those that I had been taught. The more I worked with Inuit community members, the more intrigued I became by both the differences and similarities between our methods of acquiring knowledge and knowledge itself. In particular, I wondered what Inuit could contribute to our understanding of climate given their intimate relationship with the environment. Soon after, I began working for the TNP with the goal to document IEK of caribou for the Bathurst herd.

Research for this paper has been greatly enhanced my northern experiences working as the principal researcher for the TNP and as an environmental scientist for numerous Arctic organizations because I have a more balanced appreciation for both disciplines. Although I have spent years in the North, I am still a “southerner”. An unwritten rule in the North is that you must live there many years to earn the status of a “northerner”. I still do not know how many years this constitutes, but even given my experience living in the North, I remain a southerner albeit one with a healthy appreciation of northern living.

3.3.2 Southerner as Researcher

Many Inuit call southern researchers *hik hiks*--or groundsquirrels--because we only poke our heads North in the summer (Kofinas 1998). In the words of an Inuk scientist who now lives in southern Canada, scientists are “those...my people love to hate, those who occasionally arrive in the Arctic only at a certain season” (Freeman 1994, 4). This short time frame for interaction between researchers and community members can compromise the quality of research and lead to feelings of uneasiness, disappointment and even mistrust in the community (Eyegetok pers. comm. 1999). Knowing this from

the outset, I committed to spending significant time in the North in all of the seasons; participating in community life and working closely with Inuit in an ethical and appropriate manner. This entailed months of contributing to daily community activities and learning the language of Inuinnaqtun in order to build the foundations of trusting relationships between community members and me.

Frequent visits to the communities were critical given that nurturing Northern relationships from a distance was at times impossible, particularly with community members who have little or no access to phones, or are unable to speak or read English. Even so, it is important to realize that establishing rich relationships is not always possible during the limited duration of one or two field seasons typical of a Master's degree. I believe it is difficult, if not impossible, for a southerner to conduct reliable IEK research without spending numerous extended periods living in Nunavut and becoming part of a community.

3.3.3 Researcher as Community Member

Throughout my research, I lived and worked in Nunavut for several periods so that I could gain an insider perspective and conduct participatory action research. On average, I have spent six months of each of the last five years in the study communities, particularly *Umingmaktuuq*. In this community of 25 people, I was given a place to live and expected to participate in the community life. My camping and land expedition duties included helping with hunting, picking berries, setting up tents, making tea, and cooking. In town, my tasks were assisting with teaching the six students of the local school, preparing meat, babysitting, cooking, cleaning, emptying honey buckets, fueling generators, and fetching water (ice). Getting involved with the community gave me insights into community dynamics and helped build trust between community members and me.

3.3.4 Coming of Age

Two pivotal experiences marked what I felt was the beginning of an acceptance that enabled me to begin conducting community research. During the first year I worked in

the Kitikmeot, I travelled by skidoo on an 18 hour journey overland from *Iqaluktuuttiaq* to *Umingmaktuuq*. Although I was travelling with experienced Inuit, we missed a critical landmark and became lost on a frigid February night. We set up camp to wait out the night. Ironically, when we awoke, we realized we had camped just 30 m from the landmark.

At the start of the journey, I declined a *puhitaq* (fur lined hood) and consequently froze part of my face. (Incidentally, this was my first lesson in the importance of listening to Northerners while travelling their land.) When we finally arrived in *Umingmaktuuq* and people saw one of my eyes swollen shut and my cheeks inflamed, I was greeted with sympathy and understanding as if my scars were testament to commitment rather than ignorance. From that point onwards, I experienced an entirely different level of acceptance. I was now expected to fend for myself in terms of getting my own gas, water and other daily needs while living in the community.

Completing an intensive three-week Inuinnaqtun course was the second experience that marked a new level of acceptance and trust. By taking the course, I was able to demonstrate my commitment to the communities and genuine interest in Inuit ways. The course helped me follow conversations or at least get the "gist" of what was being said while I lived in *Umingmaktuuq*. I sensed that people started to feel more comfortable talking with me, not only about research related topics, but also about personal issues.

My skidoo journey and taking the Inuinnaqtun course were fundamental "coming of age" experiences that enhanced my ability to communicate with Inuit and conduct participatory action research. I was afforded an insider view from which to conduct research that I would not otherwise be granted because I was able to spend significant time in the community and learn the traditions, culture and dialect. Ironically, my age and gender also worked to my advantage in this process (Eyegetok pers. comm. 1998).

To conclude, my experiential framework includes my worldview, background, education and other factors that influence my methods of analysis. Related to these were research challenges, the topic of the following section.

3.4 Research Challenges

My role in the community influenced how the research both evolved and proceeded. Challenges that I face in conducting qualitative research for the TNP relate to:

- cultural differences
- language barriers
- time spent in the field; and
- my age and gender.

As I will explain, it was not always better or possible to overcome these challenges.

3.4.1 Cultural Differences

There are many differences between western or *qaplunaaq* (white person) and Inuit culture that were difficult to identify and overcome. Ross (1992) presents a rich account of cultural differences between Cree, Ojibway and western culture, many of which hold true for Inuit culture as well. For example, he explains that Cree and Ojibway have different concepts of time and priorities than non-Cree and non-Ojibway. Compared to Inuit culture, I found that western culture operates on a more rigid time schedule and is less grounded in spirituality and animism. For example, Qitirmiut believe that if a caribou comes close to town that it is an old relative coming to visit (Kaniak 1998).

An example of a cultural difference that took me some time to realize was that community members hired to conduct the interviews had difficulties using the interview questionnaire as a discussion guide rather than as a list of questions that needed to be systematically asked. As a result, when the interviewee answered simply “yes” or “no” to a question, the interviewer did not probe for more elaboration. Several community members (Kadlun-Jones pers. comm. 1999; Eyegetok pers. comm. 1999; Stern pers. comm. 2000) explained to me that the difficulty stemmed from people being nervous and not wanting to take responsibility for straying from a system or ‘breaking the rules’.

As an interviewer, one cultural difference that I learned after meeting with a few elders was that extended periods of silence during a conversation are typical in Inuit culture.

When I patiently waited, the interviewee usually continued to develop a thought. Like learning the non-verbal ways to say “yes” and “no”, this important cultural difference took me some time to discover.

Other examples of cultural differences, such as non-verbal communication and the act of taking responsibility, were illustrated best through stories. During the first week that I lived in *Umingmaktuuq*, I was sewing with Alice Keyok, a young mother, and her *nuka* (younger sister), Doris, who was home for two weeks from her job at a local mine. We sat in a circle on the floor of my seaside cabin and talked about elders as we stitched. I was curious to know peoples’ names and family relations and so I asked the women about their parents. After awhile I looked at Alice and asked her if she thought that her father, Charlie, would be interested in being interviewed. In response to my question, Alice acknowledge me with expressive wide eyes. She didn’t answer me aloud so I wondered, “Is she scorning me for asking?” and “Did I not ask the question loudly enough?”

I returned to my sewing for a moment, then asked again, but this time I practically yelled my question. Once more, she looked at me with wide eyes. Again, her lack of response was frustrating me. This time, I began to take it personally. I thought, “How could she be so rude as to not answer me?” and “Why did she not say yes or no to me?”

Resigned, I gave up on my question and, as time passed and stitches were sewn, our silence became comfortable again. Soon my fingers tired and I put my sewing aside to melt some ice for tea. While tending the Coleman stove, I turned to ask Doris and Alice if they wanted some tea. In response, they both looked at me, but this time, Doris had wide eyes and Alice a scrunched nose. Suddenly it hit me: wide eyes means “yes”, scrunched nose means “no”! To test my realization, I asked if they wanted sugar. Yes and no they answered with their eyes and nose. “What about milk?” I asked. Again, their facial expressions told me their preferences. This was my first lesson in understanding non-verbal ways of communication in Inuit culture.

3.4.2 Language Barriers

As if non-verbal communication differences were not enough to challenge my research, verbal communication difficulties plagued me as well. It would have been much easier to conduct interviews and ask probing questions if I would have been able to speak Inuinnaqtun, or, alternatively, if there had been more translators in the region. Having to interview unilingual Inuinnaqtun speakers was my most significant, albeit unavoidable, obstacle. Elders and others taught me to speak some Inuinnaqtun while I lived in the Qitirmiut region, but it was not enough for conducting interviews.

My research partners were not always able to translate my questions in the way I had asked them. Sometimes this was because my questions were inappropriate or offensive. In other cases, finding the exact translation for an English word or phrase was impossible because it didn't exist. Since one of my guiding principles was to build capacity and because of the paucity of trained translators, often I worked with community members who were not perfectly fluent. Not surprisingly, fluent speakers are gainfully employed, overworked and unavailable. As a result, my research partners varied in their ability to speak and understand both English and Inuinnaqtun.

Ironically, my inability to speak Inuinnaqtun and my research partner's difficulties in translating sometimes led the dialogue towards a more appropriate direction. As one Inuk interviewing another, a community researcher knew how to phrase a question better than I. In some cases, particularly when I was new to the TNP, I asked poorly worded questions or too many all at once. When this occurred, my research partner was able to rephrase or alter a question so that it was more concise.

3.4.3 Life in the Field: How Long is too Long?

Throughout my research, determining the 'right' amount of time to spend in a community during one visit was a formidable task. At first I spent extended rather than shorter periods in communities, for example, in 1998 I spent my longest consecutive stay of six and a half months. This precluded me from stepping back to assess my research situation in two ways. Since living in a community became my reality, I had difficulties

reflecting upon my daily routine and keeping up with my field notes. It seemed tedious to record my daily chores of fetching ice to melt for drinking water or catching fish for dinner. In the same way, it would have been odd for me to document my daily routine while I lived in Vancouver. Once community living became my life, it was difficult to analyze it. I may have avoided this situation if I had spent shorter time periods and visited more frequently instead.

Although I didn't realize this at the time, I became over-stimulated and burned out when I spent long stints in one place. What length of time that 'too long' constituted, varied for me over the years and often depended on my personal state. In general, I found four feelings that defined "too long" for me: overwhelmed with research material, detached from community members, lonely for southern family and friends, and unable to decipher important versus superfluous research material. Perhaps there comes a time when the boundaries get overly blurred, the primary research objective is lost and one becomes too much of a participant!

In accordance with a key tenet of PAR, I found that spending long periods in a community was, at once, both a burden and benefit to the research process. For example, when I felt at ease I was able to ask certain questions and partake in special expeditions or events. This advantageously steered the direction of the research process in that I gained access to happenings such as a hunting expedition, cutting meat or preparing caribou stew that I might not have otherwise. On the other hand, I may have steered the process away from a more natural path and therefore burdened the research. For example, people may have acted differently, for example while butchering a caribou or identifying popular caribou forage in order to please me. Since participatory action research necessarily entails that a researcher spend meaningful time living or working in communities, it is important to reflect upon exactly how this level of involvement both positively and negatively influences the research process.

3.4.4 Young and Female

Being female and in my twenties exposed me to different field experiences than if I were a male or in my fifties, for example. It is impossible to say *exactly* how my research

experiences would have differed, but my sense is that I would have been able to identify and connect with male hunters better if I were a man. This might have enhanced the breadth, depth and quality of my observations.

At first I thought my gender and age might hinder my research since hunting is usually "a man's job". I'd been told stories such as the *qaplunaaq* woman who was discouraged from seal hunting with some Inuit men although her husband was invited. She was told she couldn't come because there was "nowhere for her to pee on the sea ice" (Thoms pers. comm. 1995). To my surprise, once I had spent extended periods of time in the communities and developed relationships, I found that hunting was a joint passion between men and women and, with time, one that I too was able to share.

In *Umingmaktuuq*, because most of the elders are widows who hunt for themselves, I was able to join them on several expeditions. These women, backs bent from years of gruelling work, easily hop onto their skidoos and race across the ice with rifles slung across their backs and determined looks frozen upon their faces. Once I had demonstrated my eagerness to learn, and my commitment to the community, I was invited to join the hunts. Contrary to what I had expected, I connected with these hunters primarily *because* of my gender. Further, I participated in "women's work": butchering and preparing the meat after the hunt. This gave me first-hand experience handling caribou and learning about meat condition from accomplished hunters. Discussions among women and myself, as we laboured over meat and skins, contributed a significant amount to my research materials.

My young age was another advantage because community members conversed at a basic level so that I would clearly understand what they were explaining. Upon arriving into communities, I was often treated as a child because my level of local knowledge was on par with (and in most cases, below) that of a child. This meant that people took extra time to explain ideas and concepts. If I had been older, I think I would have been more threatening and less easily categorized as "naïve". Not only for my safety living in a harsh climate, but also for my education, it was important for me to admit ignorance, reveal vulnerability, and ask "stupid" questions. It was easier for elders to talk about caribou, climate, vegetation or Inuit ways of living at an elementary level because I was

an eager young *qaplunaaq* who didn't know any better.[7] The more I learned, the more they elaborated.

[7] In fact, when my Inuit research partner wanted to ask a question to which she ought to have known the answer, she would tell the elders that I was actually asking the question so that she would not be chided. In addition, my ignorance would more easily be forgiven.

4.0 METHODS: AN ADAPTIVE APPROACH

Research for this paper on IEK of climate change impacts evolved from the TNP when I noticed that many interviewees spoke about *Hila*, in particular, the relationship between climate, vegetation and caribou[8]. This is a result of the fact that the TNP and my thesis are examples of qualitative research based on adaptive approaches. In this way, the research designs were inductive, pliable, and responsive to input from community members. These research design qualities are critical in community research because "any significant pre-structuring of the methods [could have led] to a lack of flexibility to respond to emergent insights and [created] methodological blinders in making sense of the data" (Maxwell 1996, 63). The advantage of using an adaptive approach was that it allowed me the flexibility to focus on particular phenomena, in this case, the effects of climatic changes on caribou.

[8] The importance of climate change became obvious after I reviewed transcripts from the TNP. One reason that people spoke about climate when talking about caribou was because it is not typical of Inuit culture to speak of just one ecological variable without linking this variable to biological, social, cultural and ecological phenomena. In fact, only sixty percent of the IEK documented for the TNP relates to caribou. Other than caribou, other topics of discussion were: fish and wildlife (e.g. grizzlies, ground squirrels, wolves, wolverines), traditional values; sewing techniques; gender relationships; views on death, tragedy and loss; Inuit culture; transitions from traditional to contemporary ways of living; starvation; *qaplunaaq* (white person) and Inuit conflicts; and women's issues (e.g. pregnancy, abuse). Inuit provided important insights on each of these issues although they do not specifically relate to caribou or *Hila*. This points to the problem of vivisectioning IEK into western compartments: information is either lost or removed from a context. I will not attempt to do justice to this important issue in the confines of this paper. For more discussion, see Berkes (1999) and Stevenson (1998) for example.

Several sources of evidence informed this research. These include:

- A representative subset (n=27) of a set (n=34) of semi-structured and semi-directed interviews conducted for the TNP between 1997 and 2000.
- Unstructured interviews and personal communication (email, telephone, and written correspondence) with key informants from Inuit and Nunavut agencies (n=5).
- My personal memos, journal entries and research notes from frequent and extended periods of qualitative research conducted from September 1996 to December 1999 as part of the Tuktu and Nogak Project.

I elaborate on each of these sources in the following three sections.

4.1 Deriving a Data Set: Semi-Structured Interviews about Climate

As a result of using an adaptive approach, I assessed 27 of 34 interview transcripts from the Tuktu and Nogak Project that were relevant to climate. In order to select which transcripts to assess, I engaged AskSam, a data management program, to systematically categorize sections within each interview transcript (n=34) according to keywords (n≈200) that I assembled (Appendix A). For this paper, I programmed AskSam to sort through the transcripts according to six keywords:

- climate change
- warming trends
- cooling trends
- environmental effects
- vegetation; and
- caribou.

After I coded the transcripts, the necessary condition to include a transcript in this research was that a discrete section within a transcript contains any combination of at least two of these six keywords. For example, “caribou” and “cooling trends” or “vegetation” and “climate change”. Accordingly, 27 transcripts met this criterion, as illustrated in Figure 4.

The interviewees from these 27 transcripts are generally representative of the age and

gender of the 34 interviewees. As shown in Table 1, the subset of interviewees are from all four study communities and range in birth years from 1911 to 1956 with an average of 1934 (or 66 years old). Table 2 shows the full list of interviewees (n=34).

Table 1:

Interviewee transcripts considered for IEK of climate change impacts

Interviewee	Community	Born	Age*	Male	Female
Akana, John	*Umingmaktuuq*	1934	66	M	
Akoluk, Martha	*Qingauk*	1957	43		F
Algona, Bobby	*Qurluqtuq*	1956	44	M	
Algona, May	*Qurluqtuq*	1934	66		F
Alonak, Jack	*Qurluqtuq*	1925	75	M	
Analok, Frank	*Iqaluktuuttiaq*	1917	83	M	
Angulalik, Bessie	*Iqaluktuuttiaq*	1936	64 (D)		F
Angulalik, Mabel	*Iqaluktuuttiaq*	1925	75		F
Hagialok, Jessie	*Qingauk*	1927	73		F
Hakongak, Naikak	*Iqaluktuuttiaq*	1963	37	M	
Hikok, Nellie	*Qurluqtuq*	1911	89		F
Kailik, Buster	*Qurluqtuq*	1919	81	M	
Kamoayok, Lena	*Umingmaktuuq*	1939	61		F
Kaniak, Mary	*Umingmaktuuq*	1932	68		F
Kaosoni, Annie	*Iqaluktuuttiaq*	1918	80 (D)		F
Kaosoni, Mackie	*Iqaluktuuttiaq*	1918	80	M	
Keyok, Charlie	*Umingmaktuuq*	1938	60	M	
Koihok, Moses	*Iqaluktuuttiaq*	1921	77	M	
Komak, Archie	*Iqaluktuuttiaq*	1946	77	M	
Kuptana, George	*Umingmaktuuq*	1916	82 (D)	M	
Nalvana, Connie	*Qurluqtuq*	1921	78		F
Omilgoitok, Bessie	*Iqaluktuuttiaq*	1939	59		F
Omilgoitok, Paul	*Iqaluktuuttiaq*	1939	59	M	
Panegyuk, Ella	*Umingmaktuuq*	1929	69		F
Anonymous A	*Qingauk*	1970s	20s		F
Anonymous B	*Qingauk*	1970s	20s	M	
Anonymous C	*Qingauk*	1960s	30s	M	
TOTAL				14	13

**Age at time of interview*

Table 2:

List of interviewees for the Tuktu and Nogak Project.

Interviewee	Community	Born	Age*	Male	Female
Akana, John	*Umingmaktuuq*	1934	66	M	
Akoluk, Martha	*Qingauk*	1957	43		F
Algona, Bobby	*Qurluqtuq*	1956	44	M	
Algona, May	*Qurluqtuq*	1934	66		F
Alonak, Jack	*Qurluqtuq*	1925	75	M	
Analok, Frank	*Iqaluktuuttiaq*	1917	82	M	
Angulalik, Bessie	*Iqaluktuuttiaq*	1936	64 (D)		F
Angulalik, Mabel	*Iqaluktuuttiaq*	1925	75		F
Hagialok, Jessie	*Qingauk*	1927	73		F
Hakongak, Naikak	*Iqaluktuuttiaq*	1963	37	M	
Hikok, Nellie	*Qurluqtuq*	1911	89		F
Kailik, Buster	*Qurluqtuq*	1919	81	M	
Kamoayok, Lena	*Umingmaktuuq*	1939	61		F
Kaniak, David	*Iqaluktuuttiaq*	1943	55	M	
Kaniak, Mary	*Umingmaktuuq*	1932	68		F
Kaosoni, Annie	*Iqaluktuuttiaq*	1918	82 (D)		F
Kaosoni, Mackie	*Iqaluktuuttiaq*	1918	82	M	
Kavanna, George	*Iqaluktuuttiaq*	1957	43	M	
Keyok, Charlie	*Umingmaktuuq*	1938	62	M	
Kingnektak, Alice	Haniraqhiq**	1940	58 (D)		F
Kingnektak, Doris	Haniraqhiq	1967	33		F
Koihok, Moses	*Iqaluktuuttiaq*	1921	77	M	
Komak, Annie	*Iqaluktuuttiaq*	1946	52		F
Komak, Archie	*Iqaluktuuttiaq*	1921	79	M	
Kuptana, George	*Umingmaktuuq*	1916	82 (D)	M	
Kuptana, Noah	*Umingmaktuuq*	1943	57	M	
Maniyogina, Jimmy	*Iqaluktuuttiaq*	1927	73	M	
Nalvana, Connie	*Qurluqtuq*	1921	78		F
Omilgoitok, Bessie	*Iqaluktuuttiaq*	1939	61		F
Omilgoitok, Paul	*Iqaluktuuttiaq*	1939	61	M	
Panegyuk, Ella	*Umingmaktuuq*	1929	69		F
Anonymous A	*Qingauk*	1970s	20s		F
Anonymous B	*Qingauk*	1970s	20s	M	
Anonymous C	*Qingauk*	1960s	30s	M	
TOTAL				18	16

**Age at time of interview. **Hanirarhiq is an outpost camp of Umingmaktuuq and therefore considered as part of this community. Note that the average age of the interviewee at the time of the interview was 64 years old. Note that there is nearly a 1:1 ratio for male:female interviewees.*

This subset of 27 interviewees provided ample data for consideration and generally represented a cross section of the communities in terms of age and gender, family groups and traditional hunting areas.

Table 3 illustrates how both the full set and subset of interviewees is representative of the four study community populations.

Table 3:

Total number of interviewees per community comparing the TNP and 699 research.

Community	Total	M	F
Iqaluktuuttiaq	14 / 10	9 / 6	5 / 4
Umingmaktuuq	9 / 6	4 / 4	5 / 2
Qingauk	5 / 5	2 / 2	3 / 3
Qurluqtuq	6 / 6	3 / 3	3 / 3
TOTAL	34 / 27	18 / 14	16 / 13

Note that the first number is for the full set of interviews (n=34) and the second number is for the subset (n=27).

4.2 Personal Communication

Over the last five years, I have built many working relationships that have developed into close friendships with community members. Consequently, I have maintained an informal dialogue with several Inuit who work for wildlife or other related agencies and these people became key confidants who guided me both personally and professionally throughout the research process. Our relationships form the second of three evidence sources for my research.

When appropriate, I kept a record of key discussions with informants in a daily journal. These notes helped in understanding an Inuit perspective of climate change effects from decision-makers and chart the differences in what people communicated over the course of several years. For the purposes of this research, I draw from discussions with the five people as listed in Table 4.

Participating in community life gave me the opportunity to inquire about climate in general everyday discussions which contributed to my general understanding of climate change as a critical component of my experiential data (detailed in Section 3.2.4).

Table 4:

Agency confidants for informal interviews

Individual	Position	Employer	Community
Sandra Eyegetok	Senior Researcher	Tuktu and Nogak Project	*Iqaluktuuttiaq*
Naikak Hakongak	Wildlife Officer	Government of Nunavut	*Iqaluktuuttiaq*
Margo Kadlun-Jones	Senior Researcher	Tuktu and Nogak Project	*Iqaluktuuttiaq*
Eileen Kakolak	Research Assistant	Tuktu and Nogak Project	*Umingmaktuuq*
Allen Maghagak	Executive Assistant	Nunavut Tunngavik Inc.	*Iqaluktuuttiaq*

4.3 Journal Entries

Following the system provided by Bernard (1995), I kept jottings and a research journal when I lived and worked in the Kitikmeot for the TNP. I noted details from informal interviews or happenings that were not recorded during interviews. In addition, my personal observations and reflections helped me to refine my methods throughout the research process. I charted changes in my relations with community members, for example, the moments when I felt trust had entered into a relationship, as discussed in Section 3.3.4. These notes were also useful in helping me to remember my first impressions as an outsider. Together, these informed my experiential data (see Section 3.2.4) and they are my basis of understanding from which to compile, assess and analyze transcriptions and other data representative of IEK of the effects of climate change.

5.0 QITIRMIUT OBSERVATIONS OF CLIMATE CHANGE

In this chapter, I present Qitirmiut observations of a warming climate and, in doing so, set the context for the next two chapters in which I present Qitirmiut reports of three direct effects of a warming climate, specifically, earlier spring-melt, later fall freeze-up and unpredictable weather (Figure 5). Further, I frame these three direct effects into causal relationships of warmer temperatures, and show how they have an indirect impact on caribou. In presenting this local knowledge, I suggest that IEK has utility in contributing new information and enhancing existing information and propose how this utility is grounded in the fact that IEK is the richness in information about the complexity and interconnectedness between ecological variables. Further, these examples illustrate the valuable nine properties of IEK that I first proposed in Chapter Two.

The signs of a warming climate are obvious to *Qitirmiut* as they observe and travel through their local environment. In this chapter, I present their accounts of warmer temperatures and discuss how they view this phenomenon as having both positive and negative elements. Next I outline a Qitirmiut explanation for this warming trend and illustrate how it may be an example of pattern thought first discussed in Section 2.0. Finally, I outline four factors that may have influenced interviewees when they talked about climate getting warmer.

5.1 Temperatures are Getting Warmer

Of the twenty seven transcripts I reviewed, eleven people spoke about temperatures increasing and one person spoke of temperatures decreasing. May Algona (1999) explained that:

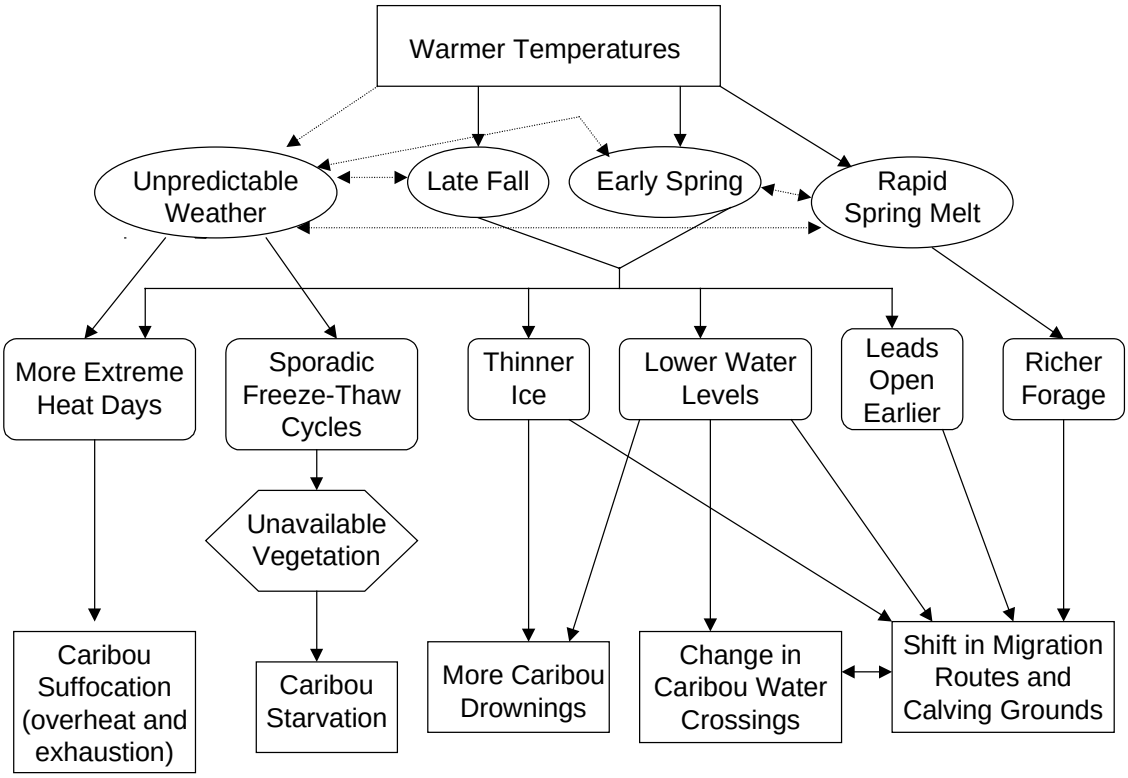
> it never gets as cold as it used to…it used to get real cold in the past but nowadays it's not the same.

Archie Komak (1998) suggested that:

> a long time ago, Cambridge Bay was usually cold. Nowadays … the weather gets too hot sometimes.

Figure 5:

Qitirmiut observations of causal relationships resulting from warmer temperatures



Note that this framework is a combination of relationships articulated by Qitirmiut as well as my interpretation of observed linkages. This figure is an oversimplification of the complexity and interconnectedness of these ecological variables, but it serves to illustrate some identifiable associations.

In addition to these interviewees, numerous other locals elaborated on their observations of recent climate changes during our informal discussions (Hakongak pers. comm. 1998, 1999, 2000; Omilgoitok, M. pers. comm. 1998).

Qitirmiut have noticed that temperatures during the 1990s were much warmer than in earlier decades (Algona, B. 1999; Hakongak pers. comm. 1998; Corey pers. comm. 1999; Kadlun-Jones 1999; Stern pers. comm. 2000). Bobby Algona (1999) explained that:

> it was so much warmer the last few years, in the 1990's and the late 80's.

An anonymous interviewee (1998) asserted that:

> It has been quite warm, though, [compared to] other winters…in the last 4-5 years I guess.

Some people (Angulalik 1998; Komak 1998) complain that these warm years have brought *too hot* (Komak 1998; Kailik 1999) temperatures that are *not so nice* (Angulalik 1998). Hot temperatures are one of the deleterious effects of Arctic warming. In the following section, I present *Qitirmiut* reflections on how warmer temperatures are both positive and negative in how they impact daily life.

5.1.1 Some Pros and Cons of Warm Weather to a Subsistence Way of Life

Qitirmiut both like and dislike the impacts of higher temperatures. Most advantages are linked to the fact that summer-like conditions last longer now. Archie Komak (1998) reported that since spring-melt happens sooner:

> nowadays, [the ice] goes earlier so waiting isn't so bad anymore.

For many *Qitirmiut,* waiting for the ice and snow to melt can be trying because people cannot leave the communities by skidoo or boat while the land is a mosaic of thin snow and bare patches and the sea ice is marked with dangerous cracks. In short, there is not enough snow and ice to travel safely by snow and ice while at the same time there is too much snow and ice to go boating.

An early spring-melt makes people excited to go travelling, hunting and camping out on the land. Locals found that, in the 1990s, the boating season and fishing opportunities

arrived earlier and lasted longer (Kakolak pers. comm. 1998). Birds were more plentiful and arrived North earlier than usual which made geese hunting and egg gathering more fruitful.

Along with these positive impacts, warm weather during the summer can also bring unfavourable conditions for subsistence activities. Recently, there have been *hot hot* and *humid summers* which has made the land *drier* (Bobby Algona 1999) and brought more bugs, especially mosquitoes (Analok 1998; Kakolak pers. comm. 1998; Kamoayok pers. comm. 1998; Kaniak pers. comm. 1998; Panegyuk, E. pers. comm. 1998). Frank Analok (1998) explained that:

> There weren't many mosquitoes back then [in the 1970s]. They would only be around for a short time.

That said, Qitirmiut explained that the number of mosquitoes increases with temperature but only until a threshold at which point the mosquitoes cannot survive. This threshold was crossed during the 1998 summer when the mosquitoes were a nuisance for only one instead of two weeks which are normally observed by community members (Kamoayok pers. comm. 1998; Hakongak pers. comm. 1999).

Locals reported that another negative impact of warmer temperatures during the summer is that some days are simply *too hot* (Komak 1998; Kailik 1999). For *Qitirmiut* who are not acclimatized to such heat, these days can be difficult to bear. During the 1998 summer, a family from *Umingmaktuuq* travelled to Yellowknife for a medical reason and holidays. Instead, they returned earlier than planned because, in the high temperatures, they joked that they were *afraid [they] were going to melt* (Kakolak pers. comm. 1998; Panegyuk, E. pers. comm. 1998). They elaborated by saying that they just couldn't enjoy themselves because the temperatures were too high and the mosquitoes were too plentiful.

Warmer temperatures combined with the increase in mosquitoes are said to make traveling, hunting and camping out on the land a challenge to one's stamina. During the 1998 summer, I travelled with an extended family to an outpost camp several miles

outside of *Umingmaktuuq*. Our plan was to spend the weekend camping, fishing and hunting. Instead, the family decided that the mosquitoes and heat were so unbearable that we left after just one night. In this case, the temperatures were hot yet not above the threshold for mosquitoes.

Finally, new birds and animals are being seen for the first time that people can remember. Robins and an unidentified yellow songbird have flown as far North as Victoria Island which are not reported to be common by locals (Haniliak pers. comm. 1998; Analok 1999; Eyegetok pers. comm. 1999).

For the first time in living memory, grizzly bears were seen crossing from the mainland Northwards to Victoria Island in 1999 (Corey pers. comm. 1999; Omilgoitok, M. pers. comm. 1999). Community members from *Umingmaktuuq* and *Qingauk* said that during the spring of 2000 there was an unusually high number of grizzlies and grizzly tracks (Maghagak pers. comm. 2000). This is a concern for Qitirmiut because they said that the bears might start visiting areas where people have their outpost camps, for example, on the south coast of Victoria Island (Hakongak pers. comm. 1999).

During the spring of 2000, hunters reported seeing strange tracks around the Hope Bay area in Elu Inlet (Maghagak pers. comm. 2000). A few weeks later, pilots from a local airline company reported seeing three polar bears in the same area. Locals explained that there were an unusually high number of cracks in the sea ice early in the spring and this caused the seals to come up onto the ice earlier than usual. As a result, Qitirmiut speculated that the polar bears simply followed the cracks southwards looking for seals. This was the first time in living memory that Qitirmiut had seen polar bears this far south.

In general, Qitirmiut are happy to see new birds because they are a food source, but are concerned about bear movements because they may threaten people's safety. Others are concerned simply because changes in the weather, environment and wildlife populations seem to be happening too quickly for people and the environment to adapt (Kaosoni 1998; Hagialok 1998).

The environmental changes associated with a warming climate in the North are plentiful.

Those outlined above are examples of general changes considered to be either positive or negative. In the next chapter, I present impacts of a warming climate that are specific to vegetation and caribou that have been observed by *Qitirmiut*.

5.2 A Qitirmiut Explanation for Warmer Temperatures

Three of the twelve interviewees suggested that warmer temperatures are a result of the sun being closer to the earth and higher in the sky nowadays. As Frank Analok (1999) explained:

> There is a change in the distance of the sun...from years back. The sun seems to be higher than it was a long time ago…In the past, the sun was lower than it is now in July. It seems to shine higher than it used to.

Similarly, Charlie Keyok (1998) said that:

> it must be hotter than it used to be now…the sun seems to be closer now.

As a researcher, my conceptual framework was tested when I had to debate including into this paper, the hypothesis proposed by Analok (1998), Kailik (1998) and Keyok (1998) that temperatures are warmer because the sun and earth are closer. However, I think presenting their speculation is important in that it shows insight into the logic and reasoning components of Qitirmiut ecological knowledge. It is my interpretation, based on my understanding gained from living with Qitirmiut, that these individuals are referencing their own experience based on the notion that the closer you stand to the fire, the hotter you will be, to a grander phenomenon. Given this notion, it is logical to imagine that the closer the sun is to the earth, the hotter the earth will be. Regardless of whether these elders were well informed of global warming by media (which is unlikely, given language barriers) or whether they have observed a warming climate on their own, the fact remains that Qitirmiut have extrapolated a global phenomenon from their knowledge of a local causal relationship. The ability to move from a small to large scale and to impute causal relationships is characteristic of Qitirmiut way of thinking. Knowing this may enable people to understand better the logic and reasoning that underlie IEK.

5.3 Influences to Observations of a Warming Climate

That eleven interviewees reported warming temperatures strongly supports the conclusion that locals perceive climate to be warmer. However, four factors may have influenced *Qitirmiut* in their statements about climate change made during their interviews.

The first possible influence follows from the fact that families have moved from outpost camps into communities within the last fifty years and now enjoy the warmth of a permanent home rather than a snow house or *iglu*. Consequently, people might think that the weather is getting warmer when really it may be their change of lifestyle that causes their perception of temperature to change. People can escape the elements better today than in the past. Therefore, they might not remember the bitter cold as well as when they faced it out on the land.

A second factor, alluded to earlier, that may influence interviewees is that news of global warming has trickled into the North. However, most media are in English and therefore are not understood by the majority of the elders. This being said, it is possible that some knowledge of global warming was gained through word-of-mouth and this *a priori* knowledge could have contributed to their comments about a warming climate. During interviews, some people made reference that weather media effectively reaches and educates some people. For example, Bobby Algona (1999) said that:

> Five years ago now… *Qurluqtuq* was the hottest spot in all of the North America.

He could not have known this except by television, newspaper or word of mouth. Clearly, weather and climate news had reached some interviewees and could have influenced perceptions.

A third possible influence is that people have a better memory of more recent events. The interviewees would better recall climatic conditions in the 1990s than 1950s and likely be more specific about contemporary events.

The fact that people remember recent years best is relevant to this research in that most interviews were conducted during the record-breaking hot year of 1998 (Jeffers 2000). Consequently, people may have over-emphasized the presence of a warming trend. People were not expecting the heat to be intense enough to melt most of the snow and ice in just a few hot days in May. Caribou meat that was kept cool safely outdoors in a snow bank, suddenly went bad and was unfit to eat. Two teenagers who were skidooing in *Umingmaktuuq* nearly drowned while trying to travel over ice that had been safe just the day before. To summarize, the fact that the hottest year on record was fresh in the minds of interviews may have influenced people to conclude that temperatures are increasing.

It is impossible to know how, if at all, these four possible influences entered into the interviews. Regardless of the magnitude of how they may have had an impact on the interviews, the fact remains that eleven interviewees observed a warming trend and reported concomitant impacts on the local environment. The similarities in the interviewees' observations suggests that perceptions of a warming phenomenon are both recurrent and systematic.

5.4 Summary

In this chapter, I have presented Qitirmiut observations of a warming climate that demonstrate the utility of IEK. I have shown that IEK contains important information about the complexity and interconnectedness of ecological variables such as climate and caribou. I have also demonstrated that Inuit observe cause-effect relationships as part of their way of knowing. In this and the following two chapters, the utility of IEK is shown to be a function of the fact that IEK is changing, orally passed, intergenerational, complex, local, iterative, adaptive and spiritual.

6.0 THE EFFECTS OF A WARMING CLIMATE ON CARIBOU: EARLY SPRING-MELT AND LATE FREEZE-UP

Safe and fruitful hunting, fishing, and sealing require careful observations of snow and ice conditions during times of melting and freezing. Locals notice ice thickness, snow patchiness, melting rates and patterns, and changes both within and between the layers of snow and ice. These observations guide Qitirmiut to safe travel routes, for example, where the ice is thick enough to hold a skidoo or thin enough to allow for ice fishing. In the past, subsistence living provided a strong impetus to monitor carefully the timing and nature of melting and freezing conditions. Today Qitirmiut do not subsist entirely off the land, yet hunting, fishing and sealing remain significant pastimes. Consequently, the monitoring of ice and snow conditions during spring-melt and freeze-up remains important.

In this chapter, I present recent Qitirmiut observations of earlier spring-melt and later freeze-up during the 1990s and how these events influence caribou. In many ways, these two phenomena are interconnected and affect the environment in similar ways. However, I have derived several cause-effect relationships related to Qitirmiut observations with the understanding that these relationships are not perfectly linear, as illustrated Figure 5 and introduced in Chapter Five.

The first half of this chapter focuses on two cause-effect relationships concerning earlier spring-melt and caribou in the 1990s. The first relationship details the way that sea ice melts earlier to become open water and consequently precludes caribou from making traditional ice crossings on route to their calving grounds. The second relationship links warmer temperatures to more abundant and diverse vegetation and its affect on caribou migration routes.

The second half of the chapter presents Qitirmiut observations of later freeze-up in the 1990s than in other years and two resulting impacts. I discuss local perceptions of thinner ice and relate these to observations of caribou drownings and population levels

as examples of cause-effect relationships. Next, I present observations of lower water levels in rivers and the ocean and suggest how these might influence caribou during their migration.

6.1 Earlier Spring-Melt

Five of twenty-seven interviewees commented that the spring-melt occured sooner in the 1990s than in the past. Archie Komak (1998) observed that

> [t]he weather is warmer now...the snow seems to go earlier in the late spring *(upin'ngaaq*).

The sea ice is also melting earlier compared to a

> long time ago [when] the ice on the ocean used to go away late (Analok 1998).

The heat generated by buildings, traffic and human activity leads to even earlier snow melt in communities compared to out on the land. As communities get larger, so does the capacity of the community to generate heat. Mabel Angulalik (1998) commented on how people have an impact on snowmelt at a local scale.

> Here in town…the snow seems to melt earlier…because the traffic makes the snow melt…because when . . . people are gathered in one area, the snow seems to go quicker.

This is an example of local knowledge that can contribute to research on the impacts of earlier and more severe melting, for example, how decreased snow cover will affect caribou.

6.1.1 Shift in Migration Routes: Leads Open Earlier

Qitirmiut mentioned two reasons why caribou shift their migration routes as a result of warmer temperatures. On a large scale, warmer spring temperatures cause the ice to melt earlier, which creates patches of open water known as "leads". Locals reported that

leads influence caribou during their spring and fall migrations across sea ice. For example, if a lead is too wide to swim across, caribou will turn around and go back to shore or they will move parallel to the lead until they find an area where the ice is thick enough to continue on their route. Sometimes caribou swim across leads if the open water stretches from the ice edge to the shore. Otherwise, Qitirmiut said that caribou rarely swim across leads because it is difficult for them to get out of the water and on to the ice. When leads are particularly wide, caribou are forced to shift their migration routes.

One interviewee commented that leads along a traditional caribou-crossing route have been opening earlier in the last few years near the community of *Qingauk* (Anonymous B 1998). According to locals, a traditional caribou-crossing route is an area where caribou have been observed by generations of Qitirmiut either swimming or walking across the ice year after year. As a result of leads opening earlier, some caribou have not been able to migrate from the west to east and across the sea ice at the southern region of Bathurst Inlet (Anonymous B 1998, Anonymous C 1998; Hakongak pers. comm. 1999). This was the case during 1997 and 1998 when caribou remained on the west side of the Inlet to calve rather than crossing over to the east side. Locals stated that the reason had to do with the animals' inability to access the southern region because they could not cross to the east side:

> [The caribou] mainly come through there [across from Elliot Point in southern Bathurst Inlet] when they are calving on the east side. For some caribou, it is still the same...The caribou…come around through from Portage Bay off Kuadjuk Island…they come south then go around again. They cannot hit that open water down there...That open water has always been the same…[but] it opens earlier and way bigger [nowadays]. (Anonymous C 1998)

Qitirmiut make careful note of which leads open first and how these leads shift throughout the melting period from one year to the next. For example, certain places in Elu Inlet and Bathurst Inlet are known to be extremely dangerous during the spring and fall because of ocean currents that make the ice thickness unpredictable. Community members repeatedly warned me of these areas each time that I made a skidoo journey

between *Umingmaktuuq*, *Iqaluktuuttiaq* and *Qingauk*. This local knowledge is valuable to travelers' safety and may be of value to scientists who are assessing how caribou are influenced while making sea ice crossings. For example, researchers are currently looking at how traditional caribou-crossings on sea ice may be affected by ice breakers and the length of the season, or shipping window, during which these large ships would operate if a port facility were constructed in the southern region of Bathurst Inlet.

6.1.2 Migration towards Rich and Abundant Vegetation

In this section of the paper, I further explore locals' observations and understanding of caribou shifting their migration routes because of warmer temperatures. In addition to leads opening earlier, another possible reason for these shifts may be the availability of richer vegetation for forage and more lush vegetation for shade.

6.1.2.1 Richer Vegetation provides Forage

Qitirmiut noticed that vegetation was more lush, plentiful and diverse in the 1990s compared with earlier decades. Five locals reported that vegetation is larger and there are more individual plants of the same species, particularly shrubs, in certain traditional camping areas such as the Hiuqqittaaq River near Bathurst Inlet (Omilgoitok P., pers. comm. 1998; Omilgoitok B., pers. comm. 1998; Kamoayok pers. comm.1998; Kaniak pers. comm 1998; Koihok 1998). The number of different types of vegetation has also increased, especially at higher latitudes such as on Victoria Island (Omilgoitok, B. pers. comm. 1999; Omilgoitok, P pers. comm. 1999). According to Moses Koihok (1998), nowadays there are some types of lichens and flowering plants on Victoria Island that he has never seen before.

On a small scale, caribou are attracted to areas where the vegetation is rich, moist and green. Frank Analok (1998) explained the caribou eat:

> All sorts of vegetation, whatever is sprouting on the land…whatever is sprouting on the shores of lakes [and] river sides.

Locals reported that forage quality is a strong force drawing caribou to a specific

location, particularly for calving. George Kuptana (1997) suggested that:

> They like it there. It might be much safer for them to have their young ones there and more food there for them. Older caribou must be used to it.

Areas that first become snow-free support abundant vegetation that is attractive to cows seeking forage rich in nutrients. When asked whether there was anything special or distinct about the vegetation at calving grounds, Naikak Hakongak (1998) speculated:

> Must be, maybe it's probably a little more richer. Maybe it comes out, maybe it's exposed earlier in the spring so that it has time to grow…they find a spot where the snow goes the soonest, the vegetation grows quicker maybe.

Later in the same interview he elaborated that:

> The vegetation would have to be better too. I think the food would have to be a bit richer because the calves need to grow quickly because they start walking soon after they are born but they need to eat all the nutrients as fast as they can before the fall or winter set in. It's going to be a long winter so what they eat probably has to be a little bit richer than what they normally eat.

Locals have observed that tundra that first becomes snow-free has more exposure to the sun. As a result, vegetation is typically rich with fresh green shoots and new bark, both of which are preferred by caribou (Alonak pers. comm.1998; Akana pers. comm.1998; Kaniak pers. comm.1998; Kamoayok pers. comm.1998). According to Bessie Omilgoitok (1998),

> when plants sprout on the land [caribou] eat it.

Caribou are drawn to these rich areas, as explained by Naikak Hakongak (1998):

> Maybe they know the migration pattern from the year before [or] maybe they know there's not going to be as much food as before so they move over a couple of miles so that they're sort of like lawnmowers. When you think about it, you know they go along at a certain length of an area on

the way up [North] and the next year they'll move over a little bit…

As the above section demonstrates, locals observed that forage quality influences caribou in selecting their migration routes and calving locations.

6.1.2.2 Tall and Lush Vegetation provides Shade

Based on Qitirmiut observations, it appears that earlier spring-melt combined with warmer temperatures promotes plant growth near water bodies which draws caribou to forage in these areas during migration and calving. Nine interviewees who discussed vegetation mentioned the significance of moisture and water bodies to caribou. Three of these interviewees spoke of the importance of the shady areas typically found near water bodies. At the same time, Qitirmiut have observed increasingly tall and lush vegetation growing near water bodies in the 1990s. I suggest that it follows that caribou may be attracted to these areas because they provide refuge from the sun.

One evening during an elder-youth camp held along the Hiuqqittaaq River in August of 1998, elders reminisced about their travels as younger children. The elders commented repeatedly that the plants near the shore of the river had grown more tall and lush than they remembered seeing in the 1930s and 1940s. When probed, some elders explained that willows and alders throughout the Bathurst Inlet region grow larger nowadays in terms of the height of the plant, girth of the stem, and number of branches than they recalled during years that they travelled with their parents and as young adults (Lena Kamoayok pers. comm. 1998; Mary Kaniak pers. comm. 1998; Omilgoitok, B. pers. comm. 1998; Omilgoitok, P. pers. comm. 1998).

Although no interviewee articulated the relationship between warmer temperatures and taller and more lush vegetation and that these conditions have ultimately provided caribou with an escape from the heat, it is possible to extrapolate this cause-effect relationship from the elders' independent observations. For example, Mabel Angulalik (1998) alluded to this relationship:

When it is hot outside the caribou would go on the shores of the ocean

> where it is cooler. They stay in the shaded areas as well.

Hunters know that caribou are often found in shaded places:

> When the weather is warm, the caribou would stay in shaded areas during the summer. People would look for caribou in the shades during warm days. It's easier for the hunters to get close to them.

When asked what caribou eat, Frank Analok (1998) responded that caribou like to forage along moist shorelines:

> They probably eat all sorts of vegetation. Whatever is sprouting on the land. They are constantly on the move and would often stop to eat as they are travelling…on lake shores, whatever is sprouting. Moist vegetation. Grass. Whatever is sprouting on the shores of lakes, river sides. Wherever there's moisture.

Confirming the importance of shorelines and shaded areas as key caribou habitat, Martha Akoluk (1998) elaborated:

> Caribou eat in the shade…by the lakes. By the lakeshores, as well as shaded areas wherever they can find what they like to eat. Moss and grass are their food.

While it is clear that caribou are drawn to moist areas near water sources, it may also be true that shade provided by large and lush vegetation also attracts caribou seeking relief from the sun. During the spring and summer, these shady areas become increasingly more important as temperatures rise.

6.1.2.3 Caribou as both Selective and General Foragers: A Question of Scale

On a local and temporal scale, Qitirmiut can contribute useful insights related to the question of whether caribou are selective foragers that prefer a certain plant type, or whether caribou are more general foragers that eat whatever vegetation they can find along their migration routes. Locals reported that caribou prefer certain types of plants, for example, willows, dwarf birch, cotton-grass and the tops of mushrooms (Akana 1998;

Alonak 1998; Kamoyaok 1998; Kaniak 1998; Omilgoitok B. 1998; Omilgoitok P. 1998). At the same time, two interviewees likened caribou to lawnmowers, selective grazers eating up the land in strips as they migrate. Given these observations, I would suggest that warmer temperatures, earlier spring-melt, and later freeze-up, as reported by locals, together alter the vegetation upon which caribou forage and this influences caribou foraging behaviour. For example, it may be that during the early spring, when the ground is still partially covered with snow, caribou are more general in their grazing approach and eat whatever vegetation is available in the snow-free areas. Locals reported that caribou have difficulty walking through slushy snow and they prefer to walk in snow-free tracts during their spring migration. As the season progresses, the snow melts and the tundra plants grow. Given these observations, I would suggest that warmer temperatures, earlier spring-melt, and later freeze-up, as reported by locals, together alter the vegetation upon which caribou forage and this influences caribou foraging behaviour. According to Qitirmiut, the answer to the question of whether caribou are selective or general grazers, is not simple: caribou exhibit both selective and general foraging behaviour depending on the time of the season. Since Qitirmiut have the opportunity to observe caribou throughout the season, they can provide valuable insight into their foraging behaviour on both local and temporal scales.

6.2 Later Freeze-Up

Qitirmiut have observed that spring-melt occurs earlier than in other decades and freeze-up happens later nowadays as a result of warmer temperatures. Thinner ice and lower water levels are two impacts that may be related to later freeze-up.

Five interviewees reported observing a later fall freeze-up in the 1990s. Frank Analok (1998) explained that the sea ice freezes later today than in the past in *Iqaluktuuttiaq*:

> Nowadays freeze-up occurs in November. Sometimes there would be no ice at all and other times it would go again after freezing up. It has changed. In the past, the ocean would be completely frozen over in November.

Before temperatures started to warm, it was common to have freeze-up begin in the late summer: late August or September. In the late 1990s, it started in October or November (Hakongak pers. comm. 2000). According to Archie Komak (1998),

> sometimes in the late summer years ago it would freeze-up. Now it seems to freeze-up late and other times it would freeze-up earlier. Sometimes it would freeze-up late. That's how it is…This happened for many years. A long time ago the ice on the ocean used to go away late. Nowadays it goes earlier so waiting isn't so bad anymore.

In this passage, Archie speaks to the variable nature of the timing of freeze-up. At the same time, as the earlier quotes illustrate, Qitirmiut have noted a recent pattern of a later freeze-up and earlier break-up within this variability.

6.2.1 Thinner Ice

With warmer temperatures, longer summer-like conditions and shorter winters, the ice does not have as much time to become as thick as in the past. Buster Kailik (1998) of *Qurluqtuq* explained how a later freeze-up affects ice conditions:

> nowadays it freezes up later than usual. It does not get thick as it used to.

A reason to explain this later freeze-up and the concomitant thinner ice was proposed by Connie Nalvana (1998):

> it does not get as cold as it used to. A long time ago it would be bitter cold and the ice would be thicker…the water gets warm now and takes longer to freeze…the ice does not get as thick as it used to maybe because the water is warmer than it used to be.

To illustrate the point that ice is getting thinner, Connie Nalvana (1998) relayed a personal experience through a story:

> …[my] brother was sealing one day and said "Sis, come and see this. The ice is thinning. It's not even spring yet and it is thin,"…the ice does not get as thick as it used to...some of the younger people have

mentioned that as well.

Thinner ice has implications for caribou that require a certain ice thickness for travel across lakes and oceans. During the fall, the ice must be thick enough for caribou to cross during their migration southwards towards their wintering grounds. In the spring, the ice must similarly be thick enough in order for caribou to cross during the migrations Northwards towards their calving grounds. If the ice is thin or if there is open water in leads, caribou will alter their migration routes by walking alongside the water body for several kilometres thereby wasting valuable energy. Alternatively, they will attempt to cross over the ice, fall through and drown.

6.2.2 Caribou Drownings

In the 1990s, several Qitirmiut observed an increase in the incidences of massive caribou drownings because of thinner ice. While travelling by snow mobile in 1996 from Umingmaktuuq to Qurluqtuq, two community members noticed hundreds of antlers frozen and sticking out of the ice like a forest where caribou fell through the ice and drowned (Kakolak pers. comm. 1998; Panegyuk, G. pers. comm. 1998). This can happen either in the spring or fall when the temperatures are not cold enough to form a secure ice surface that caribou can cross.

6.2.3 Lower Water Levels

Qitirmiut have noticed a change in the water levels of lakes, rivers, and the ocean around Bathurst Inlet which have consequence for caribou. All five interviewees who spoke of changing water levels said that water levels were decreasing. John Akana (1998) provided a vivid description:

> The water level seems to be getting lower…In the past, the water levels were higher. Some of the rivers have gone…During the summer, in August, people travelling by boat have noticed that the water level has dropped compared to the past. People liked the water levels of the rivers and ocean then. The islands on the ocean seem to be getting bigger than they used to be. Kanuyauyaq, an elder, used to say the rocks barely showed back then. Now the island seems longer, higher and bigger.

This is comparable to what May Algona (1999) of *Qurluqtuq* noticed:

> The water level seems to have gone down in the lakes and the rivers do not flow as strong as they used to. The lakes seem to dry out too…I wonder why that is happening.

Annie Kaosoni (1998) of *Iqaluktuuttiaq* agreed:

> The water level seems to have dropped. It seems like there is less water. The lakes seem to be smaller and dry out.

In all four study communities, elders noticed the same phenomenon of decreasing water levels in lakes, rivers and the ocean. Nobody specified why this is occurring, but based on other observations made by Qitirmiut, I would speculate that water levels are likely dropping for a combination of reasons related to warmer temperatures: earlier break-up, later freeze-up, increased evaporation, and decreased snow-pack.

There are two ways that decreasing in water levels may influence caribou, according to locals. With less water in rivers, caribou do not have to swim as far as they used to from one side of the river to the other. Qitirmiut identify crossings by hoof prints leading into and out of the water, and by the presence of caribou fur washed up onto the shore:

> That's what they're called: crossings. Sometime during the spring, there would be a lot of caribou hair at a crossing (Bessie Angulalik 1998).

On a local and small scale, I suggest that not having as far to swim at crossings might benefit caribou because it conserves their energy.

The second way that dropping water levels can influence caribou relates to the importance of shorelines as key habitat as observed by Qitirmiut. Charlie Keyok (1998) suggested that:

> [caribou eat] along the shores of lakes and the ocean…close to water, where there's moisture…they'd eat along the shore…by the lakes on the land. Things must be different now because the water level is dropping on the ocean.

> There would be trails by the lakes, and along the mouth of the river. The trails look like they've been drawn in when you're flying over the lakes. (Koihok 1998)

It is probable that changes to shorelines caused by lower water levels affect caribou, but it is unclear how. Several interviewees commented on the importance of shoreline habitat for caribou because it provides grazing potential as well as a cool and shady refuge from both the sun and mosquitoes.

> In the summertime, in the evening, when it gets dark, they'd walk along the shore and graze. Caribou like to eat on the lakeshores where the grass is plenty. When it is hot outside the caribou would go on the shores of the ocean where it is cooler. (Angulalik 1998)

> The caribou . . . stay along shore in the summer in June and July…To stay away from the bugs and to keep cool [caribou] stay by the ocean and the islands. (Koihok 1998)

> The caribou usually go to the ocean along the coast. They can also be seen swimming in the lakes, staying away from mosquitoes. (Analok 1998)

> When it is hot outside the caribou would go on the shores of the ocean where it is cooler. They stay in the shaded areas as well. They'd lie on the patches of the remaining snow as well to keep cool. (Angulalik 1998)

One reason cited by Qitirmiut may have to do with the fact that shorelines are important habitat for caribou because they provide easy access to water which is an escape from predators.

> When it starts to get dark outside [caribou] would go to the lakes. . . Night time, caribou stay by lakeshores, which makes it easier for them to escape the wolves. (Kaosoni 1998)

These examples of local knowledge need further investigation and offer great potential for corroboration with remote sensing studies, as discussed in Chapter Eight.

6.3 Summary

Locals observed that the combination of earlier break-up in the spring and later freeze-up in the fall has led to a longer period of summer-like conditions. This may have some benefits to caribou, for example, in providing richer forage or more abundant vegetation that provides shade. However, most locals suggest that the effects of warming temperatures and the accompanying longer period of summer-like conditions are negative because they can lead to caribou fatalities. Ice is thinner and can cause caribou to drown during their instinctual drive northwards to their calving grounds and southwards to their wintering grounds. Alternatively, they may inefficiently expend energy by being forced to take less direct routes during their migrations. Lower water levels make river crossings shorter for caribou thereby conserving energy, but at the same time they influence shoreline habitat that is important to caribou for grazing and escaping the heat, insects and predators.

Qitirmiut have observed important cause-effect relationships contribute to our understanding of the indirect and direct effects of a warming climate on the environment and, in particular, on caribou.

7.0 UNPREDICTABLE WEATHER

With the onset of warmer temperatures, Qitirmiut have found weather forecasting more problematic. Based on my interviews, I have identified two possible cause-effect relationships articulate by locals that are associated with warming temperatures as illustrated in Figure 5. First, Qitirmiut have observed that there are more sporadic freeze-thaw cycles that lock vegetation in frozen sleet and make it unavailable as caribou forage. Locals also report that this can cause caribou to become malnourished or die. Second, days of extreme heat are perceived by locals to be more common in the 1990s. High temperatures make caribou overheated and exhausted. Local suggests that both of these relationships can result in decreased caribou population levels.

In this chapter, I discuss how Qitirmiut use their ecological knowledge to interpret and understand the effects of a changing climate on caribou and the predictability of weather patterns. In doing so, the nine properties of IEK discussed in Chapter Two are demonstrated.

7.1 Qitirmiut Seasons

In the spirit of their mystical world-view, Qitirmiut believe that intangible forces may guide the weather. This concept is a tenet of animism that underlies much of Inuit culture. It is owed partially to a legacy of loss and struggle that force people to not only respect social and environmental changes brought by climate but also to provide an explanation to such changes when the reasons for changes are not obvious.

A respect for weather combined with the need to monitor climatic conditions has led Qitirmiut to identify and group these similar weather patterns into five seasons:

- fall is *ukiakhaq*;
- winter is *ukiuq*;
- early spring is *upin'ngakhaq*;
- late spring is *upin'ngaaq*; and

- summer is *aujaq*.

Locals reported that before the days of calendars, months were identified by phases of the moon and grouped together according to environmental conditions such as weather events and wildlife activity. For example, winter includes the months that are bitterly cold (*iijji)* where as fall and early spring include the months that are just cold (*alappaa*).

Today, Qitirmiut continue to observe weather, wildlife and phases of the moon but now they link these to current calendar months. Frank Analok (1998) explained how people knew the seasons by detailing an annual cycle of weather changes; wildlife migrations, births, and deaths, and moon phases.

> They used the moon only, the moon. The moon, the moon was used to tell the seasons. Like it's June right now. They used the moon as a way to tell seasons long ago. It was a way to tell the seasons. When the moon would come during the spring thaw, when there's water, the caribou are calving and the birds are nesting. That's how it was. The month of June.

He continued to explain the transition of season into what is now referred to as July and August:

> The moon would go away again during the month of June. When it returns you know when the birds are moulting. You know they're moulting that time of the year which is during the month of July. The moon was the only way the Inuit knew the time of the year. That's the time of year the birds would moult, when the moon returned after the last…We didn't know it was July then. After it disappeared it would return then it would be August. That's when the caribou furs would get nice. People would mention they were good for clothing. The birds would be flying again. The young birds would have grown then. That's how they knew the seasons. That's during the month of August.

In order to categorize seasons, Qitirmiut identified weather patterns within repeated observations, again following a patterned thought process, as introduced in Section 2.3. For example, Qitirmiut noticed predictable cycle in the moon phases and connected these with the timing of the geese migration or sea-ice melting. Grouping these observations and relating them to the moon phases through a thought process that

inherently links patterns led Qitirmiut to classify seasons. That is, linking these patterns to wildlife activity and moon phases enabled people to combine days into months and months into seasons through a very specific thought process characteristic of Qitirmiut. Charlie Keyok (1998) provided a good example of connecting weather conditions to wildlife:

> When there're too much water in the spring…when it rains too much, the number of squirrels would go down. That's how it is.

Another common way to predict weather is to watch the behaviour of birds.

> I remember when Bessie [Omilgoitok] talked about weather predictions. She said, 'The loons are circling high. The weather will be funny tomorrow.' Later I asked her how she knew. . . She said that animals can sense weather changes which makes their behaviour different and that it was taught to her to use animals unusual behaviour to predict weather. (Sandra Eyegetok pers. comm. 2000)

Qitirmiut that I have travelled with use patterns in the snow and ice, changes in the wind strength and direction, and temperature flucuations to forecast what the weather will be like. In other regions, it has been reported that "when clouds obscure the sun. . . Inuit study the reflection of the ice on the underside of low clouds (Davis 1998, 35).

In making these linkages, Qitirmiut predicted some weather conditions associated with certain months and seasons. In the 1990s, this element of predictability changed as a function of warmer temperatures and increasing variability in weather patterns.

7.2 Predicting Weather Today

Three interviewees commented that it is becoming increasingly difficult to predict the weather.

> Back in the 60's I could almost say I could predict the weather any day. Whereas nowadays you might think it's going to rain… or snow back then but today there's nothing. Turn back and no [snow] dump…That's the big difference from the 60's and today. (Algona, B 1999)

Bobby Algona (1999) suggests that other community members have observed the same phenomenon:

> Everybody I talked to said they can predict the weather in the 60's. It's more predictable and stable, whereas, nowadays it's unstable…any kind of weather any day. You can have rain in February sometimes nowadays. Or snow in August. Hail in August. Hail or even snow in July. I can remember…six or seven years ago, we had a snow bank outside my door in August. That one night it really snowed and froze and a big snow piled outside my tent in August. About seven years ago (1992), I think it was…And next day it was all gone again.

Although weather seems to be more difficult to predict, Qitirmiut are cautious to point out that weather can never be predicted with perfect accuracy.

> You never know the weather…it's a fact that the weather is never the same…every year is always different…everything is always changing. Right now it seems to be getting worse. That I've noticed in my lifetime. It used to get real nice outside when I was younger, right after a storm. Right now when the weather gets bad, it seems consistent. We do not know the weather. It has a caretaker of its own. (Analok 1998)

This quote speaks to an element of Inuit culture that I discussed in the introductory paragraph of Section 7.1. That is, inexplicable forces control weather and all other ecological variables. It follows that Qitirmiut try not to take chances with the weather given that it can be so unforgiving.

7.2.1 Freeze Thaw Cycles

Since the weather has become more difficult to predict as a consequence of warmer temperatures and greater variability, Qitirmiut have also noticed more short-term temperature fluctuations. At times these fluctuations cause a repetitive and sporadic freeze-thaw cycle. This occurs when a few days of warm weather that start to melt the ice and snow are followed by a sudden cold period that causes the melt-water to freeze and from an icy layer on top of the snow. These freeze-thaw cycles can happen in both the spring and fall, particularly during the times of break-up and freeze-up.

Local observations of the freeze-thaw cycle illustrate Qitirmiut understanding of the complexity and interconnectedness of environmental variables. Five interviewees discussed changes in the frequency and nature of freeze-thaw cycles.

> It's been melting sooner than usual, [and] then freezing again…it's been melting and freezing. (Anonymous C 1998)

For caribou, the problem with this condition is that it locks lichen and other forage into the ice, and makes it unavailable as a food source. Several interviewees described this phenomenon.

> … [It was] raining heavily. That's what happened once in Bay Chimo, it must have been 1977. There was hardly any caribou to eat that time because of the ice on the snow. It was really slippery. (Keyok 1998)

> The snow was covered in ice. It had rained after a big snowfall. That's when some of the caribou had starved to death but in another area of land, where it isn't so rough, they were fine…Some areas were fine where it didn't rain…The land was covered in sleet and ice and some caribou and musk-ox froze to death. When the land is covered in ice, where it isn't so rough, some caribou would freeze to death. (Komak 1998)

> They had starved to death because of sleet. They had nowhere to eat. The ice was too thick … they couldn't dig through it. (Koihok 1998)

Qitirmiut have noticed that caribou numbers decrease during and after the years of frequent freeze-thaw cycles. Therefore, an indirect effect of warmer temperatures and the concomitant unpredictability of weather conditions is a possible decrease in caribou population levels owing to starvation or death.

7.2.2 Days of Extreme Heat

During the last few years, Qitirmiut have seen that days of extreme heat are more plentiful. This was particularly the case during the 1997 summer when temperatures were hot enough to melt the ice and snow in just a few short days both in communities and out on the land. These hot days are said by locals to be common in this recent era

of unpredictable and unstable weather.

High temperatures can cause caribou to overheat and die of exhaustion according to five interviewees. In extreme cases, caribou are thought to overheat and then fall unconscious. In some cases, this can lead to death.

> We saw dead caribou; they had died of exhaustion. We saw this in the recent past. (Komak 1998)

An indirect effect of hotter summer days is an increase in the number of mosquitoes. Caribou are said to suffocate on hot days because they run frantically to escape insects:

> When there are too many mosquitoes [the caribou] would gather and go in circles to get rid of the mosquitoes. Sometimes when they shook the flies off it would make the sound like thunder. There would be so many mosquitoes that they would look like snowflakes, you can see, even from a distance. (Koihok 1998)

Bessie Angulalik (1998) observed that same event.

> During the summer when there are a lot of mosquitoes in the warm weather they would die of exhaustion…when the weather is too hot for them.

Another indirect effect of hot temperatures is that they increase the number of forest fires in the southern regions of the Northwest Territories and Nunavut. Winds carry the smoke northwards making the skies hazy. The summer of 1997 was the haziest that several people could remember (Akana pers. comm. 1998; Keyok pers. comm. 1998; Kaniak pers. comm. 1998; Kamoayok pers. comm. 1998).

Hazy or smoky skies can influence caribou. Charlie Keyok (1998) suggested that smoke from forest fires caused caribou to perish.

> From the smog, there were a lot of dead bulls on the land. It was really hot that time and some caribou had died.

One interviewee noted how the smoke influences the region (Anonymous D 1998).

> There is always smoke. When there is a forest fires down south, it really gets smoky up here and if it is foggy you could smell the smoke. Last year (1997) it was really smoggy. You could smell forest fires, maybe for at least 5 days, 4 or 5 days anyway. Somewhere there was a big forest fire and it was a dry year for the Yellowknife area.

When probed whether caribou were sensitive to the smoke, the interviewee suggested that they were.

> Probably [caribou were sensitive to smoke]. We were. We'd go out and say "So stink! Cover your nose and mouth!"

The days of extreme heat which appear to be more common nowadays are reported to be associated with decreases in caribou numbers. Hot temperatures increase the number of mosquitoes that harass caribou and can lead them towards becoming overheated, exhausted and dead.

Community members speculated that these same hot temperatures raise the number of forest fires and make the skies hazy that may also contribute to caribou fatalities. Based on local observations, I deduce that as climate generally warms and days of extreme heat become more frequent, ways to prevent dehydration and overheating become more important for caribou.

7.2.2.1 Ways that Caribou Combat Heat

Qitirmiut mentioned that caribou drink water, eat vegetation with high water content, and eat and suck on mushrooms as ways that caribou avoid dehydration in extreme heat.

Locals suggested that caribou drink water to keep cool, often tasting the water before they make a crossing at a river. Even if Qitirmiut have not observed caribou drinking water, they speculate this is important for regulating body temperature.

> Lakes are important [to caribou] for fresh water. . . I do not know how much water a caribou drinks though. I have never seen a caribou drink water. Sure eat lots of lichen. (Hakongak 1998)

Seven interviewees mentioned that mushrooms are an important part of the caribou diet as they provide nutrients as well as water.

> [Mushrooms] are what the caribou use to keep their mouths moist when they walk. They need water and that's what they use when they're thirsty…they'd keep these mushrooms in their mouths because they're moist inside. Wet, really wet…When caribou are walking around, they could smell [mushrooms] right away and they go after them…[They] last a long time. The caribou would keep them in their mouths at the back of their cheeks…Just like whale blubber…just like snuff. (Alonak 1998)

Bessie Omilgoitok (1998) agreed.

> When the weather is hot during the summer the caribou would have those [mushrooms] when they're thirsty.

Caribou can try to prevent dehydration by sucking or eating mushrooms and other plants that are high in water content.

7.3 Unpredictable Weather across Nunavut

Elders in other parts of Nunavut also suggest that weather is becoming increasingly more unpredictable. According to Bessie Inuktalik and Sadie Joss of the Olokhatomiut Hunters and Trappers Committee in Holman, weather is difficult to predict because storms and winds are stronger and more frequent and the rate of their onset is different.

> Weather changes happen so fast and are so different. (Inuktalik pers. comm. 2000; Joss pers. comm. 2000)

Observations made in Holman are similar to those made in *Umingmaktuuq* and *Qurluqtuq*.

> It does not snow as much as it used to. (Algona, M. 1999)

> There seems to be less snow. (Anonymous D 1998)

These observations point to the changeability, instability and variability in weather patterns nowadays that make it more difficult for people to know what to expect.

Locals reported that weather changes suddenly more often and in ways that are atypical relative to peoples' lifetime observations. For example, in mid-June 2000, there were two weeks of 15 degrees Celsius days which lead people to expect that summer conditions had arrived. Suddenly, the winds started to gust and the temperatures dropped back to 3 degrees Celsius. Weather is variable, but locals report that this kind of changeability is more common in the 1990s because of the overall warming trend (Maghagak pers. comm. 2000).

In other regions of Nunavut, changes in climate have made it difficult to know what to expect from the weather. Near Resolute Bay, Inuit have complained about the weather becoming "wilder" and the sun hotter each year" (Davis 1998, 44). In Coral Harbour and Rankin Inlet, east of the Kitikmeot region, elders are saying that the weather is warmer, there are more storms, and frost does not form on top of snow like it used to (Ussak pers. comm. 2000).

> Even if we try to predict what it is going to be like tomorrow…the environmental indication isn't what the Elders said it would be. Sometimes, it is still true but sometimes it isn't. In the past, when they said, "it's going to be like this tomorrow," it was. But our weather and environment are changing so our knowledge isn't true all the time now. We're being told [in Hudson Strait] that maybe if we put January, February, or March one month behind, our knowledge of weather would be more accurate, because the weather in those months isn't the same anymore. (Lucassie Arragutainaq *In* McDonald, Arragutainaq and Novalinga 1997: 27).

Elders across Nunavut have similarly observed that the weather is changing and becoming increasingly unpredictable. Inuit are observing climatic conditions that they have never seen in their living memory, and variations in weather phenomena that are of increasing frequency or magnitudes, such as extreme heat conditions and freeze-thaw cycles.

7.4 Summary

In this chapter, I have shown Qitirmiut observations of an increasingly more unpredictable climate. Since time immemorial, locals have linked weather patterns with wildlife phases, the moon and seasonality. Recently, these linkages have been difficult to assess. Planning for weather has always been important for Qitirmiut for safe travel, hunting, fishing and subsistence purposes. In the olden days, weather is considered to have been easier to predict. Now it is more difficult because weather patterns are changed. Unprecedented patterns being observed.

Freeze-thaw cycles during spring-melt and freeze-up seem to be increasing in their frequency according to local observation. These have consequence for caribou who are not able to forage through the hard layer of ice and snow that traps tundra vegetation such as lichen.

Days of extreme heat were more common in the 1990s which led caribou to overheat and mosquito harassment to increase. Locals noticed that increased number of forest fires and the concomitant hazy skies also had an impact on caribou, causing them to suffocate from the smoke, particularly in the hot year of 1998. In these days of extreme temperatures, caribou need to prevent dehydration. Qitirmiut suggested that caribou try to combat overheating and dehydrating by sucking on mushrooms, eating vegetation high in water content and staying near water bodies.

As with Qitirmiut, Inuit across Nunavut are also finding weather increasingly difficult to predict. This speaks to the utility of IEK at both a local and regional scale in contributing to our understanding of climate change impacts.

8.0 HYPOTHESES AND CONCLUSIONS

This research presents local observations of causal relationships between a warming climate, the environment and caribou of the Bathurst herd in the Kitikmeot region of Nunavut. In doing so, the product of this systematic research suggests the utility of IEK to contribute new information and enhance existing understanding. In this closing chapter, a list of hypotheses generated by Qitirmiut observations of climate change is provided, followed by my speculations of causal relationships drawn from a combination of Qitirmiut observations in addition to my northern experience. Together, these 20 hypotheses can be used to guide further IEK and western scientific research.

As Qitirmiut observations presented in this paper suggest, the strength of IEK is owed to the fact that it is uniquely aggregating, changing, orally passed, intergenerational, multifaceted, local, iterative, adaptive and spiritual. Together, these qualities differentiate QEK and IEK from other ways of knowing and thereby emphasize the need to incorporate local knowledge into northern social, political, and biological realms. In the words of Laura Nader (1996),

> we need not idealize non-Western science to make the point that there are different types of knowledge that provide valid truths of use to human kind. If a dominant science silences that knowledge, we all lose. (Nader 1996, 24)

Arguably, one of the greatest strengths of IEK is that it can provide detailed local observations. This attribute stands out as one of the most important considerations when we -- academics, scientists and members of a polar nation -- attempt to find ways to integrate IEK into decision-making in general, and to our understanding of climate change in particular.

Keeping in mind the strength of IEK on a local scale, it should not be applied too broadly or removed from its roots in Inuit culture. Attempts to juxtapose, integrate and otherwise consider IEK in northern decision-making frameworks must not ignore the limitations of

IEK. Cruikshank (1998) comments on this.

> Even more ironic is the expectation that [indigenous people] should make these contributions at national and international levels, as members of conference panels and regulatory boards, rather than at a local level where such knowledge could make an actual difference. Such a formulation seems to suggest that indigenous traditions should provide answers to problems created by modern states in terms convenient for modern states. (Cruikshank 1998, 51)

Recently, efforts to implement local knowledge into decision-making, such as through the implementation of the Nunavut Land Claims Agreement (1993), have empowered Inuit as holders of valuable and useful knowledge. This empowerment is supported by the research documented in this paper, in particular, local ecological relationships observed by Qitirmiut.

8.1 Qitirmiut Hypotheses for Further Research

In order to demonstrate the utility of IEK, I list the following useful hypotheses that can contribute new information and enhance existing information regarding climate change. In doing so, I assert that IEK is both useful and valuable. These hypotheses are relevant to the Kitikmeot region and may be considered as starting points for future research conducted by both western scientists and Inuit researchers.

1. On average, spring-melt occurred earlier in the 1990s than in the 1950s through 1980s.
2. On average, fall freeze-up occurred later in the 1990s than in the 1950s through 1980s.
3. In the 1990s, vegetation was more abundant and lush than in previous decades between the 1950s and 1980s and in the Bathurst Inlet area versus other parts of the Kitikmeot region.
4. Certain types of vegetation, particularly flowering plants, grew on Victoria Island in the 1990s and not during the decades between the 1950s and 1980s.
5. In the 1990s, ice on lakes, rivers and the ocean became thinner in and around Bathurst Inlet and on southern Victoria Island than in previous decades.
6. In the 1990s, water levels in rivers, lakes and the ocean dropped in and around Bathurst Inlet, Qurluqtuq and Iqaluktuuttiaq than in previous decades.

7. Shoreline habitat is critical to caribou as an escape from the heat and insects as well as predators.
8. Shoreline habitat is important for caribou to regulate body temperature.
9. Snow cover and the time of the season are key determining factors as to whether caribou are specific or general in their foraging behaviour.
10. In the 1990s versus decades between the 1950s and 1980s, weather was more variable and difficult to predict because it was winder, stormier, and warmer.
11. In the 1990s, variability in weather patterns increased compared to previous decades between the 1950s and 1980s.
12. In the 1990s, freeze-thaw cycles were more frequent compared to previous decades between the 1950s and 1980s.
13. In the 1990s, there were more extreme heat days compared to previous decades between the 1950s and 1980s.
14. In the 1990s versus the decades between the 1950s and 1980s, there were more incidences of Bathurst caribou drownings owing to thinner sea ice and changes in the timing of spring-melt and freeze-up.
15. In the 1990s, Bathurst caribou shifted their migration routes as a function of the timing of spring-melt, in particular, thinner sea ice and the opening of leads in the sea ice.
16. Bathurst caribou population levels drop with extreme heat and warmer temperatures because of deaths due to insect harassment, suffocation, overheating and exhaustion.

8.2 Researcher Hypotheses

Throughout this paper, I suggest that IEK is uniquely aggregating, changing, orally passed, intergenerational, multifaceted, local, iterative, adaptive and spiritual. In highlighting that a key strength of IEK is that it contributes local knowledge, I must also point out that IEK has the potential to be understood by non-local people, for example, outside researchers such as myself.

The fact that I presented and interpreted local knowledge in this paper suggests that both QEK and IEK can be interpreted easily by a larger audience. That I was able to consider local knowledge and then present observed ecological interactions, relationships and phenomena speaks to the capacity of local knowledge to be understood by people from other cultures. Further, the ease at which I was able to make

linkages between Qitirmiut observations of climate change impacts, even where causal relationships were not articulated, is encouraging given the current efforts to integrate western scientific knowledge and Inuit ecological knowledge. One way to ease this integration is through the formulation off hypotheses based on Qitirmiut ecological knowledge of climate change impacts in the Kitikmeot region.

1. Water levels in lakes, rivers and the ocean dropped in the 1990s compared with levels in the decades between 1950s and 1980s for a combination of reasons related to warmer temperatures, specifically, earlier break-up, later freeze-up, increased evaporation, and decreased snow-pack.

2. Lower water levels in lakes, rivers and the ocean means that Bathurst caribou conserve energy by swimming shorter distances while making water crossings during their migrations.

3. Caribou are attracted to areas of increasingly tall and lush vegetation growing near water bodies because they provide refuge from the sun. In the 1990s compared with the 1950s through 1980s, these areas were increasingly more important because vegetation became more tall and lush owing to warmer temperatures.

4. In the 1990s, warmer temperatures, earlier spring-melt, and later freeze-up than experienced in decades between the 1950s and 1980s, together altered the vegetation upon which caribou foraged thereby influencing caribou migration and foraging behaviour.

8.3 Conclusions

Together, the hypotheses presented in the above two sections can facilitate the contribution of IEK to furthering an understanding of the impacts of climate change in the Kitikmeot region. These hypotheses summarize a series of interconnected causal relationships that have been noted by locals. Specifically, Qitirmiut have observed warmer temperatures in the 1990s compared to the decades between the 1950s and 1980s. Warmer temperatures have led to more variable and unpredictable weather, late

fall, early spring and rapid spring melting which are linked to more days of extreme heat, sporadic freeze-thaw cycles, thinner ice, lower water levels, ocean leads opening earlier and more abundant, rich and lush vegetation, as observed by locals. The effects of these conditions on caribou have been numerous. For example, locals have noticed that caribou have suffocated, overheated, become exhausted, starved, drowned and shifted their migration routes. This paper has presented these local ecological observations of causal relationships that were documented through a systematic, consistent and rigorous research process and interpreted easily by an outsider.

The product of this research suggests the utility of IEK in advancing our understanding of climate change effects on caribou. Further, it demonstrates that Inuit and non-Inuit, insiders and outsiders, local scientists and western scientists, can work together to further our understanding of climate change phenomena. The next challenge for decision-makers is in the application and integration of local and western scientific knowledge.

8.3.1 Reconciling Methodological Differences in Knowledge Systems

Given the nine properties of IEK that I have highlighted throughout this paper, there are some methodological challenges to integrating IEK and western scientific knowledge in furthering our understanding of climate change and deciding how and where the contribution of IEK can be fully realized. For example, a formidable task is to determine where integration versus the exclusive application of local knowledge and western scientific knowledge is most appropriate. Even when it is appropriate to integrate the both local and western scientific knowledge, there are methodological problems with combining two fundamentally disparate knowledge systems. The challenge for all researchers, both Inuit and non-Inuit, is to determine when, where and how each knowledge system can contribute best. This worthy and complex discussion is a topic for further research. In the context of this present research, it is relevant that western scientific and Inuit ecological knowledge are at once similar and different and therefore should be used both in conjunction and alternately in an iterative way.

The fact that IEK has many spiritual underpinnings is significant methodological

challenge to integrating IEK and western scientific knowledge. Although the dimension of spirituality is too broad to address in this paper, one key challenge is that the "rational" scientific method does not allow for the subjectivity that spirituality may suggest. Rather than trying to discredit IEK on this basis, perhaps examining the spiritual component of IEK can further our understanding of the logic and reasoning that underlies IEK. For example, recall the hypothesis presented in Section 5.2 that warmer temperatures in the 1990s were because the sun and earth were closer together than in times between the 1950s and 1980s. One could use this hypothesis to dismantle IEK or one could view such speculations as insights into the logic and reasoning processes underlying IEK. This may be the first step in bringing Inuit and non-Inuit knowledge of ecological relationships together and furthering our collective understanding.

Despite methodological challenges, my experience suggests that local knowledge has tremendous potential in providing very systematic, local, and detailed observations over a given period of time. These observations can contribute best both in and of themselves and as hypotheses for further research, as I have presented in this paper.

8.4 Closing Remarks

In this paper, I have presented a collection of Qitirmiut observations of climate change and climate change impacts and thereby demonstrated the unique and important ways in which local knowledge can contribute new information and enhance existing understanding of causal relationships. Specifically, that IEK is local in scale is one quality of IEK that differentiates it from other systems of knowledge and renders it best to contribute at various spatial and temporal levels on a small scale.

In an effort to demonstrate the utility of IEK as a starting point for further research, I formulated Qitirmiut observations into hypotheses and supplemented these with hypotheses that were not articulated by Qitirmiut, but which I suggest are likely realized by locals. In doing so, this research will facilitate further works in advancing both Inuit ecological and western scientific knowledge that will ultimately enhance our understanding of climate change and climate change impacts.

REFERENCES

Akana, J. 1998. Board Member, Tuktu and Nogak Project: Huiqqittaaq River, personal communication.

_____, Elder. 1998. Interview by author, Eileen Kakolak and Doris Keyok. June 8, Umingmaktuuq. Tape recording. Tuktu and Nogak Project, Iqaluktuuttiaq.

Akoluk, M., Hunter. 1998. Interview by author and Myste Kamingoak. May 22, Qingauk. Tape recording. Tuktu and Nogak Project, Iqaluktuuttiaq.

Algona, B. Hunter. 1999. Interview by author and Sandra Eyegetok. November 2, Qurluqtuq. Tape recording. Tuktu and Nogak Project, Iqaluktuuttiaq..

Algona, M. Elder. 1999. Interview by author and Sandra Eyegetok, November 1, Qurluqtuq. Tape recording. Tuktu and Nogak Project, Iqaluktuuttiaq.

Alonak, J. 1998. Board Member, Tuktu and Nogak Project: Huiqqittaaq River, personal communication.

--------, Elder. 1998. Interview by author and Sandra Eyegetok, August 8, Huiqqittaaq River. Tape recording. Tuktu and Nogak Project, Iqaluktuuttiaq.

Analok, F., Elder. 1998. Interview by Sandra Eyegetok and Eva Komak, July 22, Iqaluktuuttiaq. Tape recording. Tuktu and Nogak Project, Iqaluktuuttiaq.

--------. 1999. Interview by author and Sandra Eyegetok, June 12, Iqaluktuuttiaq. Tape recording. Tuktu and Nogak Project, Iqaluktuuttiaq.

Anderson, D.G. 2000 (*in press*). *Rangifer* and human interests. *10th Arctic Ungulate Conference* 20, no. 2-3.

Angulalik, B., Elder. 1998. Interview by Sandra Eyegetok and Eva Komak, July 30, Iqaluktuuttiaq. Tape recording. Tuktu and Nogak Project, Iqaluktuuttiaq.

Angulalik, M., Elder. 1998. Interview by Sandra Eyegetok and Eva Komak, July 24, Iqaluktuuttiaq. Tape recording. Tuktu and Nogak Project, Iqaluktuuttiaq.

Anonymous A. 1994. Water Resources Division, Indian and Northern Affairs Canada: Yellowknife, NWT, personal communication.

Anonymous B, Hunter. 1998. Interview by author and Karen Ongahak, June 5, Qingauk. Tape recording. Tuktu and Nogak Project, Iqaluktuuttiaq.

Anonymous C, Hunter. 1998. Interview by author and Karen Ongahak, June 5, Qingauk. Tape recording. Tuktu and Nogak Project, Iqaluktuuttiaq.

Anonymous D, Hunter. 1998. Interview by author, June 3, Qingauk. Tape recording. Tuktu and Nogak Project, Iqaluktuuttiaq.

Archie, B. 2000. Member, Aklavik Hunters & Trappers Committee: Yellowknife, personal communication.

Atatahak, G. 2000. Researcher, Naonayaotit Study: Qurluqtuq, personal communication.

Berkes, Fikret. 1999. *Sacred ecology: Traditional ecological knowledge and resource management.* Philadelphia: Taylor and Francis.

Bernard, H. Russell. 1995. *Research methods in anthropology: Qualitative and quantitative approaches*. Wal t Creek: Sage Publications.

Bielawski, E. 1984. Anthropological observations on science in the North: The role of the scientist in human development in the NWT. *Arctic* 37, no. 1: 1-6

Briggs, Jean L. 1970. *Never in anger: Portrait of an Eskimo family*. Cambridge: Harvard University Press.

Burgess, Robert G. 1984. *In the field: An introduction to field research*. London: George Allen&Unwin.

Chataway, C.J. 1997. An examination on the constraints on mutual inquiry in a participatory action research project. *Journal of Social Issues* 53, no. 4: 747-765.

Coady, L. 1996. Executive Director, Nunavut Planning Commission: Yellowknife, personal communication.

Cohen, D.W. 1989. The undefining of oral tradition. *Ethnohistory* 36, no. 1.

Cohen, S. 1997. What if and so what in northwest Canada: could climate change make a difference to the future of the Mackenzie Basin? *Arctic* 50, no. 4: 293-307.

Corey, G. 1999. Wildlife Officer, Resources, Wildlife and Economic Development, Government of the Northwest Territories: Iqaluktuuttiaq, , personal communication.

Cruikshank, Julie. 1981. Legend and landscape: Convergence of oral and scientific traditions in the Yukon Territory. *Arctic Anthropology* 18, no. 2: 67-93.

--------. 1984. Oral tradition and scientific research: Approaches to knowledge in the North. In *Social science in the North: Communicating northern values*. Ottawa: Association of Canadian Universities for Northern Studies.

--------. 1998. *The social life of stories: Narrative and knowledge in the Yukon Territory*. Lincoln: University of Nebraska Press.

Cunnison, Ian. 1951. *History of the Luapula: An essay on the historical notions of a central African Tribe*. London: Oxford University Press. Quoted in D.W. Cohen. The undefining of oral tradition. *Ethnohistory* 36, no. 1, 1989.

Davis, Wade. 1998. Hunters of the Northern ice. In *The Clouded Leopard: Travels to*

Landscapes of Spirit and Desire:31-45. Vancouver: Douglas and McIntyre.

deCoccola, Raymond and Paul King. 1989. *The incredible Eskimo: Life among the barrenland Eskimo*. Surrey: Hancock House Publishers.

Dene Cultural Institute. 1994. Guidelines for the conduct of participatory community research. In *Traditional Ecological Knowledge and Modern Environmental Assessment*, ed. Barry Sadler and Peter Boothroyd:69-75. Vancouver: Canadian Environmental Assessment Agency, International Association for Impact Assessments and University of British Columbia, Center for Human Settlements.

Dyke, L.D. and J.N. Jasper. 2000 (*in press*.). *Workshop on Climate Change Impacts and Adaptation Strategies for Canada's Northern Territories*. Final report for Climate Change Action Fund Project A072. Ottawa: Climate Change Secretariat.

Eyegetok, S. 1998. Senior Researcher, Tuktu and Nogak Project: Iqaluktuuttiaq, personal communication.

--------. 1999. Senior Researcher, Tuktu and Nogak Project: Iqaluktuuttiaq, personal communication.

--------. 2000. Senior Researcher, Tuktu and Nogak Project, Iqaluktuuttiaq, personal communication.

Feit, H. 1988. Self-management and state-management: Forms of knowing and managing Northern wildlife. In *Traditional knowledge and renewable resource management*, ed. Milton M.R.Freeman and Ludwig N. Carbyn:72-85. Edmonton: Canadian Circumpolar Institute.

Ferguson, M.A.D. 1997. Arctic tundra caribou and climatic change: Questions of temporal and spatial scales. *Geoscience Canada* 23, no. 4: 245-252.

--------, R.G. Williamson and F. Messier. 1998. I it knowledge of long term changes in a population of Arctic tundra caribou. *Arctic* 51, no. 3: 201-19.

--------. 2000. Regional Wildlife Biologist, Department of Sustainable Development, Nunavut Government: Pond Inlet, personal communication.

Fox, Shari. 1998. I it knowledge of climate and climate change. Master of Environmental Studies in Geography, University of Waterloo.

Freeman, M.A. 1994. Angry spirits in the landscape. In *Biological implications of global change*, ed. Rick Riewe and Jill Oakes:3-4: Canadian Circumpolar Institute, Royal Society of Canada, Association of Canadian University for Northern Studies.

Freeman, M.M.R. 1999. The nature and utility of traditional ecological knowledge. http:/www.carc.org/pubs/v20no1.

Glesne, Corrine and Alan Peshkin. 1992. *Becoming qualitative researchers: An introduction*. White Plains: Longman.

Gombay, Nicole. 1995. Bowheads and bureaucrats: indigenous ecological knowledge and natural resource management in Nunavut. Master of Environmental Studies, University of Waterloo.

Gordon, Bryan C. 1996. *People of sunlight: people of starlight: Barrenland archaeology in the Northwest Territories of Canada*. Edited by Archaeological Survey of Canada. Mercury Series. Hull: Canadian Museum of Civilization.

Greenwood, D.J., W.F. Whyte and I. Harkavy. 1993. Participatory action research as a process and as a goal. *Human Relations* 46, no. 2: 175-190.

Gunn, A., G. Arlooktoo, and D. Kaomayok. 1988. The contribution of the ecological knowledge of I it to wildlife management in the Northwest Territories. In *Traditional knowledge and renewable resource management*, ed. Milton M.R. Freeman and Ludwig N. Carbyn:22-30. Edmonton: The Canadian Circumpolar Institute, IUCN Commission on Ecology.

Hagialok, J., Elder. 1998. Interview by author, Myste Kamingoak, and Martha Akoluk, May 26, Qingauk. Tape recording. Tuktu and Nogak Project, Iqaluktuuttiaq.

Hakongak, N, Hunter. 1998. Interview by author and Meyok Omilgoitok, May 11, Iqaluktuuttiaq. Tape recording. Tuktu and Nogak Project, Iqaluktuuttiaq.

--------. 1999. Wildlife Officer, Nunavut Government: Vancouver, BC, personal communication.

--------. 2000. Wildlife Officer, Nunavut Government: Vancouver, BC, personal communication.

Haniliak, N. 1998. Community Researcher, Tuktu and Nogak Project: Umingmaktuuq. Tape recording. Tuktu and Nogak Project, Iqaluktuuttiaq.

Hikok, N., Elder. 1999. Interview by author and Sandra Eyegetok, October 30, Qurluqtuq. Tape recording. Tuktu and Nogak Project, Iqaluktuuttiaq.

Holden, S.T. and L.O. Joseph. 1991. Farmer participatory research and agroforestry development: A case study from Northern Zambia. *Agricultural Systems* 36: 173-189.

Howard, A. and F. Widdowson. 1996. Traditional knowledge threatens environmental assessment. *Policy Options* 17, no. 9: 34-36.

Huntington, H. P. 1998. Observations on the utility of the semi-directive interview for documenting traditional ecological knowledge. *Arctic* 51, no. 3: 237-42.

Inglis, J.T., ed. 1993. *Traditional ecological knowledge: Concepts and cases*. Ottawa: Canadian Museum of Nature.

Inuit Circumpolar Conference. 1996. Recommendations on the integration of two ways of knowing: Traditional indigenous knowledge and scientific knowledge. In *Seminar on the Documentation and Application of Indigenous Knowledge*. Inuvik.

Inuktalik, B. 2000. Resource Person, Olokhaktomiut Hunters and Trappers Committee: Yellowknife, personal communication.

Ipellie, Alootook. 1997. Thirsty for life: A nomad learns to write and draw. In *Echoing silence: Essays on Arctic narrative*, ed. John Moss:93-101. Ottawa: University of Ottawa Press.

Irlbacher, Stephanie M. 1997. The use of Aboriginal traditional knowledge in public government programs and services in the Northwest Territories. Master of Arts, University of Alberta.

Jeffers, S. 2000 (*unpubl.*). Arctic Ocean ice cover during the last 30 years. In *Workshop on Climate Change Impacts and Adaptation Strategies for Canada's Northern Territories*. Yellowknife.

Johnson, Martha, ed. 1992. *LORE: Capturing traditional environmental knowledge*. Ottawa: Dene Cultural Institute, The International Development Research Center.

Joss, S. 2000. Representative, Olokhatomiut Hunters and Trappers Association: Yellowknife, NWT, personal communication.

Kadlun-Jones, M. 1999. Senior Researcher, Tuktu and Nogak Project: Iqaluktuuttiaq, personal communication.

--------. 2000. Senior Researcher, Tuktu and Nogak Project: Vancouver, BC, personal communication.

Kailik, B, Elder, 1999. Interview by author and Sandra Eyegetok, November 1, Qurluqtuq. Tape recording. Tuktu and Nogak Project, Iqaluktuuttiaq.

Kakolak, E. 1998. Community Researcher, Tuktu and Nogak Project, Umingmaktuuq, personal communication.

Kakolak, P. 2000. Research Assistant, West Kitikmeot Slave Study: Yellowknife, personal communication.

Kamoayok, L. 1998. Board Member, Tuktu and Nogak Project: Umingmaktuuq, , personal communication.

--------, Elder. 1998. Interview by author and Eileen Kakolak, August 9, Hiuqqittaaq. Tape recording. Tuktu and Nogak Project, Iqaluktuuttiaq.

Kane, D.L, L.D. Hinzman, M.Woo and K.R. Everett. 1992. Arctic ecosystems in a changing climate: an ecophysiological perspective, ed. R.L. Jefferies F.S. Chapin, J.F Reynolds, G.R. Shaver and J. Svoboda:35-57. San Diego: Academic Press.

Kaniak, M. 1998. Board Member, Tuktu and Nogak Project: Umingmaktuuq, personal communication.

--------, Elder. 1998. Interview by author and Eileen Kakolak, August 9, Hiuqqittaaq. Tape recording. Tuktu and Nogak Project, Iqaluktuuttiaq.

Kaosoni, A., Elder. 1998. Interview by Sandra Eyegetok and Eva Komak, July 22, Iqaluktuuttiaq. Tape recording. Tuktu and Nogak Project, Iqaluktuuttiaq.

--------. 1999. Elder, Tuktu and Nogak Project: Iqaluktuuttiaq, personal communication.

Kaosoni, M, Elder. 1998. Interview by Sandra Eyegetok and Eva Komak, July 22, Iqaluktuuttiaq, Tape recording. Tuktu and Nogak Project, Iqaluktuuttiaq.

--------. 1999. Elder, Tuktu and Nogak Project: Iqaluktuuttiaq, personal communication.

Keyok, C., Elder. 1998. Interview by author and Eileen Kakolak, July 29, Umingmaktuuq. Tape recording. Tuktu and Nogak Project, Iqaluktuuttiaq.

Kofinas, G. P., J. Tetlichi, C. Arey, D. Peterson, and M. Nershoo. 1997. Community-based ecological monitoring: A summary of 1996-97 observations and pilot project evaluation. *North Yukon Ecological Knowledge Co-Operative*.

Kofinas, Gary P. 1998. The costs of power sharing: Community involvement in Canadian porcupine caribou co-management. Ph.D, University of British Columbia.

--------. 2000. Research Fellow, Institute or Arctic Studies: Keene, NH, personal communication.

Koihok, M. 1998. Board Member, Tuktu and Nogak Project: Iqaluktuuttiaq, personal communication.

--------, Elder. 1998. Interview by author and James Panioyak. May 13, Iqaluktuuttiaq. Tape recording. Tuktu and Nogak Project, Iqaluktuuttiaq. Tape recording. Tuktu and Nogak Project, Iqaluktuuttiaq.

--------. 1999. Board Member, Tuktu and Nogak Project, Iqaluktuuttiaq, , personal communication.

Komak, A., Elder. 1998. Interview by Sandra Eyegetok and Eva Komak. July 30, Iqaluktuuttiaq. Tape recording. Tuktu and Nogak Project, Iqaluktuuttiaq.

Krech, Shepard. 1999. *The ecological Indian*. New York: W.W. Norton.

Kuptana, G. 1998. Elder, Umingmaktuuq, personal communication.

--------. Elder. 1998. Interview by author, Eileen Kakolak and Karen Kamoayok. June 7, Umingmaktuuq, .

Maghagak, A. 2000. Executive Secretary, Nunavut Tunngavik Incorporated, Iqaluktuuttiaq, personal communication.

Maxwell, B. 1980. *The climate of the Canadian Arctic islands and adjacent waters*. Climatological Studies 30. Downsview: Atmospheric Environment Service.

-------. 1997. *Responding to global climate change in Canada's Arctic. Volume II of the Canada Country Study: Climate impacts and adaptations*. Ottawa: Environment Canada.

Maxwell, Joseph A. 1996. *Qualitative research design: An interactive approach*. Edited by Leonard Bickman and Debra J. Rog. Applied Social Research Methods. Thousand Oaks: Sage Publications.

McDonald, Miriam , Lucassie Arragutainaq, and Zack Novalinga. 1997. *Voices from the Bay: traditional ecological knowledge of I it and Cree in the Hudson Bay bioregion*. Ottawa: Canadian Arctic Resources Committee.

McGhee, Robert. 1996. *Ancient people of the Arctic*. Vancouver: UBC Press.

McMullen, A. 1998. Wildlife Officer, Government of the Northwest Territories: Qurluqtuq, personal communication.

Michaels, Anne. 1998. *Fugitive pieces.* Toronto: McClelland & Stewart.

Nader, L., ed. 1996. *Naked science: Anthropological inquiry into boundaries, power, and knowledge*. Edited by Laura Nader. New York: Routledge.

Nahanni, P. 1992. Thoughts on social science in the North. In *8th Inuit Studies Conference*, ed. Peter Ernerk et al:23-29. University of Laval.

Nakashima, D.J. 1986. Inuit knowledge of the ecology of the common eider in Northern Quebec. In *Eider Ducks in Canada*, ed. Austin Reed:102-113. Ottawa: Canadian Wildlife Service.

--------. 1993. Astute observers on the sea ice edge: Inuit knowledge as a basis for Arctic co-management, ed. Julian T. Inglis:99-110. Ottawa: International Program on Traditional Ecological Knowledge and International Development Research Centre.

Nalvana, C., Elder. 1999. Interview by author and Sandra Eyegetok. November 1, Qurluqtuq. Tape recording. Tuktu and Nogak Project, Iqaluktuuttiaq.

Neis, Barbara and Larry Felt. 2000 (in press). *Finding our Sea Legs: Linking fishing people and their knowledge with science and management*. St Johns: Institute of Social and Economic Research Press.

Nelson, Richard. 1969. *Hunters of the Northern ice*. Chicago: University of Chicago Press.

Nelson, Richard. 1980. *Shadow of the hunter: Stories of Eskimo life*. Chicago: University of Chicago Press.

Ohokak, G. 1999. Inuinnaqtun Instructor, Nunavut Arctic College: Iqaluktuuttiaq, personal communication.

Omilgoitok, B. 1998. Board Member, Tuktu and Nogak Project, Iqaluktuuttiaq, personal communication.

--------. 1999. Board Member, Tuktu and Nogak Project, Iqaluktuuttiaq, personal communication.

--------, Elder. 1998. Interview by author and Meyok Omilgoitok. May 14, Iqaluktuuttiaq. Tape recording. Tuktu and Nogak Project, Iqaluktuuttiaq.

Omilgoitok, M. 1998. Wildlife Officer, Resources, Wildlife and Economic Development, Government of the Northwest Territories: Iqaluktuuttiaq, , personal communication.

--------. 1999. Wildlife Officer, Resources, Wildlife and Economic Development, Government of the Northwest Territories: Iqaluktuuttiaq, , personal communication.

Omilgoitok, P. 1998. Board Member, Tuktu and Nogak Project, Iqaluktuuttiaq, , personal communication.

--------, Elder. 1998. Interview by author and Meyok Omilgoitok. May 14, Iqaluktuuttiaq. Tape recording. Tuktu and Nogak Project, Iqaluktuuttiaq.

-------- 1999. Board Member, Tuktu and Nogak Project, Iqaluktuuttiaq, personal communication.

Overpeck, J., K. Hughen, D. Hardy, R. Bradly, R. Case, M. Douglas, B. Finney, K. Gajewski, G. Jacoby. A. Jennings, S. Lamoureux, A. Lasca, G. MacDonald, J. Moore, M. Retelle, S. Smith, A. Wolfe, G. Zielinski. 1997. Arctic environmental change of the last four centuries. *Science* 278, no. 14: 1251-6.

Panegyuk, E., Elder. 1998. Interview by author and Eileen Kakolak. August 9, Hiuqqittaaq. Tape recording. Tuktu and Nogak Project, Iqaluktuuttiaq.

Panegyuk, G. 1998. Community Member: Umingmaktuuq, personal communication.

Pinkerton, E. 1994. The future of traditional ecological knowledge and resource management in native communities: Where do we go from here? In *Traditional Ecological Knowledge and Modern Environmental Assessment*, ed. Barry Sadler and Peter Boothroyd:51-60. Vancouver: Canadian Environmental Assessment Agency, International Association for Impact Assessments and University of British Columbia, Center for Human Settlements.

Riedlinger, D. 2000 (*in press*). Looking in new directions to understand Arctic climate change: Contributions of Inuvialuit knowledge to climate change research in the Western Arctic. *Issues in the North* .

Ross, Rupert. 1992. *Dancing with a ghost: Exploring Indian reality*. Toronto: Reed Books.

Sallenave, J. 1994. Giving traditional ecological knowledge its rightful place in environmental impact assessment. *Northern Perspectives* 22, no. 1.

Spink, J. 1969. Historic Eskimo awareness of past changes in sea level. *Musk-Ox* 5: 37-40.

Spradley, James P. 1980. *Participant Observation*. New York: Holt, Rinehart, & Winston.

Stern, D. 2000. Hunter: Iqaluktuuttiaq, personal communication.

Stevenson, M. G. 1996. Indigenous knowledge in environmental assessment. *Arctic* 49, no. 3: 278-291.

--------. 1997. Ignorance and prejudice threaten environmental assessment. *Policy Options* : 25-28.

Strauss, Anselm L. 1987. *Qualitative analysis for social scientists*. Cambridge: Cambridge University Press.

Svoboda, J. and D. Nabert. 1994. Introduction: Climate of change. In *Biological implications of global change*, ed. Rick Riewe and Jill Oakes:3-4: Canadian Circumpolar Institute, Royal Society of Canada, Association of Canadian Universities for Northern Studies.

Theis, J. and H.M. Grady. 1991. *Participatory rapid appraisal for community development: A training ma al based on experience in the Middle East and North Africa*. London: International Institute for Environment and Development.

Thoms, M. 1995. Teacher, Yellowknife, NWT, personal communication.

Thomson, A. 1999. Researcher, Nunavut Impact Review Board: Iqaluktuuttiaq, personal communication.

Tigullaraq, J. 2000. Assistant Director, Department of Sustainable Development, Nunavut Government: Iqaluit, personal communication.

Ussak, L. 2000. Member, Rankin Inlet Hunters and Trappers Organization, Yellowknife, personal communication.

Walsh, J. 1993. The elusive Arctic warming. *Nature* 361: 300-301.

Webber, L.M. and R.L. Ison. 1994. Participatory rural appraisal design: Conceptual and process issues. *Agricultural Systems* 47: 107-131.

Wenzel, George W. 1991. *Animal rights, human rights: Ecology, economy and ideology in the Canadian Arctic*. London: Belhaven Press.

--------. 1999. Traditional ecological knowledge and Inuit: Reflections on TEK research and ethics. *Arctic* 52, no. 2: 113-124.

Whyte, William Foote, ed. 1991. *Participatory action research*. Newbury Park: Sage Publications.

Winkelaar, Felix. 1990. The science institute of the Northwest Territories and the westernization of traditional knowledge. Master of Arts, Carleton University.

Wolfe, Jackie, Chris Bechard, Petr Cizek, and David Cole. 1991. Indigenous and western knowledge and resource management systems:38. Guelph: University of Guelph, School of Rural Planning and Development.

Wolfley, J. 1998. Ecological risk assessments: Their failure to value indigenous traditional ecological knowledge and protect tribal homelands. *American Indian Culture and Research Journal* 22, no. 2: 151-166.

Appendix A: List of Keywords for TNP

Keywords for Coding the TNP Interview Transcripts (English/Inuinnaqtun)

Category	*Sub Category*	*Sub-Sub Category*
Interview Information	date/qanga	
	place/humi	
	interviewers/apiqhuijut	
	tapes/nipit	
	maps/nunauyat	
Biography/inuuvia	born/inuuvia	
	died/tuquyuq	
	spouse(s)/aippait	
	children/nutaqqat	
	siblings	
Place Names/atiit nunat		
Camps/initurliit	winter/ukiuq	child/nutaraq
	summer/aujaq	youth/inulrammiq
	spring/upiningakhaq or upin'ngakhaq	adult/inirnilrammiq
	fall/ukiaknaq	elder/inirniq
	travel/aullaaq	
People/Inuit	aging/getting old/inirninngulirniq	
	white people/qaplunaaq	
	families/qatangutigiit	
	traditions/pitquhiit	
	culture/ilitquhiit	
	olden days/ingilraat	
	transition/nutaanguqtirniq	
	story telling/unipkaarniq	
	trap trapping/naniriaqtuqtut	lots of words
	snare trapping/nigaqtaqtuq	
	starvation/aqiarualiqtut	
	trading/niuwaajuq	
	caribou hunting/tuktuhiurniq	
	survival/ayuqhaqtut	
Residence/Iglu	previous/past/	
	current/present/tajja	
	future/qakugu	
trading/niuvvaajuq Posts/niuvvaa	CanAlaska	
	HBC/kapanit	

Travel Routes/aullaariarniq	early spring/upin'ngakhaq late spring/upin'ngaaq summer/aujaq early fall/akiaknaq fall/ukiaq winter/ukiuq travel to sea/ataaqpaqtun travel inland/tigvau getting ready to go/haniyutut	
Caribou/tuktut	behaviour/pitquhiat	feeding (diet)/niriniaqtut heat relief/niglaqhiqtuq mosquitoes/kikturiat instinct/ learning/ayuiqhaqtut mortality/tuqutpalliavaktut moving/aulaniq overheat/ivyan'nguyuq postpartum/nurraliuqtaaramik pregnancy/najjitaaqtuq prenatal/nivyaalattiyuq resting/unaguiqhiqtut rutting/nuliaqtut swimming/naluktuq thermoregulation/ communication/ilittuqhipkainiq making noise/nivyayuktuq snorting/auqhaqtut diving/auqhaaqtut crossing/nalluq
	body condition/timip qanurinnia	antlers/nagyuit contamination/tuqunaanikhimayuq disease/aanniarutilgit
	calving grounds/nurraliurviit or nurriviit	birthing/nurraliurniq or nurriyut calving/nurraliarniq or nurriyut fecundity/ fidelity/nunaviminirminut habitat/nunagiat learning/ayuiqharniq location/humi recommendations/pitquyauyut shifting/ahinunngarniq timing/qanga
	disturbance/kuinginnarniit	

caribou/tuktu	habitat	impacts
		heat relief/niglaqhiqtuq
		shade/tarrarmi
		water/imaq
	human usage/inuit atuqpagait	bedding/qaaq
		clothing/aannuraat
		medicine/havaut
		sewing-clothing/miqhuq
		tools/ingilrutit
		traditional foods/ingilraat niqigivagait
		caribou hunting/tuktuhiurniq
	movements and migrations/ingilrauillu at	spring migration/kilumuuqtut
		fall migration/atiqtat
		daily/ubluq tamaat
		water crossings/naluktut or nalluq
		land crossings/nunapkuuktut
		winter grounds/ukiiviit
		summer grounds/auyiviit
		leaders/hivuliqtit
		aggregation/katimavaktut
	names/atiit	cows/kulavak
		bulls/pungnik
		calves/nurraq
		cow with no calf/nurraittuq
		young bull/anguhalluq
		young summer fur/hagvaaruqtuq
		thick winter fur/tulruhiyuq
		belly fur/pukiq
		winter caribou/pitiktaakkat
		summer newborn calves/auyalingnik
		yearling/nukatukkaaq
		fall caribou/ukiakharnitaq
		spring caribou/upin'ngaaliq
	post calving/nurritaaqhutik	grounds
	population/qaffiniit	changes/aallannguqtirniq
		comparison/aajjikuhiurniit/aajjikkiiktirutin
		herd interaction/aallatqiit tuktut katitpaktu
		Island caribou

caribou/tuktu	predators/niqikhaqhiuqtut	wolf/amaruq
		grizzly/akhaq
		human/Inuk
		other/aallat
		musk-ox/umingmak
	range/	condition
		location/humi
		sightings/takuviit
	vegetation/nuna	diversity/
		abundance/amigainniit
		lichen/qariuyat
		grass and sedges/ivik
		trees and shrubs/qiuvaluit
		other
	recommendations/pitquyauyut	conservation
		land use/nunamik aturniq
		management/aulapkaijuq
	Miscellaneous/quyaginnaq	comparison/aajjikuhiurniit
		preferences/piumalluaqtait
	caribou hunting grounds/tuktuhiuqviit	
	months/tatqiqhiutit	all 12
Climate/hila	cooling trend/niglaqpallialiqtuq	note: 1990 category includes 1990-1999
	freeze cycle/qiqiqattaqtuq	
	ice conditions/hikup qanurrinnia	
	environmental effects/nunamiittunik taman qanurinningit	
	seasons	no word, always specific
	snow conditions/aputip qanurinnia	
	warming trend/uunnakpalliqtuq	
	weather/hila	
	climate change/hila aallanguliqtuq	

Gender	division of labour	
	politics	
	power	
	traditions/pitquhiit	
	other	
land use/nunamik aturniq	exploration and development	pros/good/naamaaktuq
	mining/uyarakhiuqtut	impacts
		locations/humi
		cons/bads/ihuangittuq
		recommendations/pitquqauyut
		trust/ukpiruhuktat
	hunting grounds/tuktuhiurviit	
	tourism/aquivigiyauyut	
	traditional land use/ingilraat nunamik atuqpauhiit	
	visiting/pulaaqtut	
	fishing/iqalukhiuqtut	
	seals/nattiit	
	bears/akhat	
Scientists/	interactions with/katimayut	
	other/aallat	
Youth/inulrammiit		
	advice to/uqautivagait	
	education/ilihaiyut	
	camp/initurliit	
	elder-youth/iningnirit-inulrammiit	
	other/aallat	
Project/havaanguyuq	comments/uqautigiyait	
	dating/qanga	
	Inuit consultant/inuit ihumatuyut	
	money/manik	
	validity/itquumattiarniq/	
	keyword/uqautigilluaqtait	
	text/titiraqhimayut	
Terms/uqauhiit or attiit	(Inuinnaqtun words)	
rules/maligakhat	culture/pitquhiq	
	customs/	
	caribou hunting/tuktuhiuqniq	
Placenames/Nunat atiit		