University of Alberta

Knowing Nanuut:
Bankslanders knowledge and indicators of polar bear population health

by

Daniel V. W. Slavik

A thesis submitted to the Faculty of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of

Master of Science
in
Rural Sociology

Department of Resource Economics and Environmental Sociology

Fall 2013

Edmonton, Alberta

In memory of:

Andy Carpenter Sr.

&

Geddes Wolki Sr.

Abstract

Polar bears (*Ursus maritimus, Nanuut*) are a culturally and economically important species to the Inuvialuit. As a result of climate change, the Arctic is experiencing rapid ecological changes with the potential for profound impacts on polar bear populations. The objectives of the thesis were to document Inuvialuit knowledge of polar bear population health and to identify the indicators used by Inuvialuit to assess polar bear health. Using community-based participatory research methodologies, participant observation, and semi-directed interviews with twenty-seven locally identified community experts and knowledge holders from Sachs Harbour, NWT, this thesis documents Inuvialuit knowledge of polar bear population health within seven categories of indicators: body condition and behavior; breeding success; diet and feeding behaviors; distribution and movements; habitat conditions; population abundance; and unique observations. This research finds that Inuvialuit of Banks Island have an accumulated wealth of traditional knowledge about polar bears and this can contribute to monitoring of polar bears.

Acknowledgements

This research process has been a test of dedication and determination. It has been more work than I ever expected a Master's degree would be, but it has also been rewarding in ways that I never expected.

First and foremost, I owe a debt of gratitude to Brenda Crnkovic for her love, support, and tolerance of me over the last six years during my many extended trips North. Likewise, to the rest of my family who quietly supported me.

I would like to deeply thank Dr. Milton Freeman, who was a mentor and gave me the guidance to get this project started. Members of the "Conservation Hunting & Sustainable Development" research team, including Dr. Doug Clark and Dr. Lee Foote, helped me to develop a holistic understanding of conservation issues. Likewise, Dr. Andrew Derocher helped me to understand the complexity of the Arctic environment and polar bear management. Marsha Branigan and the staff at the Inuvialuit Joint Secretariat (WMAC & IGC) were instrumental in advising me and supporting this project.

This research received funding from the Cumulative Impacts Monitoring Program (CIMP) through Aboriginal Affairs and Northern Development Canada (AANDC). Additional funds for fieldwork logistics were provided through AANDC, the Aurora Research Institute Research Assistant Program, EnviroNorth (NSERC CREATE Training Program- Communications with local communities), and the NWT Species at Risk Stewardship Program. Elaine Maloney and Cindy Mason at Canadian Circumpolar Institute kindly supported me through the various challenges associated with funding this research. I owe gratitude to the Aurora Research Institute and the Parks Canada Aulavik Field Office for providing accommodations while I was in Inuvik and Sachs Harbour.

At the University of Alberta, I would like to acknowledge Dr. Brenda Parlee and Dr. Naomi Krogman for their guidance and supervision, and Rick Pelletier for his assistance in GIS mapping. To my colleagues Raila, Zoe, Kristine, Roger, Angie, Wayne, Brian, and Andrea, thank you for your solidarity and I wish you all the best.

Finally, a big thank you, *quyanainni*, and *quana* to the to the entire community of Sachs Harbour, especially Lawrence Amos, Joseph Carpenter, Larry Carpenter, Edith Haogak, Wayne Gully, the Sachs Harbour Hunters and Trappers Committee, and my research assistant Charlton Haogak. While a book could never fully capture your unique relationship with *Nanuut*, I hope this thesis respects your knowledge and history, contributes to passing this knowledge on to the next generation, and assists in the conservation of polar bears for generations of Inuvialuit to come.

Table of Contents

List of Tables

List of Figures

List of Acronyms

AANDC -	Aboriginal Affairs and Northern Development Canada
CAFF -	The Conservation of Arctic Flora and Fauna
CITES -	Convention on International Trade in Endangered Species
CIMP -	Cumulative Impacts Monitoring Program
COSEWIC -	Committee on the Status of Endangered Wildlife in Canada
ENR -	Dept. of Environment and Natural Resources, NWT
FJMC -	Fisheries Joint Management Committee
HTC –	Hunters and Trappers Committee
ISR –	Inuvialuit Settlement Regions
ITK -	Inuit Tapariit Kanatami
IFA –	Inuvialuit Final Agreement
IGC –	Inuvialuit Game Council
IQ -	*Inuit Qaujimaningit*
IUCN -	International Union for Conservation of Nature
NWT -	Northwest Territories
NU -	Nunavut
PBSG –	Polar Bear Specialist Group
PBAC –	Polar Bear Administrative Committee
PBTC –	Polar Bear Technical Committee
SARA –	*Species at Risk Act*
TEK –	Traditional Ecological Knowledge
WMAC-	Wildlife Management Advisory Council

Chapter One: Introduction

1.1 Background

Polar bears (*Ursus maritimus,* Inuvialuktun: *nanuut*) are a culturally, spiritually, and economically important species to the Inuit and Inuvialuit[1] of the Canadian Arctic. As a result of climate change, Northern peoples and wildlife are experiencing rapid ecological changes. Biologists predict that an overall decrease in the distribution, and abundance of both annual and multi-year sea ice, has the potential for profound negative impacts on the health and abundance of polar bear populations (Derocher et al., 2004; Stirling et al., 1999; Stirling and Derocher, 1993). However, there has been contention between the Inuit and Inuvialuit, and the scientists studying the species over the current population health, and the future of the animal (Clark et al., 2008; Dowsley and Wenzel, 2008). Scientific assessments of polar bear population health have conflicted with traditional knowledge in some regions of northern Canada (Clark et al., 2008; Dowsley and Wenzel, 2008). In fact, "nothing better illustrates how serious the stand-off between science and traditional knowledge has become than the ongoing debate over polar bears" (Struzik, 2007). As a result of this conflict, there has been a growing perception by Arctic peoples that their own knowledge and understanding of observed changes in polar bears and the environment are being ignored in research, management, and conservation decision making, leading to concerns that the very foundations of wildlife co-management are being weakened (Tyrell, 2007; Clark et al., 2008).

Inuit want a greater say in polar bear management, and argue that their traditional knowledge, complemented by community-based monitoring, could help inform scientists and managers on the state of polar bear population health. As Gabriel Nirlungayuk (Nunavut Tunngavik Inc. Director of Wildlife) recently asserted: "What we [Inuit] feel could fill the [biological research] gap is traditional knowledge, but it's not widely considered" (Rogers, 2011).

[1] The term "Inuit" refers to the Inuit of the Eastern Arctic (present-day Nunavut), while the term "Inuvialuit" refers to the Inuit of the Western Arctic (Northwest Territories (NWT) and Northern Yukon). For a specific summary in the cultural heritage of the regions, see the *Handbook of North American Indians: Arctic Edition* edited by D. Damas (1984)Washington: Smithsonian Institute.

Inuvialuit traditional knowledge is defined as "the knowledge gained by individuals through traditional learning patterns, and through living on and using the land… [as] observing, listening, testing, determining and experiencing all play considerable roles in retaining traditional knowledge" (MPEG, 2006: 6.1.1). While extensive biological research has been carried out on the Southern Beaufort polar bear population, at the time of this research, there had not been a comprehensive study of Inuvialuit traditional knowledge of polar bears in the region. Traditional knowledge studies of polar bears have been conducted elsewhere across the Arctic, including Baffin Bay (Dowsley, 2005), Taloyak (Keith et al., 2006), Gjoa Haven (Keith et al., 2005), Foxe Basin (Sahanatien, 2011), Chukotka (Zdor, 2007), Greenland (Born et al., 2011), and the Alaska coastline (Kalxdorff, 1997). This research builds on previous work by focusing on traditional knowledge of the Inuvialuit of Sachs Harbour.

1.2 Research Purpose and Objectives

The purpose of this thesis is to develop a comprehensive understanding of traditional knowledge of polar bear to the Inuvialuit of Sachs Harbour to fill a gap in research on traditional knowledge of polar bears in the Beaufort Sea. This was achieved through research conducted in Sachs Harbour, NWT from 2008-2010. I used participant observation and conducted semi-directed in-depth interviews with twenty-seven locally identified community experts and knowledge holders across a spectrum of age, experience, and gender. Through collaborating with the community of Sachs Harbour to record and communicate their knowledge of polar bear ecology, behavior, and habitat, as well as the cultural and socio-economic significance of polar bear hunting, this thesis documents the rich knowledge of the Inuvialuit of Banks Island for future generations of Inuvialuit.

The primary objective of this research is to document Inuvialuit knowledge of polar bear population health. Beyond describing Inuvialuit knowledge of polar bear population health, the secondary objectives of this thesis are to identify the traditional signs and signals (i.e. indicators) that Bankslanders' use to holistically assess the health of individual polar bears and the population.

1.3 Organization of Thesis

This thesis is organized in a manuscript format to meet the requirements for an M.Sc in Environmental Sociology. Chapter Two (Literature review) summarizes the geographic and ethnographic setting of the research in Sachs Harbour in the Inuvialuit Settlement Region; provides a brief overview of polar bear ecology; introduces the context of polar bear research and management in the Western Arctic; and summarizes previous contributions of traditional knowledge research to polar bear management. The theoretical context reviews the current literature defining traditional knowledge and its meaning to the Inuvialuit. It continues to examine literature from previous biological and traditional knowledge research on polar bears and other Northern wildlife to examine other indicators of polar bear health that have been identified in other studies that can be used as a framework for understanding local perspectives of polar bear health. The methods chapter discusses the methodological approach used to design the fieldwork, data collection, and analysis of results. Chapter four (Results) will discuss Inuvialuit knowledge of polar bear population health. This will be presented around a seven categories of indicators that Bankslanders understand to be polar bear population health, including: body condition and behavior; breeding success; diet and feeding behaviors; distribution and movements; habitat conditions; population abundance; and unique observations. Chapter five (Discussion) will discuss my contributions of this study to on-going polar bear research and management, specifically examining the spatial and temporal strengths and limitations of Bankslanders knowledge of polar bears, and discus how traditional knowledge and community-based indicators can contribute to the on-going monitoring and management of the species. As an addendum, Appendix 1 (Historical and Contemporary Use and Importance of Polar Bears on Banks Island) combines additional results recorded through interviews with an literature review, to create an important contextual reference on Bankslanders historical and contemporary relationship with polar bears to supplement this research question.

Chapter Two: Literature Review

2.1. Introduction

The following research setting summarizes the geography, ethnography, and unique history of Sachs Harbour and the Inuvialuit. The objective of this section is to illustrate that, due to their continued reliance on land and marine animals for economic and subsistence purposes, the Inuvialuit of Sachs Harbour have a history of learning from their environment. The research context section provides a brief overview of some aspects of polar bear ecology, and provides the policy and management context significant to this discussion; particularly emphasizing how traditional knowledge has been (or is required to be) incorporated in polar bear research and management. The final section will establish the theoretical context for understanding the traditional signs and signals, or "indicators", that are used to assess the polar bear health by reviewing previous scientific and traditional knowledge studies and examining indicators discussed in these works.

2.2 Research Setting

2.2.1 The Inuvialuit of Canada's Western Arctic

To set the stage, it is important to understand the history and ethnography of the modern-day Inuvialuit- the Inuit people who live in the western Canadian Arctic region- and the distinct make-up of the community of Sachs Harbour[2]. As a distinct Indigenous people, the Inuit possess the largest range of any peoples on earth, extending from Siberia, across the coastal areas of Alaska and Canada, to the East coast of Greenland (Freeman, 1976; Damas, 1984; Riewe, 1991). Situated in the Mackenzie Delta-Beaufort region of Canada's Western Arctic, modern-day Inuvialuit have origins from at least three regionally and cultural distinct Inuit ancestors - the Mackenzie Inuit, the Iñupiat, and the Copper Inuit (Ayles and Snow, 2002). The Mackenzie Inuit of the Mackenzie Delta region consisted of five groups whom lived in proximity to each other. While linguistically unique, their relations were so friendly and extensive that they "almost formed one community" (Stefansson, 1914: 6). The Mackenzie Inuit held a strong orientation to both land and marine mammal hunting, hunting seals and whales using the *qayaq* and *umiak* on

[2] Historical ethnography in Sachs Harbour is limited due to its isolation and relatively recent establishment of a permanent settlement, so this review draws extensively on the volumes of Usher (1966 and 1971), Stefansson (1914, 1919), Alunik et. al. (2003), and the Inuit Land Use and Occupancy Study (Freeman 1976).

sea, and dog sled on ice (Damas, 1984). West of the Mackenzie Inuit, the Iñupiat of the North Slope of modern-day Alaska spread from the Chukchi Sea through the Beaufort coast all the way to Cape Perry (Ayles and Snow, 2002). The Copper Inuit, the western most group of Central Inuit, occupied the areas East of Mackenzie Inuit, including Southern Banks Island and Victoria Island (Damas, 1984). The Copper Inuit were less dependent on seals and marine mammals than the Mackenzie and Iñupiat, subsiding on a caribou, fish, fowl and small game (Stefansson, 1919).

In the late 19th and early 20th centuries, the Mackenzie Inuit were considered one of the largest Inuit populations in Canada (McGhee, 1974). However, the negative effects of disease and alcohol from exposure to the whaling industry decimated the Mackenzie Inuit population, who were considered by some to be extinct by the 1920's (McGhee, 1974). Over the period of 1889-1908, the whaling industry encouraged the immigration of Iñupiat into the Mackenzie Delta region, resulting in the cultural absorption or "Alaskanization" (Stefansson, 1913: 79) of the remaining Mackenzie Inuit into the Alaskan Iñupiat.

The decline of the whaling era in the early 1900s coincided with the rise of the trapping era. An increase in demand for furs from various trading companies fueled immigration into the region and fostered new harvesting practices and the prosperous enterprise of fur trapping, resulting in an influx of people into the fur-rich Beaufort-Delta region from 1910 onwards. The increased harvest pressure resulted in the depletion of muskrat (*Ondatra zibethicus*) in the delta and white fox (*Vulpes lagopus*) along the coastline (Usher 1971a). Usher (1971a) concludes that the "centralization of people into a few large communities has often led to the local over exploitation of the fur resource, but also to its under-utilization in the distant hinterlands" (p. 17). This harvest pressure on the mainland enticed trappers into unexplored territories and culminated in the early schooner trips to Banks Island.

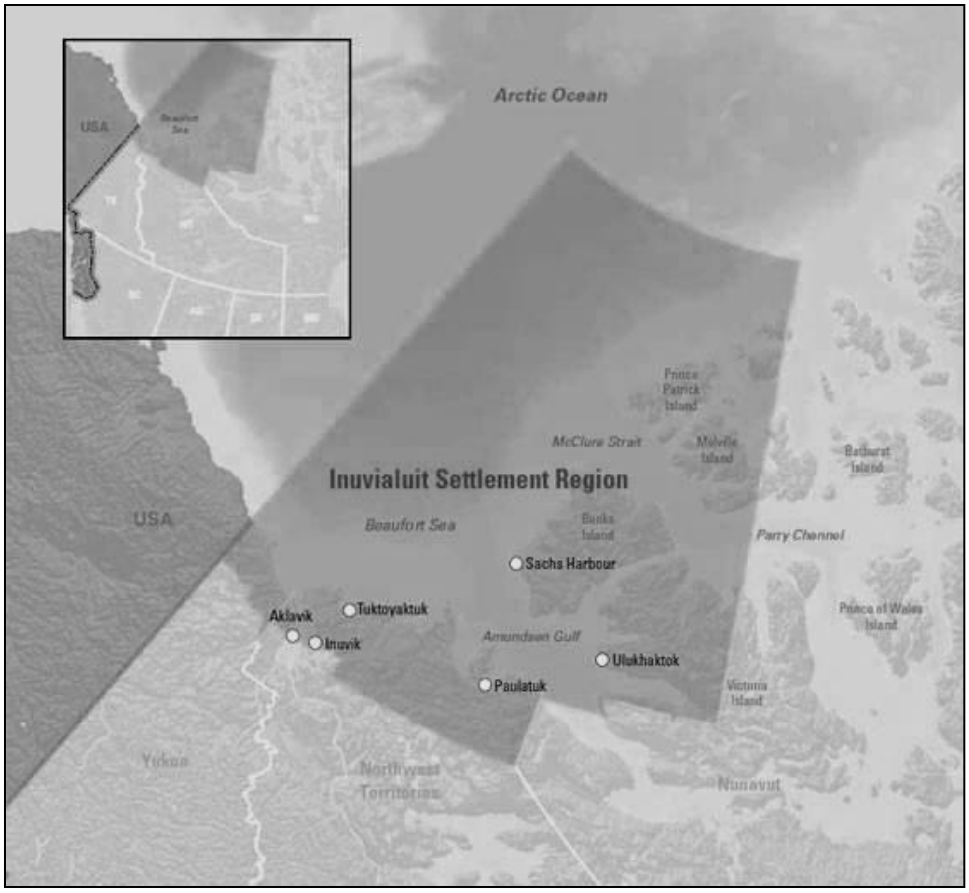

Figure 1: Map of the Inuvialuit Settlement Region (Source: National Energy Board)

2.2.2 Geography Banks Island and Ethnography of the "Bankslanders"

At roughly 70,028 km^2 (27,083 sq mi), Banks Island is the fourth largest of the Canadian Arctic Islands. Its climate is characterized by long, cold winters and short, cool summers. With minimal precipitation (about 4 inches of water annually as both rain and snow), Banks Island was considered an "arctic dessert" (Usher, 1971a). The Island consists of low, flat, and rolling landscapes, almost featureless to the foreign traveler except for the high banks on the extreme Southern point known as Nelson Head. Banks Island is surrounded by the Amundsen Gulf on the South, Prince of Wales Strait along their East coast, and M'Clure Strait to the North. Along the South and South-west shores lies the Beaufort Sea, which receives a steady inflow of cold and relatively unproductive polar water from the Arctic Ocean via a continuous clockwise current known as the "Beaufort Gyre" (Pomeroy, 1997; Stirling, 2002). As the most westerly of

the Arctic Islands, further west beyond the island is a vast, largely unexplored area of generations' old multi-year ice. Today, Sachs Harbour is the sole settlement on Banks Island and is locally known as *Ikaahuk* – "the place where people cross" (BINS, 1975). Provided it's unique history of migrations to and from the Island in historical and more recent time, it is a deserving name!

Banks Island was assumed to be uninhabited until the early 20th century (BINS, 1975), but more recent archaeological explorations suggests that Banks Island has been inhabited at least sporadically for about 3,400-3,500 years- first by pre-Dorset peoples, followed later by the Thule (Usher, 1971a; Muller-Beck, 1977). Excavation of Thule occupations from 500 to 600 years ago

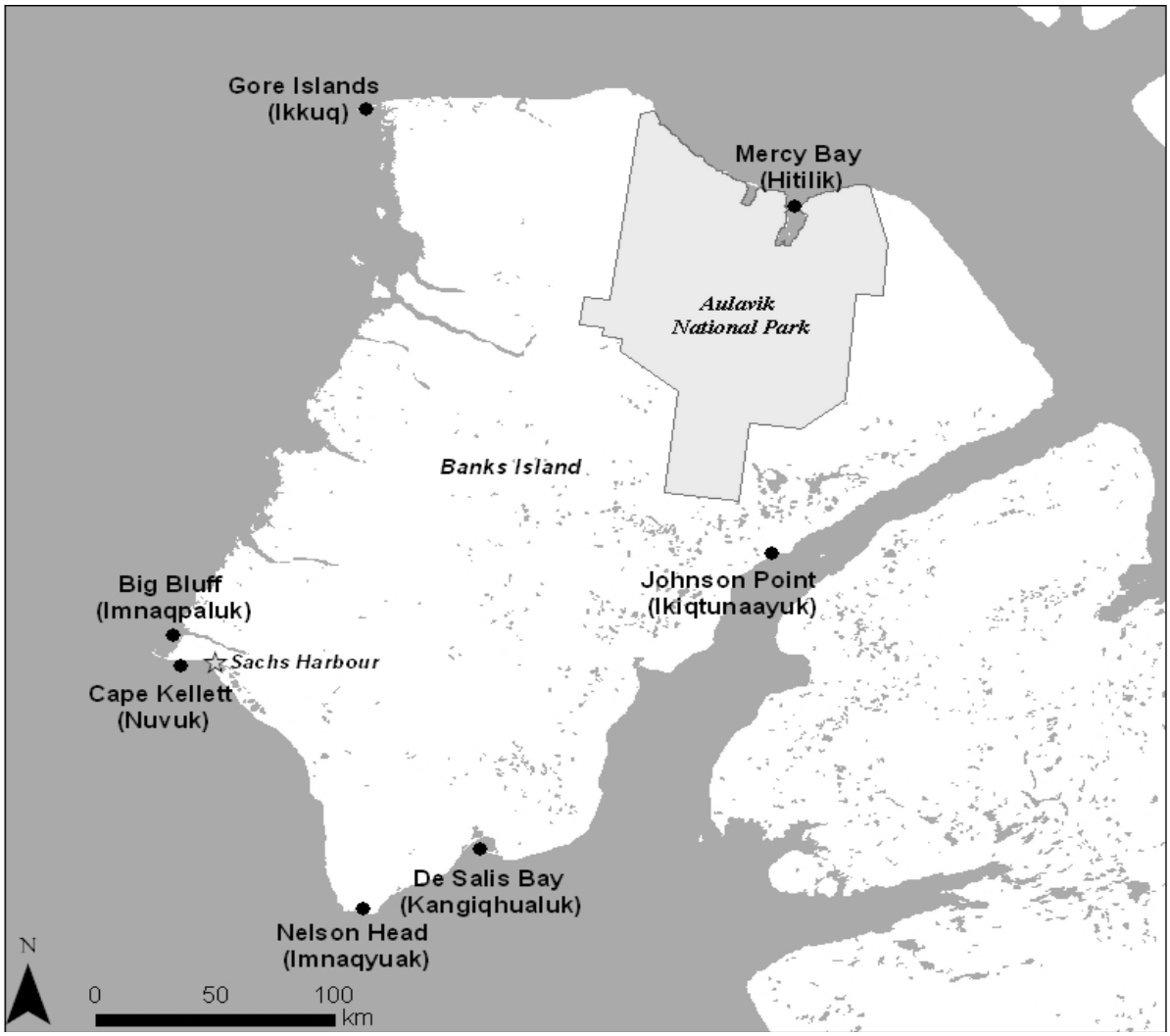

Figure 2: Map of Banks Island, NWT with Traditional Place Names (Source: ENR)

suggest a population of about 150 individuals along the South-west and South-east coast (Usher, 1971a), while more recently examined archaeological sites on Southern Banks Island suggests visits from Inuvialuit ancestors as recently as 1650s to 1820s (Stevenson, 1993).

Prior to the first traders traveling to Banks in 1916, Banks Island was occupied seasonally by the *Kangiryuarmiut* – a group of Copper Inuit from the Walker Bay and Minto Inlet region of Victoria Island (Nagy, 1999; Usher, 1971). This group moved back and forth across Prince of Wales Strait between Western Victoria Island and South-Eastern Banks Island, and as Stefansson (1913) observed, this group was unique in their strong tradition and practice of polar bear hunting:

> [The *Kangiryuarmiut*] live on a diet differing from that of any other Eskimo tribe known to us; for more than three-fourths of their food consists of polar bears, which they hunt with dogs, knives, and bows and arrows on the ice off Nelson head, where the strong currents keep the lanes of water open all winter (p. 453).

In the early 1600s Sir Joseph Banks, the president of the Royal Society in Britain, tasked the British Navy to resume exploration of the Northwest Passage. In 1820, explorers Frederick Beechey and William Parry were traveling along the shore of Melville Island and "discovered" the Island, naming it "Banksland" after Sir Banks (SHHTC, 1992). Several decades later, Captain Robert M'Clure made the first European landing on Banksland on September 7, 1850, in the ship *The Investigator*, a vessel later abandoned at Mercy Bay at the North end of the Island. *Iron*ically, European exploration itself helped encourage the re-settling of Banks Islands, as regular reconnaissance trips were made by the *Kangiryuarmiut* people to salvage wood and *iron* from the *Investigator* at Mercy Bay between 1853 up to the arrival of the Stefansson's Canadian Arctic Expedition in 1914 (Usher, 1971a).

Between 1910 and 1916, Inuvialuit living around the Amundsen Gulf area, were oriented to the trapping economy and the rifle (Usher, 1966). By mid 1910s, Inuvialuit families from the mainland and Victoria Island began traveling to Banks Island to in order to trap white fox (Ayles and Snow, 2002). The first trappers to arrive on Banksland in 1916 were August Mahik and Adolf

Binder, followed soon after by Fritz Wolki and Adam Inualthuyak (SHHTC, 1992). *Natkusiak* ("Billy Banksland"), guide to Stefansson, explored the trapping potential of Banks Island from 1918-21 (Alunik et al., 2003), and in March 1920, Banks Island was made into a Game Preserve by the Canadian government for exclusive use by the Inuvialuit (Usher, 1971a: p. 38).

By the early 1920s, price of furs of muskrat and white fox had increased nearly twenty-fold (BINS, 1975). Fur-bearing animals were harvested intensely, and as Mackenzie Delta trappers attained unprecedented prosperity, they began to invest considerable sums in gas powered whaleboats and schooners[3]. The Inuvialuit who became wealthy from trapping in the Delta were some of the first to regularly travel to Banks Island, sparking what Alunik et al. (2003: p. 125) refer to as the "heyday of schooner captains". Each summer, trappers and their families would travel from Aklavik to Banks Island and return in the autumn. As many as twelve schooners would regularly make this voyage at one time (Alunik et al., 2003. *See figure 3 for list of Schooner names and their Captains*). The first true "Bankslanders" were a group of a dozen or so core families that would return to the Island year after year (BINS, 1975). In the early years, these trappers established seasonal camps in thirteen sites throughout the island that favored safe anchorage and haul-up of the schooners. The main camps were located at Siksik Bay, Storkerson Bay, Sea Otter Harbour, Blue Fox Harbour, Lennie Harbour, De Salis Bay, and Jesse Bay (SHHTC, 1992). Dispersed camps discouraged over-harvesting in one area (BINS, 1975), as "once it was known that one group camped at a particular location, it was unthinkable for another group to encroach on their camp or hinterland" (Usher, 1971a: p. 60).

- *Saucy Jane* [Frank Cockney]
- *Sea Queen*
- *Golden Hine*
- *Beluga* [Charlie Gruben]
- *Shamrock*
- *Lady Richardson*
- *Nanualuk (or Nanuk or Nanuuq)* [Susie Sydney]
- *North Star* [Fred Carpenter]
- *Reindeer* [Sam Lennie]
- *Blue Fox* [Noel Elias]
- *Fox* [Angus Elias]
- *Umingmak* [Paul Adams]
- Qutchigaluk
- Qunnigaluk
- Only Way

Figure 3: List of Schooner Names and Captains. (Cockney 1997, Alunik et al. 2003, S. Lennie pers comm. 2011)

[3] Of the forty-five Inuvialuit families who traded in Aklavik in 1923, most were reported to own schooners valued at between $2,000 and $7,000 each, and over a five year period Usher (1971a) calculated a total investment of over $128,000 in capital equipment.

The first Inuvialuit trappers to over-winter on the Island were Fred Carpenter, Kowitchuk Raddi, Jim Cockney, and Bennet Nigasea, near the present day site of Sachs Harbour (Alunik et al., 2003; SHHTC, 1992). Fred Carpenter described this at the Berger Inquiry in 1976 (Berger 1976):

> [I] moved to Sachs Harbour in 1938. [Me] and Jim Wolki bought a schooner named "North Star", and found the harbor here. [We] heard that it was good for fishing and a good place to live, and [I've] been here ever since… (p. 4031).

The first settlers to Banks Island were from Victoria Island, Tuktoyaktuk, Herschel Island - many were of mixed heritage from early whalers or trappers of European ancestry (Usher, 1971a). To these new arrivals, Banks Island was both a difficult and a bountiful land, and the early settlers had to be especially hardy. Settlement of families onto the uninhabited Banks Island, and the resourceful use and management of the Islands wildlife populations, speaks to the Bankslanders adaptability and resilience. As the highest latitude settlement in the Western Arctic, the winter darkness in Sachs Harbour is longer and more intense than on the mainland, with the sun staying below the horizon for seventy straight days. Trappers would have been limited to no access to firewood or coal for fuel, which would have been available in other settlements through the Western Arctic (Usher, 1971a). The adaptation to the new environment favored immigrants from the coast (i.e. Baillie Island, Tuktoyaktuk, Herschel Island) as opposed to the Delta as they were used to the weather, wind, fauna, and lack of firewood fuel (Usher, 1971a). Furthermore, knowledge of sea navigation was an essential skill for first visitors, as the journey to and from the mainland, although short, was as treacherous as the weather was unpredictable (Usher, 1971a).

The settlement of Banks Island grew with the decline of settlements on Herschel Island, the epicenter of the white fox trade throughout the 1930s, and the expansion of the fur trade beyond the Mackenzie delta (BINS 1975). Usher (1971a) describes how Banks Island was in a unique position due to its isolated location and government policy:

> In terms of the new fur-trade economy, it had become a resource rich area, but due to government policy [i.e. establishment of Game Reserve that excluded non-Native trappers], its lack of a permanent resident population precluded the

> trading companies from being the agents of its exploitation, as under normal circumstances, they would have (p. 39).

As a result, Banks Island trappers were shielded from competition with non-Native trappers.

Unfortunately, by the late 1940s, the white fox fur economy collapsed in the Western Arctic. Only on Banks Island did trapping recover from the "bust", although by 1948 most Banksland trappers, like trappers elsewhere, were seriously in debt to mainland traders (Alunik et al., 2003). Without funds to outfit additional trapping seasons, coupled with a widespread flu epidemic, Bankslanders could not return to the Island in the autumn of 1948, and were grounded on the mainland for several years (Usher, 1976b). This decline was countered by opportunities in the wage economy on the mainland in the 1940s and 50s through the establishment of Inuvik as the new regional centre and the construction of the Distant Early Warning (DEW) line (Alunik et al., 2003). These income opportunities brought scattered populations of Inuvialuit from off the land to permanent settlements such as Inuvik. However, in the Cold War period after WWII with pressure on the Canadian Government to defend Canada's sovereignty in the Arctic Islands, the government was open to providing more support to establishing a permanent settlement on Banks Island (Alunik et al., 2003). The government also became more involved in regulating the fur-trading industry to "control the depletion of animal resources and prevent the destruction of the native livelihood" (BINS, 1975: p. 3).

By 1951 trappers returned and were once again trapping (and flourishing) on Banks Island (Alunik et al., 2003). Following their return in the early 1950s, a different pattern of immigration and settlement emerged on Banks Island, where almost all residents were of coastal origin or had been raised on Banks Island (Usher, 1971a). In Usher's extensive ethnography of Bankslanders, he counted that between 1928 and 1967, of the "95 adult men have trapped full-time for at least one season on Banks Island, almost half were Alaskan lineage (although very few were born in Alaska), with the rest being Mackenzie Eskimo, Copper Eskimo, or mixed-blood in approximately equal proportions" (Usher, 1971a: p.58). Nonetheless, the community was not "saddled with any deep rifts between these two or three group along tribal

or religious lines" (Usher, 1966: p. 29) and Bankslanders' developed an identity as "a distinct group both in their own eyes and those of others, rather than being members of other mainland groups" (Usher, 1971a: p. 62).

Until the late 1950s, Banks Island was known for its remarkable isolation. Throughout the 1950's to 60's, families that had traditionally camped at dispersed sites throughout the island, moved into Sachs Harbor and began erecting wooden buildings on the current site of Sachs Harbour (71°59'N and 125°14'W). Sachs Harbour became a permanent community in 1956. In the early 1950s, Northern Administration and Lands Branch favored establishing a permanent trading post to encourage settlement on the island, but the HBC could not be persuaded to establish a post on Banks Island (Usher, 1971a). Instead, Fred Carpenter, who had long been a leader of the Banksland community, started the Island's first trading post in 1958. No longer tied to the mainland for trading, people began to live year around at Sachs Harbour (Alunik et al., 2003). Families would stay on the island over summer months and shipment of their furs to market would be handled through commercial shipping (Usher, 1971a). The first commercial air flight to Sachs Harbor was made in spring 1948. The establishment of an RCMP regiment in 1953 rooted a government presence on the Island as well as a radio link. Along with a meteorological station (est. 1955), and Roman Catholic and Anglican missions (est. 1962), non-Natives became more frequent on the island. Schooner traffic soon came to an end with the venerable *North Star* making its last voyage in 1961 (Alunik et al., 2003).

The fur trapping lifestyle and economy of Bankslanders from the 1920-1960s could be classified by their hard working, entrepreneurial spirit, amidst lonesome and risky conditions, adapting to new conditions and resources, driven by the promise of a big reward. Usher (1966: p. 29) observed that "Sachs Harbour trappers are highly individualistic and have considerable initiative, which after all, is presumably why they moved to Banks Island in the first place". Trapping was part of the tradition and culture of Banks Island and Bankslanders were among the best fox trappers in the world. In 1975, trapping was the full-time activity of almost every adult

male in Sachs Harbour, with a net income among the highest in the entire NWT (BINS, 1975). Alunik et al (2003) describe the trapping lifestyle at this time:

> The community was small enough – 143 people in 1974 – that town activities did not compete with the trapping way of life. And the introduction of the snowmobile in 1968 greatly extended the trappers range and mobility. During the 1970s, many Banks Island Fox Trappers ran 800 - 1,000 traps on lines up to 500 kilometers long. Checking such a trap line took two weeks on the trails, with six or seven trips a season.

Throughout the 20th century, Sachs Harbour has remained "the most successful example of an Arctic settlement that was founded and continues to thrive upon the fur trapping industry" (BINS, 1975: p. 8). Today, Sachs Harbour is the smallest community in the Inuvialuit Settlement Region with 112 residents (NWT Bureau of Statistics, 2011). Modern Bankslanders participate in a mixed-subsistence based economy (Walker and Wolfe, 1987), where throughout the year, they harvest caribou, muskox, arctic hare, bearded seal, ringed seal and polar bear, along with several fish and bird species for food (Riedlinger, 2001). With weekly-charter services to Inuvik, access to satellite television and Internet, the community is no longer isolated as it once was.

In conclusion, although the settlement of Banks Island was relatively recent in terms of historical occupation, due to the close interaction with and continued reliance on land and marine animals for subsistence and economic purposes, the people of Sachs Harbour have considerable knowledge of the environmental conditions on the island and sea ice. Their reliance on the land and ice for income and subsistence has emphasized the importance of monitoring and learning from their environment.

2.3 Research Context

While the intention of this thesis is to provide knowledge and information about polar bears from the perspective of the Inuvialuit, it is important to set the context of polar bear ecology and provide a very general summary of the findings of current biological research on the species, and frame this issue in the context of current management issues and the legal and

policy framework for incorporating traditional knowledge into polar bear research and management.

2.3.1 Polar Bear Population Health in the Western Arctic

Polar bears (*Nanuut, Ursus maritimus*) are large white bears (although classified as marine mammals) that are found throughout the ice-covered Arctic seas and along the coastline throughout the circumpolar Arctic regions. Polar bears live mostly on the sea ice and in marine environments, but will den, travel, and occasionally feed on-land on the Arctic Islands and along the Beaufort coast. Polar bears cover large ranges and are constantly moving in order to find ideal ice conditions and an abundance of seals. Polar bears are an opportunistic predator, but specialize in hunting ice-dependent seals. Their diet consists mainly of ringed seals (*Phoca hispida, natchiit*[4]) and bearded seals (*Erignathus barbatus, ugyuit*[5]) in most of their range. Although polar bears are capable of catching seals of all age classes, seal pups (young-of-the-year) form the bulk of their diet (Stirling, 2002). The distribution of seals (and consequently of the polar bears that hunt them) is strongly influenced by the distribution of shore leads, polynyas, and areas of annual and multi-year ice, and by both short- and longer term variations in the pattern of freeze-up and breakup (Stirling, 2002).

In ecological terms, a population can be defined as group of individuals of one species, occupying a defined area and usually isolated to some degree from other similar groups (Lincoln et al., 1982). In regards to polar bears in Canada, as the term "population" simply means the individual polar bears that inhabit a given geographic area (Taylor and Lee, 1995). Ricklefs (1986) notes "ecologists apply the term 'population' very loosely to pragmatically defined assemblages of individuals of one species" (p. 507). This is the case in defining polar bear populations in Canada, as population boundaries were chosen to conform to this above criteria, but also to be as small as possible to confer a sense of stewardship on the communities that harvest polar bears from the population (Taylor and Lee, 1995). Nineteen subpopulations of polar bears are recognised by the IUCN/ Species Survival Commission Polar Bear Specialist

[4] Siglitun translation of ringed seal (Lowe 2001).
[5] Siglitun translation of bearded seal (Lowe 2001).

Group (PBSG, see fig. 4), of which, adequate scientific trend data exist for only three of the subpopulations, fair trend data for five and poor or no trend data for the remaining eleven subpopulations (PBSG, 2010).

Figure 4: Circumpolar distribution of Polar Bear sub-populations (Source: IUCN Polar Bear Specialist Group, 2006).

There are three sub-populations of polar bears in the Inuvialuit Settlement Region of Canadian Western Arctic, chosen based on analysis of movement data from mark-recapture studies and tracking of adult female bears with satellite radio collars (Stirling, 2002): the Northern Beaufort (NB) population that inhabits the west coast of Banks Island and Amundsen Gulf; the Southern Beaufort (SB) that is resides along the mainland coast from Cape Bathurst in Canada to roughly Icy Cape in Alaska; and the Viscount-Melville (VM) population of the high Arctic Islands. The Inuvialuit of Banks Island hunts the NB population and, very occasionally, the VM population.

Research on polar bears in the Beaufort Sea has been ongoing since the late 1960s (Amstrup et al., 1986; Stirling, 2002; Stirling et al., 2011). Recent biological studies suggest that the South Beaufort subpopulation is currently declining due to sea ice loss, and based on projections of

global climate models, it is anticipated by wildlife scientists that the South Beaufort subpopulation will face extirpation in the next 100 years (Durner et al., 2009; Hunter et al., 2010). Current research suggests that the size of the North Beaufort subpopulation has remained stable at approximately 1,200 bears as a result of relatively stable ice conditions and lower harvest pressure (Stirling et al., 2011).

Whereas human-caused mortality was once perceived as being the most serious threat to polar bears (Taylor et al., 1987), with amplified climate change, it is anticipated that the overall decreases in the distribution and abundance of both annual and multiyear sea ice caused by climate change has the potential for profound negative impacts on their populations (Derocher et al., 2004; Stirling and Derocher, 1993; Stirling et al., 1999; Amstrup et al., 2006; Stirling and Parkinson, 2006; Regehr et al., 2007). Scientific studies predict that spatial and temporal reductions in sea ice changes will lead to nutritional stress through reduced availability and abundance of seals, the main prey of polar bears, which will in turn impact the health and reproductive performance of polar bears and hence survival of their young (Derocher et al., 2004; Stirling, 2002; Stirling and Derocher, 1993). As a result of these stressors to their habitat and food availability, scientists expect that the overall range of polar bears will be drastically reduced and specific populations will decline in numbers, or even become extirpated (Stirling and Derocher, 1993). Several studies have provided substantial ample evidence that polar bears in most subpopulations will experience significant declines in their sea ice habitat over the next 50 to 100 years, if not sooner (ACIA, 2005; Amstrup et al., 2008; Serreze and Rigor et al., 2006; Parkinson and Cavalieri, 2008; Vongraven and Peacock, 2011).

2.3.2 Polar Bear Research and Co-Management in the ISR

Marine mammal populations such as polar bear, pinnipeds, and cetaceans, are inherently more difficult to study than their terrestrial counterparts (Mace and Purvis, 2008). Polar bears, by their very nature, and the extreme, remote vast environment of the Circum-arctic landscape and icescape in which they live, are inherently difficult to study and monitor. The harsh climate encountered during the winter season (up to 8 months of the year), the extensive distribution and migration behavior of the species, the high cost of travel, and other logistic considerations

in the isolated regions present challenges to researching polar bear populations with accuracy and consistency. The financial, logistical, and political challenges of consistently conducting scientific surveys across the distant subpopulations, requires a long-term commitment to research and monitoring be effective (Vangroven and Peacock, 2011). To this end, government guidelines and agreements with local communities propose to conduct population inventories on a 10 – 15 year cycle (Vangroven and Peacock, 2011). However, the success in these programs and the frequency, intensity, and scope of research is highly dependent on the consistency of funding and capacity for both regional, federal academic initiatives, as well as support from local communities, which is becoming less predictable as a result of opposition to the capture and handling of polar bears (Vangroven and Peacock, 2011).

Polar bears are considered one of the most comprehensively managed (non-commercial) species worldwide (Fikkan et al., 1993). The coordination between the international researchers and stakeholders through bodies, such as the IUCN Polar Bear Specialist Group, has been one of the hallmarks of these efforts (Prestrud and Stirling, 1994), although the discourse at these agencies remains overwhelmingly that of science-based wildlife conservation (Berkes et al., 2005; Clark et al., 2008). Within Canada, polar bears are managed by a complex network of government agencies, academic researchers, Aboriginal governments, and co-management organizations. These include the Federal-Provincial-Territorial Polar Bear Technical Committee (PBTC), and the Polar Bear Administrative Committee (PBAC).

In the Canadian Western Arctic, wildlife management must be viewed within the framework of co-management that was established through the Aboriginal land claims process. Co-management has been defined as the sharing of power and responsibility between the government and local resource users, through various levels of integration of local and state level management systems (Notzke, 1995; Carlsson and Berkes, 2003). Co-management agreements define the system of rights and obligations for stakeholders for the resource or region, including the collection of rules indicating actions that subjects are expected to take in

various circumstances, and the procedures for collective decision-making that affects the interests of government actors and user organizations (Osherenko, 1988).

Following ten years of negotiations, the Inuvialuit Final Agreement (IFA) was signed on June 5, 1984. The IFA was the first comprehensive land claim agreement signed North of the 60th parallel, and only the second comprehensive land claim in Canada at that time. The goals of the IFA are to preserve Inuvialuit cultural identity and values within a changing Northern society, enable Inuvialuit to be equal and meaningful participants in the Northern and national economy and society, and protect and preserve the Arctic wildlife, environment and biological productivity. In regards to the final goal, the IFA established three co-management bodies responsible for "conservation" of wildlife within the ISR: The Wildlife Management Advisory Council (North Slope), Wildlife Management Advisory Council (WMAC-NWT) and Fisheries Joint Management Committee (FJMC). The IFA also established the Inuvialuit Game Council (IGC), which represents the collective Inuvialuit interest in all matters pertaining to the management of wildlife and wildlife habitat in the Inuvialuit Settlement Region. It consists of a Chair and a 12-member board involving two representatives from each of the Hunters and Trappers Committees in the communities. The Inuvialuit Game Council is the primary vehicle for wildlife management and has authority to make recommendations to the NWT Minister of Environment and Natural Resources for any management changes within the ISR, including quotas. These collective organizations act as forums to share information at many scales- between scientist, between communities, across political boundaries, and even at a larger scale through participation in many international organizations (i.e. PBSG, IUCN).

2.3.3 Incorporating Traditional Knowledge into Polar Bear management

Through the negotiation and settlement of Aboriginal land claims throughout Northern Canada, and establishment of co-management regimes, there has been a shift in the distribution of power in wildlife management systems (Nadasdy, 2003; Armitage and Clark, 2005). Traditional knowledge of Inuit and First Nations must now be considered alongside science as the basis for decision-making (Berkes, 1999; Treseder et al., 1999; Menzies, 2006). However, Nadasdy (1999 & 2003) argues that using traditional knowledge along with scientific research requires

Indigenous peoples fundamentally change their way of presenting their knowledge and culture in a form that is compatible with scientists and resource managers, thereby forcing Indigenous peoples to conform to institutions of state management rather than their own beliefs, values, and practices. Nadasdy (2003) and Cruikshank (2004) have determined that involving traditional knowledge in research and management has fundamentally changed how that knowledge is communicated and assert that when traditional knowledge is modeled according to western science it "heads in bureaucratic directions" and "forces indigenous people to speak in uncharacteristic ways" (Cruikshank 2004: p. 27). Dowsley and Wenzel (2008) specifically recognized this epistemological clash in relation to Inuit and polar bear management, concluding that "the differences between *Inuit Qaujimajatuqangit* and scientific knowledge are not fully understood and accounted for within the co-management system, and that the system does not effectively integrate Inuit cultural views into management" (p. 177). Others argue that co-management arrangements must recognize such epistemological differences and find some way to accommodate them, or else they will fail (Osherenko, 1988; Prystupa, 1998; Taiepa et al., 1997). Therefore, while co-management is one mechanism to re-distribute power and decision-making to Indigenous groups and incorporate traditional knowledge into wildlife management, to suggest that it is a bridging mechanism between the science and traditional knowledge may mask deep cultural disagreements, and restrict the ways of talking about important issues (Cruikshank 2004).

Regardless of these critiques, at the territorial level in Canada, the incorporation of Inuit traditional knowledge (referred to conceptually as *Inuit Qaujimajatuqangit (IQ)* in Nunavut) has been policy since the early 1990s (Wenzel, 2004). In Nunavut, the role of *IQ* in polar bear management has increased significantly since the 1990s through its direct use in quota-setting procedures (Dowsley and Wenzel, 2008). Meanwhile, the Government of the Northwest Territories adopted a "Traditional Knowledge Policy", recognizing that "Aboriginal traditional knowledge is a valid and essential source of information about the natural environment and its resources, the use of natural resources, and the relationship of people to the land" and as policy, sought to "incorporate traditional knowledge into Government decisions and actions

where appropriate" (GNWT, 1993: p.11). In the Western Arctic, the Inuvialuit Final Agreement states, as a principle, that "the relevant knowledge and experience of both the Inuvialuit and the scientific communities should be employed in order to achieve conservation" (Canada, 1984: article 14.5).

At a National-level, federal legislation on species at risk has explicit requirements for input by Aboriginal Peoples at all stages of designation and recovery. The Species at Risk Act (SARA) requires "the traditional knowledge of the Aboriginal peoples of Canada should be considered in the assessment of which species may be at risk and in developing and implementing recovery measures" (SARA, 2002: s.15(2).). The terms of reference for the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) already require the status of species to be assessed according to criteria based on science, and to include traditional and local knowledge. To this end, COSEWIC established the Aboriginal Traditional Knowledge Subcommittee to facilitate access to and gathering of the available traditional knowledge, as well as guide the incorporation of that knowledge into the COSEWIC species status assessment process. Environment Canada, the key government agency for polar bear research, claims to be basing its research on a combination of science, experience and traditional knowledge, on the basis that "the inclusion of traditional knowledge helps to provide information on polar bear abundances, movements, behaviors, and provides valuable long-term perspective on changes in the population" (Environment Canada, 2012). This approach is unique, as according to Environment Canada, Canada is currently the only country that considers traditional knowledge in the management and conservation of polar bear (Environment Canada, 2012).

Within the International scientific forum of the IUCN Polar Bear Specialist Group (PBSG) held concerns about incorporating traditional knowledge in polar bear management. This fundamental debate came to head in December 2004 with the substantial increase in Nunavut's polar bear harvest quotas based on *IQ*, which can be considered one of the most contentious recent decisions about polar bear management to date (Clark et al., 2008). Shortly after this controversy, the PBSG made a resolution "that polar bear harvests can be increased on the basis

of local and traditional knowledge only if [that knowledge is] supported by scientifically collected information" (PBSG 2005: p.57). At the most recent Polar Bear Range States Meetings in Iqaluit 2011, representatives of the Range States (comprising the five countries which signed the Agreement on the Conservation of Polar Bears in 1973- Canada, United States, Denmark (Greenland), Russia and Norway) agreed that polar bears play an important role for people living in Northern regions, and that traditional knowledge should complement science in polar bear management across the range of the polar bear (Rogers, 2011).

Traditional knowledge studies of polar bears have been conducted elsewhere across the Arctic, including Baffin Bay (Dowsley, 2005; Dowsley and Wenzel, 2008), Taloyak (Keith and Arqviq, 2006), Gjoa Haven (Keith et al., 2005), Foxe Basin (Sahanatien, 2011), Greenland (Born et al., 2011), the Alaska coastline (FWS, 1995; Kalxdorff, 1997), Chukotka (Zdor, 2007). While extensive biological research has been carried out on the Southern and Northern Beaufort polar bear populations (i.e. Amstrup and Gardner, 1994; Regehr et al., 2006; Stirling, 2002; Stirling et al., 2008), at the time of commencing my research, there had not been a traditional knowledge study or a study on the Inuvialuit perspective of polar bears in the region. However, in the years since, several other studies have taken place and been published, including Slavik (2009) and Richardson (pers. comm., 2011). An extensive field study of Inuvialuit knowledge of polar bears was initiated in 2009, and results of this research will be published in 2013.

In conclusion, the legal and policy framework to incorporate traditional knowledge into conservation decision-making is present, but many feel that there still exists conflict, misunderstandings, and lost opportunities to incorporate traditional knowledge with science for the sake of better understanding polar bear population health. As discussed in the previous section, part of the reason for this conflict is epistemological differences and imbalances in "power relationships between western experts and aboriginal experts who have different political agendas and who relate in different ways to the resource in question" (Berkes 1999: 11). As a result, research on polar bears involving Inuit and Inuvialuit communities is not a

simple or objective endeavor and is complicated by the social-cultural and political context of polar bear management.

2.4 Theoretical Context

This research aims to contribute to discussions within the wildlife management and traditional knowledge literature better understanding Inuvialuit knowledge of polar bear population health, and by exploring the traditional signs and signals (indicators) that are used to holistically assess the health of individual polar bears and the population health. This literature review establishes the theoretical context for addressing this question by summarizing previous research of traditional knowledge in relation to research and management of polar bears and Northern wildlife and identifying the knowledge and indicators used by Inuvialuit (and Inuit) to assess polar bear population health.

2.4.1 Traditional Knowledge

While a key goal of this research is to document Inuvialuit knowledge of polar bears and their ecology, we must first understand what traditional knowledge is, as defined within the literature. Traditional knowledge has been defined 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 with one another and the environment" (Berkes 1999: p.8). One of the more comprehensive and specific definitions was developed by the Traditional Knowledge Working Group of the Northwest Territories (Legat 1991: p.1), which defines traditional knowledge as:

> Knowledge that derives from, or is rooted in the traditional way of life of Aboriginal people. Traditional knowledge is the accumulated knowledge and understanding of the human place in relation to the universe. This encompasses spiritual relationships, relationships with the natural environment and the use of natural resources, relationships between people; and, is reflected in language, social organization, values, institutions, and laws.

Usher's (2000) broader definition of traditional knowledge, which I found more pragmatic in application, refers specifically to "*all types* of knowledge about the environment derived from experience and traditions of a particular group of people" (p. 185). In the context of this

research, traditional knowledge also encompasses place-based observations, both historical and contemporary, which inform the understanding and perspectives of one's environment.

As Nadasdy recounts in *The Politics of TEK* (1999), "the most fundamental and least examined concept underlying the idea on TEK is that of "knowledge". Traditional knowledge is developed through evolving livelihood practices, social institutions, and spiritual beliefs, and is maintained largely through an accumulating and evolving oral history (Cruikshank, 1998). While the term "traditional" suggests a foundation based upon historical observations, past experiences, and oral histories, Indigenous peoples' traditional knowledge is not frozen in the past, but is an accumulation of adaptive responses that evolve over time and are still evolving (Berkes, 1999). As a system of knowledge, it is cumulative, adaptive, and dynamic; and like western science, the two ways of knowing are "distinct, but equally positive sciences" that Berkes (1999: p. 9) compares as a "parallel mode of acquiring knowledge about the universe".

As a system of knowledge, traditional knowledge is developed and transmitted on two levels: the "natural" level, how it exists in the organic system; and the "cultural" level, how it is perceived and encoded within the human and social systems. From the Inuit point of view, traditional knowledge is not so much knowledge, as it is a way of life - there is no separation between nature and culture, people are part of the environment and the environment is understood through their cultural lens (Berkes, 1999; Ingold, 2000). Their worldview and culturally based cosmology is the foundation their traditional knowledge and relates to the assumptions and beliefs about how things work, the way in which things are connected, and the role of humans in the world which guides their human–animal relations. (Houde 2007; Neis et al. 1999, Nickels 1999).

As a holistic method of understanding the environment, traditional knowledge is deeply rooted in the cultural context of place, which includes the people and their stories of the environment- there is no separation between nature and culture- and people are part of the environment and the environment is understood through their cultural lens (Ingold, 2000). Because traditional

knowledge is embedded within a particular community and is contextually bound to the history and culture it develops from, its examination requires a commitment to the local context (Agrawal, 1995). To this end, *Inuit Tapiriit Kanatami* (ITK) cautions against combining or generalizing very complex knowledge from different locations, groups and context in to present a generic picture of local Inuit knowledge which is, in fact, distinct or unique (ITK and NRI 2007).

Traditional knowledge or "TK"; is also commonly and often interchangeably referred to in social and natural science literature as Traditional Ecological Knowledge or "TEK". In the Canadian North, it is often synonymous with terms such as Local Knowledge, Local Expert Knowledge (LEK) or Aboriginal Traditional Knowledge. Within Nunavut, Inuit Traditional Knowledge is a component of *Inuit Qaujimajatuqangit or* IQ (see Wenzel 2004). As the terminology and significance of these terms for traditional knowledge varies between cultural groups and individual preference, for the sake of this thesis, I will use the term "traditional knowledge" when referring to traditional knowledge as a general concept (inclusive of TEK, LEK, and IQ), and the term "Inuvialuit knowledge" when revering to the specific knowledge systems and observations specific to Inuvialuit people and communities, including Sachs Harbour. The following section defines traditional knowledge as it specifically relates to the Inuvialuit.

Within the *Inuvialuit Region Traditional Knowledge Report*, Inuvialuit define their traditional knowledge as "the knowledge gained by Inuvialuit individuals through traditional learning patterns (e.g. stories and songs), and through living on and using the land… observing, listening, testing, determining and experiencing all play considerable roles in retaining traditional knowledge" (MPEG, 2006: 6.1.1). In this regard, Inuvialuit recognize knowledgeable elders are the most valuable resource that Inuvialuit had in the past and have today (MPEG, 2006). Nelson write in *Hunters of the Northern Ice* (1969), referring to the Inuit of Northwest Alaska:

> [Inuit] are traditionally concerned with knowing as much as possible, and individuals are given special respect and prestige if they are especially knowledgeable. Thus they are willing and anxious to learn from their fellows, both by watching them as they hunt and by listening as they recount their

experiences or relate what they have heard from others (p.374).

The sharing of knowledge is highly valued in these societies of oral tradition (Usher et al., 1995). As discussed in *Inuvialuit Pitqusiit* (GNWT Dept. Education, 1991):

> In the time before the Inuvialuit had books, our elders, both men and women, were the keepers of Inuvialuit knowledge…The hunters especially relied heavily upon the stories and advice given by their elders so they could become better hunters and leaders (p.13).

In summary, traditional knowledge is highly valued and central to the survival, culture, and identity of the Inuvialuit and through years of accumulated experiences and place-based observations, holds wisdom, insight, and perspective into the complex Arctic environment.

2.4.2 Traditional Knowledge and Wildlife Research in the Canadian North

In regions where scientific studies have been limited, traditional knowledge and observations of the local of indigenous peoples can often provide a useful, complementary data source for managing wildlife species (Johnson, 1992; Freeman, 1993; Barsh, 1997; Ferguson et al., 1998; Gilchrist et al., 2005; Moller et al., 2004). Within the context of wildlife and resource management in the Canadian North, over the past several decades, several scholars have discussed distinctive characteristics of traditional knowledge in comparison to Western scientific knowledge (see Freeman 1985; Gunn et al., 1988; and Berkes, 1993; etc,), which has lead to extensive discussions (sometimes pragmatic, sometimes, purely academic) about the benefits (Berkes, 2008; Huntington, 2000) and challenges (Agrawal, 1995; Nadasdy, 2003) of incorporating traditional and scientific knowledge in wildlife and resource management. Several case studies in the Canadian Arctic have asked how traditional knowledge can enrich and expand understandings of complex environmental changes, and how, and to what extent, can it be used for monitoring ecosystem change (Berkes et al., 2007; Peloquin and Berkes, 2009; Riedlinger and Berkes, 2001). This section will explore literature that examines how traditional knowledge can contribute to ecological monitoring of wildlife within the complex Arctic ecosystem.

Traditional knowledge has provided insight into historical trends and specific ecological information on several different species, especially throughout the Arctic (Ferguson et al., 1998; Huntington et al., 1999; Gilchrist et al., 2005). Traditional knowledge and observations have served as a red flag to draw attention to changes in particular species (Mallory et al., 2003), improve baseline data on species and ecological processes (Nakashima, 1991; Ferguson et al., 1998; Mallory et al., 2003), and broaden the range of inquiry through formulating research questions and hypotheses (Riedlinger and Berkes 2001; Berkes et al. 2007; Berkes and Armitage, 2010). Insights, testimony, and observations from traditional knowledge are significant as a cost-effective means to fill knowledge gaps and increase the sample size needed to asses and monitor change in the status and trends in population abundance, density and distribution of species (Riedlinger 2001; Moller et. al. 2004). The contribution of local resource users in monitoring on-going or unique environmental changes and environmental anomalies is necessary for adaptive management (Riedlinger, 2001; Parlee et al., 2005, Moller et al., 2004). Oral history and harvesting experience can inform baseline data, monitor locally-based population trends, and distinguish natural variability from non-natural or unexpected change (Riedlinger 2001). As such, Inuvialuit knowledge, observations, and experiences have been recognized as essential components in sustaining the monitoring and management of wildlife in the Western Arctic (SHHTC 2000).

Providing the ability to help detect important changes and provide the needed on-the-ground and on-going monitoring, traditional knowledge contributes to adaptive management and wildlife co-management partnerships, especially in times of rapid change (Moller et al., 2004). Within the context of co-management, researchers and resource managers recognize the importance of cooperation and engaging local stakeholders as part of a constructive partnerships, to develop a shared conservation concern and improved cultural understanding between scientists and communities (Zabel et al., 2002; Gilchrist et al., 2005; Moller et al., 2004). As is often stated in the literature supporting co-management of wildlife, by including traditional knowledge with that of scientific knowledge, the resulting resource management system is better informed and suited to the resources, the people who rely on it, and the needs of scientists and conservationists (Nuttall, 2000). For example, in her work on Banks Island, Nagy

(2004) advocated that "[traditional] knowledge provides us with hints as to the rich behavior of Arctic mammals, but also with wisdom on how to arrange wildlife so as to suit local needs" (p.93). Beyond providing important information, observations, and indicators that help to direct scientific investigation, incorporating traditional knowledge is an important tool to help develop wildlife research and management policies that incorporate cultural values (Gunn et al., 1988; Gilchrist et al., 2005). These processes help to develop a consensus in identifying the state of the resource or health and abundance of wildlife population and help to develop mutual understanding regarding management actions to ensure the sustainability of the resource. More significantly, the processes of combining scientific and traditional monitoring methods not only builds partnerships and community consensus, but also, and more importantly, "allows indigenous wildlife users to critically evaluate scientific predictions on their own terms and test sustainability using their own forms of adaptive management" (Moller et al., 2004: p.1).

However, while many wildlife biologists appreciate traditional knowledge for its variety of observations, they are often critical of the methodologies informing traditional knowledge as being unquantifiable, often unverifiable, and therefore unreliable. Hence, biologist are cautious about incorporating traditional knowledge as inaccurate data may lead to flawed interpretations and inappropriate and ineffective decision making (Walters and Hilborn, 1978; Ludwig et al., 1993; Gilchrist et al., 2005). Evidence that traditional knowledge has been received skeptically by biologists and wildlife managers is the lack of peer-reviewed articles that incorporate it within the biological literature (Nadasdy, 2003; Gilchrist et al., 2005). Two critiques that are appropriate for the continued discussion involve, first, the scale of observations and interpretations traditional knowledge can accurately inform, secondly, the reliability and credibility of traditional knowledge amidst the rapid socio-ecological changes taking place in the North.

In regards to the first criticism, while traditional knowledge is almost always derived from local-level observations, it may not always translate well into discussions of wildlife health at the population level across the larger geographic scale-- especially in areas where no harvest occurs

(Dowsley and Wenzel, 2008). Local observations are often criticized for being specific to individual animals or events without incorporating the larger ecosystem or population levels which scientists focus their research. In these instances, it is argued that science can sometimes offer "better tests of potential causes of population change by research on larger spatial scales, precise quantification, and evaluation of population change" (Moller et al., 2004: p. 1).

Secondly, the pace of socio-ecological change in the North has also raised concerns about the credibility and reliability of traditional knowledge (Fast and Berkes, 1998). In respect to accompanying ecological changes, Riedlinger and Berkes (2001) concluded that certain environmental cues become difficult to interpret under conditions of climate change. Lent (1999) argues that, "even if [traditional knowledge] were being adequately maintained, passed on and applied to resource management, changes in Northern ecosystems are occurring that are beyond the scope of that knowledge" (p. 272). Socio-economic, technological, and international wildlife policy present challenges to the transmission of traditional knowledge and skills to younger generations of harvesters, as declining subsistence hunting and guiding opportunities could threaten the transmission of Inuit knowledge of polar bears (Keith et al., 2005). Keith et al. (2005) documented in Gjoa Haven, NU, that "modern methods used by hunters on personal polar bear hunts or even guided hunts, continue to use *IQ* related to polar bear habitat and tracking; however, other skills and knowledge are not being maintained" (p.59). Similar changes have been recorded in Inuvialuit communities (Pearce et al. 2011). In regards to knowledge of sea ice, a critical knowledge and skill for polar bear hunting, Aporta (2005) observes that "the context for learning has greatly changed, as elders do not often find a suitable context for transmitting what they know to younger generations, and formal education does not generally focus on local knowledge, and even less on Inuit knowledge" (p.222).

While some scientists criticize and dismiss traditional knowledge, others are overly optimistic that traditional knowledge can address all research questions pertaining to Arctic environmental change (ITK and NRI 2007). In order for traditional knowledge to be applied more appropriately in resource management, many scientists and policy makers often require that it fit the rigors of

positivistic western-science models. Cruickshank (2004) argues that traditional knowledge should not have to "provide answers to problems created by modern states, in terms convenient for modern states" (p. 22). These critiques further expose the power dynamics between Indigenous knowledge and scientists who attempt to apply this knowledge in a western science framework (Agrawal 1995; Berkes and Henley, 1997; Bielawski, 1992; Houde, 2007; Huntington, 2000).

Feyeraband (1987) acknowledges the intolerance of many scientists toward knowledge and insights that originate outside of their institutionalized western science. In order for traditional knowledge to be used alongside scientific research, some are of the view that it must be analyzed and presented through a western science framework. Several authors have expressed their concern with the "scientization" of traditional knowledge, which ultimately results in the separation on knowledge considered "useful" and that perceived by scientists to be "useless" (Bielawski, 1992; Berkes, 1999; Agrawal, 2002) Furthermore, in the scientific paradigm of management, it is often argued that science compartmentalizes and de-contextualizes traditional knowledge to filter out the practical knowledge from the anecdotal stories (Berkes, 1999; Nadasdy, 2003; Cruikshank, 2004). This promotes both specializations of certain knowledge and discourse, while encouraging the exclusion of others. As Foucault (1971) warns us "we are unaware of the prodigious machinery of the will of truth, with its vocation of exclusion" (p. 220). Meanwhile, Cruickshank (2004) observes how biological classification and coding tend to work with the surface features of traditional knowledge. This distances knowledge holders from their lived experiences, and drains the rich context from the narrative. Unfortunately, in an attempt to make very complex knowledge understandable, local knowledge is often separated from the context in which it is situated (ITK and NRI 2007).

A specific epistemological difference between western science and traditional knowledge is in terms of the scope of knowledge. Nagy (2004) argues that scientists take a reductionist approach, looking for discrete causation, while traditional knowledge looks at holistic systems and patterns of interrelation between animals. A reductionist approach is often applied to many

traditional knowledge studies, examining individual species, or at most, a handful of important species rather than ecosystem interaction. This approach conforms not to the views of native elders and hunters, but to the needs and specifications of the scientists, policy makers (and graduate students), who are researching and managing these populations in an established institutionalized setting.

These critiques present obvious and persistent challenges to both documenting traditional knowledge and making it available in a format that is useful and reliable in wildlife management and decision-making. When combined with concerns over categorizing and de-contextualizing traditional knowledge, Berkes (1999) concedes that "writing down will never be an adequate format for the teaching of indigenous knowledge" (p. 28). Due to the complex cultural, spiritual and economic role that polar bears play to the Inuit, this research attempts to document and present traditional knowledge in a way that is representative to Inuvialuit culture and ways of knowing, and attempts to honor the knowledge of the Inuvialuit of Sachs Harbour and their ways of knowing *Nanuut*. As further discussed in the methods section, Fehr and Hurst (1996) and Huntington (2000) provided some guidance in how to respect power dynamics and design this methodology accordingly. Likewise, due to the complex ecosystem interactions in the Arctic between species and their environment, it would be unwise to look at a single species without examining broader ecosystem trends. Nagy (2004) and Nadasdy's (2003) guidance to look at the holistic, socio-ecological issues outside of polar bear populations was key to designing this study. Semi-directed interviews and other social science methods allowed for a more holistic and inclusive scope to be applied to this research and better understand the longitudinal observations, holistic knowledge, and logic shared by the community. Recognizing that while this research attempted a more holistic and ecosystem scope of inquiry, a complete understanding of the depth of knowledge and ways of knowing would require a lifetime of study and practice.

Despite these epistemological challenges, today, the value and utility of traditional knowledge is recognized at multiple levels, as local resource users, researchers and decision makers have

moved beyond the point of demonstrating the value of traditional knowledge and towards the discussion on how this knowledge can be documented and applied to some of the significant conservation challenges faced in the 21st century (Usher, 2000). Utilizing traditional knowledge in wildlife management and decision-making requires balancing and respecting the strengths, limitations, and appropriate applications to utilize its strengths, while acknowledging and controlling for challenges to its accuracy and veracity. In light of these challenges, due to the growing need for information on local environmental changes, community based monitoring of ecological indicators is gaining increasing interest as a tool to address the challenges of expensive biological research programs, and allows for the involvement and recognition of resources users in the research and management processes (Moir and Block, 2001; Weber, 2003; Fernandez-Gimenez et al., 2008).

2.4.3 Ecological Indicators

Ecological indicators are used by many indigenous peoples to understand and communicate ecological change (Berkes, 1999; Berkes et al., 2000; Parlee et al., 2005). These indicators can relate to the mundane, the predictable, or the novel (Davidson-Hunt, 2006). The approach of using a holistic suite of simpler indicators, as used in traditional monitoring techniques, as opposed to a select few detailed and costly indicators, is finding favor in western science and wildlife management, especially in light of increasing ecosystem complexity:

> Unlike common scientific indicators, local indicators do not produce formalized generalizations but provide holistic snapshots of the environment on a continuous time scale. This gives community-based indicators built-in flexibility to be modified with changing conditions… This is because the use of a few indicators, no matter how well chosen and researched, seem to be inadequate in reflecting ecosystem complexity (Berkes et al., 2007: p. 154).

In designing and developing these new approaches for monitoring, significant focus and energy have been placed on finding indicators that are based on traditional knowledge (Berkes, 1999; Parlee et al., 2005). In *Sacred Ecology*, Berkes (1999) asks "what are the prospects for designing community-based monitoring systems that do not merely use local technicians for scientific monitoring, but are based on TEK?" (p.188). Traditional monitoring techniques based upon local

ways of reading environmental signs and signals and observing ecological relationships can help decide what indicators are to be monitored and how (Riedlinger, 2001). It can also lead to a common understanding of environmental and population health and form the basis for further conversations about needed research and management actions. For example, Berkes et al. (2007) found that Cree and Inuit of James Bay relied on the knowledge and expertise of their hunters and fishers in reading the signs and signals of such variables as sea ice, currents, and species distributions, to produce a comprehensive evaluation of environmental health assess regional-scale changes. In other case studies from Northern Canada and Southern New Zealand, traditional monitoring techniques were based on many health-related indicators, including body condition, population health and abundance, rate and direction of movements breeding success, behavior, and so on, to monitor the health of wildlife populations. (Moller et al., 2004; Berkes et al., 2007; Parlee et al., 2005). Assessment of species indicators are viewed interactively with other variables in other related species and environmental indicators such as ice and weather conditions (Krupnik and Jolly, 2001; Parlee et al., 2005).

As subsistence harvesters, Inuvialuit hunters are in intimate contact with their complex Arctic environment. Experienced hunters, especially those that develop skill in hunting a single species such as polar bear, will have expertise in reading multiple and interacting signs and signals of the sea ice, animal behavior, movements, and interactions. As a result they have an experience and expectations of what is "normal", and have keen senses in assessing conditions, events, and behaviors that are outside of the normal range of variability they have noticed in the past. In application, Berkes et al. (2007) have assessed that "when these skills are transferred to the monitoring of marine environmental quality, indigenous hunters are piecing together signs and signals of wellness indicators (or lack thereof, e.g., low body fat) and those of problem indicators (e.g., physical and behavioral abnormalities, pathological conditions)" (p.158).

Due to Indigenous peoples' in-depth exposure to their environment, reliance on it's' resources, and importance of learning from and monitoring its' changes, Indigenous harvesters are in a position to make unique and finely grained observations of their environment and the wildlife.

Indigenous harvesting activities often occur throughout different periods of the year. Following an annual harvest cycle, over a very large area, harvesters will make use of their detailed knowledge of animal behavior to concentrate hunting on small, core areas where the likelihood of success is greatly enhanced (Freeman 1984). Their collective and cumulative knowledge of local trends, patterns, and processes, derived from generations of reliance on the land allows them to observe and synthesize a very large number of variables at multiples scales (Riedlinger and Berkes, 2001; Peloquin and Berkes, 2009). Peloquin and Berkes (2009) discuss how Indigenous peoples have developed practices that are adapted to live with complexity through their relational and holistic approach to understanding their environment. The holistic observation of species from an ecosystem perspective is akin to "fuzzy logic".

Fuzzy logic involves qualitatively scanning a large number of variables at multiples scales, fuzzy logic seeks to deal with complexity through approximate relations and "rules-of-thumb"- simple prescriptions based on indigenous knowledge and ways of knowing based on a holistic view of the environment (Gadgil et al., 1993; Moller et al., 2004; Peloquin and Berkes, 2009). Science attempts to reduce complexity to a relatively small number of few measurable, quantitative, and controllable variables that "are normally segregated out and studied by different 'tribes' of social and natural scientists" (Peloquin and Berkes 2009: p.541). Whereas the environmental monitoring practices of some indigenous societies are significant in their ways to perceive the continuum of nature holistically. Traditional knowledge and methods of observing usually lack the quantitative tools, technology and approaches used by western science. Instead by qualitatively scanning a large number of variables at multiples scales, indigenous knowledge systems seem to have developed ways to deal with complexity analogous to the use of "fuzzy logic" in western science (Peloquin and Berkes, 2009; Berkes and Kislalioglu-Berkes, 2009). Rather than numerically precise cause-and-effect reasoning, fuzzy logic seeks explanation through approximate relations and "rules-of-thumb". By scanning, monitoring and holistically evaluating a large number of variables across continuum of nature, as opposed to trying to reduce complexity to a few measurable and controllable variables, "hunters grasp the implications of complex interactions of social and ecological processes occurring at multiple

levels, and respond to them in various ways" (Peloquin and Berkes, 2009, p. 536). "Keeping an eye" on ecological indicators and ongoing environmental changes is essential for adaptive management (Manseau et al. 2005), and this approach appears consistent with a focus on adaptive learning rather than 'control' and is more useful for management in conditions of uncertainty and data-deficiency (Zadeh, 1973; Peloquin and Berkes, 2009; Holling and Meffe, 1996; Davidson-Hunt, 2006; Pahl-Wostl, 2007). Through holistically monitoring a large number of indicators at multiple sources at multiple scales, hunters and co-management participants grasp and reflect on complex interactions of social and ecological processes occurring across temporal, spatial, and trophic levels (Berkes et al., 2000; Moller et al., 2004; Peloquin and Berkes, 2009).

2.4.4 Indicators of Polar Bear Health

As current knowledge is inadequate to understand of the present and future impact of climate warming on the health of polar bear populations, international efforts are underway to develop a monitoring plan for polar bears that would identify indicators to comparatively assess the status of polar bear populations at a pan-Arctic scale (Vongraven and Peacock, 2011). In a background paper prepared by the biodiversity working group of the Arctic Council (Conservation of Arctic Flora and Fauna or CAFF) to develop a pan-Arctic monitoring plan for polar bears, Vongraven and Peacock (2011) establish a set of circumpolar indices and indicators to monitor and report on the health and status of polar bear subpopulations, and assert that polar bear biologists and managers must identify parameters that meaningfully represent the health or status of a population or its individuals. They identify the metrics and methods that are necessary for monitoring parameters of abundance, trend, distribution, harvest, human-bear interactions, individual body condition, and habitat.

In a review of previous studies of Inuit knowledge of polar bears (Berger, 1976; Freeman, 1976; FWS, 1995; Kalxadorff, 1997; Hart and Amos, 2004; Keith et al., 2005; MPEG, 2006; Zdor, 2007; Dowsley and Wenzel, 2008; Wong et al., 2011; Richardson pers. comm., 2011), these studies have shown that experienced Inuit hunters use the following metrics to assess the health, conditions and characteristics of both individual bears and polar bear populations: 1) body

condition and behavior; 2) breeding success (denning habitat, mating behavior, and fecundity); 3) diet and feeding behaviors; 4) distribution and movements; 5) habitat conditions; 6) population abundance; and 7) unique observations. Other indicators are used by experienced hunters, and these will be mentioned in the results and discussion chapters. The following section elaborates on previous traditional knowledge research of polar bears, specifically in relation to the methods other Inuit groups employ to monitor these indicators.

2.4.4.1 Body Condition and Behavior

Changes in body condition can be an obvious and appropriate way of assessing and forecasting polar bear population health. Scientists have hypothesized that changes in body condition will precede demographic change in polar bear populations (Stirling and Derocher, 1993; Obbard, 2008; Vongraven and Peacock, 2011). Conclusions of other ecological research of bear species suggest that the overall size of bears of similar ages may be the best metric of individual condition, deducing that larger individuals reflect a population that has access to higher quality and/or abundant food sources (Noyce and Garshelis, 1994; Hilderbrand et al., 1998; Zedrosser et al., 2006).

In the Canadian Arctic and sub-Arctic, numerous traditional methods exist for monitoring the body condition of animals besides polar bears. For example, a number of distinct Indigenous peoples in Northern Canada and Alaska have systems of monitoring caribou body condition through assessing fat content (Berkes, 1999; Kofinas et al., 2004). In caribou herds, body condition is a key indicator of herd health (Parlee et al., 2005). Kofinas et al. (2002) identified back fat, stomach fat, and marrow color as three of indicators of body condition that the Porcupine Caribou hunters for assessing caribou health. However, the assessment of improved body condition among individuals, while frequently interpreted as sign of healthy individuals (Kofinas et al., 2004), should not always be interpreted as saying that the population is healthy or that the population size is stationary or increasing (Moller et al., 2004). Furthermore, even if a sick or diseased animal is occasionally encountered, this does not mean the entire species is threatened (Poirier and Brooke, 2000). Inuit elders and experienced hunters have a highly developed knowledge and capacity to assess body condition, abnormalities, and illnesses

occurring among harvested animals through a complex diagnosis based on signs such as the behavior of the animal, the color and the texture of its organs, fur, or fatty tissues (Poirier and Brooke, 2000). For example, traditional knowledge from Alunik et al. (2003) describes how Inuvialuit could even differentiate the sex, age, and area of where a polar bear was harvested based on the taste of polar bears.

In another example, O'Neil et al. (1997) explains how the diagnosis of a sick animal is filtered through the paradigm of a hunter: "The Inuit know what animals are sick or when they are not sick because they know it even without samples because they have been hunting it for years and years" (p.32). Assessments of individual animals or populations as "sick", "unhealthy", or "threatened" can lead to misinterpretation between scientists and Inuit based on their distinct understanding of "health". For example, in a traditional knowledge study in Gjoa Haven, one hunter commented that: "I have seen lots of bears and I have never seen and unhealthy bear" (Keith et al., 2005: 146).

Inuit use the body condition of individual polar bears as an indicator of its health. Through the process of tracking the polar bear, and butchering, and preparing the hide and meat, hunters process multiple variables that can lead to the qualitative and occasionally quantitative assessment of the health and physical characteristics of the individual animals. These qualitative assessments examine the blubber quality and quantity, condition of fur, color and texture of muscles and internal organs, size of animals, gender and age distribution, and behavior.

Through the fleshing and butchering processes, a hunter and his wife can make many in-depth assessments about the health of the animal and its fitness for consumption. Fleshing the bear, both as a rough dressing and then through the careful hands on fleshing of the hides done by the women, allows both men and women to assess the quantity and quality of blubber on individual bears. The body condition and amount of blubber on polar bears varies throughout the year, depending on available food resources, specifically seals (Dowsley and Wenzel, 2008).

Keith et al. (2005) found that expert hunters in Gjoa Haven were able to use the tracks of an individual animal to assess its size and gender. The reliability of this method was re-affirmed by Wong et al. (2011), who demonstrated the size and the sex of an individual bear can be distinguished by Inuit hunters based on their tracks. Expert hunters are able to visually distinguish male and female polar bears by the size in the case of a full-grown male, or by the presence of cubs in the case of a female (Keith et al., 2005). However, if the male is not full-grown and the female does not have cubs, visual identification makes it difficult to distinguish between the sexes (Keith et al., 2005).

Inuit have developed terminology to deal with phenotypic variation between individual bears. For example, in the Inuvialuit region, many experts say there are actually two different types of polar bears:

> There's a bear that you get once in awhile that has a longer neck; it's high and pure white, but looks like a weasel and runs fast like a weasel—*tiriaranaq*—bears and ermines are similar. *Pualrisiktualuit* is the polar bear that has paws as huge as a shovel, "that other type, they've got another name too—*nannuktauguktualuit*—not scared of anybody too, those (MPEG 2006: 11-31).

Inuit stories from Gjoa Haven also speak of larger than normal bears, which they refer to as "*nanurliut"* (Keith et al., 2005). The presence of distinctive terminology in *siglitun* and *uumarmiut* dialects suggest a history of knowledge of unique physiologies and behaviors of polar bears. Unfortunately, many of these terms have not been documented alongside their English translation to demonstrate the detailed linguistic knowledge (I have attempted this briefly in Appendix 12).

2.4.4.2 Breeding Success

Observation of breeding success is another method used by scientists to monitor population health and abundance. Vongraven and Peacock (2011) identify the reproductive parameters often measured by wildlife scientists for polar bears as including litter size; litter production

rates; mating interval; age of first reproduction; age of weaning; sex ratio at birth; natality; and whole litter loss.

Biological surveys have found that Banks Island, particularly around Nelson Head and Cape Kellet, is one of the 15 core denning areas in the entire Arctic and is regarded as the chief denning area for polar bears in the Western Arctic (Harrington, 1968; Stirling and Andriashek, 1992). Known locations of polar bears maternity dens are concentrated in relatively few, widely scattered locations (Amstrup and Gardner, 1994)[6]. However, Amstrup and Gardner (1994) found that Beaufort Sea region of Alaska and Canada has the largest knowledge gap in regards to the concentration of denning areas in the Arctic. In the past, and true today, identifying polar bear dens is very challenging due to the inaccessibility of denning areas, conspicuousness of dens, and the challenges of observing dens from low-flying light aircrafts-- especially during the difficult weather conditions during denning season (October-March).

During the earliest polar bear biological research on polar bears on Banks Island, biologists Charles Harrington and Tom Manning both utilized traditional knowledge to supplement their studies and hired local guides to facilitate their fieldwork. Regarding traditional knowledge of polar bear denning, Harrington (1968) wrote:

> In some cases, information on polar bear dens denning habits was obtained from Eskimos. Most data used was provided by Eskimos I knew well, or had traveled with for extended periods. This gave me an opportunity to estimate the reliability of their statements. Other verbal reports were used if corroborated by more than one individual, or if they were consistent over time (p.8).

In Harrington's fieldwork on Banks Island, he was told by "two reliable Eskimo" that mature males will den between October and January, and along with his guides, identified three adult male occupied dens between mid-December and the first week of January (Harington, 1968).

[6] Harrington's (1968: 12) survey of 113 dens recorded in the Canadian Arctic found about 61 percent were within 8km of the coast and 81 percent lay within 16km, with no dens being found more that 50 km inland.

Across the polar bear hunting cultures of the circumpolar north, the preferred locations for polar bear dens in any area is known to the local hunters (Freeman, 1984). Up until the 1970s, sled dogs were used extensively in polar bear hunting and were especially useful to locate maternity dens with their keen sense of smell (Harington, 1968). Hunting bears in dens could be a safer harvesting technique than cornering a bear on the open ice with dogs. Traveling the trap line, especially along the coast, provided opportunities to hunt bears at their denning sites, as a result hunting from dens was undertaken more frequently during the fur-trading period (Farquarson, 1976).

In regards to monitoring polar bear population health based on breeding success, Inuit monitor indicators relating to denning locations, denning habitat quality and litter size (i.e. number of cubs per litter). Historical and current polar bear research has used oral histories, traditional knowledge, and local observations to identify denning locations and features (i.e. Manning and MacPherson, 1958; Harington, 1962; Harington, 1968; Stirling and Andriashek, 1992; Kalxadorff, 1997; Van de Velde et al., 2003; Richardson pers. comm., 2011). For example, in the Eastern Arctic (Pelly Bay), Missionary Franz Van de Velde conducted interviews with Inuit hunters from 1936-1969 (Van de Velde et al., 2003). At this time, hunting bears in their dens was widely practiced and the Inuit hunters shared valuable information about polar bear den locations and features, which he documented. These interviews provided valuable new information and were the first time non-Inuit would hear about denning males and females denning with yearlings or 2 year olds (Van de Velde et al., 2003; Stirling, 2011)[7]. Modern satellite collars would later allow scientists to monitor and locate where females were denning, and this technology reaffirmed Inuit knowledge to scientists that bears were denning far off-shore on the multi-year ice (Stirling, 2011).

[7] There are two types of dens polar bears will use: Maternity dens (*apitchivik)* (Lowe 2001) and Temporary dens or shelters. These temporary dens are described in the Inuvialuit Region Traditional Knowledge Report (MPEG 2006: 11-32): "It's not only the female bears that use dens; when the males get too fat sometimes they go the hole and rest for awhile and wait until they lose some weight before they come out again. They don't sleep like grizzlies, though; they're always up. When the male bear is hibernating, if there's too much disturbance he will just break right through the snow. When they get disturbed they get mad and stand up."

Wisdom and strategy to identify denning locations can be found in the knowledge and traditional practices, although many of these traditional practices are no longer practiced. Before hunting polar bears in their dens was prohibited, this harvesting practice developed knowledge that could assist local hunters in identifying core denning sites and assessing polar bear denning habitat. In Gjoa Haven, hunting bears in their dens gave hunters knowledge of core denning areas, and "skills in locating dens and probing for the presence of denning bears are the direct result of this practice" (Keith et al., 2005: p.53).

The quality of denning conditions is determined through habitat by observing the quality and quantity of snow that are integral to form the well-insulated dens in snow banks. Through interviews in Gjoa Haven, Keith et al. (2005) recorded that some of the areas that often had dens in the past could not support dens this year due to lack of snow: "Several informants reported observing low snow accumulations and a change in snow quality in recent years… [which was] later emphasized as the reason for the scarcity of dens on Eastern Victoria Island" (Keith et al. 2005: p.100).

Recently Inuvialuit elders were interviewed regarding polar bear denning on the Yukon North Slope and shared knowledge of important denning areas, timing of cub birth, number of cubs, and timing of den exit (EBA Engineering Consultants Ltd., 2008). Additionally, recent research by Richardson (pers. comm., 2011) examined the distribution of polar bear dens and polar bear denning habitat, using both scientific data (denning surveys and satellite telemetry) as well as traditional knowledge, to identify important maternity denning areas within the Mackenzie Delta and Southern Beaufort Sea. Traditional knowledge of denning areas is a significant contribution to polar bear management, particularly with respect to oil and gas development (Gunn et al., 1998; Richardson pers. comm., 2011) and developing infrastructure along the coastlines (EBA Engineering Consultants Ltd., 2008).

2.4.4.3 Diet and Feeding Behaviors

Scientists use comprehensive monitoring and complex laboratory techniques, such as fatty-acid or stable-isotopes analysis of polar bear tissues samples (collected from samples of fat, blood,

hair, muscle), to identify diets of individual polar bears and monitor changing food webs (Vongraven and Peacock 2011). Inuit assess the diet and feeding observations of polar bears through direct or indirect observation of polar bears hunting seals, or through examining the stomach contents of a harvested bear. In Inuit harvesting practices, examining stomach contents (among other organ systems) is part of the (almost) routine biological examination that accompanies the butchering process (Freeman, 1985).

Polar bears diet consists mainly of ringed and bearded seals, as the concentrated energy in the form of seal blubber is a key physiological requirement. Assessments of polar bear diet can be inferred from knowledge and observations of seal abundance, and the ecology and habitat of seals. Traditionally, polar bear hunters would have in-depth knowledge of seal distribution and habitat, as the effort to hunt polar bears was aided by knowing where the best places for hunting seals are to be found, as "the density of breeding seals appears to be positively correlated with extent and stability of coastal sea ice" (Freeman 1984: p.39). In her study of Inuvialuit observations of climate change, Riedlinger (Riedlinger and Berkes 2001) documented that some Sachs Harbour hunters have noticed that seals are sinking to a deeper water level when they are shot at the floe edge, "a phenomenon attributed to a lowered fat content and/or the greater freshening of the ocean water from melting sea ice" (p.317). As elaborated in the results, this assessment contributes to a holistic assessment of polar bear health.

2.4.4.4 Distribution and Movements

Kalxdorff (1997) summarizes traditional knowledge provided by native Iñupiat hunters regarding polar bear habitat use in the Beaufort, Chukchi, and Bering Sea and adjacent lands, which mapped seasonal observations of habitat use and denning habitats. In the U.S. Fish and Wildlife Service (FWS) report on *Habitat conservation strategy for polar bears in Alaska* (FWS, 1995), traditional knowledge of Polar bear hunters out of Kaktovik was used to describe habitat use between Brownlow Point and Demarcation Point, including seasonal movements, feeding, and denning. Several other sources discuss absence or abundance of polar bear or seals at different locations and at different times, which can be used to infer movement, habitat use, and

abundance at certain times (i.e. Berger, 1976; Hart and Amos, 2004; see Table 1 for summary of observed changes in abundance).

On Banks Island, Stirling (2002) recorded that most local observations of polar bears are made in wintertime when the bears move south toward the shoreline of the mainland coast or Amundsen Gulf. In the late 1960's Usher's (1971b) study of harvesting activities on Banks Island recorded that:

> In winter [polar bear] range tends to extend Southward – in the Western Arctic to Banks Island, Amundsen Gulf, and the mainland shore. They may even be found inland many miles. In summer, they retreat North with the ice. In years when Amundsen Gulf and Beaufort Sea are ice free, there are no bears at all (although they have been sighted swimming tens of miles from the nearest ice or land). If a heavy concentration of ice persists throughout the summer, bears may remain in or close to the area, and will be more available to hunters not only in the summer but often in the following winter as well….There was a general belief in Sachs Harbour that the bears tended to make a clockwise migration around Banks Island; hence when the Holman Islanders significantly increased their harvest starting around 1965, it was felt that this was the direct cause of a marked drop in the harvest at Sachs Harbour (p. 74).

2.4.4.5 Habitat

Sea ice is critical habitat to polar bears and their key prey species, and serves as a platform for hunting and traveling. Keith et al. (2005: 107) concluded from TK that polar bears can be found in areas that provide good access to seal breathing holes- areas of thin, new ice that have formed after a crack has opened or a pressure ridge has formed. The presence and abundance of polar bears and their accessibility to hunters at any particular time and place is largely a function of ice conditions (Usher, 1971b; Freeman, 1984).

Freeman (1984) noted that "South Banks Island, one of the major denning areas for bears, will have no bears present when there is not pack ice in adjacent areas of the Beaufort Sea and

Amundsen Gulf in the summer months"(p.44). These observations were confirmed in Hart and Amos (2004):

> During years when leads of polynyas did not open up in the winter and there were few seals to hunt, Inuvialuit in the Cape Bathurst area counted on polar bear meat. This was also a bad situation for bears as there was little food for them to eat, and they turned into the primary animal hunted over the winter… Joe Nasogaluak also reported that in 1910 there was little open water, few seals, but lots of polar bears which were used for meat…People at Cape Bathurst also had a hard time during the winter of 1922-1923 because of bad ice conditions. There was little food at the post to trade for, and seals, foxes and bears were scarce…It was even difficult to get polar bears and seals we could only get through breathing holes in the ice. The ice was so rough that the cracks didn't open up all winter… The people would walk and hunt for polar bear but couldn't get any because the ice on the ocean didn't have any openings. They called this *piilauyuq tariuq*. This was in 1923… That winter, all the people of Baillie Island (*Utqaluk*) had nothing (p.72-74).

The Inuit have utilized the sea ice since time immemorial (Riewe, 1991). The accumulated practical knowledge that the Inuit possess of the sea ice is one of the most underutilized sources of information in many vital areas of arctic research and development (Roots, 1981; Riewe, 1991). Detailed knowledge of the dynamic sea ice and weather conditions is important for safety and security in traveling in potentially dangerous conditions, and to hunt marine mammals that are found above or below the ice-covered Beaufort Sea (Freeman, 1984). As life or death could depend upon your level of knowledge of sea ice throughout the entire process of the hunt, special recognition is given to those who hold this knowledge and continue to use it to hunt polar bear. This knowledge is very subtle and obtaining it takes many years of actual daily experience within this unique environment (Freeman, 1984). There are numerous complex signs and signals, observed at multiple scales, by which hunters assess weather and sea ice conditions (Aporta, 2005: Freeman, 1984; Krupnik et al., 2010; Peloquin and Berkes, 2009). Inuit hunters

describe changes in sea ice through a complex of interacting variables akin to fuzzy-logic-- by comparing the past and present conditions through the combination of multiple variables such as sea-ice conditions, wind speed, direction. When observed together in context by the Inuvialuit, this combination of variables provide a higher level of understanding that a combination of instrumental atmospheric data and remote sensing over time and provides insight that scientific technology could not equal (Riedlinger and Berkes, 2001; Berkes et al., 2007; Nichols et al., 2004).

Riedlinger (2001) study in Sachs Harbour on Inuvialuit observations of climate change found Inuvialuit observations of weather and seasonal changes were very broad, including changes in frequency, timing, amounts and severity of weather events and increased variability in temperature, precipitation, storms, and wind. She recorded local observations that the "the weather is increasingly variable … there are more extremes [and] Elders in Sachs Harbour say that it is more difficult to predict the weather these days" (Riedlinger, 2001: p. 68). In terms of Inuvialuit observations of changes in ice conditions, she recorded observation of changes in the ice thickness (depth of seal holes, thickness of ice in pile ups); timing of ice freeze-up and break-up dates; amount and quality of land fast ice; multi-year ice and ice-bergs; the number and size of polynyas; and changes in wind patterns and currents which in turn effect pressure-ridge and lead distribution (Riedlinger and Berkes, 2001). All-in-all, she concluded that these changes in ice abundance and distribution are impacting the way Inuvialuit use the sea ice environment, affecting hunting and traveling safety, polar-bear and seal distributions, and animal health in the region (Riedlinger and Berkes, 2001).

In the *IQ* study of polar bears in Gjoa Haven, Keith et al. (2005) recorded that hunters have observed "sea ice is not reaching the thickness that it once was, changes in the timing of freeze-up and break-up of the sea ice has also changed over the years, a change in prevailing wind direction, and the late arrival of snowfall and decrease in yearly snow accumulation" (p.117). Community members also acknowledged the disappearance of icebergs/multiyear ice and associated a "connection between the absence of icebergs and the low numbers of polar bears

in the study areas" (Keith et al., 2005: p.117).

2.4.4.6 Population Abundance

Fuller and Hubert concede, "in the absence of historical records it is even more hazardous to estimate future animal populations than it is to project human populations" (1981: p.15). Fluctuations in abundance have been recorded in many of the previous traditional knowledge studies; however, the degree of fluctuation is always subjective. For example, Jim Wolki described one season in the early 1920s as the "Year of the bear", referring to a year when he observed a much high abundance of polar bears in his region that previously. There are obvious challenges in interpreting changes in abundance over time, from changes in distribution, to changes in sea ice quality, and distribution and abundance of prey. The following table is an extensive summary of several (English) documented sources that mention of abundance or absence of bears from regions in the western Arctic, to illustrate trends in abundance and health of polar bears and their prey over time.

Table 1: Abundance (or absence) of polar bears and their prey in the western Arctic from previously documented historical, archival, and traditional knowledge sources.

Date and Place	Abundance/ Scarcity/ Condition of species	Observation	Source/Reference
Late 1800s - Beaufort Sea/ Amundsen Gulf	Bears scarce in Beaufort Sea	"For more than 20 years after the first penetration by Whites into the Beaufort Sea/Amundsen Gulf area, there were no recorded sightings of bears, or tracks of bears".	Barr, 1996: p. 64
1903-1906 - Beaufort Sea	Bears scarce in Beaufort Sea	"In his account of the expedition Amundsen makes no mention of bears during his trip through these waters in 1905-06, including a wintering at King Point just eat of Herschel Island. The scarcity of bears in the Beaufort Sea at this period is also confirmed by Stefansson, in this area on his first expedition to the Arctic in 1905-06. He commented: 'I went home at the end of my first polar expedition without ever having seen a bear'	Amundsen, 1908; Stefansson, 1922: p. 283
1920s - Baillie Island	Bears abundant	"They said there was so many bears on Baillie Islands some years, that in one day they kill 32 bears in one day one time."	F. Wolki (in Slavik and WMAC, 2009)

1922-23 - Cape Bathurst	Bears, seal and foxes were scarce	“The people would walk and hunt for polar bear but couldn’t get any because the ice on the ocean didn’t have any openings… This was in 1923. That winter, all the people of Baillie Island (*Utqaluk*) had nothing’”.	Hart and Amos, 2004: p.73
1929 - Sachs Harbour	Bears abundant at Sachs Harbour	"That was the first trip my dad made to Banks Island, and the year was 1929. We wintered at Mary Sachs on Banks Island … In the fall there was a lot of polar bears there. Our parents never let us play out because polar bears came from all directions."	P. Gruben (in Berger, 1976h: p. 1575)
1975-76 - Sachs Harbour	Young seals scarce	"The seals there, for the last two years they have not been having young." (A. Carpenter, 1976)	A. Carpenter (in Berger, 1976f: p. 1429)
1975 - Sachs Harbour	Young seals scarce	"hardly any [young]seals around"…"only [harvested]one young one."	W. Lucas (in Berger, 1976f: p. 4032)
1976 - Sachs Harbour	Seals scarce, polar bears in poor condition	"hardly any seals any more, and the polar bears are starving due to lack of food."	F. Carpenter (in Berger, 1976f: p. 4031)
1976 - Ulukhaktok	Bears abundant	““For the 1975-76 calendar year, the Ulukhaktok settlement area had a quota of 16 polar bears. According to the records kept by the HTC, this quota was filled in approximately one and a half weeks, with 99 percent of it in a 25-30 mile radius of Ulukhaktok.”	Kasam 2009: p. 128
2006 - Tuktoyaktuk	Polar bears not in good health	" polar bears aren’t in good health right now (i.e., in 2006) because the rough ice has covered up the seal breathing holes, meaning the bears have to dig through three feet of ice to get the seals now.”	MPEG 2006: p. 11-32

2.4.4.7 Unique Observations

Experienced hunters, especially those that develop skills in hunting a single species such as polar bear, will have expertise in reading signs and signals of the sea ice, animal behavior, movements, and interactions. As a result, they have an experience and expectations of what is “normal”, and have keen senses in assessing conditions, events, and behaviors that are outside of the normal range of variability they have noticed in the past. Moller et al (2004) note that the “key characteristic of traditional monitoring is that observers would tend to note unusual rather than average patterns and occurrences” (p.3). Beyond observing general fluctuations, hunters are also privy to unique observations- including rare and unique behavioral adaptations,

environmental conditions, or physiological abnormalities (Moller et al., 2004; Berkes et al., 2007; Riedlinger and Berkes, 2001).

2.4.5 Indicators of Change at Different Scales

Several studies have examined the complementarities of traditional knowledge and western sciences at different spatial and temporal scales for wildlife (Usher, 2000; Moller et al., 2004; Berkes et al., 2007; Dowsley and Wenzel, 2008; Gagnon and Berteaux, 2009) and ecological change (Riedlinger and Berkes, 2001), and emphasize the importance of gaining reliable information at temporal and spatial scales appropriate for monitoring natural resources (Folke et al., 1998). These studies have concluded that combining traditional knowledge, local observations, and scientific knowledge greatly expands the spatial and temporal scales of currently documented knowledge by extending the known range of observations. In past studies integrating both scientific knowledge and traditional knowledge, it was found that traditional knowledge and local observations provided better information at more local geographical scales and have the potential to broaden the temporal context of scientific data (Gagnon and Berteaux, 2009).

Traditional knowledge is almost always formed from a local geographic focus, although it can be applied to a range of spatial scales depending on the region of occupancy, the resource use, and harvesting practices (Riedlinger and Berkes, 2001). The knowledge of Indigenous peoples often has a greater temporal and geographical scope than other resource-users (such as farmers or fishermen) because it is not limited by legal or customary property rights or by highly restricted harvesting periods (Usher, 2000). Furthermore, Usher (2000) continues that “traditional knowledge can contribute to a fuller understanding of local environmental processes 'at a finer and more detailed geographical scale than conventional scientific knowledge can offer” (p.187).

In terms of temporal scale, traditional knowledge spans from the present and living memory to the past through individual recall and collective oral history. Usher (2000) explains how this provides a diachronic perspective, creating a baseline for expected deviations from 'normal'

conditions. As opposed to scientific knowledge, traditional knowledge is based on an accumulation of in-depth observations and information acquired during longer time series (diachronic) but over regionally-specific localities (place-based) (Johnson, 1992; Riedlinger and Berkes, 2001; Moller et al., 2004; Gagnon and Berteaux 2009). By contrast, scientific monitoring techniques often specialize, and at times "stove-pipe", individual environmental phenomena in isolation from other factors, making it best suited for simultaneously observed (synchronic) data collection (Riedlinger and Berkes, 2001).

Spatial and temporal trends in species are well understood by the people that depend on wildlife for subsistence (Parlee et al., 2005; Parlee et al., 2001). In the context of monitoring changes in caribou population health, one *Denesoline* elder commented in Parlee et. al. (2005) that "people who don't care so much won't notice the changes" (p. 173). Likewise, in relation to unique hunts such as polar bear, Usher and Wenzel (1987) reported that subsistence hunters recall precise quantities of their harvest when harvesting is rare or done under special circumstances.

However, tensions exist in the literature between people who think indicators based on traditional knowledge is too reductionist. The strengths, weaknesses and limitations of traditional knowledge of wildlife in the North must be explored before areas of complementarities and convergence/divergence can be elaborated. Both scientific and traditional knowledge have intrinsic limitation in the depth of their sampling and their form of measurements. As Gagnon and Berteaux (2009: p. 19) elaborate:

> An observer can usually specialize in only a subset of existing scales because of the nature of economic motivations, time and logistical constraints, or personal and cultural interests. In particular, scientists and local community members usually have very different motives and access to different observational equipment for studying the natural world.

In conclusion, this review of literature has defined the meaning of Inuvialuit traditional knowledge and its relevance to wildlife research and management in the Canadian North, and better appreciates the significance of polar bears to the community of Sachs Harbour and the value that traditional knowledge has in everyday life and monitoring changes in their environment.

Chapter Three: Methods and Methodology

3.1 Introduction

"*Knowing Nanuut: Bankslanders knowledge and indicators of polar bear population health"* is based on research conducted from 2008-2010 in Sachs Harbour, NWT. The objectives of the thesis were to document Inuvialuit knowledge of polar bear population health and to identify the indicators used by Inuvialuit to assess polar bear health. I used methods of participant observation, group discussions, and semi-directed, in-depth interviews with twenty-seven locally identified community experts and knowledge holders across a spectrum of age, experience, and gender. This methods chapter is written not only to outline the details and chronology of this study, but to also allow for critical reflection on my personal experiences, ethical challenges, and lessons learned from attempting to do justice to the praxis of community-based research.

3.2 Methodology

As a key goal of this research was to understand Inuvialuit traditional knowledge of polar bear population health, the design of the methods was built around the framework of community-based participatory research (CBPR). Within Indigenous communities, CBPR works with the perspectives and local knowledge of participants to jointly design research to which the study community will relate and develop a research question that stems from a community identified problem or need for information (Marullo and Strand 2004, Israel, et al., 1998). In this way, community based participatory research acts as a "pathway towards advancing an Aboriginal research agenda" (Smith 2004: 125). Developing new models of community-based research that do justice to local observations and facilitates sharing of knowledge is a challenge (Cobb *et. al.* 2005: 78), but as a philosophy, CBPR is an appropriate methodological framework for this research as it incorporates multiple perspectives and is inclusive of different ways of seeing the world (Fletcher 2003). It recognizes traditional knowledge systems as valid on their own epistemological foundations and views them as contributing to a larger understanding of the world and the place of humans in it (Fletcher, 2003). Despite critiques that traditional knowledge research has the potential to force Indigenous peoples to fundamentally change their way of presenting their knowledge and culture to a form that is compatible with scientists

and resource managers, the methodology used in this research enhanced the study to better discuss, document and analyze the traditional knowledge of Bankslanders within their own epistemological framework. While this is a challenge to non-Inuit researcher, through applying social science methods to research biological data, I hope my work accounts for documenting diverse knowledge and perspectives within a more holistic context, meanwhile, presenting this knowledge in a format that is useful to wildlife managers and policy makers, and beneficial and respectful to the community. As Nadasdy (2004) writes, "A rule of thumb for local traditional knowledge research might be to ask the question, "*who is going to actually use, interpret, and/or manipulate it?*" If the answer is not "*local community members*," then the research will probably do more harm than good" (p. 15). Applying principle of CBPR throughout the design of the study helped to ensure these conditions were met.

Numerous traditional knowledge studies have been completed in Canada's Arctic and internationally, incorporated a CBPR methodology and multi-disciplinary methods to investigate and record traditional knowledge of the environment. These efforts have generally attempted to collect both quantitative and qualitative information, as well as to examine the cultural, economic, epistemological, and spiritual relationship between people and their environment (Houde, 2007; Usher, 2000). However, there is no single, established methodology for traditional knowledge research (Riedlinger, 2001) and there are contrasting opinions on the most appropriate methods to conduct knowledge studies across the circumpolar region. Some researchers advocate for a standardized methodology in documentation (Gilchrist et al., 2005; Fehr and Hurst, 1996), which would allow for comparable analysis in communities with the large sub-population management boundaries, such as among polar bear sub-populations across the Arctic. Others advocate that traditional knowledge studies must involve creative methodologies to match the conditions and context of where the study takes place (Riedlinger, 2001). A methodology must strive to preserve the inherent accuracy and precision of observations by individual informants while gathering knowledge that has depth of focus and a scope that covers an appropriate spatial and temporal range (Arima, 1976; Woodman, 1991; Freeman, 1993; Ferguson and Messier, 1997).

CBPR is "characterized by a flexibility of thought and action which was not present in classical scientific research" (Fletcher, 2003: p. 38). While CBPR is flexible in terms of what methods can be used for data collection, a mixed methods approach is often most common and useful (Israel, et al., 1998; Minkler, 2005). Research methods are further exacerbated by the need to use social science methods to gather biological data, so that traditional knowledge research and application inherently becomes a multidisciplinary undertaking (Huntington, 2000). For this study, I have researched the methods used in similar studies examining traditional knowledge of polar bears and other species in the Arctic (e.g. Zdor, 2007; Dowsley, 2005; Keith et al., 2005; Kalxdorff, 1997) to look for opportunities to standardize documentation and identify best practices. Based on reflection of these previous studies, I chose to focus the methods to include in-depth, semi-directed interviews, combined with participant observation and group workshops.

3.3 Study Background

I was introduced to the issues, complexities, and the human dimension of polar bear management in the summer of 2007 when I joined an inter-disciplinary research team devoted to assessing how "conservation hunting" fits with polar bear management[8]. I oriented my Master's research through a scoping trip to the Inuvialuit Settlement Region in July 2007. This trip allowed me the opportunity to familiarize myself with the political, cultural, and physical landscape of the Western Arctic, both within the Mackenzie Delta (Inuvik) and Beaufort Sea (Tuktoyaktuk), gave me the opportunity to gather support for my research from local organizations, and to identify which community would be best to conduct my fieldwork. I arranged meetings with representatives of the Inuvialuit Joint Secretariat, the Tuktoyaktuk Hunters and Trappers Committee, Parks Canada, and the Government of the Northwest Territories Department of Environment and Natural Resources (ENR). These formal meetings, along with numerous informal chats with local hunters, guides and residents, allowed me to discuss numerous research ideas from an institutional level and personal level, and identify the

[8] For detailed elaboration on this issue, see *Inuit, Polar Bears, and Sustainable Use: Local, National and International Perspectives*. Freeman, Milton M.R., and Lee Foote (eds.). (2009) Edmonton: CCI Press.

issues that were of interest and importance to the local people and wildlife management agencies. The Wildlife Management Advisory Committee (WMAC) listed documenting traditional knowledge on polar bears and Peary caribou as a research priority (K. Thiessenhausen pers. comm., 2007). The territorial biologist at ENR was interested in the ways to overcome the challenges surrounding how to incorporate traditional knowledge into monitoring programs (M. Branigan, pers. comm. 2007). Sachs Harbour was recommended because of their involvement in harvesting activities, established polar bear sport hunts, history of participating in similar studies (i.e. Riedlinger, 2001).

This scoping trip was followed by a thorough review of literature to identify knowledge and research gaps. This exploration covered the broad range of issues that familiarized me to polar bear ecology, management, and cultural significance of polar bears to circumpolar Indigenous people. Examples of topics and select readings included: Polar bear ecology and climate change (e.g. Derocher et al., 2004; Stirling, 2002); Traditional knowledge of polar bears (e.g. Zdor, 2007; Dowsley, 2005; Keith et al., 2005; Kalxdorff, 1997); The relevance of polar bears to circumpolar peoples culture and economy (e.g. Freeman and Foote, 2009; Tyrell, 2007; Wenzel, 2005) and; Community-based wildlife management in the Canadian North (e.g. Usher, 2002; Anderson and Nuttall 2000; Berkes et al., 2005; Moller et al., 2004; Nadasdy, 2003). The direction of this study was further developed by conducting an informal research project in a graduate level sociology class, that interviewed both natural and social scientists with expertise in polar bear management regarding their perspectives on the value, the practicality, and the constraints of incorporating traditional knowledge into scientific research of polar bears, and how this can best be accomplished. My discovery as a result of these endeavors exposed that there was a lack of research, and a desperate need, for researching and documenting traditional knowledge of polar bear population health, and an interest to examine the question of how traditional knowledge can be used in monitoring polar bear populations.

3.4 Fieldwork Methods and Data Collection

3.4.1 Semi-directed Interviews

The most commonly practiced and recommended ethnographic method for documenting traditional knowledge is through semi-directed interviews. Semi-directed interviews are a standard yet flexible interview protocol in place of a formal questionnaire (Poirier and Brooks, 2000; Huntington, 1998; Fergusson and Messier, 1997). It permits the participants, as well as the researcher, to guide the interview, so that associations developed, and the scope of information collected, are defined by the knowledge holders (Keith et al., 2005; Huntington, 1998). As this allows the interview to progress through unanticipated topics as well as the expected ones, this method was especially useful given my unfamiliarity with the community.

As Huntington (1998) found in his traditional knowledge research amongst the Inupiaq and Yupik (Inuit) of Alaska, semi-directed interviews are closer to their natural way of discussion than a formal questionnaire. Semi-directed interviews worked well for the "Inuit Knowledge of Polar Bears" research project in Gjoa Haven (Keith et al. 2005), and other traditional Knowledge studies on polar bear conducted in Baffin Bay, NU (Dowsley, 2005), Arviat, NU (Tyrell, 2007), and Chukotka, Russia (Zdor, 2007).

Semi-directed interviews took place in Sachs Harbour during the first field season from March-May 2009. Participants were identified by the Sachs Harbour HTC or through chain referrals (snowball sampling method). The interview process would begin with an informal introduction of myself to the potential participant to introduce the nature of the research. An information sheet and consent form (see Appendix 2 and 3) was shared with them, allowing them time to review the details of the project at their convenience. A time and place were determined for the formal interviews at the participant's convenience and a standard rate for honoraria was offered as compensation for their participation.

Interviews were conducted on a one-to-one basis or with a husband-wife combination. Interviews took place at participants' home if they preferred, or the interviewer's office, where

quality audio could be recorded and there was space to work with maps. One interview took place at a workshop while during the process of a hunter butchering a bear he had recently harvested. Interviews lasted between one and four hours. All interviews were recorded on a digital voice recorder and a picture was taken of the participant. Where possible and with the consent of the participants, the interviews were documented on video with the assistance of a community research assistant. Due to constraints in accessing video equipment, however, only a single interview was filmed during the first field season. At the request of the participants, a trained community translator was made available to conduct the interview in their native language (*siglitun* or *ummarmiut*).

3.4.2 Description of Interview Sample

The interview participants were identified through recommendations from the Inuvialuit Game Council and the Sachs Harbour HTC. Following the initial project meeting, twenty-seven participants were suggested by the HTC on the basis of being past or present polar bear hunters or having come from polar bear hunting families. Six additional elders were identified in other communities who had lived on Banks Island in the past and would be expert knowledge holders. Four additional participants were identified through recommendations in the interview (i.e. chain referrals) based on the questions: "who else is knowledgeable about polar bears in the community?" and "who taught you about polar bears?"

The community was made aware of this research through a community notice poster (see Appendix 4). The Sachs Harbour HTC provided me with the phone numbers of the selected participants and I contacted them and visited with them to describe my project and scope of the interviews prior to conducting the formal interview. Thirty-one people were contacted to do interviews, and of this, twenty-seven agreed to participate. The overall composition of the interviews was:

- **6/6** -Male/Female Elders (identified as "elders" or over 60 years old);
- **11/2** - Male/Female Adults (30-60 years old);
- **3/0** - Male/Female Youth (younger than 30 years old)

The relatively small sample size is due to the fact of the small community size and young median age (112 residents of Sachs Harbour with a median age of 28.5 (GNWT, 2012)). While there is no "golden-rule" for a reliable sample size, because the accuracy of traditional knowledge may vary within a community, Gilchrist et al. (2005) suggest an "adequate" sample size to reach data saturation and increase the confidence in the information provided. For example, Keith et al. (2005) found in their study of polar bear traditional knowledge in Gjoa Haven, Nunavut (pop. 1,064), that there was a limited pool of expert informants, even fewer being elders, and of these, even fewer still active polar bear hunters. Therefore, their study was limited to 16 informants, including men who are polar bear hunters or women from polar bear hunting families (Keith et al., 2005).

3.4.3 Developing Interview Instrument and Guiding Questions

A list of guiding questions was drafted and shared with colleagues at the U of A prior to fieldwork to sharpen the focus within 11 streams of questioning (see Appendix 11 for list of guiding questions). In developing and asking these questions, I was conscious to avoid leading questions that would affect the reliability of individual responses (Fergusson and Messier, 1997). While en-route to Banks Island, I took the opportunity to meet with the late Roger Ipana, Chair of the Inuvik HTC at the time, to pre-test the draft interview questions for comprehension and leading questions. Roger's feedback was invaluable as it allowed me to refine the terminology and flow of the interviews to make it more familiar to the hunters I would soon be interviewing in Sachs Harbour. Furthermore, I was cognizant that the consistency in how the wording of interview questions could influence the reliability of responses (Fergusson and Messier, 1997). A final review of the questions and terminology was completed with members of the Sachs Harbour HTC prior to commencing research.

A consistent interview structure was followed for all interviews. The formal interview began with a question about the participants' first memories about polar bear. This was meant as a rapport-building question to facilitate participant comfort with sharing their stories. This approach included questions regarding memories and experiences in living with and harvesting polar bears, such as "tell me about your first polar bear experience?" These questions also

asked them to identify their personal history and area of expertise with polar bears (subsistence harvester, hunting guide, biologists assistant, etc.) as well as map the spatial range for harvesting or observing polar bears. Following this, questions were asked regarding age, hunting experience and hunting range to build a profile and establish a life-history. To many elders, calendars were foreign to them until later in life, therefore, a timeline of significant events in the region was developed prior to interviews to triangulate time periods abstracted from interviews and cross-reference throughout the interviews. A question of "who in the community is knowledgeable about bears in the community" explored knowledge networks, and also functioned to generate chain referrals and validate community experts.

3.4.4 Mapping

Ethnographic research frequently employs maps as a stimulus for discussion and a means of documenting land-use and other spatial data (Freeman, 1976; Nahanni, 1977; Cruikshank, 1981; Huntington, 1998). During their interview, each participant was given a map of Banks Island (see appendix 5) to identify his or her range of knowledge and experience. They indicated this by mapping their polar bear hunting range, their travel routes, and camps. Throughout the interview the map was referred to stimulate conversation, provide a common reference point, and document locations of specific observations. These observations included denning locations, migration routes, kill sites, sea-ice features, and unique observation or general features of the ecosystem.

As GIS files of Banks Island were not available as the time, the map was accessed through Circumpolar Library at the University of Alberta. As I soon learnt, this map did not contain the detail, and was not an appropriate scale, and my mapping methodology was inconsistent to meet the needs for accurate and consistent spatial data collection. Hence, the mapping component of this study was largely abandoned. However, the broad-scale geographic references collected using the map, such as denning locations and place names, were integrated into my results.

3.4.5 Participant Observation and On-the-Ice Trips

Due to the complexity of "expert knowledge", putting one's "know*ing* in the form of know*ledge*… [is] often incongruent with the understandings and know-how implicit in their patterns of practice" (Schon, 1987: p.252). In-depth interviewing is often supplemented participant observation by to explore this embedded knowledge in traditional knowledge holders. This ethnographic approach allows for the greater examination of knowledge, perspective, and understanding as it lets people describe their experiences, clarify their concerns, and elaborate on their own perspective on their lived world (Kvale, 1996). "On-the-ice" interviews and participant observation in polar bear hunting would provide invaluable depth and context into this research, as the most advanced form of understanding is achieved when researchers place themselves within the context being studied (Flyvbjerg, 2007).

Based on my scoping trip and early discussion with the community, March was selected as the best time to conduct fieldwork as most residents of the community would be at home (rather than on the land), and was when hunters would begin to regularly go on polar bear hunting trips[9]. Choosing the timing and giving myself enough time (3 months) to allow for participation in community life and subsistence hunts would afford me the opportunity for directed and focused "participant observation". Field notes provided an opportunity to make note of comments, behaviors, and interactions that took place outside of the formal interview to understand and observe actions and knowledge development in practice (Brody, 2000; Cruikshank, 1998).

Understanding this was not my environment or culture, I did not have an expectation that I would become an "expert" on the people, place, and ecosystem. As Aporta (2002: p.341) wrote in relation to understanding Inuit knowledge of sea ice, "[one] does not pretend to give a full account of a system of knowledge the understanding of which requires a lifetime of practice and observation." Instead, I attempted to arrive eager to learn and unabashed to ask questions. I owe the community, and a few key "champions" who helped me make connections and get me

[9] Polar bear hunting season in Sachs Harbour begins October 1st for males and December 1st for females. However, as in other communities, the majority of hunters will begin polar bear hunting when there is enough daylight. In Sachs Harbour, this is March. Note: In the past, before quotas, hunters would hunt bears throughout the year, even during winter under the light of the moon.

out on the ice. I participated in two subsistence polar bear hunts South of Cape Kellet- one with a single hunter, one with a group of both experienced hunters and youths. This gave me the opportunity to observe the active practices of learning, developing, and utilizing knowledge of polar bears and their environment. Besides being a great opportunity to get to know the hunters better and have an amazing life experience, it allowed me to take pictures and detailed field notes about the hunting, traveling, and observing processes immediately after the events. Over 40 pages of field notes that chronicled my experiences, anecdotes, and summaries of informal conversations were compiled. These field notes were drafted into memos and incorporated into the thematic coding and analysis alongside with interview transcripts.

3.4.6 Verification

The verification process took place during a community workshop of six elders and HTC members in March 2011. A research assistant was hired and trained to assist in organizing the verification workshop. This workshop allowed these participants to verify the accuracy of quotations and interpretations, add missing information, and review and provide input on the preliminary results of the study. The preliminary results stimulated discussion, especially among elders present, that provided more stories, and clarified certain discrepancies I found in my analysis. After the completion of the context and results chapters, the community report was offered to the HTC for a final opportunity to review for accuracy and to add additional information prior to publication in the thesis.

3.5 Participants

Traditional knowledge is specialized by gender, experience, age, and geographical range. In order to gather a broad depth of knowledge relating to bears, I sought a sample that reflected diversity in these four categories. The target sample included men and women of various ages. Because of the district roles men and women have in polar bear hunting, each can make equally valuable contributions in different areas of community traditional knowledge (Fehr and Hurst 1996). While polar bear hunting has always been a male-dominated activity, women would occasionally accompany men (usually their husbands or fathers) on polar bear hunts, and would be responsible for fleshing the bear hides and preparing the meat to eat (Tyrell, 2007). As a result, men and women have specialized knowledge, especially regarding anatomy, feeding

habits, diseases, and physical condition of the animals they harvest and butcher (Usher, 2000; Fergusson and Messier, 1997). Gender roles and expertise surrounding polar bears are discussed further in Appendix 1.

While most hunters interviewed practice mixed-subsistence, harvesting (hunting, trapping, or fishing) different species at different times of the year, certain hunters were identified as being experts for certain species. A few hunters were recognized as polar bear experts as they guided and hunted extensively for polar bear. Others were from polar bear hunting families – whose fathers or uncles were exceptionally knowledgeable. In addition, hunters who would guide sports hunters or biologists could also be viewed as having distinct expertise and specialized knowledge.

Participants ranged in age from young adults to elders. As the oldest living holders of the tradition, "elders have the greatest breadth of inherited knowledge, and the longest time spent assimilating new *experiences* into their framework of [knowledge]" (Keith et al., 2005: p.231). This being said, while "the elders know about the past and how things are changing, it is the young hunters who likely know the existing conditions best" (A. Derocher cited in Freeman 2006). Furthermore, young adults may also be more exposed to different forms of knowledge from western science and media than elders, and their perspective is valuable to gain a comparative perspective in generational differences in knowledge and perceptions.

3.6 Analysis

Interviews were transcribed immediately upon returning from fieldwork. All 27 interviews were transcribed and the over 650 pages were coded and used for analysis. The transcripts were coded and analyzed using *NVivo 8* software. A coding framework organized transcripts segments into several categories:

1) Historical, Contemporary, and Future Importance of Nanuq to Bankslanders;
2) Bankslanders Knowledge of Polar Bear Health and Ecology;
3) Ways of learning about Polar Bears;
4) Community-based Monitoring and Indicators of Polar Bear Health;

Within these categories, transcripts and field notes were further sorted into themes and sub-themes developed after reflecting on patterns that emerged out of several interviews and relative to the design and hypothesis of this research.

3.6.1 Transparency, Validity, and Reliability

As with other forms of social science research, methods of researching and analyzing traditional knowledge must be both flexible and formulaic in order to accurately and reliably record a community's knowledge, while also meeting the scrutiny of the academic community. Therefore, this requires the same level of independent "truthing" as other kinds of data, either from community members, through participant observation, or other means (Wenzel 1999).

While it may seem disrespectful to question the wisdom on local experts, I have been reminded on several occasions at the *community*-level, to be cautious regarding the reliability, validity, and accuracy of the information being shared in interviews, as indigenous experts and organizations are as concerned about correct facts as any scientific researcher (Johannes, 1993; Ferguson and Messier, 1997; Usher, 2000). The acceptability of traditional knowledge requires attention to the following criteria: reliability and validity; accuracy and recall; and transparency.

3.6.2 Reliability and Validity

With traditional knowledge and within cultural perspectives, individuals will selectively contribute both subjectively and objectively. I was attentive to the contrast in responses between objectivity (i.e., observations) and subjectivity (i.e., inferences), and how these should be weighed and interpreted in the findings. Further, provided the tensions, conflict, and discussions surrounding polar bear management and hunting during the time of this fieldwork, I was cognizant of the potential for social desirability and response biases throughout the interviews. The purpose of being critical in participants' responses is not to question the authority and integrity of individuals, but rather to ensure that the findings of this study are accurate, representative, and reliable. I was challenged in coding and analyzing the transcripts in terms of differentiating between observations and inference, as well as between first-hand accounts, here-say, or speculation. Fergusson and Messier (1997) would consider speculative answers the least reliable and to be used only in certain circumstances. However, Inuvialuit are

generally hesitant to generalize beyond their own personal experience and tend to be cautious about over-generalizing or simplifying their knowledge and prefer to admit ignorance rather than speculating on topics (Usher, 2000; Gilchrist et al., 2005; Dowsley, 2007). In my experience, participants would disclaim that they were speculating, or they would share information as anecdotes of individual events, rather than drawing generalizations as they are critical of scientists who do. Through the interviews, nearly all respondents admitted that "they did not know" certain answers, and would often defer to other informants who may be seen as more knowledgeable rather than speculate.

3.6.3 Accuracy and Recall

As with reliability, accuracy of knowledge depends on the source and the context through which the observation was made or knowledge shared. Accuracy of current observations may vary based on hunting range, frequency and intensity. Gilchrist et al. (2005) predict that the quality of knowledge declines with increasing range from the community and frequency of land-use and travel routes. This is especially important for knowledge of polar bears given their range and habitat preference may limit the contact and opportunities for observation by both hunters and biologists alike.

When it comes to recording past observations and oral histories, one key concern relates to the reliability and clarity of recall of the respondents. Arima (1976) found that Inuit recall was highly reliable within "living memory" (young adulthood forward) with memories lasting over two generations: "People in a non-literate culture are trained from childhood to remember accurately… in a hunting society, the greatest emphasis in training is placed on accurate recall of environmental information" (p.53). Informant recall is especially high amongst subsistence hunters, who can precisely recall harvest information, especially so when done under rare or special circumstances (as is the case with polar bear) and for species which local people have great familiarity with through year-round contact, annual harvesting, or both (Gilchrist et al., 2005; Usher and Wenzel, 1987). However, with elders or seniors, some concerns with memory attrition present the need for patience and clarity. To address this issue, during the interview process, and between the initial interview and follow-up workshop, I practiced "take-(re)take".

This involved asking the same question twice in the exact wording so as not to be misinterpreted. Take-re-take is a good practice to ensure accuracy of memory.

In ethnography, the primary technique for testing accuracy is through "triangulating"- cross-checking between several informants and secondary sources (Arima, 1976). Triangulation is an attempt to get a "true fix on things by combining different ways of looking at it or different findings" (Silverman and Marvasti, 2008: p.260). Opportunities to cross-check or triangulate traditional knowledge through secondary data sources such as oral history, ethnographies, and government reports are possible. However, in this case, opportunities were limited due to the sparseness of recorded stories related to polar bears in the Western Arctic. However, certain sources were invaluable; especially work done exclusively on Banks Island (Hart and Amos, 2004; Usher, 1971; Berger, 1976; Nagy, 1999).

3.6.4 Transparency

Response bias is a type of cognitive bias that can affect the results of an interview if respondents answer questions in the way they think the questioner wants them to answer rather than according to their true beliefs (Fergusson and Messier 1997). In this study, I anticipated response bias could result for several reasons. Due to the sensitivity of this issue from a cultural and political nature, informants could be reluctant to reveal knowledge that would be considered of proprietary or sensitive nature or filter some information if they perceive the interviewer may misuse the information. Secondly, and more because of my own limitations in the research field, informants may withhold information that they assume is known or obvious to the interviewer if they perceive them as an expert (which I am not).

3.6.5 Confidentiality and Anonymity

In similar studies in Nunavut, Keith et al. (2005: p.232) found that "in small communities, the individual's authority on a specific subject will be well-known, [and]...in some areas of specialized knowledge, few and sometimes only one authoritative informant may make a statement that will be credible". Transparency and reliability are reinforced through identifying knowledge sources, as this allows the community to assess the reliability of the knowledge (Fergusson and Messier 1997).

In previous land use and harvest studies, confidentiality issues have often precluded more specific acknowledgement of Inuit collaborators (Wenzel, 1999). In indigenous communities, identifying the knowledge holder (*i.e.* the research subject) acts to validate that the knowledge and perspective shared in the research. Furthermore, this allows for transparency in the research process. More frequently, local people seek credit for contributing their expert knowledge to scientific studies and decisions-making, and their contributions should be recognized when using TEK for wildlife research and a management (V. Sahanatien cited in Freeman, 2006). To recognize the value of their knowledge and perspective within the community and among other researchers, interview participants will be identified by name in the research findings unless the participants choose to remain anonymous[10]. The option to remain anonymous was provided in the consent form, and only one participant chose to remain anonymous.

3.7 Limitations, Advantages, and Potential Improvements in Methods

As a young researcher with limited experience working in the Arctic, I was faced with several limitations to my fieldwork, both systemic and unexpected. This included my unfamiliarity with community and geography, and lack of time to develop relationships in the community before beginning my fieldwork due to the time constraints of a Masters degree. These time constraints were obvious in restricting the depth of my level of understanding of Inuvialuit epistemologies, as understanding this system of knowledge and practice would require a lifetime of study, observation, and practice.

Fergusson and Messier (1997) outline that "understanding Inuit knowledge is dependent on the investigative techniques used to record it, the researcher's assumptions about the cultural basis for that knowledge, and the researcher's conscious and unconscious assumptions derived from his or her own culture." One of the challenges of this study that I immediately realized was my social location in regards to the cultural and geographic context in which this research would

[10] Transcripts, raw footage, and other materials from community interviews are to be securely stored at the "Social Response to Ecological Change" Canadian Research Chair Lab on the U of A Campus. The community will be allowed un-restricted and unlimited access to the audio and interview transcripts. Any future use of this raw material, outside of the uses outlined in this project, by the researcher or other researchers will require consent of the SHHTC.

take place. To clarify upon my social location, I am a young, white male, who relative to the Inuvialuit, would be considered a "Southerner". I have never been a resident to the Northwest Territories, but I have been a visitor. I had the opportunity to educate myself on the issue (albeit through books and lectures), and I've had numerous life-experiences living, working, and researching in cross-cultural situations. I anticipated that my social location could result in challenges related to communication & language barriers, limited exposure to local context for the interviews and familiarity with the interviewees and local culture as a whole. As an outside researcher, I was continuously reflective on my biases and infamiliarity in the process, recognizing that I could never be "truly competent in another's culture" (Minkler 2005:ii4).

My academic location in regards to the research subject, polar bears, also posed a challenge. For the sake of this research, it required that I have firm grasp of polar bear biology, and a solid comprehension of the principles of conservation ecology, including wildlife population dynamics and the complexities of Northern ecology from permafrost to polynyas. The use of social science methods to gather the biological data requires that traditional knowledge research be a multidisciplinary undertaking (Huntington, 2000). As an Environmental Sociologist, I stand in a unique space in between the natural sciences (biological sciences, ecology, etc.) and the social sciences (sociology, anthropology, and human geography). While this gives me the opportunity to be trans-disciplinary in my approach, it also requires that I be conversant in both disciplines. Strand (2003, p. 79) recognizes some of the challenges inherent in CBPR, which makes me think that perhaps, this inexperience could be seen as an advantage to engage in cross-cultural CBPR:

> For academics used to being the expert, community-based research is challenging because it recognizes multiple sources of expertise: the abstract, generalized knowledge of the academic, the detailed, experiential, hands-on knowledge of the community member, and the fresh perspective that is brought by students, unencumbered by community traditions or academic canons.

Furthermore, due to the lack of experience in community-based research and the fact that this project was driven by a sole-researcher (as opposed to a research team, project, or institution),

there was limited capacity and resources to carry out my ambitious goals for community involvement. Due to funding limitations, my scoping exercise in summer 2007 did not allow me to visit Sachs Harbour, which would have been beneficial in building relationships and initiating certain aspects of community-based research prior to my field research. While in my preparation for a research license and ethics approval, I corresponded extensively with the co-management agencies and received letters of support for my research from the Inuvialuit Game Council (IGC), Wildlife Management Advisory Council (WMAC), and Sachs Harbour HTC (see letters in Appendix 6-8). Despite my early efforts to engage in community consultation through scoping trips and correspondence, as one member of the Sachs Harbour Hunters and Trappers Committee (SHHTC) joked to me, *"[I] was not real until I was in front of [him]"*. This awakened the realization that, despite all the efforts I had to facilitate community-based research, it did not begin until I arrived in the community.

In reality, this project lacked the capacity and resources to develop a formalized CBPR protocol including the development of a research agreement and formal steering committee). Instead, the HTC acted informally as a steering committee. Several "champions" on the HTC provided essential feedback and guidance to approaching the issue and community. Other concerns regarding reliability, verification, community response to, and dissemination of results, were addressed in my research methods to their satisfaction.

All this being said, I was very proud of the strengths in the design that allowed this research to function smoothly. These included early and extensive consultation with regional management agencies to identify their interests and identify relevant participants for the study. Another strength was in selecting the timing of the fieldwork to work around the community's harvesting schedule, and the length of my fieldwork that allowed me the opportunity to work at a relaxed schedule and allowed me to participate in subsistence polar bear hunts.

One additional benefit to the scoping trip was anticipating the research needs of both communities and management agencies. Very shortly after conducting the field research and

analysis, I was recruited to conduct similar studies by both the co-management agencies and government departments. The lessons learnt from my fieldwork were incorporated into these later studies, enriching them and adding the components that I was unable to fully incorporate in my thesis research (i.e. in-depth mapping, video, and youth engagement) due to technical and financial restraints. Through my fieldwork in Sachs Harbour, I gained an important baseline of knowledge (terminology, biology, geography) and experience (i.e. having participated in subsistence hunts) that complimented my set of research skills and tools to enhance these later projects[11]. These side-projects were extremely valuable to me as a student researcher as they provided income for a living allowance that was not included in my research funding and allowed me to develop a deeper context of community knowledge, history and perspectives that I was able to incorporate into my thesis, which was being written alongside (albeit slowly) these other research opportunities.

[11] In Fall 2008, I was invited to co-lead a workshop of elders from across the ISR to prepare a report on community knowledge of polar bears for immediate needs of the co-management agencies (i.e. CITES). The following year (2009), I was hired by ENR/WMAC to conduct the field-research for a larger study of traditional knowledge of polar bears in the ISR, conducting extensive interviews, mapping, and videography in all six communities. In 2010, I was hired to prepare a report on traditional and community knowledge of polar bears for the NWT Species-at-Risk Committee, to assess the status of polar bears in the NWT- the first time they have commissioned traditional knowledge reports for consideration into the status assessments.

Chapter Four: Results

4.1 Introduction

This thesis examines Inuvialuit knowledge and observations of polar bears and their ecology to find out what Bankslanders know about polar bear population health. The objectives of the thesis were to document Inuvialuit knowledge of polar bear population health, and to identify the indicators used by Inuvialuit to assess polar bear health. This thesis argues that Inuvialuit of Banks Island have an accumulated wealth of traditional knowledge about polar bears and this traditional knowledge and local observations can contribute to ecological monitoring of polar bears. Through descriptive narratives from semi-directed interviews and personal insights from field notes and participant observation, I will recount the observations and knowledge of Bankslanders as told through their individual observations and first-hand experiential knowledge. This also includes what they have learnt from others' observations, including oral histories and traditional knowledge, as well as from years of working with and interacting with scientists. In the previous literature review, I outlined seven themes of indicators that Inuit from other communities use to assess polar bear ecology and population health. These include: body condition and behavior; denning breeding success; diet and feeding behaviors; distribution and movements; habitat conditions; population abundance; and unique observations. This chapter will summarize Bankslanders knowledge and observations regarding these seven categories, and will pave the way for a discussion on how these can be applied to understanding, monitoring, and communicating polar bear population health.

4.2 Body Condition and Behavior

One of my early questions in the interviews to explore this was "*How do you know that a polar bear is healthy?*" In general, Bankslanders responded that an unhealthy bear would be a starving bear, a "sick" bear, or a skinny or injured bear. For example, one hunter described his assessment of an unhealthy bear:

> *"I've seen a starving bear; I don't know what you call unhealthy? Me, I consider an unhealthy bear a starving bear. A bear that you know is hungry… it could be because he's young or he could be old. The only way I see a healthy bear is ... [in] my eyes is y'know, [if] he ain't skinny, you know he's healthy." - L. Amos*

Although hunters and residents would frequently see a skinny or starving bear, which is rare but not uncommon around Banks Island, hunters rarely ever see what they would consider an "unhealthy" or "sick" bear." One elder said that he had seen bears that looked and behaved as they were starving, but had never seen an "unhealthy bear":

> *"Never saw [an unhealthy bear]. There was some that are pretty skinny you know, but a lot of them - I seen a few of them you know that come right into town, eh. And they'd start chasing anything… they see a track or anything and they go for it, you know, ah. They're not scared, even, when we had the dogs at that time you know, some skinny bear you know go in and start going after the dogs." - A. Carpenter Sr.*

While this chapter explores multiple components of polar bear ecology that affect the populations health, the most significant assessment of individual bears health is through examining the body condition and behavior of an individual bear. However, the relationships between body condition and health are not always directly correlated. These observations must be taken in light of other considerations, such as where the bear is seen (i.e. close to town vs. on the sea ice), the time of the year when the bear is seen, and the age of the bear. These conditions would be assessed at multiple stages when observing and examining the polar bears body condition and behavior.

4.2.1 Body Condition

Body condition and behavior of individual bears is the key metric for assessing that individual's health. For example, I interviewed one hunter while in the process of butchering a bear, and he discussed how he assesses the body condition and behavior in his assessment of the individual bear's health:

> *"See that other skull I have out there, he's got three broken molars. That bear was unhealthy- he was a big bear, but he didn't have [any] fat on him. From what I could see in that, is that he's pretty well starving. He's having a hard time to eat- it looks like it hurts him to eat. That's what an unhealthy bear is. Like*

when you're driving up to him, he looks almost like a weasel-bear. He's just long and skinny. That's what an unhealthy bear is." – W. Gully

When posed with the open-ended question of "*Over your lives have you seen changes in the bears?*" hunters would primarily discuss changes in the body condition and size of individual bears. The assessment of body fat can be subjective, based on a hunter or elders past experience with polar bear body condition or their expectations. Comparing the replies of two elders when asked "*Have the bears looked different (better/worse/healthier) in the last 5 years? In the last 30 years?*" demonstrates this:

"No- they're basically the same. I haven't seen much changes in them… I haven't seen much of the bears lately, but some say [polar bears are] "not as much fat as they used to be before". But the ones that [they harvest], the meat that they bring back, it seems to be pretty fat" - A. Carpenter Sr.

"Yes- They're not fat like before. I notice that when they give us polar bear [meat], some of them [have] no fat on it. Some of them had a lot of fat- they're easy to flesh. Some of them, no fat, just sinew-like. I found out around the eighties… Some of them [started getting less fat], not all of them. Maybe the older ones [be]cause they don't hunt too much anymore cause they get too old." – M. Kudlak

Several other hunters commented that polar bears are not as big as they were in the past. The decline in polar bear size is locally attributed to the "big" bears moving North, or that they are out on multi-year ice. One senior hunter explains these observations and rationale:

"Back in the day, 20 years ago [1990], you used to see huuuge bears, really huge bears- 11, 12 feet. Now nowadays they aren't as big as they used to be. Really you don't see them big tracks anymore. Because of the sea ice or, the multi-year ice has moved away. You go to the North end of the island in the wintertime and you'd chase some huge tracks! ... [The tracks are] not as big as long ago, no.

Cause all the big bears they stay out on that multi-year ice and they don't leave that. They just stick around it. I know it's close enough to land here and they'll wander into land, wander around on the land in the springtime, but that's it." – J. Keogak

This assessment of body size is less subjective than body fat, as from my experience, hunters have methods for measuring the size or length of bears and recall these details, especially in the extremes. The younger hunters recall with excitement the stories of the "monster bears" that their elders hunted in the past, some which recalled that these bears grew up to 14 feet based on their rough measurement. These are described as "monster bears", or "shovel bears", because their tracks look like they were dug by a shovel. A younger hunter shared his perspective on big bears that was informed both by traditional knowledge and by working with scientists:

"I used to work for Canadian helicopters, and one of the pilots used to go out with the guys that tag bears. And he said way out on the ice they run into monsters. Like jut about 14 footers, just killer heavy too. Some of them have to be weighed with the chopper. Close to 3,000 lbs. Just huge!… My dad [Geddes Wolki] used to tell me. He said those bears are so smart they just stay out there and they never get close to people or anything. And if they hear something, then right away they are just gone. They're hard to run into cause they're smarter eh!...They know how to survive and avoid people I guess." – J. Wolki

Many of the elders and hunters brought up "weasel bears" in the interviews, which are also known as "*tiqiaknituk*"[12] or "*tegiaanak*"[13]. David Haogak explains:

"There's two types of polar bears: one, they had a teddy bear face, small head, they really look like a teddy bear. Then there's the real long weasel nose. Those ones with weasel nose are dangerous. They're really smart. They sneak. They're really good sneakers. Dangerous… They know how to hide their nose. I was always worried by, if I see them. Weasel bears if they disappear, watch your

[12] J. and S. Lucas
[13] F.and M. Kudlak

back… Teddy bear, little faces, those they're usually healthy. Fat ones, the other real fat ones, they end up with fat all over their face."

Several other hunters commented that "weasel bears" are more aggressive and have been known to stalk humans. One young hunter explained the physiological difference he was told about a weasel bear:

"Seven or eight years ago, Roger [Kuptana] got a "weasel bear". It was an 11 foot bear with the skull of a seven foot bear. It was skinny, long and narrow and had a long neck. So that's probably for going down in seal holes and grabbing them." - W. Esau

As mentioned in the previous section, Bankslanders describe an unhealthy bear as a starving bear (or a skinny bear) or a "sick" bear. Starving bears are referred to as "*kayangnituk*[14]*"* or "*katyaaq*[15]*"*. Skinny bears are referred to as "*otonik*[16]*"* or "*mummik*[17]*"*. According to Roger Kuptana, *"there's always been the odd starving bear."* Another senior hunter commented that:

"There's a lot of starving bears, the year before. I guess we don't see them die, that's all, don't see the carcasses. Maybe they have a place to go die or something like that. They could fall down anyplace I guess." – E. Esau

According to several hunters, it is uncommon to see a bear carcass on the sea ice, or even on land. Occasionally, hunters will come across the carcass of a bear killed while fighting, but will rarely ever have come across a bear carcass from natural causes. One senior hunter explains:

"We've ran into a bear carcass with still the hair on. Skin and bones, like they hadn't eaten for quite sometime, or they were sick or something. But not very often, you rarely hardly ever see a bear carcass." – F. Lennie

The residents of Sachs Harbour would occasionally see "starving" bears in their community, but have not seen this for several years, and would often only see this at certain times of the year when bears have been fasting over summer and fall.

[14] J. and S.Lucas
[15] E. Haogak
[16] L. Wolki
[17] F. and M. Kudlak

> *"You see skinny bears, some that are pretty much starving, from age or anything. I've always seen healthy bears! Just once or twice in early fall or October and November you're going to see skinny bears, but that's just cause they're really not out on the ice yet- the ice is not formed. But it's always been that way." – F. Lennie*

One hunter commented, *"about five years [~2004] ago there were really starving bears. They seen starving bears, even in the summertime" (E. Esau).* Due to the lifecycle of polar bears and the ecological fluctuations in habitat conditions and prey availability can make assessing temporal fluctuations in polar bear health challenging, as distinguishing annual changes in body condition, as opposed to seasonal changes, to determine trends in health and body conditions.

The age of the polar bear would be another variable in assessing the health of the animal. One hunter stated that the *"only [bears] that were really unhealthy were the ones who just left their mothers" (F. Raddi).* Several hunters and elders mentioned that cubs would often be skinnier as they are learning to hunt, as well as exhibit more curious and inquisitive behavior, especially around communities.

> *"Some of the bears, the younger ones, that had [been] driven away by their mothers. They're not the one's who are really ready to hunt yet. They get, some of them get, pretty skinny." – A. Carpenter Sr.*

The word for "sick bear" in *kangiryuarmiut* is *"aanniaqtuq*[18]". When I asked hunters to elaborate about "sick bears", they were unfamiliar with any specific disease, outside of being starved or emaciated. I asked if they had seen bears exhibiting disease or parasites, and one senior hunter replied that *"I've never seen a diseased bear, only starving… too cold for parasites" (E. Esau).*

Another concern regarding polar bear health, but more so the health of community members who eat polar bear meat, related to contaminants and uncertainty of the safety of polar bear

[18] E. Haogak

meat for humans consumption. One female summarized that *"there's a certain amount of contamination in the bears and seals…all the chemicals from the South somehow ends up here and affects the bears."* As the apex predator, polar bears are affected by impacts to ecosystem, which raised concerns about bio-accumulation for ocean contaminants up the food chain: *"If there's an oil-spill, it will affect everything…It will affect the seal. And the polar bear will get it. It's just a chain reaction, you know" (R. Kuptana).*

Observing and monitoring polar bear body condition

As I learnt through interviews and participation in hunts, monitoring and assessing body condition would occur at multiple stages when observing, and examining the polar bears body condition and behavior. When a hunter comes across polar bear tracks in the snow, a skilled hunter will have a technique for measuring size, as well as the sex, of bear by characteristics of the footprint. Another senior hunter mentioned that it was more accurate to gauge the tracks for the bear size, as opposed to estimating from viewing with binoculars, as confounding factors such as a white out or snowstorm could skew a visual assessment.

When a hunter reaches fresher tracks and glasses for signs of the individual bear, the initial visual assessment of the bear can inform the hunter of the body condition, the fur condition, and behavior. Hunters will look at the body and bone structure: the length of legs, the boniness of hips, and the shape of belly and rump. This initial body condition assessment could inform a hunter's subsistence harvest decision, as one hunter explained that he would *"only hunt [a polar bear for food] if it's got fat on it."*

However, once a bear is harvested, its body condition can be examined and assessed in a more detailed and hands-on manner that a purely visual assessment- examining body condition through the harvesting and "fleshing process". A hunter will conduct a very quick field dressing of the bear- quick because the harvest site is often in dangerous ice conditions, and also because it must be done before the carcass can freeze in temperatures that often reach below minus 40^{o}C. The purpose of the field dressing is to harvest the hide and the choice meat of the

bear. As is common practice, during either the field dressing or a more elaborate butchering process, the hunter will examine the vital organs (liver, kidneys, lungs, heart) and stomach contents. At this point a hunter can identify abnormalities in the vital organs. The liver will be examined for any spots to see if it's sick. Through examining the stomach contents, the hunter can gauge the diet of the animal. This can further help inform the hunter if the bear is healthy and if the meat should be used. If a hunter finds garbage in the stomach this may dissuade them from utilizing the meat. Likewise, if hunters looks for signs that the bear was recently handled by scientists (i.e. lip tattoos, tranquilizer dart bruising, other identification), this may also impact their decision to use the meat. Once the field dressing and rough assessment is complete, the hunter will load the hide, meat, and skeleton into their sleds to return to their camp or to the community.

One key indicator of individual polar bear health is the condition of the fur and hide, as healthy bears will "*take care of themselves*". Several hunters described that when a bear is in poor condition, their fur looks dirty or dark yellow. The fur will also be assessed for signs of fighting, such a fresh cuts, scars, or signs of rubbing.

When examining the carcass, the hunters will pay attention to the condition of teeth (especially the canines), as the condition of the teeth will provide insight into the age of the bear, as well as hunting success. *"It's not very often you shoot an old bear,"* says Earl Esau, *"Some of those old bear have no teeth. Don't see those anymore. I haven't seen one of those for a long time."*

Hunters will often examine the feet, claws guard hair, and the amount of fur and the wear of the fur around the feet in-between the individuals toe pads. This can provide insight into the amount of traveling a bear has done, as well as the terrain a bear has traveled across, as walking across land, as opposed to snow or sea ice, will wear away their guard hair. In the case of hybrid grizzly-polar bears, the feet have been identified as one of the key identifying features (Branigan pers. comm. 2012). When I was in Sachs Harbour, one senior hunter shared news of a bear he

harvested who had a claw that resembled a grizzly bear claw. Word of this quickly spread amongst hunters.

Once a bear hide has been field dressed by the hunter, a woman, likely their wife or a close relative, will flesh the hide. As discussed in the section on "Gender and polar bear hunting" in Appendix 1, women's main role in polar bear hunting is to prepare the hide by "fleshing" the bear. "Fleshing" is a detailed process of scraping the hide with an *ulu* to scrape excess flesh and blubber. Because of the intensive, detailed and hands-on process involved in fleshing, women can provide important information about polar bear health and body conditions based on the involved task of fleshing- this includes thickness and amount of fat, the quality (color, texture) of the fat, and further assess the hide for cuts, scars, or other abnormalities. In this regards, women are a wealth of information on the health of polar bears, comparing diachronic observations and experiences about changes in the quantity and quality of fat- a key indicator of polar bear health:

> "*There's probably everyone has an opinion on polar bear health, but it would probably have to be the ladies that do all the fleshing [who would be really knowledgeable about polar bear health]. They see the marks and…how much fat or blubber's left on them." – M. Kudlak*

During the field dressing and butchering process, the condition of the meat will be examined to further assess its suitability for consumption. Hunters have found bears that presented bruising and "infection" from a tranquillizer dart. The quality of the meat (i.e. taste and texture of meat) and the amount of fat on the meat is also assessed when eating bear meat, such as the ribs, back strap, and the paws.

4.2.2 Behavior

Polar bears are considered by some to be a shy animal, but can also be curious and inquisitive. As dealing with polar bears in the community and at their camps have long been a way of life on Banks Island, it is an important skill to distinguish between a curious bear and a starving and potentially dangerous bear. Roger Kuptana described a hungry and potentially dangerous bear:

"A hungry bear faces you, if you're at camp out there, he'll head straight for your camp. That tells you that he's quite hungry." In the community of Sachs Harbour, residents will commonly see polar bears in fall time during "freeze-up" as they pass by in their migration. If the bears are "healthy", they keep their distance, but if they are starving or curious, they will come into town. Andy Carpenter Sr. distinguished between hungry bears and curious bears:

> *"Always the ones that [are] hungry, they go for the camps. They smell some seal or something and they go to the camp and they're not scared, eh. But the healthy ones, they come to the camp sometimes, but they run away easier."*

However, this distinction between starving and curious is significant, as usually the younger bears (2-3 years old) that just left their mother, will be curious rather than starving, and will be viewed and managed differently from the dangerous starving bears. Larry Carpenter describes this:

> *"You can tell if it's a skinny or poor bear really easy. If it's hungry bear that's in poor health, those are the ones that usually come in to town, but we've had healthy ones come into town too, but usually it will be the younger ones who have just been chased away by their mothers."*

It is common that the bears that do come near town will be killed as they may pose a threat as a nuisance bear and are harvested for safety reasons. A starving bear is considered a threat, whether in the community or at camp. While some efforts will be made to deter a bear that comes through the community, the threat of a starving bear to safety and property is a big concern.

An additional behavior that can inform harvesters of the health of individual bears is what hunters and elders would describe as "spooked bears" (*kayaaniq*[19]). Harvesters and elders discussed how disturbances from hunting, helicopters, gunfire, or other startling occurrences invasive research techniques can "spook" bears. 'Spooked bears' are jumpy *(kogluk)*, and as a result, are ineffective hunters and eventually suffer from nutritional stress. Geddes Wolki explains:

[19] E. Haogak

"Some bears they say, the ones that got away from the hunters, they get jumpy. And they're never good at seal hunting anymore. Because when they hear something, a little noise, they kind of jump and the seal never come up. That's when they get hungry."

There were several concerns expressed that increasing amount of activity in the region due to exploration and development could disturb and scare the bears and seals away. Polar bears were described as being especially vulnerable to disturbances from aircraft and shipping, which not only impacts the travel and habitat use, but can also scare bears away from some of the prime hunting locations for Inuvialuit. Cumulative impacts of disturbances are anticipated to increase as more industry and traffic occur in the regions:

"I think the Northwest passage is going to be a big [threat]! ... I think that's going to have a big effect [as] you will have a lot of technology infringing on them- planes, boats. Snowmobiles are a big one." – W. Gully

Likewise, there was concern regarding the increased interaction and human-bear conflict at industry sites could result in more bears becoming spooked, or potentially killed.

Observing and monitoring polar bear behavior

The behavior of polar bears can serve as a qualitative indicator of an individual's health. Behavioral indicators include signs of aggression, as starving bears are aggressive and don't scare away easily. Bears whom appear "spooked" are not as successful at hunting and could face nutritional stress. Community members often distinguish starving and often aggressive bears from the younger, curious bears based on qualitative features, and expect these bears to be juveniles/sub-adults that just left their mothers:

"To me, the unhealthy ones tend to come right to our town- the starving ones, the smaller bears, they're the ones that come around, cause the smell the garbage and smell some of the food around here… But I've seen a lot of bears come in to town. A lot of small bears. Usually all the healthy bears are way out. Usually the starving ones, not sick, but starving, because they're not hunters. They just left

their mom's or whatever and they don't know how to hunt seals, so sometimes go without food for a long time I guess." – F. Raddi

In summary, the assessment of body condition and behavior is based on a largely qualitative set of indicators. The skill in the detailed observations of these indicators are developed over years of experience observing bears and in close contact with and examination of their body condition, comparing their observation against years of experience to identify trends and oddities.

4.3 Breeding Success

4.3.1 Denning Habitat and Behavior

In the interviews, Bankslanders identified key denning areas on Banks Island as Cape Lambton, Norway Island, Nelson Head and generally along the west-side of the island. Observations of individual dens, as well as specific denning areas were identified by community members, and included Bernard Island; Blue Fox Harbour; Big Bluff (*Imnaqpaluk*); Cape Kellet (*Nuvuk*); DeSalis Bay (*Kangiqhualuk*); Gore Islands (*Ikkuq*); Nelson Head; Norway Island; Sachs River; Siksik Island; Terror Island; and Thesiger Bay. One young hunter commented that *"[polar bears] just love to stick around Banks [Island] because of all the denning sites they can find" (M. Kudlak)*, which reflects biologists views that Banks Island is one of the key polar bear denning sites in the Canadian Arctic.

- Bernard Island
- Blue Fox Harbour
- Big Bluff (*Imnaqpaluk*)
- Cape Kellet (*Nuvuk*) (Kellet Bluffs, Kellet River)
- DeSalis Bay (*Kangiqhualuk*)
- Gore Islands (*Ikkuq*)
- Nelson Head
- Norway Island
- Sachs River
- Seal Camp (near Sachs Harbor)
- Siksik Island
- Terror Island
- Thesiger Bay

Figure 3: Denning Areas on Banks Island identified in interviews

Characteristics of snow, such as timing, quantity, location, and structural properties are important, as it provides a layer of insulation for the sow and her cubs. *"The main things is that there's snow"*, one hunter explains *"if there ain't no snow cover they have to go way up land or just drop their cubs." (F. Lennie).* If snow is packed too hard or if there is not enough snow, the bears may have a more challenging time digging dens, may move locations, or possibly lose

their litter. The ideal conditions for denning are where there is deep snow to provide insulation for the mother and cubs:

> *"The snow has a big part of it too. You need snow for a bear to go and den in. And if you don't have as much snow, the bear will try to find places where there's more snow. For a bear to den, you gotta have possibly 10-12 feet snow."*
> *- L. Amos*

One elder commented that if there is not enough snow, *"sometimes they just dig down a little ways to have young ones, but they move to where there's more snow later on." (G. Wolki).* Fluctuations in the amount and timing of snow have been observed and related to changes in ability to find dens and the denning locations: *"One year we hardly had snow*," said Wayne Gully, *"so it was pretty hard for the bears to find good dens."* With inadequate snow in certain areas, bears may move to different location:

> *"It all depends on how deep the snow is. …. A year before, our snow conditions were worse, we got a quarter to one-third of our snow by December. So they must've denned on this side, cause always this side was, hardly any snow."*
> *- E. Esau*

Wind direction is key in determining where snow will accumulate and create ideal conditions denning. The West and South sides of Banks Island were identified as ideal denning locations because the prevailing wind on Banks Island blows North-East to South-West:

> *"There's a lot of denning areas on the West coast. You'll probably find some [dens] on the East coast. But the best snow is coming from the East. Prevailing winds are East and West. The Banks along the West side, the East winds bring a lot of snow there- those areas are where the bears are denning." - W. Gully*

Bears have been observed to den inland, in creeks, or depressions where snow will accumulate. Bears look for dens in areas where the wind blows over a bank, so the location of dens will depend on prevailing winds and the aspect of the slope. Floyd Lennie explains the influence of winds on denning conditions:

> *"The lack of snow depends on the wind. If you got a lot of wind, then there's nothing for a bear to hide underneath. But it depends on where you go. Even if*

there's not much snow on the land, on drop-offs, or bluffs, or banks, there can be pretty good snow banks there. They use that. A few years ago we didn't have much snow out by the coastline East, so a lot of bears went up the river where it was good for denning. I counted, what, about 21 female bears with cubs walking out from the river… [Polar bears are] pretty adaptive."

Hunters are noticing a change in the direction of prevailing winds which could cause snow to accumulate in different areas and bears to change their denning locations:

"We've got banks [cliffs] going all over the South coast of Banks [Island]. There's some very high banks and drifted with snow. And the wind is always usually coming this way [North-East to South-West]. I'd say more bears would be denning on [the West side] than they would on the Eastside because our winds are mostly this way [points North-East to South-west] and they make drifts that are a really good area for denning. I've heard in the past that there's been a lot of dens on the islands. And I'd say it's mostly been on the West and the South [coasts]… Our winds here for years have been [West-ward], they're switching now they say to more Northwesterly. But West-wind coming, from the East. Now it's North-East, an easy wind. It used to be our prevailing winds, cause you could see the drifts would always go like this, now they're going more from the North-East." - L. Carpenter

Females will also make dens in the snow banks high on the coastal cliffs of Nelson Head along Southern Banks Island. One concern with climate change is that the thawing permafrost resulting in slumping and erosions could de-stabilize the banks that are the prime denning locations.

While dens are generally located on land and along the coastline, a small number of dens also may occur on land-fast or multi-year ice. Lawrence Amos shared that *"there's bears that den way out on the multiyear ice. The old ice that's way out here – you know 30-40 feet thick."* Oral history and hunters experiences have observed bears denning on the sea ice. However, this occurrence is rare and requires lots of snow.

Observing and monitoring polar bear denning

In late October to early November, hunters traveling along the coast expect to see a lot of polar bear tracks going inland. This is when pregnant females begin looking for a den where they can birth and feed their newborn cubs. During the trapping days, trappers who consistently traveled the coast during the fall and springtime would have strong longitudinal observations of denning locations. In the past, dogs were used to identify the locations of polar bear dens and hunters would harvest bears in their dens. As dogs are not used as extensively for hunting bears, hunters use other techniques and indicators to identify the location of dens.

As it is now prohibited to hunt or disturb polar bears in their dens, hunters do not search denning areas as extensively. However, hunters will still identify and locate bear dens using binoculars and continue to make observations over time of denning locations and behaviors. For example, John Lucas Sr. shared that "y*ou would notice [the den] right away because foxes always urinate on it [on the hole]."* Dens are also recognized while traveling along the coast during denning season and observing tracks traveling inland either away from or towards the sea ice (often accompanied by the tinier tracks of cubs).

Beyond identifying the location of dens, monitoring the amount of snow, location of snow accumulation and prevailing winds can determine the quality and location of denning habitats and are important considerations in monitoring polar bear dens and population health.

4.3.2 Mating

Mating season is generally in March-April, when male bears will follow in the tracks of females with determination to mate. John Lucas Sr. talks about big male bears traveling great distances, coming in from "way out" on the sea ice, to track down and mate with females:

> *"I mean this time of year [March-April], other than a hibernating bear, you're going to get some healthy animals, cause they had the whole winter to hunt. And now the bigger bears, the last thing on their mind is going to be food, cause they are going to go one month without food because they're breeding right now. This*

time of year… bears are really travelling. Cause the males are following the females, and where the female goes, there's definitely bound to be a male following her tracks. Like you know, even though it's three or four days old and covered up really good, a big bear will follow that right until he catch[es] the female."

"Bears are very social animals," says Paul Raddi, *"they always stick together. If you see one bear, you're going to notice another somewhere."* Bears are known to congregate, possibly for mating purposes, and several hunters have heard stories of this or observed signs on the ice:

"One year when I was really young, I was out here and, out this way [...], we ran into a place where there probably [had] been about 10 bears in that one area- you could see all the different size tracks. They'd been breeding or something. I've heard that they congregate like that in certain areas, and that's the first time I noticed this- thirty years ago." - L. Carpenter

During their rutting, males are very aggressive and will fight off other male bears, and possibly kill or cannibalize cubs, in order to mate with a female. This behavior is well documented in Inuvialuit knowledge, and many hunters mentioned that Inuit reported cannibalism long before it was picked up by Southern media and sensationalized in the context of climate change:

"Well, it's always been known that, if they're hungry, they'll eat another bear….And when they're in heat this time of year, if he runs across a female and it has cubs, it will kill the cubs so the female can get in heat again. Those big bears, they're aggressive, and he'll get the females to submit because he's so aggressive. The female is scared and smaller." – R. Kuptana

Pregnant females will spend the winter in dens, emerging in springtime (March – April) when mothers begin hunting for seals on the shore-fast ice, keeping their young cubs close by as they watch and learn hunting behavior:

"Those females with those cubs are always really fat. And those cubs get big right away…. They teach them to stay away while the [mother] bear is waiting for seals at the breathing hole. If they keep going to their mom, the seal wouldn't come up and no one eats. Yeah, they're good hunters." - G. Wolki

Sub-adults whom have just left their mother have a difficult time hunting on their own. These bears who have not yet mastered hunting can often face nutritional stress as they learn how to hunt and survive on their own. Quite often it will be these young ones – curious or starving- who wander into town. *"The one's that are stressed out, they're either old bears or young ones that just got booted out from their mother."* Lawrence Amos explains, "*Those are the ones that struggle. Until they become serious, good hunters."*

Fecundity refers to the potential reproductive capacity of an individual or population. Female polar bears generally have two cubs (twins), but triplets have been observed on several occasions, and oral history exists of a bear with four cubs around Baillie Island, which could was also hypothesized as either adopted cubs, or her cubs from the previous year. The most obvious indicator of fecundity is the number of cubs with the mother. Fecundity is an appropriate indicator of individual female's health, as it takes a lot of energy and nutrients to raise two or three cubs. Likewise, the more cubs a mother has, could potentially decrease the survival rate for the cubs, as one young hunter explains through a story of seeing a polar bear with triplets:

"The cubs looked healthy but the mother was probably doing a lot of work to keep them in shape. Cause they're saying there's just a 70% chance [for each cub] to live, so you gotta be the dominant one from the beginning. So if you saw a sow with 3 cubs, that's a pretty lucky sow, cause those males will even eat the cubs" - W. Esau

4.4 Diet and Feeding Behaviors

4.4.1 Diet and Feeding Behaviors

Ringed seal (*Pusa hispida; natchiq* (sing.), *natchiit* (pl.)), and Bearded seal (*Erignathus barbatus; ugyuk* (sing.), *ugyuit* (pl.)) are the main prey of polar bears, and polar bears depend on seals for their survival more than any other species. A key physiological requirement for polar bears is concentrated energy in the form of seal blubber or '*uqsuq*'. *"What they really live on is the blubber of the seal,"* explains Fred Lennie, *"sure they'll eat meat and that, but they prefer the oil and blubber".* When a bear kills a seal, it will strip the blubber from the carcass and leave the rest of the meat, often for foxes to scavenge. It will typically only eat the carcass if it is starving, or needs the nutrition for their cubs. Floyd Lennie continued, to point out:

> *"Female bears with cubs and that, they eat the whole thing. Male bears, you see that, but that's rarely, because [female bears with cubs are] pretty hungry having not eaten for quite some time when they do that."*

Likewise, several hunters shared observations of polar bears caching dead seals as they travel along an open lead hunting, or cache a partially consumed seal while they rest. Roger Kuptana explains that:

> *"When the bear gets a seal, he might not eat for a couple of weeks or something, so when he does get the chance to eat he'll eat as much as he can and when he does, maybe after a while he'll wander 100 meters and dig a little hill or area to lie, and sleep it off for a while and then wander off again."*

Polar bears will hunt seals from their breathing holes, as well as when they are hauled up on the ice, and are very proficient at hunting seal pups in their dens in the spring, when they do most of their hunting. However, other times of the year, bears will stalk and kill seals from their breathing holes on the young ice. Two senior hunters shared several insights into polar bears' hunting behaviors that are worth noting:

> *"[Polar bears] always follow the young ice. That's where they hunt. They look for breathing holes of seals. They dig on this side [close to the breathing hole] they make it thin. When the seal come up, they slap [the hole] in at the same time as*

they dive. They just slap that thin ice they make. Bite the seal right away. I used to see lots of places where they hunt like that! I think after it gets thin, they cover the hole with their body, so a seal won't see through. I always wonder how they learn you know. They're so good hunters… When the bear is hunting, I used to hear that they covered their nose when they're crawling towards the seal in the flat, cause that's the only dark place here [points to nose]. They put their paws like this and lie flat on it's belly, and keep pushing." - G. Wolki

"It would be better [seal] hunting for [polar bears] in the dark than in daylight- you know- when their shadow could be seen… They put a thin layer of snow a top the hole- very thin. So maybe they don't see their shadow or see them before they come out. I've seen that a few times. Just light snow right atop the water. You know, [stop seals] from seeing their shadow maybe and if they see a bear up there, they wouldn't go up, so they cover it with snow. They're very smart animals… [Polar bears] can smell a seal hole through about [3-4 feet] of snow. I seen a big hole one time. And right at the end of the hole their was a den for seals. You know that's solid ice they can smell a seal through. When you watch a polar bear, you never see a polar bear traveling fair wind. Always head-wind. Always going like this to smell seal holes and that. They're always going headwind." - J. Lucas Sr.

Local hunters have also observed different feeding and hunting behaviors beyond seals. *"Well right now [polar bear] lives mainly on seals, but like I said, if he's hungry he'll be opportunistic"* says Roger Kuptana, *"the polar bear is a wanderer. He lives by his nose."* In summer and fall time, bears are often seen scavenging along the coast when there's no ice. Numerous stories were shared about groups of bears congregating to feed on beached bowhead whales along Cape Kellet, Thesiger Bay, and Nelson Head. Further in-land, bears have been observed scavenging on dead muskox and Peary caribou.

"They'll eat anything that's dead. Dead muskox. Any chance they get they'll eat whatever. It's usually the small [sub-adult polar bears] that aren't usually good hunters, the ones the mother decides to let go. But even the big ones too I guess."

- F. Raddi

Some elders believe that bears will also attempt to hunt walrus, muskox, and caribou. This has not been observed on Banks Island, although this has been documented in other parts of the Arctic, and several hunters and elders were aware of this through media (i.e. BBCs *Planet Earth* Series) and working with scientists:

"I've seen bears, some that eat [Peary] caribou… Around February, some of the young [caribou] freeze… [polar bears] scavenge mostly, but they may hunt the caribou too… Or in some years there's a big die-off from the caribou."

- A. Carpenter Sr.

Both in oral history, and more recently, hunters have observed polar bears eating grass in the fall, prior to denning, and possibly in the spring. Geddes Wolki describes his observations from Baillie Island:

"I used to see them eating grass in the mainland one time one polar bear. When we skin it after we got it, it was full of grass in it's guts. Just like a herd of cows. [It looked] really healthy."

Observing and monitoring polar bear diet and feeding behavior

It is routine practice for harvesters to assess the stomach contents, not just for polar bears, but all species of animals they harvest. This is the most direct way harvesters can assess the diet of the bear that they harvest. Several hunters and elders explained that the stomachs of a really healthy bears will usually have "*straight [seal] oil*", while finding contents beside straight seal oil, such as garbage, or other species, is a cause for taking note or raising concern:

"Sometimes you skin some of those bears, and we'll check what's in their stomach. All it is just oil that comes out. Sometimes gallons of [seal] oil comes out… You'd find the hide of a seal, chunks here and there. You'd find different

bones. I know Wayne Gully has checked out a few stomachs of polar bears where he'd find paper and plastic in their stomach contents." - F. Lennie

The hunting behavior and consumption of seals can be used as indicators or qualitative inferences of polar bear health in several ways. Signs of seal kills such as carcasses, blood stains on the ice, or collapsed seal dens, indicate hunting attempts and success. As hunters will often come across the seal carcass of a kill. Inferences about the individual bears health and behavior can be made from examining the kills. For example, if the seal is only partially consumed (the blubber and oil), then the bear would not be nutritionally stressed. Where as if the entire seal is consumed (meat as well as blubber) this may indicate that the bear was hungrier, nutritionally stressed, or that the seal was shared between mother and cubs, as females with cubs will usually consume entire seal carcass. Floyd Lennie shared his story on how he observes how polar bears hunt and consume seals, and how he examines the kill sites:

"I've seen bears where they've hunted seals either on a pressure ridge or out by their seal holes. You see them standing, or just waiting, out on a pressure ridge, you gotta be pretty patient to stay in one area for that long. But we've seen them standing there for hours and hours without making a move. When they do get a seal, they drag it around for a bit, and all they do is scrape up all of the blubber and the oil off the meat and the hide. It depends on how hungry they are, it will leave the hide behind and some of the carcass of seal. But most times, the last few years, you would be lucky to find a nail off a seal from a bear kill. Now they just about devour the whole thing. They like eating ringed seals or bearded seal- they call them 'ugyuk'. And you see them hanging around the ugyuk for a few days until it was pretty much finished….Big change. I don't know if it's big, but it seems big to me because you never used to see that before. It depends on what time of year too. I guess if they're hunting, on what they've had to eat before. Female bears with cubs and that, they eat the whole thing. Male bears, you see that but that's rarely because they're pretty hungry having eaten for quite some time when they do that."

For polar bears who are stalking seals or waiting to surprise them at their breathing holes or pressure ridges, patience is required so as not to scare away the approaching seal. Several hunters commented that young bears who lack the experience, or as discussed in the behavior section, bears that have been "spooked" and become jumpy, may not be successful at hunting seals in this manner. Likewise, if the bear caches the seal or hangs around until the seal is fully consumed, they may be having less success in hunting. Compared to stories in the past where hunters would observe numerous kill sites of only partially consumed seals along the trail of one bear in the last few years, some hunters in Sachs Harbour have noticed on occasion that, of the seal kills they have come across, bears have consumed the entire seal:

> *"Most times [in] the last few years, you would be lucky to find a nail off a seal from a bear kill. Now they just about devour the whole thing. They like eating ringed seals or bearded seal (ugyuk). And you see them hanging around the ugyuk for a few days until it was pretty much finished….Big change." - F. Lennie*

An indirect observation of bears potential harvesting success can also be inferred by the number of foxes on ice. As the arctic fox lives in mutuality with the polar bear, signs that they have been scavenging seal (fox health, abundance on the sea ice, etc.) could potentially be an indicator of the number of polar bear seal kills.

4.4.2 Seal Health and Abundance

In the train of questions involving polar bear diet, I asked "*how does the health of the bear depend on the health of other animals?*" As anticipated, this lead into discussions on knowledge and observations of seal health, distribution, and habitat. As the key prey species of the polar bear, discussions regarding polar bear health cannot occur without considering the health of seals: *"If people start seeing the seal population crashing,"* says Fred Raddi, *"we know the bears will soon follow, cause that's their main diet."* As the obligate prey to polar bears, seal are one of the key indicators of bear health. In this regard, seal abundance and condition can be used as an indicator of polar bear population health. As Geddes Wolki said, *"Well, when there's lots of*

seals, [polar bears are] healthy all the time and fat." The observed abundance, health, and body condition of seals helps local harvesters infer the health of polar bears and vice-versa:

> *"The way I see it, if I see seals disappearing, I know automatically that the bear will start disappearing… To me, there's not much change right now for seal population. It does seem like the seal population is doing pretty good, the polar bear population will stay at a steady normal base." - F. Raddi*

When asked *"how can you tell if the polar bear population is healthy",* there was near consensus among the hunters that the distribution, abundance, and the body condition of the seals were key indicators of polar bear population health. These two quotes are reflective of this perspective:

> *"That's how I see a healthy bear. There's probably other things that make a bear healthy. It's probably the abundance of seals that are out there. The more seals you see, you know a bear has more chance to get a seal. That's my take on it." - L. Amos*

> *"I think it's very important for the animals that they get ... in order for the bears to be where they are. Like if you've got about four inches of fat, that seal or bearded seal is going to be pretty healthy. If they don't have very much fat, just imagine how thin a bear would be. To me I think it's very important how healthy the seals, the bearded seals are. [If] there's not too much fat on a bearded seal, the polar bear is not going to be fat." - J. Lucas Sr.*

Harvesters in Sachs Harbour have observed fluctuations of seal health and abundance in the past, as Andy Carpenter Sr. tells:

> *"Some years that I seen, I know one year it was really bad, there was hardly any seals, and when you get the seals you know, they were just poor. And a lot of them were sick. And it was that time, every year when you're hunting that seals that aren't in the water, they're probably sick. That's in the springtime when*

there's not, they don't have much fat and there's not enough salt, I guess, in the ocean…Well that's the same time that Ian [Stirling] noticed that polar bears weren't very fat and that[20]. They [were] kind of in poor shape."

When these interviews were conducted in 2009, there were conflicting viewpoints on seal health. And while the interviews did not probe the discrepancies, it mirrors the fact that monitoring of seal abundance and condition is challenging. Several people commented that were not as many seals as in the past, while others mentioned that seals were skinnier that in the past. Others commented that the abundance and condition of seals fluctuates depending on the ice conditions. Some believe if they are not seeing seals, it is because they are traveling to places where there are better ice conditions, or they are following their food source to different areas- and as a result, polar bears are following the seals.

"Seal population, there's seals all over the place. They're really good…The last couple years we figured the seals were really going to have it tough because the ice never got as thick as it should have. There was only young ice and with young ice it's really hard for the seals to den, hard for them to hide their pups. And there was hardly any snow, so the last couple of years must've been really hard [for the seals]." - W. Gully

Although people aren't seeing or harvesting as much seals, does not infer the seal population has declined. Instead, infer that populations have moved:

"When there's a lot of ice floats around in the summer… [it's] easy to get seals. When there is no ice it is hard to get seals, I don't see any. Just because there is no ice, some summers it's hard to get seals- but that does not mean there is less seals….if there is no ice around they will just go further North where there is ice and hang out there…But [that] doesn't indicate to me less bears or less seals. If there is nothing around the South part of the island, no ice, then polar bears will just move up North where there is ice." - J. Carpenter

[20] This comment is referring to Ian Stirling's work that found a decline in seals numbers and reproductive success in the mid 70s and mid 80s due to thick ice pack that last roughly 3 years (Stirling 2002). This consequently resulted in nutritional stress and declines in the natality of polar bears and survival of subadults. This observed decline in polar bear health was mentioned frequently in the transcripts of Berger's' community hearings.

In regards to the distribution of seals around Banks Island, several people mentioned how seal will migrate or travel and use the many harbors and inlets around Banks Island: *"The seals they travel- migrate,"* says Fred Raddi, *"They go out on certain areas of the ice, on the outskirts of the island. There's a lot of harbors all over the island and they have a lot of harbors a lot of inlets and a lot of bays."* Polar bears will follow the seals, so the distribution of seals is perceived to determine where polar bears will travel and be found.

Observing and monitoring Seal Health and Abundance

Hunters can monitor the abundance and body conditions of seals through harvesting. For example, the body condition and fat content is assessed based on whether the seal will sink or float after being shot. While the body condition will fluctuate seasonally, several people commented on the decline in seal body condition:

> *"Well a lot of the people now are saying that they're getting really skinny seals- skinny and less on them because there's no ice to hunt from. Where as long ago, when you shot a seal, it would never sink. Whereas nowadays you shoot a seal and they sink like a rock." – P. Raddi*

Others commented that seal body condition will fluctuate annually:

> *"For a couple years, [seals] were getting pretty thin- meaning not much blubber and stuff. But last year [2008] and the year before, they were coming back to health… the last couple years I've got a couple myself and they've been in pretty good health. But they're a little more scarce nowadays with less ice coming through now." -F. Lennie*

In Sachs Harbour today, hunters are harvesting fewer seals than in the past because of the lack of demand for human and dog consumption, change in diet, lack of market for the skins. It has also become more challenging to harvest seals because there is less ice to harvest from in summer, also resulting in rough open water, both attributed to climate change:

> *"Well the number of seals right now it's really hard to tell cause we never really hunt that much seals anymore because out here there's no more ice- it's always*

rough, too rough to go hunting. Last year we went out a couple of days to go hunt seals and that's it. Down at Cape Kellet. When it went, we never hunt seals all summer. In fact, we never even got an ugyuk, or bearded seal, for oil. To make oil for ourselves. We never even got one. It's very rough water now the last few years." - J. Lucas Sr.

Assessing seal abundance and condition is further challenged by the transient and migratory nature of seal populations:

"It's hard to tell, like, how the seal population is doing, cause seals they could be anywhere, you know. I guess you could tell by polar bears. If you aren't finding any starving polar bears, seals must be in good shape. By the seal population they must be in good shape." – J. Keogak

4.5 Distribution and Movements

"A polar bear ain't got no compass, not like people [laughs]," jokes Frank Kudlak, *"they go where they want to go."* Amidst the ecological changes taking place in the North, monitoring abundance and distribution of polar bears can be challenging as polar bears are adjusting and adapting their distribution and movement. Different perspectives exist in the community regarding the travel patterns of polar bears, and several people interviewed discussed changing trends or new observations such as more bears seen in-land, fewer in the community, and bears moving Northward. The recurring theme is that the distribution of polar bears will be determined by both ice conditions and distributions of seals. However, as one hunter put it: *"A polar bear you can see in any place, at any time. You'd think polar bears don't go there, and then you might see one." (E. Esau)* Throughout the interviews, many hunters and elders identified travel routes and areas where bears were likely to be found at certain times of the year, and this section will examine this knowledge based on seasonality. However, there were differing perspectives on where bears could be found, and which direction they would be traveling at a certain time of the year.

4.5.1 Distribution and Movements

"I know they migrate!" exclaims Paul Raddi, *"Everybody knows- all the guys my age and older. By now [late-March] the bigger bears will be starting to come down this way, they migrate South."* During springtime (March to May), bears have been known to migrate South along west coast of Banks Island. At this time, hunters would expect to see lots of tracks around Cape Kellet. One hunter described this area outside of Cape Kellet as a "polar bear highway":

> *"Mid-February to the end of March bears are traveling or migrating … There'll be more bears around this time of the year. There'll be big bear and females- big bears are running around right now. You see a lot of tracks, sometimes you see where so much bears walk through an area it becomes a pathways-like a highway! All around this area here [Cape Kellet]." – F. Lennie*

Traveling is especially extensive during the mating season (March-April) with bears following females in heat. When tracking female bears, hunters expect to see males bears following close behind a female, even if the tracks are a couple days old.

Another young hunter commented that bears have a "*different travel pattern at different times of the year*", observing that: *"they usually come from the East and make their ways along the West [coast of Banks Island]… In spring they go North." (T. Lucas).* Likewise, one senior hunter who has hunted extensively in the Northern part of Banks Island observed the migration routes between Victoria Island, Melville Island, and Banks Island. He observed that:

> *"Between Melville [Island] and North of Victoria [Island] is where they migrate the most. Heading West in spring time, all the polar bears are heading West, from North of Victoria [Island] to Melville [Island], heading West you know. These ones here, when they come from here [N. Victoria Island], they end up down here [points to Nelson Head], from the [Prince of Wales] Strait here. I think they're from the North of Victoria cause when you get polar bears from up that way, I kind think they're from up that way, cause they don't have a tag on them…They have a migration route! From North of Victoria Island." – J. Lucas Sr.*

During the summer or early fall (August - September) several people have observed bears in-land, around the middle of the island, which is uncommon as one hunter describes:

> *"I notice a few more bears you'll see upland, either during the fall or summer time around the middle of the island or something which before was rare, but now you'll see that a little more often… Sure you see them up on the land, but not way up on the middle of the island… around fall time you see them [in the middle of the island]. Early fall- August, September… we see them, we check them out, check to see what their health is like. Stop to have a look…they always look pretty good and healthy. The one's I've seen anyways. I thought they were females looking around for a place to den. You go right up to them, but they're little male bears… The biggest one I've seen was probably about 9 feet, upland." - F. Lennie*

While females have been known to travel in-land to den, another elder confirmed that young/sub-adult males were also observed in-land. Several hunters commented that they knew bears to "portage" or take a shortcut across land:

> *"Like sometime you'll see them inland, sometime you see them in a river cooling off over summer. Some are walking around in the summer, like moving from one part of the island, like say around Sachs, to another part of the Island like Blue Fox, like portaging overland. I've seen them in the water before, in the river…they portage once and a while. They move around a lot!" - T. Lucas*

Three elders commented that they did not used to see or hear of bears traveling on land when they were younger, or at least it was very uncommon, and are surprised to hear of more observations of seeing bears in-land. *"Young people going to fish lake in the summer they see bears inland,"* says Lena Wolki, *"[I did not use to see bears inland] when I was growing up."* A senior hunter confirms that the sightings are more frequent:

> *"We've actually seen more inland. Even last summer we saw one way up, we were fishing up North and we seen one in the middle of summer around that [Deep Creek]area… it was a young one and they are learning the ropes. But, people have been seeing more [inland]." – L. Carpenter*

During fall time in October and November, bears are observed along the coastline and on the beaches, waiting for freeze-up so they can begin hunting seals on the sea ice.

> *"Well a lot of them we see, when there's no ice out here, they're mostly on the beach. You know, wandering around the beach here, especially on the West side while when we are traveling. You see polar bears right on the beach. Where there's no ice, they're kinda on the shoreline instead of where they should be, out on the ice. I think it's got a lot to do with their health in the fall time. Like you know, they go a long time without hunting seals, going without their regular diet, that they have to really push it in the winter just to survive." - J. Lucas Sr.*

One elder commented that he observed extensive polar bear migration around Nelson Head in the fall-time.

The number of bears coming to the community fluctuates seasonally and depends on ice conditions, availability of food, and potentially nutritional stress of a bear. The general belief is that "healthy" bears will stay further away from land and settlements, as often, the unhealthy bears are the bears that will come into the community:

> *"A lot of times you don't see that many bears like that. Maybe only one you got might be in a bad shape. There are always animals like that. But you very rarely get that bad of shape bears out there on the ice…. The one's that are really unhealthy, they come to the communities I guess are scrounging." - J. Keogak*

Several hunters and elders described "unhealthy bears" as the ones that come to the community. These bears will often be skinny and/or potentially starving. Paul Raddi describes his view of polar bear health:

> *"I never did see an unhealthy bear, ever. Unless it came to town and somebody shot it. And then they'd skin it and you'd find nothing down in the guts. No food – nothing. And they're skinny when they come to town."*

However, healthy bears will also travel through town, and these would include curious juvenile bears, or bears that now have to travel along the shore waiting for freeze-up. As one elder

describes, the behavior of the bear can help to distinguish if it is "unhealthy" and potentially a threat to community members:

> *"Well, a healthy polar bear, you don't have to worry too much about them coming into town. [laughing] I know there are healthy bears [that] come into town, but it's because they get stranded on land or something, and are walking along coastline. To me a healthy polar bear is not much threat to humans." – J. Carpenter*

The number of polar bears coming to the community fluctuates seasonally depending on ice conditions. There was consensus that the community is noticing an overall trend of less bears coming into the community than in the past:

> *"This year, there was the one in town. Last year there were two or three. Some years we've had, because there were more dog teams around and we had more seal meat, more seals would be left down on the beach. We always pull them up by our boats. So those years we had a lot of bears. So I'd say less bears are coming into town now." – L. Carpenter*

Several hypotheses were shared about why there are not as many bears coming into the community lately. One is that there are less attractants near town including fewer dog teams and less seal meat around the community. Also, the town moved the garbage dump further away from town. Another is that in the old days, bears were not used to seeing humans around Banks Island and were curious. Manny Kudlak shares his observations:

> *"There's a lot less of them, there used to be quite a bit that would come into town all the time and big bears, not just the young curious ones, that's pretty much every bear would try and sniff out the town. Now the numbers aren't really there, they're avoiding Sachs or they just know about human beings I guess…. It sort of makes you wonder where they all went, cause they used to always just wander into town even though there was like hundreds, 2 or 3 hundred dogs on the beach and they'd still keep wandering in. Now there's only like 10-15 dogs on the beach and you don't see a single [bear]. So it's a bit different from way back then, 20*

years ago…I think they're probably getting more used to us being around, back then Sachs was still pretty fairly new. I suppose a lot colder too so there was not as much open water for them so they had to come looking in town for their grub."

Today, bears may be "scared off" by the noises in town and deterred by hunters. The most common reason was because the ice is not good near the community and polar bears are adjusting their travels to where there is good ice and there is lot's of food (i.e. follow their nose). No one associated the lack of bears in the community as a decrease in the polar bear population.

Several hunters and elders hypothesized that polar bears may be adjusting their range in response to sea ice decrease, moving further North or further out onto the multi-year ice. One senior hunter explains this:

"Because of the sea ice or, the multi-year ice has moved away. You go to the North end of the island in the wintertime and you'd chase some huge tracks! They stay on the multi-year ice. They won't leave that!" – J. Keogak

Likewise, as previously discussed in the section on seals, several hunters believe that polar bears are following their food source, seals, which are migrating to different areas.

"[Seals] don't always need ice. But that's what they say- the ice is going and the seals are going with it. But if the ice goes, what are the seals going to have? They'll probably just keep traveling North. And that's what the bears are going to do to- keep traveling North. So it's pretty hard to say if they're going to depend on the seals health." - W. Esau

While some Inuvialuit hunters commented that they are seeing fewer bears, this is not always interpreted this as population decline, as they are aware of the decline in harvesting range:

"[People are saying they are seeing] less bears, but in these days you gotta go further North. Less bears on the South part of the island. That doesn't mean there's less of a bear population, just that you have to go further North to start seeing them. And we really can't go out on the ice … more than a couple of miles out, because polar bears like to hang out 14, 15, 20, 30 miles out." - J. Carpenter

Observing and monitoring Distribution and Movements

The distribution and movements of polar bears can be assessed through the locations of sighting of bears and their tracks. This includes unique observations of animals and tracks in-land, along the beach, or in the community. From my experience, there was not formal documentation of individual polar bear sightings, but hunters would share stories and observations about where they observed bears and tracks. Information can be extrapolated from tracks, such as the direction of tracks, which inform hunters of the movements of polar bears in certain areas.

As mentioned in the section on body condition, the feet of the bear will be examined, with consideration of the wear of the fur around the feet to determine if it's been traveling over land extensively. These quotes from two young hunters explain:

> *"I'm hearing a lot about them traveling over land now. Like the one bear I got up at Gore Islands, it had all its hair gone from its paws and John was saying that's because it had traveled so much, they drag their feet and it rubs off all the hair." - M. Kudlak*

> *"From the polar bears that we got last time, the middle of February, they have thick fur on the bottom of their feet. But then April comes around they'll have pretty much no more hair. Sometimes their feet would even bleed because they walk so much in April…I've seen polar bears with no more hair on their feet from all the walking." - T. Lucas*

4.6 Habitat

When referring to habitat conditions of polar bears, I am referring to sea ice which the bears will use as a platform for hunting and traveling. As so much of the knowledge about polar bears and polar bear hunting is related to knowledge of sea ice, I soon learnt from the interviews that to understand polar bears is to understand sea ice, and vice-versa. While I cannot expect to cover all the intricacies of sea ice knowledge and the complex relationship between polar bears

and sea ice, I can share some of the knowledge and key observations shared by hunters and elders whom have considerable expertise on this subject.

In discussing habitat conditions, I asked "*how do changes in the sea ice affect the health of polar bears?*" The relationship between polar bears and sea ice has created a rule of thumb about how sea ice conditions will dictate polar bear distribution and health. *"We have no ice, we have no bears"* says Lawrence Amos. Another senior hunter reiterates: *"Whatever happens to the ice is going to happen to the polar bear. That's the bottom line." (J. Keogak)*

4.6.1 Habitat Preference

Polar bears will use certain formations of sea ice at different times, but according to many of the hunters interviewed, most of the times polar bears can be found hunting and traveling along thin or "young" ice – thinner sea ice (<2m thick) that forms in winter and melts in summer. Roger Kuptana explained, *"a bear likes to walk around where there's thin ice. They're always walking around, looking for seals."* Another hunters describes young ice as a *"bear highway"* as there are *"usually a lot of bears going through." (W. Gully).* Young ice also provides the best conditions for hunting seals from their breathing holes. Elder Geddes Wolki described his observations of young ice:

> *"When you look you could see bears all over walking. When they got young ice and when it's flat. Hardly any rough ice…they always follow the young ice. That's where they hunt."*

Likewise, bears will also look to hunt seals along open leads or fresh cracks in the sea ice. One young hunter describes these open leads as good hunting conditions for polar bears because *"there's a lot of current and a lot of open water. Bears like the open water and young ice cause it's easier for them to hunt" (J. Wolki).* During April and May, seals will "haul-up" on the edges of open leads, and *"[bears] usually follow the open leads where the seals come up to breathe" (M. Kudlak).*

A senior hunter explained to me the different ice conditions where he would expect to find polar bears:

"When you run into polar bears, there's young ice and open water, that's where they're going to be. Not up here where it's solid- they're going to be out here trying to find food. That's where they always are. Either there's an open lead or young ice… Most of the times they are traveling where the old ice and the young ice meet. That's where they hunt. Cause a lot of the times when they are traveling the young ice is where a seal makes a fresh seal hole. When you see a polar bear, sometimes it's lying on young ice- it's waiting for a seal, by a fresh seal hole. Sooner or later that seal is going to make it's rounds." - J. Lucas Sr.

Bears will look for areas where seals have their breathing holes along young ice and open leads or "cracks". Wayne Gully tells a story of bear hunting seals along an open lead:

"If you ever go at the end of April, first week in May, you head out and find a crack out here, and find a nice fresh crack. On each side there'll be a hundreds of seals all along. The crack will just be just black with seals. And if you run into an area where the polar bear is hunting a crack, it's almost like a killing field. There's seal holes all over the place. They just swim along, do their kill and move on and then another bear will come along to the crack and do their kill. It's really something to run into that.... As long as there's cracks like that, and there is young ice, the bears will be pretty good." - W. Gully

Young ice and pressure ridges are especially good seal habitat, and this is one reason why local hunters believe that bears may be more successful hunters on the annual ice that will replace multi-year ice in climate change scenarios. Two hunters commented that a greater prevalence of annual or young ice, as anticipated, would actually provide better polar bear habitat. Elder Joey Carpenter commented, *"my guess is that so much young ice out there, it is probably better for the bears… you know where the rubble ice pile up...Pressure ridges, yeah. Seal go in there and make a breathing hole or a den."* One hunter whom works closely with scientist explains how this perspective has been informed through working with scientists: *"the people I work with, the guys from doing the ice studies [are] telling us that with the changes in ice, the first year ice is actually better bear habitat because it's more likely for them to get seals." (L.*

Carpenter). Likewise, two other hunters added that the increased prevalence of young ice would be beneficial to polar bears, as it could reduce harvest pressure on bears, as it is not always possible for hunters, with their heavy skidoos, to reach thin ice or travel on thin ice in pursuit of polar bears.

Bears do not fare well in solid ice, as senior hunter John Keogak explains, *"Everything depends on ice conditions. If this was solid all year round- completely solid, no young ice, nothing – more than likely you won't see a [polar] bear at all."* The negative relationship between polar bears and solid ice exists both in recent memory and in oral history. Geddes Wolki recalls the year when there was no open water and that the bears were hard to find and were skinny:

> *"When I was 17 years old [1950], I thought there were no bears that time, I was the only one that got bears! It was frozen so much there was no open water and nothing at Baillie Island… But big freeze way out … I think it was two days going out steady from the land [to reach] open water- way out. So they went back and no other bears show up. I got two starving bears that fall. No open water, that's why they were so skinny."*

During February and March, polar bears will hunt seals and their pups from their dens, which are generally located in or around pressure ridges, as John Lucas Sr. explains:

> *"And this time of year [February-March] there's a lot on the main ice, [be]cause a lot of them have pups now. In February, the seals are born and a lot of them have young ones on the solid ice, where there's a pressure ridge."*

Old ice or multi-year ice is thick (>5m) sea ice that stays frozen year round. There was a shared belief among many of the hunters that the "big" or the "healthy" bears stay out on the multi-year ice west of Banks Island. They hold this view in spite of what many biologists have told them about the multi-year ice being poor habitat for polar bears. From one hunter's perspective, Banks Island could be last to see effects of climate change on polar bear health because the bears have access to multi-year ice west of the island in the Arctic basin:

"To me, if climate change comes up here, we'll be the last to see the change, cause, it never really affected us… To me, here, all this area is ocean from here to Russia. There's no more islands [west of Banks]. To me, this area is all big main ice area- a big chunk of ice. Anywhere from 20, 30, 40 miles this way, that's where the bears are enjoying their life, all up this way, cause that's not really affected yet." – F. Raddi

In recent memory, hunters would recall observing polar bears floating by on pack ice and ice floes, as Fred Raddi recalls:

"There'd be a lot of open water, and sometime you'd run into a big span of ice - like a big chunk of floating ice that's about three or four miles wide. And you run into a couple of bears, three or four, basking on that, floating on a big chunk of ice and eating as much seals as they can."

However, the community is no longer seeing ice floes near shore in the summer, and as Geddes Wolki saw as a result, *"just like seems to be not too many [bears] as there used to be. Ice bergs sometimes they come in and that's when there's lots of polar bears around".* Bears would come floating by the community on ice floes in the summer (July-August), but as there are no ice floes coming by the community, community members just see them on the beach at this time. Andy Carpenter Sr. recollects:

"In the summer, even [on] the little chunks of ice, they see bears on them. And every once in a while there's some ice floating around… You could really tell in the summer [a]round here now, there used to be ice going back and forth steady all year. You don't see the old ice anymore. In the summer you hardly see any ice over here… Before, it used to be all summer you used to see ice around. And if it keeps on that way, it keeps melting and it's longer melts, then there might be a worry!"

4.6.2 Changes in Habitat Conditions

One of the key observations regarding changes in polar bear habitat is the near absence of sea ice in the summer, attributed to climate change. As elder Lena Wolki explains: *"Nowadays it has*

really changed too because of climate change. No more ice bergs in the summer- no more ice in the summer around here. All the ice has melted." (L. Wolki). As mentioned previously, ice floes would pass near the community in the summer would come from the North in the summertime. Ice floes going from East (Nelson Head) to West from would also come near the community in July and August, but this is no longer common as Floyd Lennie explains:

> *"There was always bears on [the ice floes]. In the last couple years it's been really thin and you never hardly see bears… [and] you rarely get the ice coming from the West to the East anymore… It used to take a week, a week and a half for the ice floe to get past. Now it's a day and a half, two days."*

Everyone interviewed noticed the shift in ice conditions from multi-year ice to annual ice: *"A lot of year ice, what they call 'year ice', it's been frozen since fall*," explains John Lucas Sr. *"there's no multi-year ice. We don't see that anymore….Old ice."* Some comment that there are areas in Northern Banks Island where multi-year ice is close to the land. As one hunter shared: *"I don't see anymore old ice- last I heard there was old [multi-year] ice, closest was probably up here [Gore Islands]" (L. Amos).*

A second key observation regarding changes in polar bear habitat relates to the length of the seasons and the timing of break-up and freeze-up. Several elders commented that the summers were longer and winters shorter. One hunter relays traditional knowledge from an elder who used to live on Banks Island:

> *"I was listening to one elder [David Nasogaluak] the other day and he said, he was talking about climate change, what he's noticed is the winters hasn't really changed all that much. What changes is the summer months. The spring came earlier and the fall came later. So it made the summer season a little longer. Shortened the winter season. And I thought about it for a while. It is true. Sure, our winters will change a bit. I know the ice conditions, like we're still getting 40 below, 50 below, well not 50 below anymore, but this is normal. Like I said, our summer season is longer." – L. Amos*

A third key observation regarding changes in polar bear habitat relates to ice thickness and ability to predict the safety of the sea ice for traveling. *"Over the years, ice has gotten really thin, because all the multiyear ice is gone,"* explains Roger Kuptana, *"That stuff used to be about 15-20 feet thick. Now it's lucky to be 4 or 5 feet. And it doesn't take very much wind or very much current to break up the ice anymore. And the ice is going out a lot faster."* The thickness of the sea ice and the rate at which sea ice conditions can change presents challenges to hunters in being able to predict the ice conditions for travelling. Floyd Lennie explains how sea ice has changed in this way:

> *"Usually in the fall time, just before freeze up, you can always tell if there will be good ice or not. But now it's hard to tell now. Even to cross young ice you have to be extra careful. Before, you were careful, you knew what to watch for and what to see. Now you have to double that caution because the ice still looks the same, but the thickness and the strength of it [decreased]."*

Impact of climate change and the ability of bears to adapt was raised by several people. These discussions followed two divergent main themes that have not been reconciled in the community's perspective. The first theme relates to the rule-of thumb-that ***"****Once the ice is gone, the polar bear will be right next… One day we'll have no more polar bears- bottom line! Once the ice is gone, the polar bear will be right next" (J. Keogak).* The other perspectives is that the future scenario for polar bears may be dire, but that polar bears will adapt to the changes presented by climate change. Roger Kuptana shares his view that *"[Polar bears] will change their ways because of global warming, you know --- If this global warming continues, the bear will change it's ways." (R. Kuptana).* Another senior hunter also believes that polar bears will adapt, but that the population will decline before they can fully adjust to climate change:

> *"I think [polar bears] will die off first! They have to die off before they adapt. They just can't adapt like that- all of a sudden. I think they will have to take ten years or longer. Maybe a generation at lEast. The females can't teach their young ones cause if it's [not conditions they are} used to." – E. Esau*

While climate change was viewed as the biggest threat to polar bear habitat, it was also seen as a vector and multiplier for other potential impacts. With decreased sea ice thickness and distribution in the future, there is expected to be an influx of industrial development, shipping, and tourism. Increased shipping and activity would have the effect of opening up leads, preventing re-freezing of open leads or young ice, and affecting the sea ice habitat for polar bears and seals: *"To me,"* says Fred Raddi *"if [the oil tankers] ever start going through the shipping areas, and they start opening up leads, that would affect the bears movements in the areas where they normally stay."* The obvious risk of potential oil spills was also a serious concern for community members:

> *"If you have an oil spill out there, I think it's going to be a catastrophe for the bears. They rely on sea ice to survive. It's going to be, not for us, but for the animals- the seals, the bearded seals, the polar bears, it's going to have a big effect! Opening up the shipping route up here. I think it's going to involve us cause we're subsistence hunters to the bears, and seals and bearded seals. It's going to have a big effect anyway." – J. Lucas Sr.*

"This so called global warming" says young hunter Jim Wolki, "*I think that would be pretty tough on bears…Not only the bears, but people who harvest the bears, the meat."* The impacts of climate change on the environment and wildlife was explicit, many hunters interviewed, both young and old, emphasized the impact of these changes on both the well-being and culture of the Inuvialuit, whom depend on polar bears for food and who's tradition on polar bear hunting is threatened by these changes. As elder Joey Carpenter points out: *"A couple things about climate change might have more to do with hunting culture than with polar bear. One way with polar bear is that you can't go out on the ice more than a couple of miles."* And while the impact of the loss of ice would impact their ability to hunt, another hunter pragmatically commented that *"ice conditions help a lot too for the polar bears, if the locals can't go out more than two miles" (W. Gully),* implying that changing sea ice conditions would benefit the polar bears as harvest pressure would decrease if locals have difficulty accessing bear habitat.

Observing and monitoring Habitat Conditions

Challenges in monitoring sea ice as changing ice conditions mentioned in the previous section affect ability to hunt and travel on the sea ice, and therefore are restricted in monitoring sea ice and polar bears in certain areas. *"The last couple years it was hard to really estimate the bears, if the bear population was good, [due to] the ice conditions"* explains Wayne Gully. Sea ice features such as high pressure ridges or pile-ups, open leads and open water, and strong wind and currents, can affect hunters abilities and willingness to travel far onto the sea ice, if they are able to access the sea ice at all. Today, hunters are generally unable to go out further than about 6-12 miles out form shore on the sea ice. Larry Carpenter shared his experience from hunting the previous year, and general trend over the last decade:

> *"Last year [2007-08] was really poor ice conditions, there weren't too many bear taken last year. Well, that's one thing we noticed with the poor ice conditions we've had since 1999, we haven't been able to go out further than about 6-12 miles. And this [year] is the first time we've been able to do it. This is the first year [2008-09] we've had ice like this in years."*

If sea ice is not shore fast, hunters will not be able to access the sea ice and will have to travel along the coast to access the ice. One hunter observed over the last decade that in several years, the ice has been *"about 6-8 miles out there." (L. Carpenter).* Another senior hunter explains that with open water right to the shore, it can be a risk traveling onto the pack ice: *"Nowadays, open water is more-or-less hugging the beach. You can cross but you're taking your chances in crossing the open leads." (L. Amos).*

As mentioned previously, the sea ice breaks up easier because it is not as thick and can break up from a strong wind or current, leaving hunters potentially stranded adrift floating pack ice. The challenges and risk to predict the safety of the ice is a major concern for the community and even experienced hunters told be that *"the ice still looks the same, but the thickness and the strength of it [decreased]" (F. Lennie).*

In light of dangerous and rapidly changing sea ice conditions, Hunters have developed adaptive responses to identify when, and where, are the best places to travel and hunt for polar bears. These adaptations have been facilitated by new communications technologies available in the community. For example, through access to the Internet, several hunters had access to sea ice maps produced by Canadian Ice Services to identify the sea ice thickness at areas around Banks Island and potential travel routes to areas to hunt bears. Likewise, hunters will use on-line weather data such as wind direction, wind speed, and snow conditions (i.e. storms) to determine whether or not they will head out on the sea ice to hunt. With more modern technologies ranging from bush and CB radio, to satellite phones, to internet communications, hunters within the community and from neighboring communities, will discuss ice conditions and presence of polar bears in certain areas, especially within the Nelson Head, Amundsen Gulf, and Cape Bathurst region.

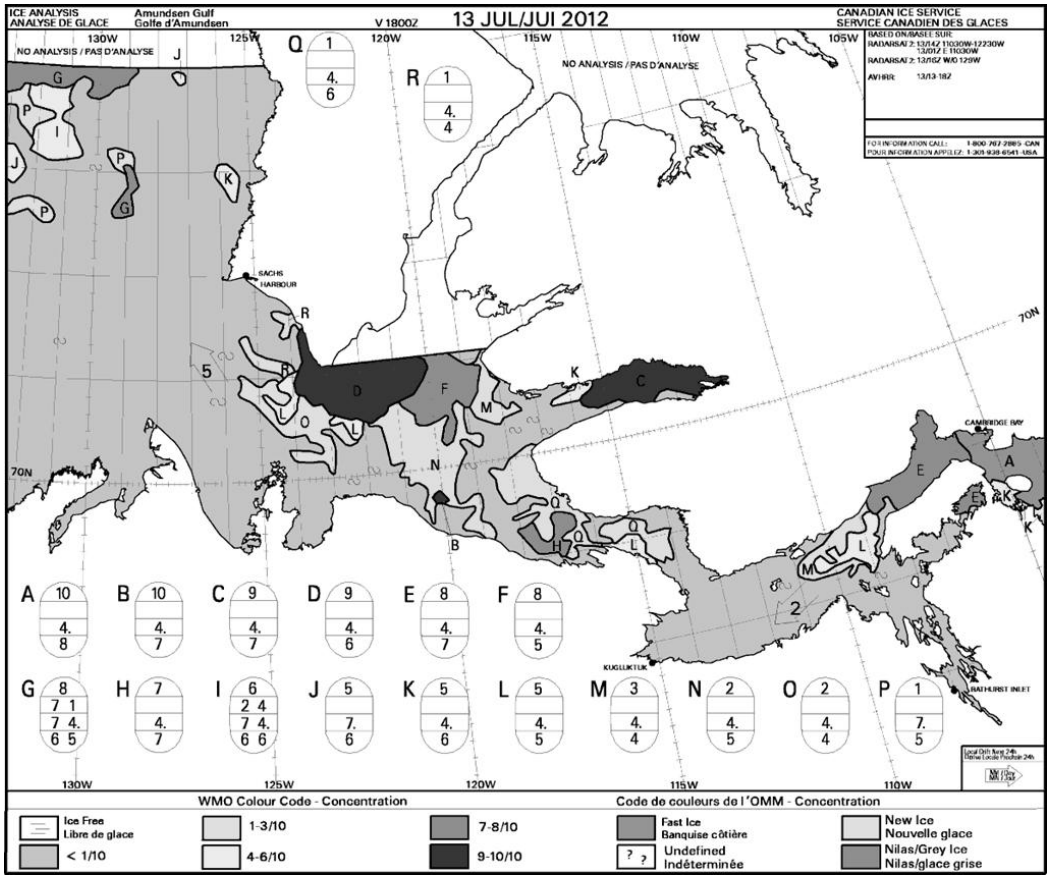

Figure 6: Example of Daily Ice Chart Map for Amundsen Gulf Region (Canadian Ice Services, accessed July 14 at http://www.ec.gc.ca/glaces-ice/).

While changes in transportation from dog sled to skidoos may have hindered hunters' ability to travel into certain ice conditions, newer transportation technologies have allowed them to view and observe ice conditions in a way that they were unable in the past. For example, with a twice-weekly charter plane service from Inuvik to Sachs Harbour, community members departing the plane will commonly discuss what the sea ice conditions were in the Beaufort Sea and Cape Kellet region, such as "there's open water six kilometers South of Cape Kellet". Through working with scientists and industry as marine mammal observers (MMOs), community members have opportunities to travel aboard seismic vessels and Canadian Coast Guard (CCGS) research ships such as the CCGS Amundsen and CCGS Louis S. St-Laurent, which can often take them through areas of sea ice that they would not be able to access by themselves. Anecdotal observations of sea ice, wildlife, and other unique observations are shared when returning to the community, and it was through this means that the community became convinced that there was an abundance of polar bears on the multi-year ice West of Banks Island, and requested that an aerial survey be attempted in this area.

Amidst the widespread public debate and concern about polar bear health and the fate of polar bears in light of climate change, at the time of these interviews, the majority of those interviewed from the community did not have concerns about the current state of polar bear health in the region:

> *"At this point I'm not worried about polar bears staying healthy cause I haven't heard anybody telling stories about starving looking bears…The only concern is that they gotta travel further." – J. Carpenter*

However, there was great concern that climate change will affect polar bear population and ice conditions, decreasing the future of hunting in the near future- forcing both polar bears and hunters to change their ways.

4.7 Population Abundance

Inuvialuit understanding of wildlife abundance and population cycles are informed through both their worldview and their past observations that animals migrate and populations naturally fluctuate. Elder Geddes Wolki recounts stories from his youth when he lived on Baillie Island,

recalling that some years there were abundant numbers of bears and other years there were no bears. Geddes Wolki tells of a year when "summer ice" meant no bears:

> *"That's when I was 17 years old, I thought too there was no bears that time, I was the only one that got bears. It was so frozen, there was no open water and nothing at Baillie Island. [There was a]big freeze way out!"*

Alternating between English and her native tongue of Inuinnaqtun, elder Martha Kudlak explains how "years are different from the years before":

> *"We never see muskox. 1958 the first muskox we see. [And now they're] all over. [laughs] Long ago they say "sometimes no polar bears, sometimes there's polar bear some years". Some of them go hunting and they never get polar bears some years. Some years it's easy for them, some years it's hard… [Inuinnaqtun] "Years are different from the years before"…Even with animals- sometimes no ptarmigans. Just an example, sometime lots of ptarmigans. Lot of foxes, no foxes… [Inuvialuktun] The elders say some years there might be no animals."*

Ideas about population cycles and wildlife dynamics have been informed by observations of population fluctuation of Muskox, Peary caribou, arctic hare, wolves, seals, arctic char, and cod. Fred Raddi shares his observations of population cycles among different species on Banks Island:

> *"But not only caribou I seen crash. I've seen the arctic hare right from thousands in a herd, all over on the island, [then] they were scarce for a while. But I think they're starting to come back again. I've seen wolf population, right from very low to very high now again. Over the past twenty years, the wolf population started coming back… So we've seen the Muskox population grow, we've seen the geese population grown, we've seen the caribou population crash and the arctic hare population crash, and what else. Our fish too, our arctic char. Every summer we'd set nets here. And years ago we used to get good sized char. Some of the good seven pounders. Eight nine pounders. Now most of the [char] are only a pound and a half or two pounds at the most …, I've seen in the last twenty*

years, I've seen our cod go from, every spring we used to all go out to the harbor, to the beach there on the ice and fish. You wouldn't have to chisel a hole, just go and walk out there in the late spring and catch as many cod as you want. But now you can't do that. You're lucky to catch any cod now."

While the health and abundance of a population may not always be directly observable, hunters can make inferences on the health of species based on observations of other species. Fluctuations in abundance of certain species are deduced through observing changes in abundance of prey or competitor species. David Haogak explains this as:

"So, with any animal like you could tell when there's a lot of foxes that means there's a lot of lemmings, a lot of owls there's a lot of lemmings, you know, their food. When they're in abundance, their food is in abundance. Same with bears. Seals migrate, so some years that doesn't mean there's not enough seals, they just swim away. That's my theory with polar bears, is that they're not dying, they're just going , they're following their food source…They're always gonna follow their food, we might just not see them – that doesn't mean they're not there. The world has a funny way of, ah, looking after itself."

Assessments of polar bear health can potentially be inferred by working down the polar bears food chain, assessing the health and abundance of seals, as well as the abundance of the fish stocks that seals will hunt. David Haogak further elaborates on the impact of the species below the polar bear on the food chain: *"Those years that were bad, we weren't catching any chars in the net and that, so, something happened. There was no sea char, there were no seals. A lot of bears. Starving bears."* Lawrence Amos further commented on how the health of the species below the food chain will cascade up to polar bears: *"I guess [if] there's not enough food for the seal, it would make the seal skinnier and it would make the bear have less chance to eating blubber."* In this way, holistic observations of the environment, and especially the environmental components and pieces that directly impact the polar bears, must be observed in order to understand and anticipate changes in polar bear health.

4.8 Unique Observations

A great case study through which to examine unique observations of polar bears, is the presence of grizzly bears and discovery of a polar-grizzly hybrid on Banks Island. Grizzly bears on Banks Island are not a new phenomenon, and while grizzly bears have been infrequently observed and rarely harvested on Banks Island, there have been more recent grizzly bear sightings and harvests. Hunters mentioned that Fred Carpenter harvested a grizzly at Swan Lake in the 1950s, another senior hunter harvested a grizzly on North end of the island near Gore Island.More recently, in the summer following my fieldwork, a young hunter harvested a grizzly close to the community. Some hunters were concerned about grizzly bears on the island as they can be more aggressive.

In 2006, the first ever-documented wild polar bear-grizzly bear hybrid was shot by an American Sports Hunter and local guide, South-East of Banks Island near Nelson Head. The guide recounted with me, that when they first contacted biologists with the news of this unique looking bear and hypothesis that the bear could be a hybrid, they were met with disbelief from the biologists. In the years since, there have been two other hybrid polar bears harvested on neighboring Victoria Island by the community of Ulukhaktok. Elder Andy Carpenter Sr. recalled:

> *"[laughs] Yeah, with all the years that I know, I never heard of a polar bear and a grizzly eh….And I know grizzly bears in the springtime and later on, in Bailey Island, they go out on the ice in the spring, grizzly bears. But I never heard of any other [hybrids], just in the last few years that you start to hear about this….I heard that, you know, in captivity, Ian [Stirling] knew that they get together….But, in the wild it's the first time I've ever heard it."*

Several hunters mentioned that other species such as arctic foxes, wolves, and grizzly bears are known to hunt for seals on the sea ice, suggesting there could be potential competition for prey from other predators. Earl Esau explains that due to global warming, *"where the seals den, out*

on this part [Prince Wales Strait]- hardly any snow. The foxes will clean out the young seals and the bears will have nothing to eat, as the foxes would clean them out first."

In regards to noticing unique events, from my brief experience in Sachs Harbour and other Inuvialuit communities, I have learnt how news of unique events or observations quickly spreads. The example of the odd polar bear claw illustrates this. And while hunters will be keen observers, especially of "oddities", there often lacks formal mechanisms to monitor, report, and publish news of these unique observations.

Chapter Five: Discussion

5.1 Introduction

The objectives of the thesis were to document Inuvialuit knowledge of polar bear health, and to identify the indicators used by Inuvialuit to assess polar bear population health. This thesis supports that Inuvialuit of Banks Island have an accumulated wealth of traditional knowledge about polar bears and this traditional knowledge can contribute to ecological monitoring of polar bears.

5.2 Bankslanders Traditional Knowledge of Polar Bear Population Health

In chapter 2, I reviewed previous traditional knowledge research dealing with polar bears such as Keith et al. (2005); Dowsley and Wenzel (2008); and Tyrell (2007). This research in the areas of Gjoa Haven, Baffin Bay, and Western Hudson Bay, in Nunavut has increased our understanding of polar bear population health in many of the sub-populations throughout Arctic Canada. I have added to this body of work by documenting the traditional knowledge of polar bears for the Inuvialuit community of Sachs Harbor, and the North Beaufort polar bear sub-population.

My ethnographic review in the research context chapter discussed the value and significance of traditional knowledge to the Inuvialuit and illustrated that, due to the close interaction with, and continued reliance on land and marine animals for subsistence and economic purposes, the people of Sachs Harbour have considerable knowledge of the environmental conditions on the island and sea ice and an accumulated wealth of knowledge about polar bear. The following discussion on Inuvialuit perspectives of polar bear population health will be first framed through defining the spatial and temporal range of their knowledge.

5.2.1 Spatial Range of Knowledge

The subsistence hunting of polar bears in the Canadian Beaufort Sea area is not well documented prior to about 30 years ago (Stirling 2002), leaving a knowledge gap about the traditional use and harvesting practices of polar bears in the academic literature. In order to understand how traditional knowledge is informed, I researched both the past and current use

of the environment through examining historical patterns of resource use and harvesting practices to develop a broader understanding of the traditional and current patterns of polar bear harvesting. This is significant as it better frames the specific context of knowledge, defines the scope, geographic range and temporal depth of Bankslanders knowledge of polar bears, and illustrates how Bankslanders knowledge of polar bears is informed.

The results of my research show that Inuvialuit harvesters have accumulated knowledge about polar bears in the geographic regions along the western and Southern coast of Banks Island, and the land-fast ice associated with this coastline. These regions have been traditionally significant areas for hunting polar bears- first by the *Kangiryuarmiut* of Victoria Island, later as areas frequently traveled and intensively harvested in the fur-trapping days, and more recently, through the continued subsistence hunting as well as guided sports hunting. Hunters would occasionally travel great distances to the Northern coast of the island and even to Melville Island for subsistence and sports hunting. Today, the spatial scale at which observations of polar bear are made is dependent on the ice conditions. For example, one senior hunter commented that:

> *"We can't access the same areas that we used to access 20 years- 30 years ago cause the ice conditions… You just can't travel as far as we used to. The ice is like our road. If we don't have that, how can you go out and find out if bears [are] healthy or [there's an] increased population [or] decreased population" -L. Amos*

Climate change and economic factors (e.g. gas prices, increased wage employment) have also seemingly decreased the spatial scale of community observations when compared to the past. At the same time, the availability of transportation (e.g. skidoos, air charters) may be increasing the range of places and the frequency of observations of polar bear health and related indicators. This is significant when considering the range of observations that inform Inuvialuit knowledge of polar bears in a changing environment.

Identifying the hunting range and spatial scale of observations is key for assessing the scope of knowledge that hunters have of a particular species. I found that the key limitations of

traditional knowledge on the spatial scale include: accessing ice, declining hunting ranges, and range affinity. My results also affirm the findings of Keith et al. (2005) that hunters generally use their traditional knowledge and past experience to target particular high-density places or "hot spots". This results in a concentration of hunting pressure in a certain areas and limiting the sample size to a restricted geographic scope. Historically on Banks Island, the greatest numbers of polar bears were taken within 20 miles of Sachs Harbour, generally in the direction of Cape Kellet, resulting in a concentration of hunting pressure in space and time (Usher, 1971b; Usher, 1976). My interviews and participant observations in Sachs Harbour, confirmed that this was still the case. Harvesting only at select locations raises a concern that observations in these areas and times may not reflect changes in the wider population (Moller et. al. 2004). Therefore, patterns they observe may not be in context of the entire environment and may not be suitable for generalizations. Likewise, because local observations are generally related to harvesting and processing of the animals, community-based monitoring cannot track population health and abundance in areas where the harvest does not regularly take place. As Dowsley and Wenzel (2008: 182-186) found in Nunavut that "traditional knowledge is almost always derived from local-level observations and may not always translate well into discussions of wildlife populations at the larger geographic scale." Therefore, one reminder from this research is that wildlife managers must be cautious in generalizing spatially-specific traditional knowledge throughout the entire range of the species.

If systematically documented, traditional knowledge and local observations can make valuable contributions of spatial data of polar bears use of their habitat. For example, denning sites can be accurately identified (and geo-referenced), and the sightings, locations, and direction of polar bear movement can be documented. Unfortunately, the findings of my work on the geographic range of land and ice use for polar bear harvesting are limited due to the mapping methodology employed (see 3.4.3). Additional studies are needed to document these spatially explicit observations and traditional knowledge, along with further investigation of the changing geographical scope of knowledge, is welcomed.

5.2.2 Temporal Scale and Depth of Knowledge

Traditional knowledge is accumulated over many generations of place-based interaction with the environment. The traditional knowledge and experience of Banks Islanders documented in this thesis seems to date back as far as the early 1920s in living memory, with some references from Victoria Islanders whom had distant relatives who visited Banks Island seasonally prior to fur trade exploration. For skilled and knowledgeable Inuvialuit harvesters, as well as Inuvialuit women who were involved in processing the polar bear hides, the depth of knowledge and recall of observations and experience seems to have been greatest for the last several decades- especially during the extensive trapping periods and sports hunting years.

This research affirms that the frequency of observations of polar bears by Inuit hunters and community members will fluctuate throughout the seasons (Lee et al., 1994; Tyrell, 2007). In the past, bears were hunted throughout the year. Following harvest restrictions in the mid-1970s, hunting was limited to the period from early winter to spring. Today, the intensity of observation of polar bears is during the prime polar bear hunting seasons in February, March, April, and May. A secondary peak in observations in the fall when polar bears will be traveling near the community, scavenging along a beach waiting for ice to freeze up. Polar bears are occasionally seen in-land in summer, although this is rare. This research found that the temporal depth of knowledge relating to polar bears is generally limited to certain times of the year, in that interaction with and observations of polar bears are limited to when they hunt, or when bears are known to travel by the community. Therefore, temporal gaps in knowledge exist for certain periods- especially during the summer months.

5.2.3 Transmission of Knowledge

Through the interviews and participant observation, I observed that Bankslanders' knowledge about polar bear ecology is informed by a diversity of experiences and sources both within their community and region, but also from outside scientific research and media sources. Besides direct observation in the hunting, butchering, and processing stages, knowledge of polar bear health is also gained through sharing oral history and stories of personal experiences. Likewise, knowledge and observations are shared between Inuvialuit from different communities- both

informally in casual conversations, and formally though participation in co-management processes. For example, Hunters will frequently communicate with friends and families in adjacent villages about hunting conditions prior to the hunts, and will continue to communicate with each other during the hunts, using radios to share information and observations on ice condition and sightings of polar bears. Lawrence Amos explains "*It's always been the practice to share information about bears or ice conditions here or the mainland, and even Victoria Island. A little bit of information just give you the idea of how the hunting and how the bear population is over there*". Through the sharing of this information, it can be presupposed that hunters gain a larger spatial perspective of polar bear health and habitat conditions throughout the region, not just in their hunting areas. This study supports that while traditional knowledge is almost always derived from local-level observations that are limited in both temporal and spatial scope, the transmission of knowledge though formal and informal venues allows local people to have a broader understanding of changes in polar bear population health and environmental conditions.

5.3 Indicators of Polar Bear Health

The second objective of the thesis was to identify the indicators used by Inuvialuit to assess polar bear population health. In a review of previous studies of Inuit knowledge of polar bears (Berger 1976; Freeman 1976; Kalxadorff 1997; Hart and Amos 2004; Keith et al. 2005; MPEG 2006; Zdor 2007; Dowsley and Wenzel 2008; Wong et al 2011; Richardson 2011 (pers. comm., 2011), it was documented that experienced Inuit hunters use many different indicators to assess polar bear population, including: 1) body condition and behavior; 2) breeding success (denning habitat, mating behavior, and fecundity); 3) diet and feeding behaviors; 4) distribution and movements; 5) habitat conditions; and 6) population abundance, and; 7) unique observations. With that in mind, my interviews focused on these same indicators.

5.3.1 Body Condition and Behavior

Body condition and behavior of individual bears is a commonly used indicator among Inuvialuit for defining and communicating about polar bear population health. Observations are made about body condition during hunting (i.e. in selecting the bear), butchering, fleshing, and consumption, give harvesters an opportunity to intimately understand the body condition and

behavior of individual animals and view these observations in comparison to other bears harvested over their lifetime. Wong et al. (2011) described how, through the process of tracking polar bears, hunters can reliably distinguish the size and the sex of the individual bears. In his study in Gjoa Haven, Keith et al. (2005) discussed how polar bear tracks could be used to read the health of an animal.

In my participation in polar bear hunts and detailed interviews with hunters, I learned that from these observations, hunters would collect information about the body condition of individual polar bears. Specifically, they will gather observations on the size of the bear, the amount of fat on an individual bar, the color and quality of its fur, and the bone structure and body shape. Combined, these inform a holistic understanding the health and body condition of an individual polar bear. Findings from interviews in Sachs Harbour yielded conflicting perspectives on overall changes in polar bear body condition, but many observed that bears are not as big as they were in the past.

Likewise, an indirect assessment of body condition is based on the behavior of the bear, something difficult to capture in scientific and community-based monitoring, but is an essential contribution to understanding polar bear health. An additional implication in monitoring is the ability to identify an aggressive, starving, and potentially dangerous from a curious bear based on behavior and body condition. Keith et al. (2005) note that there are specific behavioral clues that a person can look for to know if a polar bear is aggressive and might attack. Tyrell (2007) identifies that "skinny" bears pose a greater danger due to their unpredictability brought on by hunger. My results discuss some of the behavioral indicators that Bankslanders use to identify bears. This ability to distinguish and read polar bear behavior is an important component of managing human polar bear conflict, and this skill helps to inform the appropriate deterrent to be used in conflict situations.

5.3.2 Breeding Success

In regards to monitoring polar bear population health based on breeding success, Inuvialuit monitor indicators relating to denning locations, denning habitat quality and litter size (i.e.

number of cubs per litter). Some researchers have used oral histories, traditional knowledge, and local observations and knowledge to identify denning locations and features (i.e. Manning and MacPherson 1958; Harington 1968; Stirling and Andriashek, 1992; Kalxadorff 1997; Van de Velde et al. 2003; Richardson, pers. comm., 2011) and these studies identified the location of polar bear dens along the coast and on sea ice. In my interviews, Bankslanders contributed information on denning areas in Banks Island, and insight into the conditions needed for polar bear dens. Limitations in my mapping methodology prevented identifying specific den sites, but key denning areas were summarized which is locally significant to limit effects of human activities to polar bear den sites. Furthermore, as hunters can reliably distinguish the sex of observed bear (Wong et al. 2011; Keith et al. 2005), the presence/absence of cubs and number of cubs, as well as inferences about the age of younger bears based on the size, make is possible, that if recorded consistently, local observations could provide estimates of the population structure.

5.3.3 Diet and Feeding Behaviors

This study confirmed Freeman's (1985) observation, that amongst Inuvialuit hunters it is routine practice to assess the stomach contents of the animals they harvest, including polar bears. In the case of polar bears, hunters commented that the stomach contents are "*usually straight [seal] oil*". An important finding from these interviews is that a healthy polar bear will eat only the blubber – the most concentrated energy on the seal. Whereas a nutritionally stressed polar bear will generally consume the blubber, flesh and other parts of the seal. Therefore, when hunters find stomach contents beside straight seal oil it is a cause of suspicion, but also a valuable source of information regarding changes in diet and feeding behaviors. Other indicators of hunting success is the number of seal kill sites (i.e. carcasses) a hunter encounters, as well as the parts of the seal consumed at these sites. Previous studies have not explored this dimension, and future research should consider the important qualitative assessment of polar bear stomach contents could play a consideration in monitoring the health of individual, their harvesting success, as well as identifying change in their diet.

Hunters also make observations of the prey that polar bear are hunting and consuming. While other traditional knowledge studies identified that polar bears are consuming other species besides seals in the past (i.e. Hart and Amos 2004), through the continued monitoring of polar bear hunting and examination of stomach contents, these observations will provide a valuable insight to adaptive practices of polar bears to climate change as they may have to look for other prey to complement their diet of seals.

5.3.4 Distribution and Movements

In my research I found that harvesters explained the number of bears coming to the community fluctuates seasonally and depends on ice conditions, availability of food, and potentially, nutritional stress of a bear. In the community of Sachs Harbour, residents will commonly see polar bears in fall time during "freeze-up" as they pass by in their migration. As a rule-of-thumb, if the bears are "healthy", they keep their distance. However, the bears that do wander into town could be *either* starving or curious. The general belief is that "healthy" bears will stay further away from land and settlements, as often, the unhealthy bears are the bears that will come into the community.

Several other sources discuss absence or abundance of polar bear or seals at different locations and different times, which can be used to infer movement, habitat use, and abundance at certain times (Zdor 2007; Kalxdorff 1997). Keith et al. (2005) emphasize that traditional knowledge related to polar bear mobility is central to understanding polar bear population dynamics. Amidst the ecological changes taking place in the North, monitoring abundance and distribution of polar bears can be challenging as polar bears are adjusting and adapting their distribution and movement. The continued monitoring of polar bear distribution is essential in a rapidly changing sea ice habitat (Vongraven and Peacock 2011). To this end, Vongraven and Peacock (2011) support employing traditional knowledge and observations to describe polar bear distribution, as this knowledge on habitat use and seasonal distribution patterns is valuable, and can help inform appropriate methodology of scientific surveys.

This research in Sachs Harbour observed that distribution and movement of polar bears can be informed by local observations in three ways: direct observations of bears; monitoring bear tracks; and examination of individual bear's feet. Whether through hunting or the ad-hoc observation of bears on the land or ice, hunters can document the location of sightings, direction bears are traveling, and (where applicable) the ice conditions they are traveling along. It also can collect data such as the direction bears are traveling at certain times of year, and the habitat that bears are using. Zdor (2007) captured this information on the direction of travel at times of year in his study of traditional knowledge of polar bears in Chukotka, Russia. Through identifying key travel routes and the timing of travel through these regions, human activities in these regions at this time could be limited to reduce the impact on polar bear. Furthermore, with the use of GPS technologies, geo-referenced and meta-data relating to sightings can be captured and incorporated into community-based monitoring systems.

When working with the carcass of hide of a harvested bears, hunters will examine the wear of the fur around the paws. As two hunters commented, this can help to determine if it's been traveling over land extensively-- an important consideration in light of adaptation to climate change. These observations can provide data to inform scientists of the habitat use (feeding areas, patterns, behaviors) seasonal movements, and range of bears in the region. More important are the qualitative observations such as traveling behavior, preference for travel routes, and rough changes in behavioral data. However, as elaborated in the previous section, the data may have selection bias as the majority of observations are limited to certain areas and times of year.

Several people interviewed discussed changing trends or new observations such as more bears seen in-land, fewer in the community, and bears moving Northward. The recurring theme is that the distribution of polar bears will be determined by both ice conditions and distributions of seals. Several hunters and elders hypothesized that polar bears may be adjusting their range in response to sea ice decreases, moving further North or further out onto the multi-year ice. These themes were not apparent in the polar bear traditional knowledge literature that I

previously reviewed, and raises an interesting question that demands further inquiry both within traditional knowledge, and biological research.

A key conflict between scientists and Inuit has revolved around the divergence between community and scientific observations and assertions regarding the abundance of bears- especially in or around communities (see Tyrell 2007). Scientists believe that the increased number of sightings of polar bears in town mean that bears are looking for food in town or are stranded on shore rather than on the ice, and *believe that more bears are in the community is a sign of nutritional stress and loss of habitat.* In some communities, seeing more bears in town is a sign that there are more bears than before (Tyrell 2007).

5.3.5 Habitat

Habitat conditions, and in essence, sea ice, is another important theme in how Inuvialuit in Sachs Harbour talk about polar bear health. The relationship between polar bears and sea ice has created a rule-of-thumb about how sea ice conditions will dictate polar bear distribution and health. *"We have no ice, we have no bears"* says one hunter, while another proclaims *"whatever happens to the ice is going to happen to the polar bear. That's the bottom line."*

There are numerous complex signs and signals, observed at multiple scales, by which Inuit hunters assess weather and sea ice conditions (Aporta 2005, Freeman 1984; Krupnik et al. 2010; Peloquin and Berkes 2009). Inuit hunters describe changes in sea ice through a complex of interacting variables akin to fuzzy-logic, comparing the past and present conditions through the combination of multiple variables such as sea-ice conditions, wind speed, direction (Riedlinger and Berkes 2001, Berkes et al 2007, Nichols et al., 2004). Riedlinger's (2001) study in Sachs Harbour on Inuvialuit observations of climate change found Inuvialuit observations of weather and seasonal changes were very broad. Keith et al. (2005) recorded that hunters have observed "sea ice is not reaching the thickness that it once was, changes in the timing of freeze-up and break-up of the sea ice has also changed over the years, a change in prevailing wind direction, and the late arrival of snowfall and decrease in yearly snow accumulation". While my research did not go in-depth into changes in the sea ice and weather conditions, as did Riedlinger (2001),

the results of my research found that Bankslanders are observing an absence of sea ice in the summer, a shift in ice conditions from multi-year ice to annual ice, and the length of the seasons and the timing of break-up and freeze-up, re-affirming many of Riedlinger's (2001) findings.

In Gjoa Haven, hunters attribute the decrease in polar bear numbers to migration due to the absence of multi-year ice, as "*IQ* emphasizes an association between polar bears and multi-year ice" (Keith et al. 2005: 117). However, one interesting contribution from Sachs Harbour is a recurring theme that polar bears will be more successful hunters within the more prevalent annual ice. This is another community-developed hypothesis that warrants further investigation by scientists, and is also a reason why all community members are not consistent in the view that climate change will immediately impact polar bear's fitness.

5.3.6 Population Abundance

Through my investigation into archival records and traditional knowledge, fluctuations in abundance have been recorded in many of the previous traditional knowledge studies. However, the degree of fluctuation is always subjective. My research found that Inuvialuit understanding of wildlife abundance and population cycles are informed through both their worldview and their past observations that animals migrate and populations naturally fluctuate. "*Years are different from years before*", said one elder from Sachs Harbour said in regards to changes in polar bear numbers, illustrating an acceptance of fluctuation in polar bear abundance.

Inuvialuit knowledge of polar bears suggests that fluctuations in abundance of polar bears are expected, as they are in other species. In fact, dealing with variability in abundance and distribution of wildlife is a way of life for many Indigenous peoples (Smith, 1978; Parlee et al., 2005a). Based on my interviews in Sachs Harbour and other discussions in the Inuvialuit communities, many hunters hold the belief that animal numbers, whether seals or polar bears, have not decreased, but they have moved into different areas. Keith et al. (2005: 137) recorded in Gjoa Haven, that "because of the sensitivity of polar bears and to variability of environmental conditions and of prey species from year to year, polar bears are understood to be plentiful in

some years, and scarce in other years." In the case of polar bears on Sachs Harbour, many hunters contend that polar bears have and will move North and out of the hunting range, so that hunters will not see, them, but understand they are in different areas.

Dowsley and Wenzel (2008) conclude that while traditional knowledge of wildlife can be useful at the population level as a source of information on population trends, traditional knowledge (as well as scientific information) has proven less reliable in discussions of animal population size or distributions. As I observed in this study, it is a challenge to differentiate declining numbers vs. movement in population to areas based solely on traditional knowledge. However, considering other ecological factors in light of these observations can help differentiate these two using fuzzy logic thinking- observing changes in distribution and abundance of polar bears over space and time in light of other indicators such as seal abundance, fish abundance, and ice conditions. Likewise, through aligning synchronous observations across multiple communities within a sub-populations range could be used to assess is more bear are being seen in one area as opposed to another, and differentiate movement and distribution from changes in abundance. Furthermore, in the absence of long-term data of abundance of polar bears, it is inappropriate to estimate a current "healthy" or optimal population level (if one exists). As historical records are sparse, elders' traditional knowledge can inform fluctuations in abundance (see table 1 for example), but not specific population estimates.

In future consideration of using traditional knowledge to assess polar bear population health, I would suggest that abundance is an inappropriate metric in which to relate traditional knowledge and scientific findings, because of the sample selectivity, sampling bias, and frequency of observations that can hinder both scientific methods and local observations. Because of the wide range in population counts, and arguments over the number of bears between scientists and natives, I suggest that the discourse should be shifted away from population numbers, to a qualitative assessment of population health that adequately assesses both the holistic health of the individual and collective population. I believe the conversation between scientists and Inuit can be improved if the conversations about polar bear expand from

discussions over abundance, to more qualitative discussions regarding the other indicators of polar bear health such as behavior, distribution, and trends in body conditions.

5.3.7 Unique Observations

Moller et al. (2004: 3) note that the "key characteristic of traditional monitoring is that observers would tend to note unusual rather than average patterns and occurrences". In regards to noticing unique events, from my brief experience in Sachs Harbour and other Inuvialuit communities, I have learnt how news of unique events or observations quickly spreads. The example of the odd, grizzly-shaped, polar bear claw illustrates this. These unique observations are measured against traditional knowledge and oral history, and shared and compared amongst local hunters and elder (and likely later through biologists) to note changes. However, while hunters will be keen observers, especially of "oddities", there often lacks formal mechanisms to monitor, report, and publish news of these unique observations for further inquiry or raising of a "red-flag". In the development of community-based monitoring programs, mechanisms to document and report unique events and sights should be encouraged. Some formal mechanisms might include: 1) a geo-tagged photographs, to identify the locations of unique sightings; 2) an expanded harvester sampling and interview program, that would document unique observations; and, 3) a comprehensive regional traditional knowledge study to research if these unique observations have appeared in the past (either in living memory or in archival records) and have this information available to compare against current observations.

In summary, through comparing my literature review and findings relating to community-based indicators of polar bear health, it is interesting to see that communities across the Arctic have similar ways in holistically monitoring polar bear population health and habitat. However, when considering the findings from this research in Sachs Harbour, as well as other previous research, one must be careful not to generalize findings across all Arctic communities and polar bear sub-populations. Combining very complex, local knowledge from different locations, groups, and contexts to present a generic picture of local Inuit knowledge is inappropriate (ITK and NRI 2007), so additional studies in different communities and sub-population boundaries is

necessary to collect the specific knowledge and observations. Likewise, as polar bear subpopulations may be responding to regional environmental changes in different ways than other subpopulations, findings such as these should not be generalized to the species as a whole.

Bankslanders interpret polar bear health based on a complex assessment of multiple and interacting variables. Exploring Bankslanders knowledge and understanding of polar bear population health is a good case study in which to expand our understanding of traditional knowledge systems ability to comprehend and interpret complex environmental processes. This thesis argues traditional knowledge can contribute to ecological monitoring of polar bears within complex Arctic ecosystem, and encourages that, through the process of sharing knowledge and observations, wildlife managers will have a better understanding of local perspectives of polar bear health and will improve capacity to monitor polar bears within a rapidly changing environment.

5.4 Contributions to Ecological Monitoring

Due to their nature, polar bears are inherently difficult to study and monitor, and extensive scientific research and monitoring of wildlife can be expensive and challenging in the remote places in the Arctic. Ecological research in the Arctic is hindered by "insufficient scientific knowledge and understanding of physical and ecological processes in the Arctic, and by the lack of historical baseline data against which to measure change" (Riedlinger and Berkes 2001: 315). Due to the growing need for information on local environmental changes, community-based monitoring of ecological indicators is gaining increasing interest as a tool to address the challenges of expensive biological research programs, and allows for the involvement and recognition of resources users in the research and management processes (Moir and Block, 2001; Weber, 2003; Fernandez-Gimenez et al., 2008).

The final objective of my work was to explore how traditional knowledge and local observations can contribute to ecological monitoring of polar bears within complex Arctic ecosystem. In section 2.3, I reviewed the current management system for polar bears in the Western Arctic

and summarized the importance to include traditional knowledge in wildlife management. Building on this, in section 2.4.4 I reviewed previous studies on traditional knowledge that examined how traditional knowledge can make a useful contribution to monitoring wildlife in the Canadian North (Johnson, 1992; Freeman, 1992; Ferguson et al., 1998; Gilchist et al., 2005; Moller et al., 2004). Based on the literature review related to my work, and in consideration of the application of my results, I assert that traditional knowledge of Bankslanders can contribute to management and monitoring in the following ways: through improving baseline data on species and ecological processes, cost-effective monitoring of on-going or unique environmental changes; broadening the range of inquiry through formulating research questions and hypotheses; incorporating holistic, integrated perspectives looking at ecosystem level interactions; and contributing to a co-management partnership to develop wildlife research and management policies that incorporate traditional knowledge and respect cultural values.

5.4.1 Improving baseline data on species and ecological processes

As the term suggests, traditional knowledge is appreciated for its historic depth which provides "robust inter temporal perspectives and baseline information that is on a local scale and based on a particular place" (Moller et al. 2004: 10). As traditional knowledge is generally more observant of extreme events and long-term trends because scientific studies generally have a short sampling period, the collection of traditional knowledge has been described by Moller and Newman (2005: 314) as "sharpening the long-term ecological perspectives". Traditional knowledge has provided insight into historical trends and specific ecological information on several different species, especially throughout the Arctic (Ferguson et al., 1998; Huntington et al., 1999; Gilchrist et al., 2005). Through the long-term and broad collection of knowledge and observations documented in this thesis, my contribution to research in both polar bear management and community-based monitoring of wildlife in the Arctic is to expand the temporal and spatial knowledge scope, and collect information that may be useful to inform, improve, and even fill knowledge gaps in baseline data on species and ecological processes.

5.4.2 Cost-effective monitoring of on-going or unique environmental changes

Traditional knowledge may be particularly valuable when wildlife populations occur in remote locations inhabited by indigenous peoples (Gilchrist et al., 2005). In these areas, including

traditional knowledge and monitoring methods may be of benefit in contributing observational data based over a long period of time with a large available sample. Furthermore, "most traditional monitoring methods used by indigenous cultures are rapid, low-cost, and easily comprehensible assessments made by the harvesters themselves as they hunt" (Moller et al., 2004: p.2) and they encourage the participation of resource users in the research.

This research project demonstrates that, relative to expensive biological survey programs, a breadth of information on the regional subpopulation can be gathered through traditional knowledge research methods. However, from my experience conducting this project, a community-based participatory method is needed to ensure that research protocols and relations are made to support community needs to record the knowledge, use the knowledge appropriately, while at the same time, collect knowledge with a rigorous research methodology. Furthermore, the need for systematic and comparative data collection is important, especially when looking at sub-populations that have a large range that will also cover multiple communities. Different methods used in different communities can lead to different interpretations, and hence draw different and potentially conflicting conclusions. Future studies should look for consistent methods in order to gain a population-wide traditional knowledge perspective. This would also prevent duplication of research efforts. Based on my personal experience conducting traditional knowledge research on polar bears throughout the ISR, I would support this argument for more consistent research methodologies and future traditional knowledge studies based on the region or sub-population, as opposed to a single community.

5.4.3 Broadening the range of inquiry

Informed by traditional knowledge, personal observations, and unique experiences, Inuvialuit have developed their own hypotheses regarding polar bear health, abundance and distribution. Through their engagement with scientists and resource managers in co-management forums, there is a venue for them to share these hypotheses and work with scientists to test these. An example of this observed through my research related to the Inuvialuit perspective that polar bears were using the multi-year pack ice west of Banks Island. While scientists were critical of this, as they believed multi-year pack ice to be poor habitat for bears and seals, traditional

knowledge and observations on Inuvialuit in this region strengthened Inuvialuit perspectives of polar bear distribution in this region. As a result of the request of the IGC, a polar bear survey of this region of pack ice was conducted in March 2012[21]. This example sets a positive precedence for sharing information and hypotheses between Inuvialuit and Scientific researchers. There is potential for some of the others findings in my results to be used by scientists to identify additional hypotheses and avenues of inquiry when studying the North Beaufort polar bear sub-population in the future.

5.4.3 Integrated perspective looking at ecosystem level interactions

Arctic ecosystems, especially under climate change scenarios, are highly complex ecological systems that function across multiple spatial and temporal scales (Wiens 1989, Levin 1992, Gagnon and Berteaux 2009). There is growing recognition that conventional scientific approaches alone may be insufficient in the face of ecological and social complexity (Moller et al 2004). Through their long history of dealing with ecological changes, some Indigenous societies have developed adaptive practices to live with complexity, and highly sophisticated knowledge systems to comprehend and interpret complex environmental processes (Berkes, 1998; Hunn et al., 2003; Moller et al., 2004; Peloquin and Berkes, 2009). Inuvialuit knowledge polar bear population health is built upon a very complex assessment of multiple variables. This research is a good case study in which to expand our understanding of traditional knowledge systems' ability to comprehend and interpret complex environmental processes and use traditional knowledge to complement scientific.

Folke et al. (2005) underlines that the management goal of complex and rapidly changing ecosystems, such as the Arctic, should be not to seek detailed knowledge of parts of the system, but improved understanding of the dynamics of the whole system. The holistic and integrated observations of species from an ecosystem perspective is akin to fuzzy logic, and this examination of Inuvialuit knowledge of polar bear is an excellent demonstration of fuzzy-logic thinking in practice! Fuzzy logic seeks explanation through approximate relations and "rules-of-thumb"- simple prescriptions based on indigenous knowledge and ways of knowing based on a

[21] This project was titled "Polar Bears in the Deep Offshore Regions of the Beaufort Sea: A Preliminary Study to Estimate Distribution and Density in Previously Under-Surveyed Areas, 2011-2012."

holistic view of the environment to deal with complexity (Gadgil et al., 1993; Moller et al., 2004; Peloquin and Berkes, 2009). Some of the rules-of-thumb directly identified in this study related to polar bear and sea ice; polar bears and seals; and polar bear behavior. Several other rules-of-thumb are expected to be in play in Inuit knowledge through indicators of wildlife and ecological process- especially for weather and sea ice conditions (Aporta, 2005; Freeman, 1984; Krupnik et al., 2010; Peloquin and Berkes, 2009). Through holistically monitoring a large number of indicators from multiple sources at multiple scales, hunters and co-management participants grasp and reflect on complex interactions of social and ecological processes occurring at multiple levels (Berkes et al., 2000; Moller et al., 2004; Peloquin and Berkes, 2009).

As an apex predator, polar bears are dependent on the species in the food web below them. Most directly, polar bears are dependent on seals, and secondarily on the fish that the seals are dependent upon. "*If I start seeing, if people start seeing the seal population crashing,*" says Fred Raddi, "*we know the bears will soon follow, cause that's their main diet*." Several hunters commented that seals are an indicator of bear health, as the abundance, distribution, and body condition of seals can be used to infer the health of polar bears[22]. This study illustrated that the Inuvialuit can make a valuable contribution to observing and interpreting changes in polar bear population health and their habitat through the holistic assessment of indicators at an ecological scale.

The approach of using a holistic suite of simpler indicators, as used in traditional monitoring techniques, as opposed to a select few detailed and costly indicators, is finding favor in western science and wildlife management, especially in light of increasing ecosystem complexity. Through better understanding these indicators and rules of thumb, this research can improve the monitoring process and dialogue between Inuvialuit and biologists to improve the co-management partnership.

[22] However, considerations in local observations of seal health and abundance are that Inuvialuit harvesters in Sachs Harbour are not hunting seals as much as in the past due to challenging ice conditions and decreased demand for seal meat, they are not in a position to make as detailed observations of seal body condition as they were in the near past. Secondly, as a highly migratory species, several elders and harvesters wonder if the seals moved to different areas and the polar bears are following them.

5.4.4 Improved co-management partnership

Within established co-management forums, researchers and resource managers recognize the importance of cooperation and engaging local stakeholders as part of a constructive partnership to develop a shared conservation concern and improved cultural understanding between scientists and communities (Zabel et al., 2002; Gilchrist et al., 2005; Moller et al., 2004). By including traditional knowledge with that of scientific knowledge, and integrating polar bear science with the "human dimensions", it is argued that the resulting resource management system is better informed and suited to the resources, the people who rely on it, and the needs of scientists and conservationists (Servheen, 1998; Nuttall, 2000). As described in my literature review, the framework to incorporate traditional knowledge into conservation decision-making is present, but many feel that there still exists conflict, misunderstandings, and lost opportunities to incorporate traditional knowledge with science for the sake of better understanding polar bear population health.

5.5 Application and Recommendations

As Peacock et al. (2011), point out, seventy percent of the world's legal polar bear harvest occurs in Canada. The on-going harvest sampling and monitoring of polar bears at the regional level has developed long-term harvest information that has supplemented ecological research (Taylor and Lee 1995). I agree with Vongraven and Peacock (2011: 30) in that there is a broad wealth of ecological information that can be garnered from harvest samples and data (given attention to biases of a harvest sample). However, I would contribute to say that there is a great opportunity to better capture other details associated with harvest and processing of polar bears. These details would largely be qualitative assessments. But if designed to account for subjectivity, bias, and distributed over a wide region, data would be valuable for on-going monitoring, recording anomalies, and trend analysis.

Monitoring programs should seek to expand the geographic scope of knowledge by synchronizing harvesters' observations over a wider range. This can help to develop a stronger set of observations over the polar bear range and the harvesters' range. These

recommendations will be of interest to the Inuvialuit Game Council, who is in process of designing an ISR wide community-based monitoring program.

Further exploration into how socio-economic and technological change are also expanding the spatial scale through direct and indirect communication between harvesters should also be explored, as I expect that these create opportunities for a broader range of knowledge through the sharing of knowledge between communities (horizontally), and between communities, scientists, and other knowledge sources (vertically). Through facilitating the sharing of knowledge and observations, across disciplines, communities, and generations, current and future generations of both Inuvialuit and scientists will be more adaptive and prepared to monitor and interpret changes in polar bear health. "All of us are smarter than one of us", says one of my favorite African proverb, and moving from a discourse of knowledge conflict to knowledge generation and co-learning will further improve the co-management of the species in the future.

Chapter Six: Conclusion

The work presented in this thesis has explored Bankslanders knowledge and indicators of polar bear health in the North Beaufort sub-population. The objectives of the thesis were to document Inuvialuit knowledge of polar bear population health, and to identify the indicators used by Inuvialuit to assess polar bear health. This thesis argues that, with years of accumulated traditional knowledge, oral history and fist-hand observations, Inuvialuit of Banks Island have an accumulated wealth of traditional knowledge about polar bears and this traditional knowledge can contribute to ecological monitoring of polar bears.

Inuvialuit traditional knowledge is defined as "the knowledge gained by individuals through traditional learning patterns, and through living on and using the land… [as] observing, listening, testing, determining and experiencing all play considerable roles in retaining traditional knowledge" (MPEG, 2006: 6.1.1). While extensive biological research has been carried out on the Southern Beaufort polar bear population, at the time of this research, there had not a comprehensive study of Inuvialuit traditional knowledge of polar bears in the region. Traditional knowledge studies of polar bears have been conducted elsewhere across the Arctic, including Baffin Bay (Dowsley, 2005), Taloyak (Keith et al., 2006), Gjoa Haven (Keith et al., 2005), Foxe Basin (Sahanatien, *2011*), Chukotka (Zdor, 2007), Greenland (Born et al., 2011), and the Alaska coastline (Kalxdorff, 1997).

Utilizing community-based participatory research methodologies, participant observation, and semi-directed interviews, coupled with an extensive review of the regional ethnography and other traditional knowledge research, this thesis attempted to collect, synthesize and document the breadth of traditional knowledge of polar bear ecology, behavior, and habitat, as well as the cultural and socio-economic significance of polar bears to the Inuvialuit. The methods used were effective in reflecting Inuvialuit knowledge and communicating knowledge through stories and relating direct experiences. Complimenting interviews with participatory observation

provided an experiential window into which I could better understand how Inuvialuit know about polar bear health.

Limitations in cross-cultural communication and the length of field research may impact the depth of understanding of this topic, and the incomplete mapping methodology prevented detailed recording of specific features and sightings. The scope and depth of this research was limited due to the modest resources available for conducting this research (see appendix 7). Limited financial resources restricted the number and length of visits to the community, which could have improved the research partnership with the community and allowed for more in-depth participant observation. However, for a Masters-level research program, I felt that with my limited resources and capacity, I was able to do justice to the praxis of community-based participatory research, and was creative in finding funding opportunities that allowed me to engage the community and re-visit the community for verification and presentation of results.

In summarizing my findings, this thesis examined what Bankslanders know about polar bear population health, and the indicators they use to monitor this. Their knowledge and observations covers the scale from the ecosystem level, to the population, to the smallest features in individual animals. Their knowledge includes broad baseline and longitudinal environmental observations to temporal trends in populations' abundance, behavior, and body condition; to unique details and events such as the appearance, diet, or behavior of individual animals. Bankslanders hold expertise in assessing qualitative details such as the taste and texture of meat that would only be apparent to someone with a lifetime of experience and exposure.

Bankslanders interpret polar bear health based on a complex assessment of multiple and interacting variables. Exploring Bankslanders knowledge and understanding of polar bear population health is a good case study in which to expand our understanding of traditional knowledge systems' ability to comprehend and interpret complex environmental processes. This thesis supports that traditional knowledge and local observations can contribute to

ecological monitoring of polar bears within complex Arctic ecosystem, and encourages that, through the process of sharing knowledge and observations, wildlife managers will have a better understanding of local perspectives of polar bear health and will improve capacity to monitor polar bears within a rapidly changing environment. Through the process of community-based monitoring, wildlife managers will have a better understanding of local perspectives of polar bear health and will develop capacity to monitor polar bears within a rapidly changing environment. Bankslanders knowledge and observations related to these categories, and I identified the indicators used by Inuvialuit to assess polar bear population health. This fills a gap in the literature and complements existing efforts (i.e. Vongraven and Peacock 2011) to inform wildlife scientists on designing community-based monitoring systems that are built around traditional knowledge and are more inclusive of local understandings and observations of polar bear health. Within the ISR, the findings of this study could be significant in developing a region-wide community based monitoring program and identifying the indicators that should be monitored. Future research might consider the usefulness of the research including indicators for monitoring. First through engaging Inuvialuit in monitoring and collecting observations, information, and samples in a way that is relevant to their harvesting practices, management boards including scientists may be able to expand their understanding of changes in polar bear population health in the region. Secondly, by monitoring common indicators among the geographically distant communities in the ISR, over time, both the communities and researchers may be gain a better understanding of polar bears across their range. Furthermore, through engaging in community-based monitoring, Inuvialuit can contribute information to researchers based around their current methods of observing and monitoring population health, and fostering an improved dialogue between scientists and community members. Inuit want a greater say in polar bear management and argue that their traditional knowledge, complemented by community-based monitoring, could help inform scientists and managers on the state of polar bear population health. This research outlines a way forward for using traditional knowledge to inform scientific research to better understand the current health of polar bear populations, and to manage for the future health and abundance of the polar bear, Monarch of the Arctic!

References

Agrawal, A. 2002. "Indigenous knowledge and the politics of classification". *International Social Science Journal*, 173: 287–297.

Agrawal, A. 1995. "Dismantling the divide between Indigenous and Scientific knowledge". *Development and Change* 26: 413-439.

Alunik, I., E. D. Kolausok, and D. Morrison. 2003. *Across Time and Tundra: TheInuvialuit of the Western Arctic*. Seattle: University of Washington Press.

Amstrup, S.C., Stirling, I., Smith, T.S., Perham, C., and Thiemann, G.W. 2006. "Recent observations of intraspecfic predation and cannibalism among polar bears in the Southern Beaufort Sea." *Polar Biology* 29(11): 997–1002.

Amstrup, S. C., Marcot, B. G. & Douglas, D. C. 2008. "A Bayesian network modeling approach to forecasting the 21st century worldwide status of polar bears". Pp. 213-268 in: *Arctic sea-ice Decline: Observations, Projections, Mechanisms and Implications.* Geophysical Monograph 180 (eds. E. T. DeWeaver, C. M. Bitz & L. B. Tremblay), American Geophysical Union, Washington DC.

Amstrup, S.C. and C. Gardner. 1994. "Polar Bear Maternity Denning in the Beaufort Sea". *The Journal of Wildlife Management* 58 (1): 1-10.

Amstrup, S. C., I. Stirling, and J. W. Lentfer. 1986. "Past and present status of polar bears in Alaska." *Wildlife Society Bulletin* 14: 241 - 254.

Anderson, D.G. and M. Nuttall (eds.) 2004. *Cultivating Arctic Landscapes: knowing and managing animals in the circumpolar North.* Oxford: Berghahn.

Aporta, C. 2002. "Life on the ice: understanding the codes of a changing environment". *Polar Record* 38 (207): 341-354.

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

Arima, E. 1976. "An assessment of the reliability of informant recall" in *Inuit Land Use and Occupancy Report*. Pp. 31-38.Berkes, Huebert, Fast, Manseau, and Diduck, (eds.) 2005.

Arctic Climate Impact Assessment. 2005. *Impacts of a Warming Climate: Arctic Climate Impact Assessment*. Cambridge Univ. Press: New York.

Ayles, G.B. and N.B Snow. 2002. "Canadian Beaufort Sea 2000: The Environmental and Social Setting." *Arctic* 55: 4-17.

Barr, W. 1996. *White Beares of a Monstrous Bigness: A historical survey of polar bear population dynamics and use in the Northwest Territories.*

Barsh, R. L. 1997. "Forests, indigenous people, and biodiversity". *Global Biodiversity* 7:20-23.

Berger, T. 1976. *Transcripts of the Proceedings at the Community Hearing of the Mackenzie Valley Pipeline Inquiry before the Honourable Mr. Justice Berger, Commissioner*. Sachs Harbour, N.W.T. March 4, 1976. Volume 42. 2003 electronic version. Allwest Reporting Ltd., Vancouver, B.C. 122 pp.

Berkes, F. 1993. “Traditional ecological knowledge in perspective”. Pages 1– 9 in Inglis, J.T., (ed.) *Traditional ecological knowledge: Concepts and cases*. Ottawa: International Program on Traditional Ecological Knowledge and International Development Research Centre.

Berkes, F. 1998. “Learning to design resilient resource management: indigenous systems in the Canadian subarctic”. Pages 98–128 *in* F. Berkes and C. Folke (editors). *Linking social and ecological systems: management practices and social mechanisms for building resilience*. Cambridge: Cambridge University Press.

Berkes, F. 1999. *Sacred ecology: traditional ecological knowledge and resource management*. Philadelphia: Taylor & Francis.

Berkes, F. 2004. “Rethinking Community-Based Conservation”. *Conservation Biology* 18: 621–630.

Berkes, F., Bankes, N., Marschke, M., Armitage, D., and Clark, D. 2005. “Cross-scale institutions and building resilience in the Canadian North.” Pages 225–248 in Berkes, F., Huebert, R., Fast, H., Manseau, M., and Diduck, A., (eds.) *Breaking ice: Renewable resource and ocean management in the Canadian North*. Northern Lights Series No. 7. Calgary: University of Calgary Press and Arctic Institute of North America.

Berkes, F. and C. Folke. 2002. “Back to the future: Ecosystem dynamics and local knowledge.” Pp. 121-146 in C. S. Holling (editor). *Panarchy: Understanding Transformations in Human and Natural Systems*, Washington, DC: Island Press.

Berkes, F., and Henley, T. 1997. “Co-management and traditional knowledge: Threat or opportunity?” *Policy Options* 18(2):29–31.

Berkes, F., M. Kislalioglu-Berkes, and H. Fast. 2007. “Collaborative Integrated Management in Canada’s North: The Role of Local and Traditional Knowledge and Community-based Monitoring.” *Coastal Management* 35: 143–162.

Berkes, F., J. Colding, C. Folke. 2000. “Rediscovery of traditional ecological knowledge as adaptive management.” *Ecological Applications* 10: 1251–1262.

Berkes, F., and D. Armitage. 2010 “Co-management institutions, knowledge, and learning: Adapting to change in the Arctic.” *Études/Inuit Studies* 34(1): 109-131.

Berkes, F., and M. Kislalioglu-Berkes. 2009. “Ecological Complexity, Fuzzy Logic and Holism in Indigenous Knowledge”. *Futures* 41: 6–12.

Bielawski, E. 1992. “Inuit indigenous knowledge and science in the Arctic.” *Northern Perspectives* 20(1):5– 8.

Boreal Institute for Northern Studies (BINS). 1975. *Arctic Summer School: Communities of the Western Arctic*. Edmonton: University of Alberta.

Born, E., A. Heilmann, L. Kielsen Holm, and K. L. Laidre. 2011. *Polar Bears in Northwest Greenland: An Interview Survey about the Catch and the Climate.* Monographs on Greenland (Meddelelser om Grønland) 351. Museum Tusculanum Press: University of Copenhagen. 232 pp.

Brody, H. 1976. Land occupancy: Inuit perceptions. *Inuit land use and occupancy project. Volume One. Land use and occupancy, Canada. Department of Indian and Northern Affairs, Ottawa, ON*, 185-242.

Brody, H. 2000. *The Other Side of Eden: Hunters, Farmers and the Shaping of the World*. Toronto: Douglas and McIntyre.

Brower, C.D., A. Carpenter, M.L. Branigan, W. Calvert, T. Evans, A.S. Fischbach, J.A. Nagy, S. Schliebe, I. Stirling. 2002. “The polar bear management agreement for the Southern Beaufort Sea: An evaluation of the first ten years of a unique conservation agreement”. *Arctic* 55: 362-372.

Canada. 1984. The Western Arctic Claim: The Inuvialuit Final Agreement. Ottawa: Minister of Indian Affairs and Northern Development.

Carlsson, L. and F. Berkes. 2003. "Co-Management Across Levels of Organization: Concepts and Methodological Implications." Presented at Politics of the Commons: Articulating Development and Strengthening Local Practices, Chiang Mai, Thailand, July 11-14, 2003. http://dlc.dlib.indiana.edu/archive/00001133/.

Castro, A.P, and E. Nielsen. 2001.” Indigenous People and Co-Management: Implications for Conflict Management”. *Environmental Science and Policy* 4(4-5): 229-239.

Clark, D. A., D.S. Lee, M.M.R Freeman, and S.G Clark. 2008. “Polar bear conservation in Canada: defining the policy problems”. *Arctic* 61(4): 347-360.

Cobb, D., M. Kislalioglu, and F. Berkes. 2005. “Ecosystem-based management and marine environmental quality indicators in Northern Canada”. In *Breaking Ice: Renewable Resource and Ocean Management in the Canadian North. Edited by F. Berkes, R. Huebert, H. Fats, M. Manseau, and A. Diduck,* p.71-94. Calgary: University of Calgary Press

Condon, R.G., P. Collins, and G. Wenzel. 1995. “The best part of life: Subsistence hunting, ethnicity, and economic adaptation among young adult Inuit males.” *Arctic* 48(1): 31–46.

Cruikshank, J. 1981. “Legend and Landscape: Convergence of Oral and Scientific Traditions in the Yukon Territory”. *Arctic Anthropology* 18(2): 67-93.

Cruikshank, J. 1998. *The Social Life of Stories.* London: University of Nebraska Press.

Damas, D. G. 1984. “Mackenzie Delta Eskimo” In *Handbook of North American Indians, Vol. 5: Arctic.* Edited by Damas, D. and W.E Sturtevant. P. 347-35. Smithsonian Institute, Washington D.C.

Davidson-Hunt, I. J. 2006. “Adaptive Learning Networks: Developing Resource Management Knowledge through Social Learning Forums”. *Human Ecology* 34: 593–614.

Derocher, A.E., N.J. Lunn, and I. Stirling. 2004. “Polar bears in a warming climate”. *Integrative and Comparative Biology* 44:163–176.

Dowsley, M. 2005. *Inuit Knowledge Regarding Climate Change and the Baffin Bay Polar Bear Population*. Nunavut Department of Environment, Final Wildlife Report. No.1.

Dowsley, M., and G. Wenzel. 2008. “The time of the most polar bears”: A co-management conflict in Nunavut.” *Arctic* 61(2):177– 189.

Duerden, F., & Kuhn, R. G. 1998. Scale, context, and application of traditional knowledge of the Canadian North. *Polar Record*, *34* (188): 31-38.

Durner, G. M., Douglas, D. C., Neilson, R. M., Amstrup, S. C., McDonald, T. L., Stirling, I., Mauritzen, M., Born, E. W., Wiig, O., DeWeaver, E., Serreze, M. C., Belikov, S. E., Holland, M. M., Maslanik, J., Aars, J., Bailey, D. A. & Derocher, A. E. 2009. “Predicting 21st-century polar bear habitat distribution from global climate models.” *Ecological Monographs* 79: 25-58.

EBA Engineering Consultants Ltd. 2008. *Polar bear maternal dens survey using airborne forward looking infrared (FLIR) imagery, Shingle Point to Mackenzie Bay, Yukon Territory, Canada, 4-5 December 2007.* Vancouver, British Columbia, 32pp.

Environment Canada. 2012. Retrieved from http://ec.gc.ca/nature/default.asp?lang=En&n=E8C6F5DD-1

Farquharson, D. R. 1976. Inuit Land use in the West Central Canadian Arctic. *Inuit land use and occupancy project. Canada. Department of Indian and Northern Affairs, Ottawa, ON*, 33-61.

Fehr, A. and W. Hurst. 1996. *A Seminar on Two Ways of Knowing: Indigenous and Scientific Knowledge*. Aurora Research Institute: Inuvik, NT.

Ferguson, M., R. G. Williamson, and F. Messier. 1998. "Inuit knowledge of long-term changes in a population of arctic tundra caribou". *Arctic* 51:201-219.

Fernandez-Gimenez, M. E., J. Hays, H. Huntington, R. Andrew, and W. Goodwin. 2008. "Ambivalence Toward Formalizing Customary Resource Management Norms Among Alaska Native Beluga Whale Hunters and Tohono O'odham Livestock Owners". *Human Organization* 67(2): 137–150.

Fikkan, A., G. Osherenko, and A. Arikainen. 1993. "Polar bears: The importance of simplicity". In Young, O.R., and Osherenko, G., eds. *Polar politics: Creating international environmental regimes*. Ithaca, New York: Cornell University Press. 96–151.

Fletcher, Christopher. 2003. "Community-based participatory research relationships with Aboriginal communities in Canada: An overview of context and process." *Pimatisiwin: A Journal of Indigenous and Aboriginal Community Health* 1(1):27–62.

Flyvbjerg, B. 2007. *Making Social Science Matter: Why Social Inquiry Fails and How It Can Succeed Again*. Cambridge University Press, Cambridge.

Freeman, M., ed. 1976. *Report of the Inuit land use and occupancy project*. Ottawa: Indian and Northern Affairs Canada. 3 vols.

Freeman, M. 1984. "Contemporary Inuit Exploitation of the Sea-ice Environment". In *Sikumiut 'People who use the sea-ice'.* Alan Cooke and Edie Van Alstine (eds) Canadian Arctic Resources Committee. Ottawa.

Freeman, M. 1985. "Appeal to tradition: different perspectives on wildlife management." In J. Brosted, J. Dahl et al. (editors) *Native Power: the Quest for Autonomy and Nationhood of Aboriginal Peoples,* pp. 265-281. Oslo: Universitetsforlaget.

Freeman, M. 1992. "The Nature and Utility of Traditional Ecological Knowledge". *Northern Perspectives* 20 (1): 9-12.

Freeman, M. 2001. "Culture, Commerce and International Co-operation in the global recovery of Polar Bears". *Pacific Conservation Biology* 7: 161-68.

Freeman, M. 2006. *Inuit Knowledge and Western Science*. Report on a Roundtable discussion. Canadian Circumpolar Institute, University of Alberta, Edmonton.

Freeman, M. and A.L. Foote. 2009. *Inuit, polar bears and sustainable Use*. CCI Press, University of Alberta, Edmonton. 252 pp.

Freeman, M., E. Wein and D. Keith. 1992. *Recovering Rights: Bowhead Whales and Inuvialuit Subsistence in the Western Arctic*. Edmonton: Canadian Circumpolar Institute.

Freeman, M. and G. W. Wenzel. 2006. "The Nature and Significance of Polar Bear Conservation Hunting in the Canadian Arctic." *Arctic* 59 (1): 21-30.

Folke, C., F. Berkes, and J. Colding. 1998. "Ecological practices and social mechanisms for building resilience and sustainability". P. 414-435 *in* F. Berkes and C. Folke, editors. *Linking social and ecological systems: management practices and social mechanisms for building resilience*. Cambridge University Press, Cambridge, UK.

Foucault, M. 1972. "The Discourse on Language" in *The Archaeology of Knowledge,* Pantheon Books, N. Y. First published as *L'Ordre du discours,* Gallimard, Paris, 1971.

Gadgil, M., F. Berkes, and C. Folke. 1993. "Indigenous knowledge for biodiversity conservation". *Ambio* 22:151-156.

Gagnon, C. A., and D. Berteaux. 2009. "Integrating traditional ecological knowledge and ecological science: A question of scale." *Ecology and Society* 14(2): 19. [online] URL: http://www.ecologyandsociety.org/vol14/iss2/art19/

Gilchrist, G., M. Mallory and F. Merkel 2005. "Can local ecological knowledge contribute to wildlife management? Case studies of migratory birds". *Ecology and Society* 10(1): 20. [online] URL: http://www.ecologyandsociety.org/vol10/iss1/art20/

Government of the Northwest Territories (GNWT). 2012. 2011 Census Population and Dwelling Counts. Yellowknife: Government of the Northwest Territories. http://www.statsnwt.ca/census/2011/Pop%20and%20Dwelling.pdf

Gunderson, L. H., and C. S. Holling. 2002. *Panarchy: Understanding Transformations in Human and Natural Systems*. Island Press, Washington.

Gunn, A., G. Arlooktoo, and D. Kaomayok. 1988. "The contribution of ecological knowledge of Inuit to wildlife management in the Northwest Territories". Pages 22-30 *in* M. M. R. Freeman and L. N. Carbyn, editors. *Traditional knowledge and renewable resource management in Northern regions.* IUCN Commission on Ecology and the Boreal Institute for Northern Studies, Occasional Publication Number 23, Edmonton, Alberta, Canada.

Government of the Northwest Territories (GNWT). 1993. *Traditional knowledge policy*. Yellowknife: Government of the Northwest Territories.

Government of the Northwest Territories (GNWT). 2012. 2011 Census Population and Dwelling Counts. Yellowknife: Government of the Northwest Territories. http://www.statsnwt.ca/census/2011/Pop%20and%20Dwelling.pdf

Harington, C. R. 1968. Denning habits of the polar bear (*Ursus maritimus* Phipps). Report Series 5. Canadian Wildlife Service, Ottawa.

Hart, E. and B. Amos. 2004. *Learning About Marine Resources and Their Use Through Inuvialuit Oral History*. Inuvialuit Cultural Resource Centre, Inuvik, NT. 163 pp.

Hilderbrand, G. V., Schwartz, C. C., Robbins, C. T., Jacoby, M. E., Hanley, T. A., Arthur, S. M., & Servheen, C. 1998. "The importance of meat, particularly salmon, to body size, population productivity, and conservation of North American brown bears". *Canadian Journal of Zoology* 77: 132-138.

Holling, C. S., and G. K. Meffe. 1996. "Command and Control and the Pathology of Natural Resource Management". *Conservation Biology* 10: 328–337.

Houde, N. 2007. "The six faces of traditional ecological knowledge: challenges and opportunities for Canadian co-management arrangements". *Ecology and Society* 12(2): 34. [online] URL: http://www.ecologyandsociety.org/vol12/iss2/art34/

Hunter, C. M., Caswell, H., Runge, M. C., Regehr, E. V., Amstrup, S. C. & Stirling, I. 2010. "Climate change threatens polar bear populations: a stochastic demographic analysis." *Ecology* 91: 2883-2897.

Huntington, H.P. 1998 . "Observations on the utility of the semi-directive interview for documenting traditional ecological knowledge". *Arctic* 51 (3): 237-42.

Huntington, H. P. and The Communities of Buckland, Elim, Koyuk, Point Lay, and Shaktoolik. 1999. "Traditional Knowledge of the Ecology of Beluga Whales (*Delphinapterus lencas*) in the Eastern Chukchi and Northern Bering Seas, Alaska". *Arctic* 52(1): 49-61.

Huntington, Henry. 2000. "Using traditional ecological knowledge in science: methods and applications". *Ecological Applications* 10(5): 1270–1274.

Ingold, T. 2000. *The Perception of the Environment: Essays in livelihood, dwelling and skill*. Routeledge: New York.

Inuit Tapiriit Kanatami (ITK) and Nunavut Research Institute (NRI). 2007. *Negotiating Research Relationships with Inuit Communities: A Guide for Researchers*. Scot Nickels, Jamal Shirley, and Gita Laidler (eds). Inuit Tapiriit Kanatami and Nunavut Research Institute: Ottawa and Iqaluit. 38 pp.

Israel, B., A. Schulz, E. Parker, & A. Becker. 1998. "Review of community-based research: assessing partnership approaches to improve public health". *Annual Review of Public Health* 19: 173-202.

Johannes, R. E. 1998. "The case for data-less marine resource management: examples from tropical nearshore fisheries". *Trends in Ecology and Evolution* 13:243-246.

Johnson, M. 1992. *Lore: Capturing traditional environmental knowledge*. Dene Cultural Institiute: Hay River, NT.

Kalxdorff, S. B. 1997. *Collection of local knowledge regarding polar bear habitat use in Alaska*. Technical Report MMM 97-2. U.S. Fish and Wildlife Service, Anchorage, AK, 71pp.

Kassam, K. A. S. 2009. *Biocultural diversity and indigenous ways of knowing: human ecology in the Arctic*. University of Calgary Press.

Keith, D., J. Arqviq and the Kitikmeot Heritage Society. 2006. *Environmental Change, Polar Bears and Adaptation in the East Kitikmeot : An Initial Assessment*. Oslo, Norway and Toronto , ON : World Wildlife Fund Arctic Programme. 49 pp.

Keith, D., J. Arqviq, L. Kamookak, J. Ameralik, and the Gjoa Haven Hunters' and Trappers' Organization. 2005. *Inuit Qaujimaningit Nanurnut: Inuit Knowledge of Polar Bears*. Gjoa Haven Hunters' and Trappers' Organization and CCI Press, Edmonton, Alberta. 242 pp.

Kendrick, A., P.O'B. Lyver, and Lutsel K'e Dene First Nation. 2005. "Denésoliné (Chipewyan) knowledge of barren-ground caribou (*Rangifer tarandus groenlandicus*) movements." *Arctic* 58(2):175–191.

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

Krupnik, I., C. Aporta, S. Gearheard, G. Laidler, and L. Kielsen Holm. (Eds.) 2010. *SIKU: Knowing Our Ice: Documenting Inuit Sea Ice Knowledge and Use*. Springer Publishing: Washington. 501 p.

Kvale S. 1996. *Interviews: an introduction to qualitative research interviewing*. Thousand Oaks, CA: Sage Publications

Lee, J., & Taylor, M. 1994. Aspects of the polar bear harvest in the Northwest Territories, Canada. *Bears: Their Biology and Management*, 237-243.

Legat, A. (editor). 1991. *Report of the traditional knowledge working group*. Yellowknife: Government of the Northwest Territories, Department of Culture and Communications.

Levin, S. A. 1992. "The problem of pattern and scale in ecology". *Ecology* 73:1943-1967.

Levin, S. A. 1999. *Fragile Dominion: Complexity and the Commons*. Perseus, Reading, MA.

Lincoln, R.J., G.A., Boxshall, and P.F. Clark. 1982. *A dictionary of ecology, evolution, and systematics*. Cambridge: Cambridge University Press. 298 p.

Liu, J., Dietz, T., Carpenter, S. R., Alberti, M., Folke, C., Moran, E., Pell, A. N., Deadman, P., Kratz, T., Lubchenco, J., Ostrom, E., Ouyang, Z., Provencher, W., Redman, C. L., Schneider, S. H., and Taylor, W. W. 2007. "Complexity of Coupled Human and Natural Systems". *Science* 317: 1513–1516.

Lowe, R. 2001. *Siglit Inuvialuit Uqausiita Kipuktirutait: Basic Siglit Inuvialuit Eskimo Dictionary*. COPE, Inuvik, NWT. 305 pp.

Ludwig, D., R. Hilborn, and C. Walters. 1993. "Uncertainty, resource exploitation and conservation: lessons from history". *Science* 260:17-20.

Lyver, P.O'B., and A. Gunn. 2004. "Calibration of hunters' impressions with female caribou body condition indices to predict probability of pregnancy". *Arctic* 7(3): 233–241.

Ludwig, D. 2001. "The era of management is over". *Ecosystems* 4:758-764.

McGhee, R. 1974. *Beluga Hunters: An Archaeological Reconstruction of the History and Culture of the Mackenzie Delta Kittegaryumiut*. Newfoundland Social and Economic Series No. 13. St. John's: Institute of Social and Economic Research, Memorial University of Newfoundland.

Mace G.M., and A. Purvis. 2008. "Evolutionary biology and practical conservation: bridging a widening gap". *Molecular Ecology* 17: 9-19.

Mackenzie Project Environmental Group (MPEG). 2006.. *Inuvialuit Settlement Region traditional knowledge report*. Submitted to Mackenzie Project Environmental Group, Calgary, AB by Inuuvik Community Corporation, Tuktuuyaqtuuq Community Corporation, and Aklarvik Community Corporation. Unknown publication information.

Mallory, M.L., H.G. Gilchrist, A.J. Fontaine, and J.A. Akearok. 2003. "Local ecological knowledge of ivory gull declines in Arctic Canada". *Arctic* 56(3): 293– 298.

Manning, T.H, and A.H MacPherson. 1958. *The Mammals of Banks Island.* Arctic Institute of North America: Montreal.

Manseau, M., Parlee, B., and Ayles, G.B. 2005. "A place for traditional ecological knowledge in resource management." In: Berkes, F., Huebert, R., Fast, H., Manseau, M., and Diduck, A., eds. *Breaking ice: Renewable resource and ocean management in the Canadian North*. Northern Lights Series No. 7. Calgary: University of Calgary Press and Arctic Institute of North America. 141–164.

Marullo, S. and K. Strand. 2004. *Community-based research*. Washington: American Sociological Association.

Menzies, C.R. (editor). 2006. *Traditional ecological knowledge and natural resource management*. Lincoln: University of Nebraska Press.

Minkler, M. 2005. "Community-based research partnerships: challenges and opportunities". *Journal of Urban Health: Bulletin of the New York Academy of Medicine* 82(2): ii3-ii12.

Moir, W. H., and W. M. Block. 2001. "Adaptive management on public lands in the United States: commitment or rhetoric". *Environmental Management* 28:141–148.

Moller, H., F. Berkes, P. O. Lyver, and M. Kislalioglu. 2004. "Combining science and traditional ecological knowledge: monitoring populations for co-management." *Ecology and Society* 9 (3): 2-17.

Muller, B. 1977. *Excavations at Umingmak on Banks Island, N. W.T., 1970 and 1973*. Preliminary Report. Verlag Archaeol. Venatoria, Inst. fur Urgeschichte der Univ. Tiibingen, Tubingen, 131 p.

Nadasdy, P. 1999. "The politics of TEK: power and the 'integration' of knowledge." *Arctic Anthropology* 36 (1–2):1–18.

Nadasdy, P. 2003. *Hunters and bureaucrats: Power, knowledge, and aboriginal-state relations in the Southwest Yukon*. Vancouver: University of British Columbia Press.

Nadasdy, P. 2003. "Re-evaluating the Co-Management Success Story". *Arctic* 56(4): 367-380.

Nagy, M. 1999. *Aulavik Oral History Project on Banks Island, NWT: Final Report*. Inuvialuit Social Development Program, Inuvik, NT. 172 pp.

Nagy, M. 2004. "'We did not want the Muskox to increase': Inuvialuit Knowledge about Muskox and Caribou Populations on Banks Island, Canada." In *Cultivating Arctic Landscapes: Knowing and Managing Animals in the Circumpolar North.* Edited by D. Anderson and M. Nuttall, p. 93-109. New York: Bergham Books.

Nahanni, P. 1977. *The mapping project.* In: Watkins, M., ed. Dene Nation—The colony within. Toronto: University of Toronto Press. 21–27.

Nakashima, D.J. 1991. *The ecological knowledge of Belcher Island Inuit: a traditional basis for contemporary wildlife co-management*. Ph.D. thesis. Montreal: McGill University, Department of Geography.

Neis, B., D. C. Schneider, L. Felt, R. L. Haedrich, J. Fischer, and J. A. Hutchings. 1999. "Fisheries assessment: What can be learned from interviewing resource users?" *Canadian Journal of Fisheries and Aquatic Sciences* 56:1949-1963.

Nichols, T., F. Berkes, D. Jolly, N. B. Snow, and the Community of Sachs Harbour. 2004. "Climate change and sea ice: Local observations from the Canadian western Arctic." *Arctic* 57:68–79.

Nickels, S. 1999. *Importance of experiential context for understanding indigenous ecological knowledge: the Algonquins of Barriere Lake, Québec.* PhD Dissertation. McGill University, Montréal, Canada.

Notzke, C. 1995. "A new perspective in aboriginal natural resource management: co-management". *Geoforum* 26(2): 187-209.

Noyce, K.V., and D.L. Garshelis. 1994. "Body size and blood characteristics as indicators of condition and reproductive performance in black bears". *International conference on bear research and management* 9: 481-496.

Nuttall, M. 2000. "Becoming a Hunter in Greenland". *Études/Inuit Studies* 24(2): 33–45.

Obbard, M. E. 2008. *Southern Hudson Bay polar bear project: Final Report*. Ontario Ministry of Natural Resources, Peterborough, Ontario, 64 pp.

O'Neil, J., B. Elias, and A. Yassi. 1997. "Poisoned food: Cultural resistance to the contaminants discourse". *Arctic Anthropology* 34:29–40.

Osherenko, G. 1988. *Sharing Power with Native Users: Co-management Regimes for Arctic Wildlife*. Ottawa, Canada: Canadian Arctic Resources Committee.

Pahl-Wostl, C. 2007. "The Implications of Complexity for Integrated Resources Management". *Environmental Modelling & Software* 22: 561–569.

Parkinson, C. L. and D.J. Cavalieri. 2008. "Arctic sea ice variability and trends, 1979-2006". *Journal of Geophysical Research* 113: C07003.

Parlee, B., M. Manseau, and Lutsel K'e Dene First Nation. 2005. "Understanding and communicating about ecological change: Denesoline indicators of ecosystem health." In: Berkes, F., Huebert, R., Fast, H., Manseau, M., and Diduck, A., eds. *Breaking ice: Renewable resource and ocean management in the Canadian.*

Peacock, E., A.E. Derocher, G.W. Thiemann, and I. Stirling. 2011. "Conservation and management of Canada's polar bears (Ursus maritimus) in a changing Arctic". *Canadian Journal of Zoology* 89: 371-385.

Pearce T., H. Wright, R. Notaina, A Kudlak, B. Smit, J. D. Ford, and C. Furgal. 2011. "Transmission of Environmental Knowledge and Land Skills among Inuit Men in Ulukhaktok, Northwest Territories, Canada". *Human Ecology* (2011) 39:271–288.

Peloquin C. and F. Berkes. 2009. "Local Knowledge, Subsistence Harvests, and Social–Ecological Complexity in James Bay". *Human Ecology* 37:533–545.

Poirier, P. and Brooke, L. 2000. "Inuit perceptions of contaminants and environmental knowledge in Salluit, Nunavik". *Arctic Anthropology* 37: 78–91.

Polar Bear Specialist Group (PBSG). 2005. *Resolutions from the 14th Meeting of the PBSG in Seattle, USA, 2005*. http://pbsg.npolar.no.

PBSG. 2009. *Proceedings of the 15th Working Meeting of the IUCN/ SSC Polar Bear Specialist Group*, 29 June-3 July, 2009. Copenhagen, Denmark. Compiled and edited by Martyn E. Obbard, Gregory W. Thiemann, Elizabeth Peacock and Terry D. DeBruyn

PBSG. 2010. *Proceedings of the 15th Working Meeting of the Polar Bear Specialist Group,* (eds. M. E. Obbard, G. W. Thiemann, E. Peacock & T. D. DeBruyn), IUCN, Gland, Switzerland, Copenhagen, Denmark.

Pomeroy, L.R. 1997. "Primary production in the Arctic Ocean estimated from dissolved oxygen". *Journal of Marine Systems* 10:1– 8.

Prestrud, P., and I. Stirling.1994. "The International Polar Bear Agreement and the current status of polar bear conservation". *Aquatic Mammals* 20:1–12.

Prystupa, M.V. 1998. "Barriers and Strategies to the Development of Co-Management Regimes in New Zealand: The Case of *Te Waihora*". *Human Organization* 57(2): 134-144.

Reghr, E.V., Amstrup, S.C., and Stirling, I. 2007. *Polar bear population status in the Southern Beaufort Sea*. USGS Open-File Report 2006-1337. Reston, Virginia: U.S. Department of the Interior, U.S. Geological Survey. 30 p.

Reidlinger, D. 2001. *Community-based assessments of change: Contributions of Inuvialuit Knowledge to understanding climate change in the Canadian Arctic*. M.Sc Diss. Natural Resource Institute, University of Manitoba.

Riedlinger, D. and F. Berkes. 2001. "Contributions of traditional knowledge to understanding climate change in the Canadian Arctic". *Polar Record* 37 (203): 315-328.

Ricklefs, R.E. 1986. *Ecology*. Second Edition. New York: Chiron Press Inc. 966 p.

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

Rogers, S. October 26, 2011 "Polar bear conservation meeting ends with nod to traditional knowledge." Nunatsiaq News. Accessed October 30, 2011 at http://www.nunatsiaqonline.ca/stories/article/65674polar_bear_meeting_ends_with_nod_to_traditional_knowledge/

Sachs Harbour Hunters and Trappers Committee (SHHTC). 1992. Sachs Harbour Community Conservation Plan. Prepared by the Community of Sachs Harbour, Wildlife Management Advisory Council (NWT), and Joint Secretariat, NT. 99 pp.

Sahanatien, V. 2011. *Interview database: Inuit knowledge of polar bears, Foxe Basin, Nunavut*. Department of Biological Sciences, University of Alberta, Edmonton, Alberta, Canada.

Sahanatien, V, A.E. Derocher, AND E. Peacock. 2011. *Polar bear habitat modeling using traditional knowledge.* Poster presentation. 20th International Conference of Bear Research and Management, Ottawa, Ontario, Canada, 17–23 July 2011.

Sandell, J., and Sandell, B. 1996. "Polar Bear Hunting and Hunters in *Ittoqqortoormiit/Scoresbysund*, NE Greenland". *Arctic Anthropology* 33(2): 77–93.

Servheen, C. 1998. Conservation of small bear populations through strategic planning. *Ursus:* 10: 67-73.

Schmidt, J., and Dowsley, M. (2010). Hunting with Polar Bears: Problems with the Passive Properties of the Commons. *Human Ecology: An Interdisciplinary Journal*, 38(3), 377-387.

Schon, D. 1987. "The crisis of professional knowledge and the pursuit of an epistemology of practice". In Christensen, C. Hansen, A. (eds.) *Teaching by the Case Method*. Boston : Harvard Business School.

Serreze, M.C. and I. Rigor. 2006. "The cryosphere and climate change: perspectives on the Arctic's shrinking ice cover". In: Glacier science and environmental change, (ed. P. G. Knight), Blackwell Science, Oxford, U.K.

Servheen, C. 1998. Conservation of small bear populations through strategic planning. *Ursus:* 10: 67-73.

Shadbolt, T., York, G. and Cooper, E.W.T 2012. *Icon on Ice: International Trade and Management of Polar Bears.* TRAFFIC North America and WWF-Canada. Vancouver, B.C.

Slavik, D. 2009. "The Economics and Experiences of Polar Bear Conservation Hunting in the Northwest Territories, Canada". In *Inuit, polar bears and sustainable Use.* Freeman, M. and A.L. Foote (eds.). CCI Press, University of Alberta, Edmonton. 252 pp.

Slavik, D. and Wildlife Management Advisory Council (WMAC). 2009. Inuvialuit Knowledge of Nanuq: Community and Traditional Knowledge of Polar Bears in the Inuvialuit Settlement Region. Inuvialuit Joint Secretariat, Inuvik, NWT. 67 pp.

Sliverman, D. and M. Marvasti. 2008. *Doing Qualitative Research: A comprehensive guide.* Thousand Oaks: Sage Publication.

Smith, L. 1999. *Decolonizing methodologies: Research and indigenous peoples*. Dunedin: University of Otago Press.

Smith, T.G., and Wright, H. 1989. "Economic status and role of hunters in a modern Inuit village". *Polar Record* 25(153):93–98.

Species at Risk Act (SARA). S.C. 2002, c. 29 Assented to December 12, 2012.

Stairs, A., and Wenzel, G. 1992. I am I and the environment": Inuit hunting, community, and identity. *Journal of Indigenous Studies*. *3*(1): 1-12.

Stefansson, V. 1913. "The distribution of Human and Animal life in Western Arctic America". *Geographical Jounal* 4: 449-60.

Stefansson, V. 1919. The Stafansson-Anderson Arctic expedition of the American Museum: Preliminary ethnological report. *Anthropological papers of the American Museum of Natural History* 14(1): New York.

Stefansson, V. 1921. *The Friendly Arctic*. New York : Greenwood Press.

Stevenson, M. G. 1993. *Man and Muskox: Human-land relationships on Banks Island, Northwest Territories.* Prepared for Environment Canada. Canadian Parks Services: Winnipeg.

Stevenson, M. 1996. "Indigenous knowledge in environmental assessment". *Arctic* 49(3):278– 291.

Stirling, I. 1988. *Polar bears*. Ann Arbor: University of Michigan Press.

Stirling, I. 2002. "Polar bears and seals in the Eastern Beaufort Sea and Amundsen Gulf: A synthesis of population trends and ecological relationships over three decades". *Arctic* 55:59–76.

Stirling, I., and Andriashek, D. 1992. "Terrestrial denning of polar bears in the Eastern Beaufort Sea area". *Arctic* 45:363-366.

Stirling, I., and A.E. Derocher. 1993. "Possible impacts of climatic warming on polar bears". *Arctic* 46(3): 240–245.

Stirling, I., N.J. Lunn, and J. Iacozza. 1999. "Long-term trends in the population ecology of polar bears in western Hudson Bay in relation to climatic change". *Arctic* 52(3): 294–306.

Stirling, I., and C.L. Parkinson. 2006. "Possible effects of climate warming on selected populations of polar bears (*Ursus maritimus*) in the Canadian Arctic". *Arctic* 59(3): 261–275.

Stirling, I., T. L. McDonald, E. S. Richardson, E. V. Regehr, and S.C. Amstrup. 2011. "Polar bear population status in the Northern Beaufort Sea, Canada, 1971–2006." *Ecological Applications* 21(3): 859–876

Struzik, E. Nov. 25, 2007. "A Culture Fights for Survival". *Toronto Star*. Retrieved from http://byers.typepad.com/arctic/2008/12/a-culture-fights-for-survival.html

Taiepa, T, P. Lyver, P. Horsley, J. Davis, M. Bragg, and H. Moller. 1997. "Co-management of New Zealand's Conservation estate by Maori and Pakeha: a review". *Environmental Conservation* 24 (3): 236–250.

Taylor, M. K., D. P.DeMaster, F. L. Bunnell, and R.E Schweinsburg. 1987. "Modeling the sustainable harvest of polar bears." *Journal of Wildlife Management*: 51: 811 - 820.

Taylor, M.K., and J. Lee. 1995. "Distribution and abundance of Canadian polar bear populations: A management perspective". *Arctic* 48(2):147–154.

Treseder, L., J. Honda-McNeil, M. Berkes, F. Berkes, J. Dragon, C. Notzke, T. Schramm, and R.J. Hudson. 1999. *Northern Eden: Community-based wildlife management in Canada*. Occasional Paper 46. Edmonton, Alberta: Canadian Circumpolar Institute.

Tyrell, M. 2007. "More bears, less bears: Inuit perceptions of polar bear populations on the west coast of Hudson Bay." *Etudes/Inuit Studies* 31 (2): 191-208.

U.S. Fish and Wildlife Service. 1995. *Habitat conservation strategy for polar bears in Alaska.* U.S. Fish and Wildlife Service, Anchorage, AK.

Usher, P. J. 1966. *Banks Island: An area economic survey, 1965*. Ottawa: Department of Northern Affairs and National Resources.

Usher, P. J. 1971a. *The Bankslanders; economy and ecology of a frontier trapping community- Volume 1*. History. Information Canada, Ottawa.

Usher, P. J. 1971b. *The Bankslanders; economy and ecology of a frontier trapping community- Volume 2.* Economy and Ecology. History. Information Canada, Ottawa

Usher, P. J. 1976. Inuit land use in the western Canadian Arctic. In: Freeman, M.M.R., ed. Report, *Inuit Land Use and Occupancy Project*. Ottawa: Department of Indian and Northern Affairs. Vol. 1, 21– 31; Vol. 3, 1–20.

Usher, P. J. 1981. *Sustenance or recreation?: The future of native wildlife harvesting in Northern Canada*. PJ Usher Consulting Services.

Usher, P. J. 2000. "Traditional Ecological Knowledge in Environmental Assessment and Management". *Arctic* 53(2): 183–193.

Usher, P. J. 2002. "Inuvialuit Use of the Beaufort Sea and its Resources, 1960–2000". *Arctic* 55 (1): 18–28.

Usher, P.J., and G. Wenzel. 1987. "Native harvest surveys and statistics: A critique of their construction and use". *Arctic* 40: 145–160.

Van de Velde, F., I. Stirling, and E. Richardson. 2003. "Polar Bear (*Ursus maritimus*) Denning in the Area of the Simpson Peninsula, Nunavut". *Arctic* 56(2): 191– 197.

Vongraven, D and Peacock, E. *Development of a pan-Arctic monitoring plan for polar bears: background paper.* Circumpolar Biodiversity Monitoring Programme, CAFF Monitoring Series Report No.1, January 2011, CAFF International Secretariat, Akureyri, Iceland. ISBN 978-9935-431-01-1

Walker, R.J., and R.J. Wolfe. 1987. "Subsistence economies in Alaska: Productivity, geography, and development impacts". *Arctic Anthropology* 24:56–81.

Walters, C. J., and R. Hilborn. 1978. "Ecological optimization and adaptive management". *Annual Review of Ecology and Systematics* 9:157-188.

Walters, C. J., and C. S. Holling. 1990. "Large-scale management experiments and learning-by-doing". *Ecology* 71:2060-2068.

Weber, B. April 20, 2008. *"Inuit hunters, scientists set to square off over polar bear quotas".* Canadian Press.

Wenzel, G. W. 1991. *Animal rights, human rights: Ecology, economy, and ideology in the Canadian Arctic*. University of Toronto Press.

Wenzel, G. 1999. "Traditional Ecological Knowledge and Inuit: Reflections on TEK Research and Ethics". *Arctic* 52 (2): 113-125.

Wenzel, G. 2004. "From TEK to IQ: *Inuit Qaujimajatuqangit* and Inuit Cultural Ecology". *Arctic Anthropology* 41(2):239-251.

Wenzel, G. 2005. "Nunavut Inuit and Polar Bear: The Cultural Politics of the sports hunt". *SENRI Ethnological Studies* 67: 363-388.

Wiens, J. A. 1989. "Spatial scaling in ecology". *Functional Ecology* 3:385-397.

Wilbanks, T. J. 2006. "How scale matters: some concepts and findings". Pp. 21-35 *in* W. V. Reid, F. Berkes, T. J. Wilbanks, and D. Capistrano, editors. *Bridging scales and knowledge systems: concepts and applications in ecosystem assessment.* Island Press, Washington, D.C., USA.

Wolforth, J. 1971. *The evolution and economy of the Delta community*. Northern Science Research Group, Dept. of Indian Affairs and Northern Development : Ottawa. 163 p.

Wong, P. B. Y., P. Van Coeverden de groot, C. Fekken, H. Smith, M. Pagès, and P. T. Boag. 2011. "Interpretations of Polar Bear (*Ursus maritimus*) tracks by Inuit hunters: inter-rater reliability and inferences concerning accuracy". *Canadian Field Naturalist* 125(2): 140–153.

Woodman D.C. 1991. *Unraveling the Franklin mystery: Inuit testimony.* Montreal: McGill-Queen's University Press.

Zabel, C. J., L. M. Roberts, B. S. Mulder, H. B. Stauffer, J. R. Dunk, K. Wolcott, D. Solis, M. Gertsch, B. Woodbridge, A. Wright, G. Goldsmith, and C. Keckler. 2002. “A collaborative approach in adaptive management at a large landscape scale”. Pages 241-253 *in* J. M. Stott, P. J. Heglund, M. L. Morrison, J. B. Haufler, M. G. Raphael, W. A. Wall, and F. B. Samson, editors. *Predicting species occurrence: issues of accuracy and scale.* Island Press, Washington, D.C., USA.

Zdor, E. 2007. "Traditional knowledge about polar bear in Chukotka". *Études/Inuit Studies* 31 (1-2): 321-323.

Zedrosser, A., B. Dahle, and J. E. Swenson. 2006. “Population density and food conditions determine adult female body size in brown bears”. *Journal of Mammalogy* 87: 510-518.

Appendix 1: Historic and Contemporary Use and Importance of Polar Bears on Banks Island

Introduction

In order to understand how local resource users engage with their environment, traditional knowledge must be viewed in the context of both the past and current use of the environment through examining historical patterns of land use, occupancy, and harvest practices (Duerden and Kuhn, 1998; Wenzel, 1999; Usher, 2000; Houde, 2007). This narrative-rich dimension of traditional knowledge explores the socio-economic and cultural significance of traditional uses of the environment, and provides a sense of identity and social relations, as well as rights, values, and interests that are intertwined in the environment and their resources - vectors that contribute to the survival, reproduction, and evolution of aboriginal cultures and identities (Johnson, 1992; Cruikshank, 1998; Houde 2007). Stirling (2002) notes that the subsistence hunting of polar bears in the Canadian Beaufort Sea area is not well documented prior to about 30 years ago, leaving a knowledge gap about the traditional use and harvesting practices of polar bears in the academic literature. This section brings together a review of literature and oral history with community interviews to help to get a better picture of traditional use, practices, and patterns of polar bear hunting on Banks Island. This chapter compiles secondary sources from previous research, archival records, and oral history to complement the stories and information shared in my interviews.

Historical importance of Polar Bears to Inuvialuit

Inuvialuit have a relationship of respect and mutuality with the animals that share their Arctic environment, based on the premise that as long as the animals are treated with respect, animals will thrive and freely offer themselves to hunters (Freeman, 2001). To the Inuvialuit place polar bears in a special symbolic category not shared by other animals or other bears, and will frequently refer to *nanuq* reverentially as the “Monarch of the Arctic”.

The polar bear is a culturally, spiritually, and more recently, an economically important species to the Inuit and Inuvialuit. When compared to other animals hunted by the Inuit and Inuvialuit, their relationship with polar bears is unique due to the esteemed position polar bears occupy in their beliefs and culture (Wenzel, 1983; Sandell and Sandell, 1996; Dowsley and Wenzel, 2008;

Schmidt and Dowsley, 2010; Keith et al., 2005). Across the Inuit cultural area, bear hunters are held in particular esteem by their communities (Sandell and Sandell, 1996; Schmidt and Dowsley, 2010). To hunt polar bears is to be considered a "real Inuk" (Wenzel, 1983: p.93) and as both a source of income and prestige, the harvesting of polar bears stands as "the pinnacle of a hunter's desire" (Brody 1976: p.167).

Polar bear hunting was one of the main subsistence species for the *Kangiryuarmiut* tribe from the Minto Inlet area of Victoria Island. Polar bear meat was an integral part of their diet and it was recorded that "more than three-fourths of their food consists of polar bears" (Stefansson, 1913: p.453). They hunted polar bears on foot on the ice off the Southeast coast of Banks Island between Nelson Head (*Imnaqyuak*), DeSalis Bay (*Kangiqhualuk*), the Horizon Islands, and Cape Baring on the Southwestern point of Victoria Island (Stefansson, 1913; Stefansson, 1919; Farquarson, 1976; Refer to Fig. 2 on p. 8). Stefansson (1919) wrote:

> … [Nelson Head] is rich in bears, and they form the chief article of food in winter for the larger portion of the Kangiryuarmiut. Even for fuel, bear grease here largely replaces seal oil, though occasionally the bear hunters near Nelson Head trade bear meat of fat for seal blubber to their neighbors towards DeSalis Bay, for these do not depend exclusively on bears. (p. 49-50)

Either alone or in pairs, *Kangiryuarmiut* hunters would venture far out onto the ice in search the polar bear, sometimes spend 10 to 12 days on the ice hunting polar bear and taking no food with them (Kasam, 2009). The Aulavik Oral History report (Nagy, 1999) describes the hunt:

> When they went to hunt, they always began with no food till they make a catch. My uncle, who was named *Ikhakgilak* and *Kudlak*, did that too. They went out with only what they have, a dog, bow and arrow, and a long stick which they used to walk with. Maybe they packed an extra pair of shoes. No food. Sometimes, they overnight or stay out longer in the coldest month of the year. They were tough people. When they slept at night, they slept in the igloo. There was just enough room for three of them, including the dog. They put their feet towards the dog to keep them from freezing.

David Haogak recollects stories of this from his Uncle about how his they would hunt with one dog and a spear or bow and arrow:

> *"They used to hunt polar bear with spears and dogs. He used to harvest polar bears not for the hides, for the meat- to eat. They just let the dog go and get the bear to stop running and they used to go and spear him, with the long spear. They used to go and get 4 or 5 bears a day. And another guy, I'm told, he got 11 bears in one day, but they used to just cut the hides off and throw them away. They had so much meat." - D. Haogak*

Historically, polar bear was harvested more for the meat than for the hides, although the hides had many purposes as well before becoming a tradable commodity. Damas (1984) shared an anecdote from the oral history of Copper Inuit, writing that:

> If a polar bear carcass was too big to pull, the hunter would cut up the skin, making a sled on which he could pull the bear home. As the hunter approached the village the people would run out and help him drag in the meat to the village.

Previous studies recorded numerous taboos and social mores were associated with polar bears and polar bear hunting on Banks Island. In the old days, men would not eat before hunting polar bears, but only drink water (Nagy, 1999). Meanwhile, while the men were hunting polar bears, the women could eat, but not drink any water during the daylight hours (Nagy, 1999). Breaking taboos while cooking, sewing, eating and hunting could lead the animals to not return to hunters, and people were told to say "nothing bad about the animals or they would have a hard time getting them and might even become scarce" (Nagy, 1999: p.10).

One of the taboos that remain strong in Sachs Harbour today relates to how polar bear meat is eaten. The polar bear liver is not eaten and not shared with dogs[23]. Other taboos relating to

[23] More for safety than cosmological concern, as polar bear liver contains toxic levels of vitamin D, and stories tell of people losing their hair after eating just small amounts of the liver.

eating polar bear including not commenting that polar bear "tastes good", and you are to cut it with a knife or an *ulu*, rather than tear it with your teeth:

> *"When I was growing up my mom talk to me about polar bears, said you got to respect them. Don't talk about them. When you eat bear meat don't chew it like this, you gotta use knives, otherwise the polar bear will eat you like that. And you can't say 'the polar bear tastes good' or the polar bear is going to say 'you taste good'. That's how my mom teached me. You got to really respect the polar bears." -L. Wolki*

In the past the intestines, meat and heart were eaten, while the bladder, bowels, liver, lungs, kidney, and genitalia not (Kasam, 2009: p.127-28)[24, 25]. Polar bear fat was commonly consumed and the paws were considered a delicacy, a tradition that remains, with hunters offering polar bear paws to the elders.

During the early years of trapping on Banks Island from 1928-1948, the polar bear harvest levels were low (relative to later peaks) because bears were used primarily for meat and clothing (Usher, 1971a). Harvesting preference in the past would be for smaller bears because their hides were easier to work on, their fur was ideal for clothing such as wind pants[26], and their meat was preferred (Nagy, 1999).

> *"For pants, they'd shoot these smaller bears because their hide was more pliable, unlike an old big thick bear. From stories I hear, they hunted a lot of these young ones. They probably preferred them over the big ones because the big ones were just too big. The meat would be tender in the smaller bear for human consumption." -L. Amos*

Before polar bear hides were being sold, when a hunter harvested a large polar bear, often they would just quarter the bear (with the fur) on so that the meat could be used for food for their

[24] Foote (1965) has estimated the average live weight of polar bears at 800 pounds, of which 75% is edible blubber and meat.
[25] Consumption of raw polar bear meat may lead to trichinosis (a parasitic disease caused by eating raw or undercooked pork or wild game infected with the larvae of a species of roundworm *Trichinella spiralis*, commonly called the trichina worm). Health officials have advised the community of this potential hazard.
[26] Sam Lennie Sr. (Pers. Comm. 2010) shared that the best bear for making wind pants were 6-7 ft bears harvested after March.

family or their dog teams. The hides of older bears were often abandoned because they were too heavy to haul (Hart and Amos, 2004) and very challenging to skin:

> *"[Large bears are] hard to work on and clean. I could skin a nine-footer myself, but it would be kind of tough skinning and 11 footer by yourself. It would be a lot of work for one person." -E. Esau*

Both polar bear meat and seal meat were essential to sustaining dog teams, and most of the hunting of these species was for dog feed:

> *"Well at that time when we'd got no quotas or anything, you could hunt as many bears as you want. So mostly you'd hunt for the meat…And polar bears, you know, here people don't eat too much of polar bear. But they used a lot of it for dogs, and the hides they used to, you know for clothing. And that time there was hardly any sale, for polar bears… there was no quota and people just hunted what, what they could get." - A. Carpenter Sr.*

Social and Economic Importance of Polar Bears

Throughout most of the eighteenth and nineteenth centuries polar bears hides were in much less demand than black bear (*Ursus americanus*) hides, commonly selling for less than £1 at the Hudson Bay Company's London fur sales, at a time when black bear hides were commanding prices of £3 to £5 (Barr, 1996). Prior to the mid 1950s, there was little economic incentive to hunt bears exclusively for their fur as trappers were making a very good income from trapping. As Joey Carpenter explained *"if you've got a lot of foxes you don't depend on polar bear for income."*

Before the value of bear hides rose, most people would not go out exclusively for bears. Instead they would hunt polar bears opportunistically, and the harvest pressure on the bears was generally low:

> *"There was never concern [that you were over-hunting them] because … you never get too much –only once and a while you hunt bear - you don't go hunting it steady. You're hunting seals and any chance you get at a polar bear well you're*

out there you know - you get 'em. Same with the seals. And that's to do with your trapping… They go out for seals and when they run into polar bears, sure, they get the polar bear when they have a chance." -A. Carpenter Sr.

However, with the start of construction of the DEW line in the summer of 1955, there was an influx of relatively affluent civilians and military personnel from the South into the western Arctic. Their high wages and desires for souvenirs created a demand and a ready market for polar bear hides. As the prices began to dramatically rise, the Hudson's Bay Company and other companies were forced to raise their prices- creating the incentive to harvest polar bears and dramatically increasing in the number of bears being killed (Usher, 1971a; Barr, 1996). Hunters responded to the rising price of polar bear hides, and could use income from skins to buy supplies and food. Frank Kudlak shares a story:

"Long ago there was no limit. Before I came here, when I stayed at DeSalis Bay, me and my brother-in-law, from DeSalis Bay, we go to Nelson Head, we get 7 polar bears in about one week. At that time polar bears getting a good price - $150. Really lots. We sell it to [RCMP] one of them in Holman Island and one of them here. [My brother-in-law] get two. I [got] five. Somebody want to buy - to order…They're important because when they start selling the skins, they buy food with it or whatever they want. Long ago they were really cheap too. One time [in the early 1950s], $25 for one polar bear- never mind small one or big one." -F. Kudlak

Jean Harry shared the importance of polar bear to her family and the community at that time:

"For my family [polar bear was] important because the hide, they sold it to Hudson's Bay. But if they don't sell it, my mother she clean it and would make my dad pants like that- with that polar bear hide. So sometimes we would sit until my dad gets so much polar bear and there was so much polar bear hides. We used them for sleeping skins. It was a lot like caribou skin. And the meat is very important to us. We eat it, we don't just eat part of it, we eat the whole thing,

[even] the feet ... and I remember my mum fleshing bears every day, every day fleshing polar bear, because you have to clean the hides up and the hides they'd keep were expensive…. they could go to the store at Hudson Bay. And sometimes if somebody comes home with polar bear, they divide the meat to everybody! Not just half one family, half another- everybody give out their meat. If they can't get enough meat, you divide that [blubber] too. Everything they divide from polar bears." -J. Harry

During the winter of 1952-53, 8 hunters at Sachs Harbour killed 22 bears (Manning and MacPherson, 1958). In 1956, 27 bears (13 adult males, 11 adult females and a cub) were harvested on Banks Island- all had been sold, mainly to DEW Line personnel for an average price of c. $75.00 (Barr, 1996). The following year a total of 22 bears (all adults, no cubs) had been taken on Banks Island, this high total being related to a poor trapping season (Barr, 1996). In his examination of harvest data, Usher (1971b) further found that the "per hunter take [of polar bears] fluctuates noticeably, although neither as sharply or as regularly as the fox take… Ice conditions have no doubt influenced this curve, but the most important factor is probably an economic one, related to fox trapping" (p. 74). In reflection of Ushers' theory, between 1958 and 1972 annual harvested fluctuated with an average of 25 polar bears were harvested, ranging from a low of 9 in both 1966 and 1968 and a high of 47 in 1962 (Barr, 1996).

When polar bear hides became a marketable commodity, priced on the size of the fur, it can be assumed that harvesting preference changed to favor the larger bears. With more value in larger hides, and *"everyone started going for the big bears" (F. Raddi)*, as larger bears meant both more income, as well as a sense of pride and bravado in a friendly competition among the hunters. Smaller bears were still hunted, and preferred on occasion for food. Usher (1971b) noted from his fieldwork in the late 1960s, Bankslanders regard polar bear meat as "a welcome change, although few would care to make a steady diet of it" (p. 75).

Prior to the introductions of "tags" with quotas, polar bears were hunted any time of the year, especially by trappers whose lines followed the coast (Usher, 1971a). Generally no special hunts were mounted for bears- rather they were shot incidentally when trappers were out on their trap lines (Barr, 1996). The trapping and harvesting cycle meant only a few alternative demands at this season. Usher (1971b) describes the harvesting decisions, writing "the ante [was] low and there is always a chance of big winnings, since individuals have been known to return with five or more polar bear] skins form a hunt" (p. 76).

Hunting female bears in maternity dens was a common practice throughout the region, including the west coast of Banks Island, until the late 1960s (Stirling, 2002). Trappers would often build and use set-guns (bear guns) along their trap-lines to incidentally harvest polar bears:

> "*They used to make bear guns too. Make a hole, and they'd put it up on a bank so when it shoots the bear would roll down and it would re-cock for the next one"*
> *-E. Esau*

Along with this, the increasing use of snow machines and boats for hunting also contributed to increased harvest levels (Stirling, 1988; Prestrud and Stirling, 1994).

International concern for the survival of polar bears (as a species) culminated in the first international meeting on the conservation of the polar bear in Fairbanks, Alaska in 1965. Anticipating that harvest quotas would soon be imposed and supply restricted, the prices of hides increased the almost ten-fold in anticipation of future shortages (Freeman, 2001). By 1967, faced with a rapidly increasing harvest, but no idea at what level it could be sustained, the Government of the Northwest Territories (NWT) established arbitrary interim quotas for each for each settlement with the understanding those quotas would be revised as new data became available (Stirling, 2002). It was not surprising that these quotas received a mixed reception across the Northern Territories. Hugh Brody (1976) wrote:

> The polar bear quotas are rapidly filled, and the restriction that the quotas impose on the hunters' activities is a source of frustration and complaint. The

> hunting of polar bears now has an importance probably greater than at any time within living memory (p. 167).

The Banks Island quota was set at 18 bears per annum and polar bear tags for subsistence use were in high demand throughout the late 1960s and 70s and stories were shared of hunters lining up at the RCMP post awaiting the return of an unsuccessful hunter, so that they could use their tag for another hunt. In this way, tags were cycled through the community, giving everyone a chance to harvest a bear within the quota.

In 1970, to address the increasing harvests due to high demand and high prices for polar bear hides, the Government of the Northwest Territories introduced guided sport hunting for polar bears, in order to allow for a new economic opportunity for realizing an increased income from the smaller number of animals allowed under the new quota system (Stirling, 2002). In 1973 the *International Agreement on the Conservation of Polar Bears* was signed in Oslo, Norway, which among other things, prohibited all taking (including hunting, killing, and capturing) of polar bears except for specific exceptions, such as traditional hunting, defense, and research (Stirling, 2002). Canada was the only nation to allow an exception for sports hunting, with the stipulation that the hunter must be guided by an Inuit guide and travel using traditional methods (i.e. dog teams).

Over the last 30 years, guided polar bear sports hunts have become economically important to Inuit and Inuvialuit communities as a means of culturally appropriate income (Wenzel, 2005; Freeman and Wenzel, 2006). In the Western Arctic, sport hunts at times accounted for roughly half of the total polar bear harvest, and brought in approximately $400 000 annually to local hunters in Sachs Harbour, Ulukhaktok, Paulatuk, and Tuktoyaktuk (Usher, 2002). These economic benefits were distributed throughout the community- women hired to flesh the bears, and guides employed assistants and helpers for sports hunts. A secondary benefit to sports hunts were that the community members would get to keep meat from a successful hunt.

When sports hunts began, the tags were split 50:50 between subsistence and guided hunts. This split allocation of bears between sports hunts and subsistence hunts is because the maintenance, transmission, and celebration of the polar bear hunting culture was highly valued by the Inuit and Inuvialuit (Freeman, 2001). Sport hunting also encouraged continuation of traditional lifestyles through the maintenance of hunting-dog teams, providing young people with on-the-ice experience, and generating the necessary income to support subsistence harvesting activities.

In Canada, the harvest from both the Northern and Southern Beaufort populations has also been below the allowable quota in recent years, mainly because not all the tags allocated to guided sport hunters were used each year, and rough ice conditions and open water in late winter and spring have made it more difficult for hunters to reach the bears in some years (Stirling, 2002).

Many hunters and guides are quick to point out how the sports hunts would actually lower the harvest as unsuccessful sport hunters could not share their tag, but subsistence hunt tags would be recycled in the community. Often, if sport hunters were unsuccessful (as in 12 out of 20 hunts in the NWT in 2008 (Slavik, 2009)) these tags would be destroyed, thus removing one bear from the available quota. One hunter explains how sport hunting had the impact of both conserving polar bears, while also generating maximum income for guides, and how these benefits have changed with the decline of the sports hunt on Banks Island:

> *"What changes how people hunt is when they start trying to put restrictions on traditional hunters- that changes how people hunt because it drives the bear prices way up. For example sport hunters in the United States cannot bring any more polar bears into the States, so that drove the prices way up for polar bears. So that gets people to go out more to hunt…you stop a person with three or four sports hunters, I'm just going to throw around some prices- he would make $25-30 thousand dollars. Now for that same price, for that same tag, he's obviously going to take that same tag and go out there and get a polar bear. For that*

harvest he's only going to bring in $3,000… So right there, they screw up the economy. But the hunter, if he doesn't have the sports hunter to take out, he's going to go get a bear no matter what. So this works against the bear population, cause the hunter he can't get his 25-30 thousand dollars anymore so he's going to try to get his $3,000-4,000. The bear is a guaranteed kill because he's got all the time. But the sports hunter only has 2 weeks." -W. Gully

Throughout their history, Bankslanders have been subjected to a long history of government interventions (both domestic and foreign) and the continual ebb and flow of the global market economy. As Anderson and Nuttall (2000) observed, these forces contribute to the Inuit to redefine hunting and fishing and threatens to subvert subsistence lifestyles and indigenous ideologies of human-animal as well as community relationships. As much as the polar bear hunt is dictated by ice conditions, seasonality and availability, harvesting pressure in influenced by the ebb and flow of economic and global policy on harvesting decisions. This includes the price of gas, willingness of Southerners to pay the high prices for guided hunts, and the price for bear hides on the global market. In recent years the value of polar bear hides has dramatically increased, from $ 6,200 (CAD) in 2006 to $12,000 (CAD) in 2010 for an avg. 8-ft. skin (Shadbolt et. al. 2012). In 2010-11, polar bear hides reached a high price on the global market, largely to due demand from affluent Chinese and Russian markets, with a 10 foot rug selling for $30,000 (CAD) (Shadbolt et al., 2012).

As many people shared in interviews, the commoditization of polar bears through sale and sports hunting was changed the relationship between Bankslanders and the animals. For example:

"*Long ago when they used to let a boy shoot a bear , you know, the younger generation when they first get a bear, the parents make wind pants and that for them cause it's their first bear. Me I didn't do that. I end up selling mine. I should have made pants, but at that time, you know $175 for polar bear was a very good price." - J. Lucas Sr.*

"Long ago people don't sell the polar bear skin. They use it for wind pants. They use it for sleeping skin. They eat the meat and they use the hide for anything. Nowadays when people go hunting they say "I'm going to make lots of money on the skin". They don't care about the meat!... I never see money when I was growing up. I didn't know what money look like. But now I can't live without money" - L. Wolki

Cultural importance of Polar Bears

To the Inuit throughout the Arctic, hunting was and still remains regarded as among the highest form of human achievement (Brody 1975, Wenzel 1991, Freeman et al 1992). Hunting plays a key role in Inuit cultural identity, wherein the behavioral, physiological and social dimensions of an individual's life are given direction (Condon et al., 1995; Freeman, 1984). Hunting is essential not only to developing and maintaining human-animal relations (Nuttall, 2000), but just as important human-human relationships, as "it is the relations among people that wildlife harvesting generates, not simply the relations between man and wildlife, which are important to native Northerners" (Usher, 1981: p.61).

On Banks Island, polar bear hunts were a reason for community celebration, gathering, story-telling and food sharing. It was a chance for bonding, for teaching, and a reason for companionship between young men and families throughout the community. There is excitement of taking a young person on their first bear hunt- something the community and family is proud about. The first polar bear hunt was a rite of passage to becoming a man and a capable hunter, and could be considered a coming of age. Today, the customary hunting of polar bear is recognized for its value in preserving Inuvialuit' connection to the environment and their cultural identity. Polar bear hunting was and still remains an important coming-of-age ritual for young men (and sometimes women) in the community.

"You know, in the old days when a young man gets a bear, your town would celebrate or the families would celebrate. It's just custom- So okay, you're a

hunter now, if you can get a bear, you're good enough to look after yourself and it's celebration time!" - L. Amos

Floyd Lennie shares the story about the first bear he harvested while hunting with his father Timothy Lennie, when he was eight years old:

"In those days we'd used dogs. We used to have two teams. I was about 6 or 7 years old. When you start tracking bears, my dad would put our team together, and let me put my own leader in the front, and he would start running. He sees me up on the iceberg, I'll be waving at you, put your leader on and you go, head straight towards them. I'd catch up to where I last seen him and then spot him another place where he's waving. In every place where I go to, there's always a bear, a bear that's been brought down already- he'd just catch them on foot. Three, four, five bears a day that way. I shot mine that way when I was eight years old… Yeah, first bear I got… When we start heading back to Holman for Easter, just before we snapped traps we ran into a sow and two cubs. So we let the two dogs go and stop the bear while we go catch up, and they held the bear back until we brought the rest of the team, and put them up on the ice berg, and that's where I shot my first polar bear. That was a pretty good experience. I was about eight years old then." – F.Lennie

Continuing the tradition of polar bear hunting, although the context may have changed, is still firmly rooted in Inuvialuit identity.

"It's over the last hundreds of years we've been doing it. It's in our blood. You can't just stop it. It's in our blood… It's just part of our life- we enjoy hunting them, we enjoy eating them, we enjoy being out on the land, and we just enjoy seeing them. They're there, even if you don't shoot them, they're part of our life. I don't know how better I could put that." -W. Gully

"Well, for me [polar bear hunting] is sort of our tradition and our culture… To me, it makes us feel like we're still at home!... I haven't been out on the ice, but I see my fellow hunters and they get bears like that and I'm proud of them, so I sure hope they continue. Keep on their tradition- going out and hunting." -F. Raddi

"[Hunting polar bear] is a way of life! We lived it. And we learn how to do something like fleshing and hunting. The skill and everything. So to go hunting you need warm clothes- the mitts and the mukluks, everything ties into hunting. So you're not just losing the polar bear, you are losing like a lifestyle, a culture." - Anonymous

The Importance of Polar Bears to Inuvialuit Today

In a study comparing Inuvialuit use of the Beaufort Sea and its resources in the 1960s and the 1990s, Usher (2002) found that the number of subsistence harvesters grew, (although by less than the rate of population growth) concluding that, contrary to many predictions in the 1960s, "subsistence harvesting persists as a significant economic as well as cultural preoccupation in the lives of Inuvialuit today" (Usher 2002: 18). The key difference being that in the 1960s, most Inuvialuit men were full-time harvesters. Today, the great majority are part-time harvesters and also earn significant cash income from regular or casual employment (Smith and Wright, 1989; Condon et al., 1995). Given wage employment available, the community is not as dependant on hunting and trapping as they were just four decades ago:

"If all it depended on was polar bears for your income, I imagine you'd get as much as you could. But there is so much opportunity to get work, jobs- training and education. You can still hunt polar bears but you don't have to hunt exclusively for income. There's other ways to make money." - J. Carpenter

With alternative sources of income available, the fact that the local economy was not totally reliant on harvesting for their income provides a potential conservation benefit, as it reduces economic imperatives to over-harvest and facilitates voluntary self-regulation (Usher, 2002). Furthermore, limitations resulting from participating in 9-5 employment result in shorter trips, often in closer vicinity.

"As everything's getting so expensive now" John Keogak says, *"people will use polar bears for subsistence or for sale."* Due to the extremely high cost of living in Sachs Harbour, polar bear is seen not only as a prize, but as a means of supplemental income. Warren Esau, a young hunter, shares his experience:

> *"[polar bear hunting], that's our culture and I think we could keep on doing it for the rest of our lives, [be]cause that brings food to our table. When someone shoots a bear, they don't use the hides. They sell the hides and that puts food on the table. Like everything with the gas prices going up. Like even me, I never even kept a bear. I got five bears and I didn't ever keep one of them - I sold all of them to put food on the table….It helps! You'd have to be like a steady hunter and harvester. It would be like a permanent job for you. So after I got a couple of bears one year, and I sold them both, that helped me out for about 3 months with pampers and food for the family, paying for gas for the skidoo. And after that I found out that, wow, this is a hard way to live." –W.Esau*

Polar bear meat is still consumed by many, but not all, of the people interviewed and their families. According to the CINE study, bear consumption in the community is low (Kasam, 2009). Polar bear fur is also used to make handicrafts and traditional clothing.

Polar Bear Harvesting on Banks Island

Polar bear hunting trips are high-investment, high-risk, and high-reward. Usher (1971b: 76) found that the "seasonality of the [polar] bear harvest varies much more than that of any other resource, as a result of the interplay of physical and economic factors …[making] the success of these trips much less predictable than any other form of resource harvesting." This section examines of the who, when, where, and how and polar bear are harvested on Banks Island.

Prior to harvesting regulations, hunters could harvest polar bear throughout the year, though the best time to hunt was during the spring months, towards the end of March because "their

fur gets real full" (J. Memogana in Nagy 1999: p.126). Conditions were more favorable at this time for the already challenging hunt:

> *"But people go when there's a lot of daylight, like right now [mid-March]. With more daylight you can travel further and have a better chance of seeing a bear in this kind of weather conditions." - L. Amos*

The duration of the winter travel season around Banks Island, both on and off sea ice, was longer than on either western Victoria Island or the mainland. Around Sachs Harbor, overland travel by sled was usually possible form late September to early June, and on sea ice from late October to early July" (Usher, 1971a: p.44). The greatest numbers of bears were harvested in the spring, although a second peak would occur during fall freeze-up, when polar bears would travel along the coastline waiting to access the freezing sea ice (Lee et al. 1994). At this time, polar bears were harvested on the sea ice, between 1 and 16 km from land, while out sealing or trapping (Barr 1996: p.131).

> *"In the fall time you'd go down here [Cape Kellet] and in the winter get to the camps …and in the spring time they'd go out further to Nelson Head and down towards Norway Island." - A. Carpenter*

Areas frequented by Sachs Harbour residents for hunting polar bears include Nelson Head, DeSalis Bay and the west coast of Banks Island from Cape Kellet North to Gore Islands. Bears were quite plentiful in the Cape Kellet area around Sachs Harbour, especially in the early days of the community, and when there were harvested seals butchered along the shores and in the communities (Nagy, 1999). Bears were killed wherever and whenever they were seen, and as a result the greatest number were taken within 20 miles of Sachs Harbour, generally in the direction of Cape Kellet, (often in association with seal hunting when summer sea ice was prevalent), resulting in a concentration of hunting pressure in space and time (Usher, 1971b; 1976).

In spring, hunters would travel to the Nelson Head – Cape Lambton area or to Storkerson Bay, Norway Island, or other camps on the west coast of Banks Island. Barr (1996: p.131) mentions a trip North to the Bernard and Norway Islands area on the west coast of Banks Island in the

spring of 1962 where two trappers harvested 10 bears, also noting that "many other bears were seen but were left unmolested as being females with cubs". Although it was not illegal yet to harvest cubs, this example demonstrates Inuvialuit conservation ethics in practice prior to the imposition of harvesting regulations. Today, polar bear hunting is restricted to open seasons, generally from October 1 to May 31 (depending on the community, and only December 1 to May 31 for sows).

In the old days, hunters would encounter or actively search for bears on foot or with dog teams. Dog teams gave hunters some advantage in locating and reaching polar bears as they could travel on thin ice conditions where a skidoo could not. Furthermore, sled dogs, with their keen sense of smell, may have also lead hunters to polar bear dens (Harrington, 1968). In the 1960s, Usher (1971) estimated that 75% of all country food obtained at Sachs Harbour was fed to dogs. Along with seals, polar bear meat was widely used for dog food, the equivalent of fuel, to work on the trap lines in the winter months:

> *"Long ago you were dependent on hunting the polar bear and seals for your dogs and that. When you have dogs, you have to get that bear or seal… You do as much hunting for your dogs as yourself… People then, you know they used to eat a lot more polar bear meat than they do now. But a lot of the polar bear meat was also for dogs. You depended on dogs to do your, do hunting. And you had to keep, you got to feed them just about same thing as you [eat]." - A. Carpenter Sr.*

Prior to harvesting regulations, hunting polar bears by boat in the open water during the summer months was a "normal practice long ago" for Bankslanders (E. Esau). Beginning in the mid to late 1960s, snowmobiles (*sikiituq*) were introduced in the community. As snowmobiles began to replace dog teams as the preferred method of travel, the demand for seal meat declined. Usher (2002) documented the mean annual harvest of country food per hunter declined from 2,083 kg/yr to 707 kg/yr due to the near-abandonment of dogs for transport. While the annual seal harvests declined nearly 5-fold, the mean annual Inuvialuit harvest of polar bear only declined from 68 (1960–65) to 56 (1988–97) bears (Usher, 2002).

As innovation through technology resulted in the "progressive improvement in resource exploitation" across the North (Freeman, 1984: p.47), and the snowmobile gave hunters the huge advantage of speed when hunting and allowed them to cover more ground in less time. Today, polar bears are hunted almost exclusively with snowmobiles (except for guided sports hunts, which are required to use a dog team). The shift from dogs to snowmobiles reduced the time required to harvest a targeted amount, and encouraged a shift from full-time to part-time harvesting (Usher, 2002). From 1960 to 2000, the demographics of harvesters in the Inuvialuit Settlement Region saw increasing separation between full-time "super-harvesters" and casual "recreational" harvesters" (Usher, 2002). However, with the advent of the snowmobile, the geographic extent of harvesting in the Inuvialuit settlement region did not change drastically over this same period (Usher, 2002). This limited effect of the snowmobile on the hunting range was also observed in a study of Resolute hunters from 1965 to 1973, where "the hunting range and frequency of [polar bear] kills was not markedly different whether the hunters used dogs or [skidoos] in their hunting" (Freeman, 1984: p.90).

The use of the much faster snowmobile over the dogsled increased the success rate of polar bear hunting, as a greater proportion of polar bears spotted or tracked on the ice (usually their tracks are found and followed) will be successfully harvested before they can escape through the safety provided by open water or areas of rough ice (Freeman, 1984)[27]. However, the introduction of this new technology brought challenges such as mechanical failures, running out of gas, and breaking through thin ice. It also could limit the hunting range on the sea ice at times as they could not travel on thin ice with skidoo, whereas dog teams could better sense the thickness and safety of the ice. In his research on Inuit use of sea ice, Riewe (1991: p.7) summarized how snowmobiles changed Inuit hunting and their knowledge of the ice:

> The snowmobiles shortened their traveling time on the hunt, reducing a three-month dog-team trip to only two or three weeks. Many hunts became weekend

[27] Freeman (1970: 290) documented that hunters of the Eastern High Arctic] indicated that they did not hunt about "two of every three bears seen because of the proximity to open water, and that one of every two bears actually pursued managed to escape."

> events. This reduced the hunters' time on the ice, but it did not diminish their knowledge of the sea ice. When dogs were used the hunters often benefited from their dogs sixth sense concerning dangerous ice, and from their dogs' abilities to travel home in blinding storms. The Inuk on a fast-moving snowmobile had to develop even greater skills to avoid treacherous ice and to navigate in whiteouts and blizzards.

This idea that a modern technology could further sharpen the intuitive knowledge and relationship to the environment runs counter to the idea that new technologies distance the relationship between man and the environment. Brody (1977: p.322) re-affirmed that:

> By using skidoos for transportation, you tend to sharpen your own senses: smell, eyes, your sense of direction in the dark or in a storm, and you prediction of weather...[Dogs] learned to walk on certain kinds of ice...You have to try to analyze that ice yourself now, before you go on it with a skidoo.

Several Inuvialuit indicated that their polar bear *"hunting area has shrunk" (L. Amos)*. Changing ice conditions are a key physical limitation to the hunting range of polar bears:

> *"I'm pretty sure there's still a good number of bears out there. It's just that we can't access the same areas that we used to access 20 to 30 years ago [be]cause the ice conditions… You know, you could tell if a bear's healthy or bears are healthy--the ones they've actually caught closer to shore than normal, if they're healthy. You just can't travel as far as we used to. The ice is like our road. If we don't have that, how can you go out and find out if bears [are] healthy or [have] increased [in] population, [or] decreased [in] population" - L. Amos*

Harvest success for polar bear at any particular time and place is largely a function of ice conditions (Usher, 1971b). The observed changes and impact of changes in sea ice is discussed in detail in the following chapter. The main impact climate change is having on limiting the harvesting range is that the ice is too thin in areas and that there is open water right to the shoreline, which prevents access to the sea ice by hunters on their snowmobiles.

Changes in the thickness and strength of ice in some areas is making it more difficult for hunters to predict the safety of the ice, and many are more cautious about traveling on the sea ice as it is more vulnerable to break-up from wind and currents. The lack of shore-fast ice and open water can reach right to the shore means their hunting range is drastically reduced as hunters cannot access sea ice on their snowmobiles. Even if hunters are able to access the shore fast ice, they are unable to go out further than about 6-12 miles as open water. High pressure ridges, and open leads affect ability to travel far onto the ice:

> "*In the 1970s you could go out 30 or 40 miles in winter hunting polar bear, then only 20 miles, then 10. Last year only 6 miles out and you reach ice you have to worry about*" (J. Kuptana in Reidlinger 2001: 62).

Today, numerous socio-economic factors including restraints on time, traveling costs, and reliance on wage income are potentially interacting to limit the geographic range of most harvesters: "*Nobody hunts out, way out anymore… don't go for 2 weeks like they used to" (D. Haogak).* The shift to a wage-economy has meant that many Inuvialuit have more rigid schedules due to various commitments in town, which reduces their flexibility and availability needed to hunt polar bears in the optimal weather and ice conditions. Hunters might chose to hunt closer to town rather than from distant camps, they might hunt in sub-optimal conditions, or that they might choose not to hunt at all. Inflation and cost of gas and supplies have further decreased the hunting range from the past. In the past, one would hunt and trap with dogs and would only be limited in range by the amount of feed for their dogs. Now with skidoos, the price and availability of gas is a variable in range of hunting trips (for most families).

> *"Like nowadays no one seems to travel that far because we don't trap anymore, like we used to. I guess the price of gas and whatever is so high that just to make it feasible to travel that far unless you're gonna--- I guess probably the closest things would be shooting wolves or hunting wolves cause they're the ones that probably can y'know make it profitable to go out." -L. Amos*

In the past, polar bear hunting was done almost exclusively by men- although women would occasionally kill bears in emergencies (Nagy, 1999). Nowadays it is more common to hear

stories about women participating in hunts:

> *"In my generation, that's when they start taking the women out. It happened in Tuk, here, and Holman. Now the women are starting to go with the men. I mean long, long ago, the woman was always with the man. But when the man went hunting, he left the woman with the family. But now he's got a skidoo and in one day can travel 100 miles get a bear and come back. Whereas long ago they didn't have room or too much weight to bring your wife along cause you only had dogs. Nowadays, woman could do anything now" - P. Raddi*

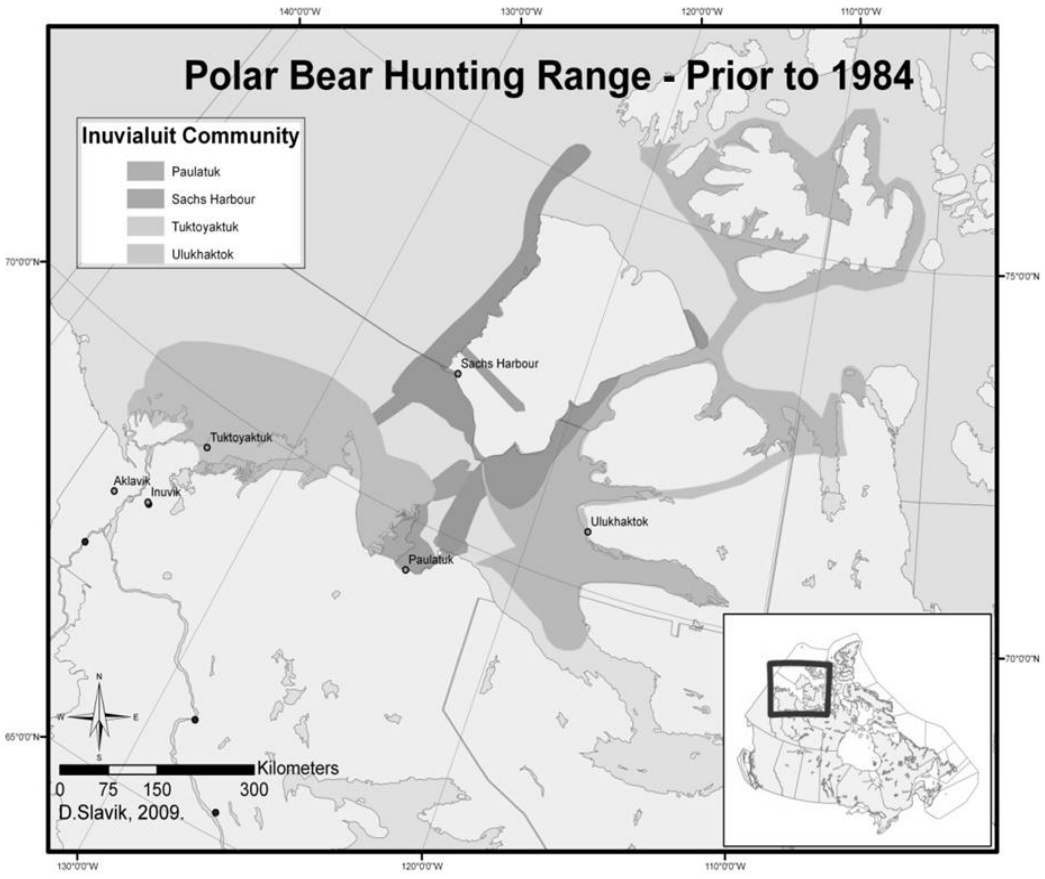

Figure 7: Approximate polar bear hunting range (prior to 1984) of 16 Inuvialuit harvesters and elders (Source: Slavik and WMAC 2009).

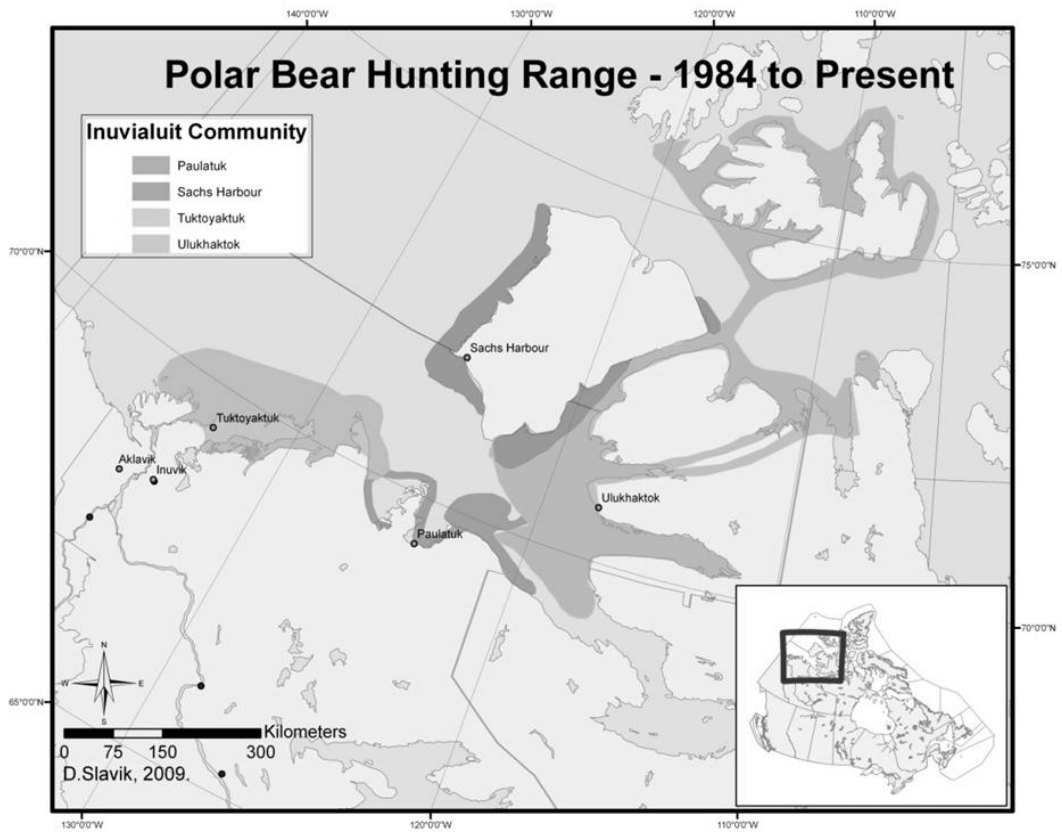

Figure 8: Approximate polar bear hunting range (1984 to present) of 16 Inuvialuit elders (Source: Slavik and WMAC 2009).

After harvesting a bear, hunters would quickly field dress the animal before the carcass could freeze in sub-zero temperatures, often in hazardous ice conditions. Women's main role was prepare the hide by "fleshing" the bear hide and teaching younger women how to flesh bear hides. "Fleshing" is a detailed process of scraping the hide with an *ulu* (or a split gun-barrel in the old days) to remove excess flesh and blubber. One elder shared the helpful tip to flesh when it's cold, so oil doesn't get everywhere. One woman tells her story about participating in polar bear hunts:

> *"I would just go along for the ride mainly, and I don't know how to skin or anything like that. The guys do that kind of work. They skin it and put it out a certain way so it won't freeze funny and the fir won't get all greasy. After you freeze it a certain way, you fold it up and bundle it up and put it in the sled and*

take it home. And when we take it home before it freezes, we put it on the floor like down here on the plastic. Maybe the same day or the next day, the ladies go and flesh the hide. It's not the men's job- it's the ladies." -Anonymous

Because of the intensive, detailed and hands-on process involved in fleshing, women can provide important information about polar bear health and body conditions based on the involved task of fleshing- this includes thickness and quality (color, texture) of fat, and scars on the hide.

"Probably everyone has an opinion on polar bear health, but it would probably have to be the ladies that do all the fleshing [who would be really knowledgeable about polar bear health]. They see the marks and…how much fat or blubber's left on them." - Manny Kudlak

This chapter has provided critical context in which to understand how Inuvialuit knowledge of polar bears is formed an informed through their subsistence and economic dependence on polar bear harvesting. Through examining harvest patterns, we have a better understanding of the temporal and spatial range of knowledge, as well as how knowledge is socially shared and transmitted. Harvesting practices today have changed along with a shift from subsistence importance to economic importance. Harvesting today is driven by economic factors at a global level, including the price of gas and of hides, and cost of living. These changes limit spatial range of observations and impact the evolving community relationship and ways of knowing about polar bears and their environment.

Appendix 2: Research Consent Form

UNIVERSITY OF ALBERTA

Rural Economy
Faculty of Agricultural, Life & Environmental Sciences

5-15 General Services Building
Edmonton, Alberta, Canada T6G 2H1
http://www.re.ualberta.ca
Rural.Economy@ualberta.ca
Tel: 780.492.4225
Fax: 780.492.0268

Research Consent Form- Interview

"Inuvialuit Perspectives of Polar Bear Health and Harvest Sustainability"

Researcher: Dan Slavik, MSc. Environmental Sociology (Supervisor – Dr. Brenda Parlee).

Affiliation: University of Alberta, Canadian Circumpolar Institute.

Funding: This research is collaboratively funded by the Government of Northwest Territories and the Dept. of Indian and Northern Affairs Canada- Yellowknife.

Purpose: In collaboration with the community of Sachs Harbour, this research explores the importance of polar bears to yourself and your community, as well as your knowledge, perspectives, and observations of polar bear population health in the North Beaufort, and how you have learnt about this. This interview may be documented on video (or audio) to provide an educational resource to the community and assist the community in communicating Inuvialuit perspectives on polar bear health and hunting. This research has potential to strengthen wildlife co-management and research partnerships, support community-based conservation and monitoring initiatives, and could inform adaptive management responses for the conservation and continued sustainable harvest of polar bears.

Timeline: Individual and group interviews will be conducted in March-May 2009. A follow-up community workshop will be held in Fall 2009.

---

1. I would like to carry out an interview with you regarding my knowledge and perspectives of polar bear population health and harvest sustainability on Banks Island. Have you read the attached information sheet?

Yes ____

No ____

---

2. Have all of your questions about the interview or research project been answered by the researcher?

Yes ____

No ____

---

3. Consent to Interview: I understand and agree to participate in this research project as outlined above. I understand that I am not obligated to participate in this research project. I can choose not to answer questions that are asked and can stop the interviews or withdraw (quit) the project at any time without prejudice or consequence.

Understand and Agree _____

Disagree _____

I CHOOSE TO REMAIN ANONYMOUS IN THIS STUDY ❑

This interview will last as long as you are comfortable with (generally 1-4 hours). If you would like to stop for the day and continue at a later time, the researcher will be happy to accommodate you. The questions in this interview have been approved by the research team and an Ethics Board at the University of Alberta, and have been revised and approved by the Sachs Harbour HTC. You are welcome to provide input and further insight beyond the questions asked by the research to guide the interview. Please answer honestly and accurately (if you can remember). You will receive compensation and recognition for your contributing your time and knowledge to this study in the amount of $ 150.00 per interview.

---

4. Consent to be videotaped: I give consent to you with respect to videotaping me in connection this research project. I grant you the right to use all video, still and motion pictures and sound track recordings and records that you may make of me or of my voice, and the right to use my name in the production of this educational video.

Agree to be videotaped _____

Disagree to be videotaped _____

If so, agree to the audio taped _____

These interviews will be compiled into an educational video to be used by the community for educational, communication, and resource management purposes. Individuals and the community will have opportunity to provide input throughout the process to verify the findings and accuracy of the interviews, add missing information, and ensure that the video meets the needs and interests of the community.

---

5. Consent for Storage of your Interview Results

During analysis of the interviews, the videotapes, transcripts, and notes will be securely stored at Dr. Parlee's CRC research lab at the U of A. Following analysis, the data will be stored at place agreed upon by the community and the researcher. The raw data will belong to the community, and it's further use, by me or by other researchers, would likely require the consent of the community.

I DO ___ want my information stored with the above organization(s).
I DO NOT ___ want my information stored and would prefer that it be destroyed once the research project is completed.

---

6. Permission to contacted for follow-up research and to use this data for future analysis: I give the researcher permission to contact me for the community workshop and any follow-up research. I allow the researcher to use this interview for future analysis.

Understand and Agree _____

Disagree _____

By signing below I am acknowledging that I have read, understand and agree to the above terms and conditions for this interview.

Respondent: _____ Date: _____

If you require additional information or have any concerns about this project, please contact:

Daniel Slavik / Brenda Parlee
Department of Rural Economy
Faculty of Agriculture and Forestry
507 General Services Building.
University of Alberta, Edmonton Alberta T6G 2H1
Tel: (780) 492-6825
Fax: (780) 492-0268
www.re.ualberta.ca
brenda.parlee@ualberta.ca
dslavik@ualberta.ca

*"In the case of any concerns, complaints or consequences contact **Helen Steinke**, Administrative Support to the AFHE Research Ethics Board, 2-14 Agric/For Centre, University of Alberta, Edmonton, Alberta, Canada T6G 2P5, ph, (780) 492-8126, Fax (780) 492-8524*

Appendix 3: Information Sheet

UNIVERSITY OF ALBERTA

Rural Economy
Faculty of Agricultural, Life & Environmental Sciences

5-15 General Services Building
Edmonton, Alberta, Canada T6G 2H1
http://www.re.ualberta.ca
Rural.Economy@ualberta.ca
Tel: 780.492.4225
Fax: 780.492.0268

Information Sheet

"Inuvialuit Perspectives of Polar Bear Health and Harvest Sustainability"

Description of Research Project

In collaboration with the community of Sachs Harbour, this research explores the importance of polar bears to yourself and your community, as well as your knowledge, perspectives, and observations of polar bear population health in the North Beaufort, and how you have learnt about this.

Dan Slavik, a graduate student in Environmental Sociology at the University of Alberta, will lead the field research and interviews in Sachs Harbour and Inuvik. Dan has undergraduate degrees in both Native Studies and Environmental Sciences and has experience in community-based research in Aboriginal communities. This research project is part of a larger research effort on "Conservation Hunting, Economic Development and Community Values" that focuses on the Inuit experiences with polar bear hunting and management. This effort is being led by Dr. Milton Freeman of the Canadian Circumpolar Institute and involves scholars from Canada and abroad, and several northern partners including the IGC.

You not required to participate in this research project. You can also choose not to answer questions that are asked and can stop the interviews or withdraw (quit) the project at any time without prejudice or consequence to pre-existing entitlements.

Description of Research Procedures

This research combines traditional knowledge research methods with community-approved methods, and will involve semi-directed interviews and group discussions with 15-30 Sachs Harbour residents identified by the IGC, Sachs Harbour HTC, and Community. Research and interviews will take place from March-May 2009 in the communities of Sachs Harbour and Inuvik, NWT, with a follow-up community workshop in Fall 2009. The researcher will consult with the Sachs Harbour HTC to guide the research protocols and practices, refine the methods and research questions, determine issues of use and ownership of research findings and deliverables, and identify appropriate community participants.

Participants will be asked to participate in individual or group interviews in the community or on-the-land. These interviews will last one to four hours, depending on the participants interest and availability. Interviews may be documented on video (or audio) with the active participation of a local youth assisting in filming and interviewing.

Five to six months after initial fieldwork, the researcher will return to the community to host a workshop with the HTC and research participants to verify the findings and accuracy of the draft report with you, add missing information (or remove information the publication of which might harm individual/community interests), and share the "rough-cut" of the video for community feedback. The footage and resulting video will remain an educational resource to the community and assist the community in communicating Inuvialuit perspectives on polar bear health and hunting.

Access to Information and Anticipated Uses of Data

During analysis of the interviews, the videotapes, transcripts, and notes will be securely stored at Dr. Parlee's CRC research lab at the U of A. Following analysis, the data will be stored at a place agreed upon

by the community and the researcher. The raw data will belong to the community, and it's further use, by me or by other researchers, would likely require the consent of the community. The community will own the video and all footage, and will be recognized as a co-producer of the video. Further details regarding issues of ownership, access and use of video by researcher and community will be negotiated with the Research Steering committee.

Potential Risks and Benefits of this Research

This research has potential to strengthen wildlife co-management and research partnerships, support community-based conservation and monitoring initiatives, and could inform adaptive management responses for the conservation and continued sustainable harvest of polar bears. The risks to community participants are minimal, but due to the political controversy associated with polar bear hunting, some concerns may arise in relation to confidentiality of interviewee data. The researcher will make best efforts to ensure that the contributions of interviewees' (e.g. place names, individual harvest data) are respected and intellectual property rights of individuals are protected.

Confidentiality

To recognize the value of their knowledge and perspective within the Community and among other researchers, interview participants will be identified by name, image, and/or voice in the video and in the research findings. If the participant chooses to remain anonymous, the researcher will honor this request, and your name, image, or voice will not be used in communicating the findings of this study and your participation will be confidential.

Payments or Reimbursement for Expenses

You will receive compensation and recognition for contributing your time and knowledge to this study in the amount of $ 150.00 per half-day. For interviews on the land, the participant will be reimbursed for all expenses related to travel, food, accommodations, and supplies.

If you have questions or require additional information, please contact:
Daniel Slavik (Researcher) or
Brenda Parlee (Supervisor)
Department of Rural Economy, Faculty of Agriculture and Forestry
507 General Services Building, University of Alberta, Edmonton Alberta T6G 2H1
Tel: (780) 492-6825, Fax: (780) 492-0268
dslavik@ualberta.ca
brenda.parlee@ualberta.ca

I have a research permit from the University of Alberta, AFHE Human Ethics Board (08-43).

For more information on Ethics contact:
Diane Lee, Research Office Coordinator, Faculty of Agricultural, Life & Environmental Sciences
2-14 Agric/For Centre, University of Alberta, Edmonton, Alberta, Canada T6G 2P5
Phone: (780) 492-8126, Fax: (780)492-8524

Appendix 4: Research Notice Poster

UNIVERSITY OF ALBERTA

Rural Economy
Faculty of Agricultural, Life & Environmental Sciences

5-15 General Services Building
Edmonton, Alberta, Canada T6G 2H1
http://www.re.ualberta.ca
Rural.Economy@ualberta.ca
Tel: 780.492.4225
Fax: 780.492.0268

You are invited to participate in a research project on

"Inuvialuit Perspectives of Polar Bear Health and Harvest Sustainability"

In collaboration with the community of Sachs Harbour, this research explores the importance of polar bears to yourself and your community, as well as your knowledge, perspectives, and observations of polar bear population health, and how you have learnt about this.

This research looks to interview

Elders, Senior hunters, Young hunters, Guides, and women from polar bear hunting families.

Interviews will last one to four hours, and can take place in the community or on-the-land.

Participants will be compensated for their time.

This interview may be documented on video (or audio) to provide an educational resource to the community and assist the community in communicating Inuvialuit perspectives on polar bear health and hunting. This research has potential to strengthen wildlife co-management and research partnerships, support community-based conservation and monitoring initiatives, and could inform adaptive management responses for the conservation and continued sustainable harvest of polar bears.

For more information, or if you are interested in participating, please visit Dan at the HTC office.

The Researcher – Dan Slavik

Dan Slavik, a graduate student in Environmental Sociology at the University of Alberta, will lead the field research and interviews in Sachs Harbour and Inuvik. Dan has undergraduate degrees in both Native Studies and Environmental Sciences and has experience in community-based research in Aboriginal communities. Dan is from Edmonton and is very interested in social and environmental issues in the North. He is very thankful to have the opportunity to visit Sachs and looks forward to hearing you stories and thoughts.

The Research Project - "Conservation Hunting, Economic Development, and Community Values"

This research project is part of a larger research effort on **"Conservation Hunting, Economic Development and Community Values"** that focuses on the Inuit experiences with polar bear hunting and management. This effort is being led by Dr. Milton Freeman of the Canadian Circumpolar Institute and involves scholars from Canada and abroad, and several northern partners including the IGC.

Appendix 5: Map of Banks Island used in Interviews

Appendix 6: Letter of Support from IGC

Inuvialuit Game Council

INUVIALUIT GAME COUNCIL

April 8, 2008

Dan Slavik
M.Sc Environmental Sociology, Dept. Rural Economy
1-07 Pembina Hall, University of Alberta
Edmonton, AB T6G 2H1
Fax: (780) 988-9684

Re: Support for research proposal

Dear Mr. Slavik,

At the last meeting of the Inuvialuit Game Council, March 16-19, 2008 in Inuvik, the Council reviewed your research proposal and are supportive of your research project-in-principle entitled "*Examining Inuvialuit Perspectives of Polar Bear Population Health and Harvest Sustainability.*" The Council passed the following resolution:

{DM0803.08}	**Be it resolved that the Inuvialuit Game Council hereby moves to support the research proposal by Dan Slavik.**
Moved by:	**Billy Storr**
Seconded by:	**Stan Ruben** **Carried**

We look forward to working with you on developing and carrying out this research project, as well as continuing to collaborate with the larger "Conservation Hunting, Sustainable Development, and Community Values" research project in general.

Sincerely,

Steven Baryluk
Resource Management Coordinator

The Joint Secretariat - Inuvialuit Renewable Resource Committees
P.O. Box 2120 Inuvik, Northwest Territories, Canada X0E 0T0
tel: (867) 777-2828 fax: (867) 777-2610 email: igc-js@jointsec.nt.ca

Appendix 7: Letter of Support from WMAC

WILDLIFE MANAGEMENT ADVISORY COUNCIL (N.W.T.)

17 December 2008

Dan Slavik
M.Sc Student, Environmental Sociology
Department of Rural Economy, University of Alberta
1-07 Penbina Hall
Phone (780) 718-2734
Email: dslavik@ualberta.ca

Re: WMAC (NWT) support for your research proposal

Dear Mr. Slavik:

I am pleased to inform you that the WMAC (NWT) fully supports your research proposal: Inuvialuit Perspectives of Polar Bear Population Health and Harvest Sustainability to be carried out in Sachs Harbour

In providing this support the WMAC (NWT) acknowledges the support you have already received from the Inuvialuit Game Council and the Sachs Harbour Hunters and Trappers Committee. Additionally we also acknowledge your previous consultation with us, in 2007, to develop this Inuvialuit knowledge-based study of polar bear population health in support of co-management efforts to conserve the species.

We would also like to note your recent consultation with the Joint Secretariat Community Support Unit which has identified a potential underestimation of some of your costs for the field research in Sachs Harbour. In light of the fact that you may have to return to your funding sources to address this potential short fall; the members of the WMAC (NWT) were made aware of this matter so that it would be clear to your funding sources that the WMAC (NWT)'s support and endorsement of your project was provided with the full knowledge of this deficiency.

We wish you all the best in your research and look forward to a written update on your progress.

Yours truly

WMAC (NWT) RB

Larry Carpenter
Chair, WMAC (NWT)

Appendix 8: Letter of Support from Sachs Harbour HTC

Sachs Harbour Hunters & Trappers Committee
PO Box 79
Sachs Harbour, NT
X0E 0Z0

Ph: (867)690 3028
Fax: (867)690 4905

April 4, 2008

Dan Slavik,
M.Sc Environmental Sociology
Dept. Rural Economy, University of Alberta
5-15 General Services Building
Edmonton, Alberta
T6G 2H1

Dear Mr. Slavik,

RE: **RESEARCH PROJECT TITLED "INUVIALUIT PERSPECTIVES OF POLAR BEAR POPULATION HEALTH AND HARVEST SUSTAINABILITY**

As per the above mentioned project the Sachs Harbour Hunters & Trappers Committee made the following motion at their Regular Meeting on April 3, 2008.

Motion 025-04-08
Moved by: Manny Kudlak
Seconded by: **Lawrence Amos**
"To approve Dan Slavik's Research Application titled "Conservation, Sustainable Development and Community Values" with a stipulation that he pay the interviewees an honoraria and that a summary report on the project be submitted upon completion"
Carried

Should you need any further clarification please feel free to contact us at the above listed phone number.

Sincerely,

for Warren Esau,
President of the SHHTC

Appendix 9: Scientific Research License

AURORA COLLEGE
Aurora Research Institute

FILE# 12 410 830

20-Feb-09

Mr. Daniel Slavik
University of Alberta
1-07 Pembina Hall
Edmonton, AB T6G 2G5

Dear Mr. Slavik:

Enclosed you will find your 2009 Scientific Research Licence No. 14475 as prepared under the Northwest Territories Scientists Act and approved by the Science Advisor, Andrew Applejohn. Should you require support from the Aurora Research Institute's Research Centre(s), please contact the applicable Research Centre Manager(s) to discuss your research needs.

According to the Scientists Act, researchers issued licences must provide a summary report for each year of their research. Accordingly, upon completion of your 2009 field work in the Northwest Territories, please ensure that you provide a 200-word (maximum) non-technical summary of your research findings to our office. **This summary is due no later than June 30, 2010, or with your 2010 application, whichever is earlier. In addition, we require a copy of your final report and copies of any papers that you publish that pertain to research conducted under this licence. Finally, if/as applicable, please provide to the communities copies of any reports that you have offered to them or that they have requested as a condition of their support for your project.** Such reports should be provided to the communities prior to submitting new applications. This is especially important on multi-year projects, for which it is to be expected that the communities would be particularly interested in inspecting the results of past work before approving future work.

Thank you for assisting in the promotion and development of a scientific research community and database within the Northwest Territories. The summary report and other information that you provide are utilized in our annual report compendium, which is distributed to communities and organizations in the N.W.T. as well as to researchers across Canada.

Best wishes for a successful study!

Sincerely,

Paulo Flieg
Manager, Scientific Services

Box 1450
Inuvik, NT X0E 0T0
Tel (867) 777-3298
Fax (867) 777-4264

Appendix 10: Ethics Approval

Faculty of Agricultural, Life and Environmental Sciences
Human Research Ethics Board
Approval
is hereby granted to:

Brenda Parlee, Principal Investigator for

08-43 Inuvialuit Perspectives of Polar Bear Population Health and Harvest Sustainability

for a term of one year, provided there is no change in experimental procedures. Any changes in experimental procedures must be submitted in writing to the ALES REB.

Granted on July 8, 2008

Lori Harach, Chair, ALES REB

Appendix 11: Guiding Questions

1. Can you tell me your memories about your first polar bear experience? Do you hunt polar bear? Where are your most common hunting areas?

2. Why are polar bears important to you? Why is it important that Inuvialuit continue to hunt polar bears?

3. How do you know that a polar bear is healthy?

4. Are you seeing a change in the bears? Are there more or less around now? If so, why is there this population change? At what times and places did you see more or less bears?

5. Have the bears looked different (better/worse/healthier) in the last 5 years? In the last 30 years? Lean/skinny polar bears? More/less bears? [*quantify*] How do you know this (weighing, eye-balling) and who does this? Why do you think this is happening?

6. What makes a good den? Where are the good denning areas and why do they go there? Are bears (and their cubs) more healthy when they are in a good den?

7. Are you seeing changes in where bears are traveling? Going closer to the communities? Traveling further? How do you observe this? When do you observe this? What do you think this means for the health of the populations?

8. How do polar bears adjust to disappearing ice? How do changes in the sea ice affect the health of polar bears?

9. Can you tell me about the polar bears feeding habits? How does the health of the bear depend on the health of other animals?

10. Who knows about polar bear health in your community? Why? Do women know? Youth? Who are you learning from? Why did you decide to learn from them? Who has been the most important teacher on polar bears for you? What is the best way for youth/young hunters to learn about polar bears? Who are you learning from? How did they decide to teach you?

11. Can you tell me about the traditional laws or rules for hunting polar bears? How did you know how many polar bears to harvest in the past without hurting the rest of the population? How do you determine whether or not you will hunt in a season?

12. What does a “sustainable” harvest mean to you today?

13. Are you involved in (co)management? What do you learn from participating in these groups? How is information shared between groups? Has polar bear management been good? How are group decisions on health/harvest quotas made? What would happen to polar bear populations if all hunting stopped? Effectiveness of current management system in a changing environment?

14. Can you tell me how you have learned about polar bear health? Have you learned anything from the Internet, TV, news, magazines about polar bears? What sources? What kind of information do you hear from these? Has it changed how you hunt? How?

15. Where do young hunters learn about polar bear hunting, hunting techniques, and assessing polar bear health?

16. What sorts of information do you get from scientists? What sort of scientific information is valuable to you about polar bear? How is this knowledge best shared between you and scientists? Do you hunt different because of this information?

17. What kind of information do you consider to be “traditional knowledge”? Has traditional knowledge ever been different to other information you have heard on polar bears? What did you do when that happened? Which one do you listen to and why?

Appendix 12: Inuvialuktun terminology associated with Polar Bears

Source: Siglitun Inuvialuit Eskimo Dictionary (Lowe, 2001)

Polar bears

Nanuq – Polar bear
Nanuaq – young polar bear
Nanuaraaluk – polar bear cub
Nannum amra – polar bear skin (entire hide)
Apitchiivik – Polar bear den
Apitchiuyuaq – hibernates
Siti - burrow
Ivayuaq – nurses, takes care of its young

Seal

Natchiq – seal; ringed seal
Ugyuaraq – young bearded seal
Ugyuk – bearded seal
Aglu – seals breathing hole
Ayulaq – Rutting male seal
Siiraq – Rear flipper of seal
Taliruq – fore flipper of a seal
Uqsuq - blubber

Ice

Siku – ice
Sikuliaq – young ice
Sikuliagaa – young ice is forming
Sikuliaraq – newly formed ice
Aayuraq – crack in ice that doesn't close during winter
Illauyiniq – candle ice
Ivunrit – piled ice
Ivvuit – rough ice
Quasaq – glare ice
Tuglu – shore ice
Sikualiraq – small broken pieces of ice
Sikuaq – thin ice on water body
Sikuaqtuaq – became covered with ice (lake, river, sea)
Tuvaq – shorefast ice
Tuvaiqtuaq – is free of ice
Quglugniq – pressure ridge
Pittaq – hole through ice
Quna / misak – slush ice
Siqumnip – icepan, broken ice

Uiniq – open water, open lead
Qisuk – black cloud over open water
Sarvaq – current
Illagauyaq – ice that has begun to melt and although solid is spongy (and dangerous)
Misaliraq – slushy and sticky top of salt water ice
Siquqpaluktuaq / ivuuqpaluktuaq – the sound of ice breaking up
Tuvaiyautiyaa / tuvairutiyaa – carried him away (of broken off ice)
Sikuliami aualayuaq – traveling on young ice

Ilutak –bay
Imnaq- Cliff, cutbank
Imnaqpak – high cliff, bank

Aniuvak – snowbank
Piqtuluk – blowing snow
Misak –wet snow
Pukak –sugar snow
Apilraun - First snow layer in fall
Apimayuaq – is covered with snow
Apiyaq – something drifted over with snow
Auqiyuaq – thaws, melts

Weather

Kanangnaq – northwind
Nigiq –eastwind
Pingangnaq – south wind
Ungalaq – westwind
Adjgu – headwind
Uqu – fair wind
Anuqqamuktuqtuaq – is getting more windy

Ukiaksaq – fall autumn
Ukiuq – winter
Upinraksaq - springtime

Hunting and traveling

Nanniaqtuaq – polar bear hunting
Nannuktuaq – got a polar bear
Aaktuaq – cuts and skins an animal
Amiiga – skinned it
Amiiqiyuaq – takes the skin off
Angusuqtuq – is a good hunter
Iluiyagaa- gutted it
Qiniraun – hunting scope, binoculars
Tumi – footprint

Tupsiuqtuaq – is looking for tracks
Tupsiyuaq – found tracks
Nanurnigaa – got eaten by a polar bear

Nanuun – piece of polar bear skin used to rub runners (of sled)
Pilraak – sled runners
Unigautik – sled brake
Qamuk – toboggan
Qamutik – sled
Sivuliqti – lead dog
Sikiituq – skidoo
Saavittuaq – went out to sea to hunt

Source: Frank and Martha Kudlak

Tegiaanak – weasel bear
Apittik – polar bear dens
Mummik – skinny

Source: Lena Wolki

Sikoliak – new ice (wavy), young ice
Manilak – rough ice
Manilaak – little rough ice (little pressure ridges)
Ayogak – thin ice
Pikaloyak – old ice
Tuvak – old ice
Kupak / Ainak – breaking up ice
Otokak – old ice
Maknigak/ Kaiutuk – smooth ice
Sayotak – moving ice
Otonik – skinny
Nikigituk – good for eating
Mamatuk – 'tastes good'
Kakolak – Top rib

Source: John and Samantha Lucas

Kayangnituk – starving bear
Tiqiaknituk – Weasel Bear

Source: Edith Haogak *spelling confirmed by Jean Harry

Katyaaq – starving/hungry bear
Angutiryuaq – big male bear
Nukauk – middle-aged bear
Aanniaqtuq – sick bear
Mitquriktuq – "nice fur"