# THE RISK OF LIVING WITH BEARS ON WESTERN HUDSON BAY

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By

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## ABSTRACT

Social-ecological systems in Canada's Arctic and sub-Arctic are changing. Although community members in Churchill, Manitoba have long co-existed with polar bears, increasing interactions with grizzly bears are complicating the human understanding of the human-bear relationship. This novel ecosystem is identified by the return of the barren-land grizzly bear population to the province and is exposes the need for adaptation and innovation to combat human-grizzly bear conflicts. I explore the relationships that people in Churchill have with the three bear species found locally (polar bears *Ursus maritimus*, black bears *Ursus americanus*, and grizzly bears *Ursus arctos*), focusing on local knowledge of the three bear species and how individuals' familiarity with these species influences risk perceptions for coexisting. This research also explored what locals identified as current gaps and/ or limitations to the current bear management institutions to address the increase in grizzly bear presence in northern Manitoba. Data were collected by combining semi-structured interviews and Q methodology in a mixed methods approach. I found that local perceptions of risk and bear species-specific knowledge have been influenced by generational knowledge, the geography of land activities, previous educational training, interaction experiences, and more. I found a total of four unique perspectives emerged based on the theme of species-specific knowledge, as well as three distinct perspectives on the theme of risk. Locals indicated that they possess limited options and knowledge to protect their property and themselves from grizzly bears. They are extremely interested in participating and supporting future grizzly bear research efforts and I have outlined recommendations for researchers and wildlife managers on what is needed to ameliorate human-wildlife conflicts, gain community support for conservation plans, and be adaptive to the evolving social-ecological system on western Hudson Bay. Overall, this thesis provides insights on the human dimensions of a novel ecosystem and how frameworks like the adaptive cycle of innovation can be used to guide policy makers, wildlife managers, and resources to support human-wildlife coexistence.

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| | |
|---|---|
| CBPAR | Community-based participatory action research |
| CNSC | Churchill Northern Studies Centre |
| CWMA | Churchill Wilderness Management Area |
| DLP | Defence of life and property |
| ECCC | Environment and Climate Change Canada |
| HTO | Hunters and Trappers Organization |
| IM | Indigenous methodology |
| LK | Local Knowledge |
| MB | Manitoba |
| NU | Nunavut |
| PAR | Participatory action research |
| PBA | Polar Bear Alert |
| SENS | School of Environment and Sustainability |
| TACSI | Transforming Arctic Communities through Social Innovation |
| TEK | Traditional ecological knowledge |
| TK | Traditional Knowledge |
| WNP | Wapusk National Park |
| WHB | Western Hudson Bay |

# PREFACE

This research documents local attitudes and community members' perceptions about human-bear coexistence in Churchill, Manitoba. This thesis has been arranged in a manuscript-style format and includes four chapters. Chapter One provides a description of the research problem and knowledge gap. I then outline the methodologies, methods, and analysis used to address the research gap. Chapter Two orients the reader to the literature and context of the research and lays a foundation to understand the findings in the following data chapter, Chapter Three, which has been prepared as a manuscript for future submission to the journal *Conservation and Society*. In this chapter, I provide an abbreviated review of the literature, define the research questions, methods and analysis used, and present the results followed by a discussion and conclusion. In the final chapter, Chapter Four, I reflect on my research process and how effectively I addressed my research questions, discuss my findings in relation to the body of literature, and offer recommendations for further research.

# CHAPTER 1: INTRODUCTION TO HUMAN-BEAR INTERACTIONS AND THEIR HUMAN DIMENSIONS

## 1.1 Background

Human-wildlife relationships and dynamics are ever evolving and shifting based on anthropogenic and non-anthropogenic needs for resources and space. Wildlife species have mainly adjusted by seeking out new regions (Hilderbrand et al., 2018), changing their behaviours (Gordon, 1991), and adapting their diets (Mangipane et al., 2018) for survival. Human influence on landscape and ecosystem dynamics is evident in areas like Churchill, Manitoba, where three different biomes—tundra, the boreal forest, and the Arctic Ocean—intersect (Clark et al., 2018). This unique ecosystem intersection creates the opportunity for North America's three bear species to overlap in range: the black bear (*Ursus americanus*), the polar bear (*Ursus maritimus*), and the barren-land grizzly bear (*Ursus arctos horribilis*), as documented by Clark et al. (2018).

The relationship between humans and bears in Canada's north is linked to culture, subsistence, economy, job security, hunting, and trading (Wenzel & Freeman, 2006). Regulations, systems to handle conflict, population management, and conservation plans have been developed for each bear species.

Although northern Manitoba is recognized as part of the historical habitat range for barren-land grizzly bears (Schwartz et al., 2003) with a documented consistent population prior to the 1900s (Sutton, 1967), historical ranges are not well understood (Clark, 2019). Prior to the 1980s, barren-land grizzly bears were suspected to have very low population numbers, and there were limited observations of their presence (Clark et al., 2022). Since the 1980s, there has been a significant increase in observations and sightings of grizzly bears in northern Manitoba, but the population is believed to be dispersed from the Northwest Territories and Nunavut grizzly bears

populations (Clark, 2019), as all documented sightings are of individuals bears rather than multiples or mothers with cubs (Clark et al., 2022).

The return of barren-land grizzly bears to the province marks a shift in the social-ecological system. A novel ecosystem is described as human intervention in an ecosystem causing a significantly altered species composition that is capable of being self-sustaining (Higgs, 2017; Morse et al., 2014). The re-establishment of grizzly bears in Manitoba means that the incoming bears must adapt to human activities and settlements just as humans have to adapt to the presence of grizzly bears. Hobbs et al. (2014) note that since returning an ecosystem to a previous context and functioning dynamic is unlikely and typically not possible, appropriate management goals and responses must be set to guide future management decisions. The current extirpated status of the Manitoba grizzly bears dictates what the management options can be. The grizzly bears are designated as a species at risk

Polar bears are culturally significant to the Inuit and other Indigenous peoples in the north (Wong & Murphy, 2016) and are the driver of many tourism operations in and around Churchill (Wilder et al., 2017; Wong & Murphy, 2016). Churchill, Manitoba is the self-proclaimed polar bear capital of the world and annually sees between 6,000 and 10,000 tourists (Dawson et al., 2010) who visit Churchill and the Churchill Wilderness Management Area (CWMA). Prime polar bear viewing season is between September and November, when western Hudson Bay (WHB) polar bears can be seen as they gather on the coast waiting for the bay to freeze, so they can return to the ice to hunt seals over the winter (Peacock et al., 2011; Stirling & Parkinson, 2006). Churchill residents pride themselves on finding a path to coexistence with the polar bears and have developed robust education and safety training for tourism operators and the public, as well as investments in infrastructure like its emergency response team known as Polar Bear Alert

(PBA) (Schmidt & Clark, 2018). PBA works to deter bears, responds to bear sighting calls, and captures bears if required. The organization has enclosed the town's dump, so it no longer attracts bears, and has built a holding facility to retain problem polar bears until they can be released during the fall freeze or relocated away from town (Manitoba Conservation, 2014). The polar bear population is also managed under a tag system (Dowsley & Wenzel, 2008).

Black bears, like other wildlife species, have been increasingly seen in and around Churchill and on the land in the last 30 years (based on participants' observations and Clark et al., 2018). Black bear-human interactions are very common in southern areas of Manitoba as black bears have a broad range. Extensive conflict-management resources have been developed in the Churchill area, and while black bear human encounters are infrequent, they can still cause as much damage to property as the polar and grizzly bears. Like polar bears, black bears are managed under a provincial tag system for hunting to manage the population size, but due to high numbers of bears, tags are readily available to anyone interested and with the knowledge and appropriate skills/designation (Herero et al., 2011).

Bear behaviour, habits, food sources, conditioning, and more are all place-based and context specific; it is therefore unreasonable to apply the traits of a different species or a different population onto another (Herrero et al., 2005). The same generalizability is true for how humans interact with a new bear species and how they perceive and assess the risk of a bear encounter (Jacobs et al., 2012). Previous research to address risk perceptions have prioritized characterization, identification, and the quantification of risk using various factors (Covello & Abernathy, 1984; Slovic, 1987). While equations and technical assessments are useful to identify desired outcomes and impacts (Kolluru & Brooks, 1995), exploring influences, norms, behaviours, attitudes, and social factors (Gore et al., 2009) can give a more holistic and well-

rounded understanding of human-wildlife conflicts. Looking at emotion is beneficial to understanding human-wildlife conflicts as emotion plays a significant role in how people perceive large carnivores (Lescureaux & Linnell, 2010) and their trust in wildlife management authorities (Ericsson & Heberlein, 2003; Linnell et al., 2003; Sjolander-Lindqvist, 2008; Skogen & Thrane, 2008), how they value wildlife populations (Bisi et al., 2007; Bjerke & Kaltenborn 1999), and attitudes towards coexistence (Williams et al., 2002). Human emotions are valuable to understanding human-wildlife dynamics and for developing successful mitigation strategies (Hudenko, 2012).

Human-wildlife conflict is best examined on a continuum to provide the space to understand how logic and practice overlap in an individual's emotions, cognition, and values (Hudenko, 2012). Slagle et al. (2012) found that individuals differ in their dispositions to wildlife and how they choose to act and support conservation efforts. Personal experience (Bernstein et al., 2006; Hudenko, 2012), social contagion of beliefs and attitudes (Carter et al., 2020; Rogers, 2003), and wildlife values' orientation (Whittaker et al., 2006) are useful to identify risk perception patterns within and between individuals, organizations, and groups (Gore et al., 2009; Marris et al., 1998; Sjoberg, 1998, 2000; Slovic & Peters, 1998). Exploring human dimensions of human-wildlife conflicts is critical to instituting community-supported and community-involved conservation plans (Gore et al., 2007).

Human-polar bear conflicts in the Churchill region have been extensively explored in relation to climate change, population fluctuations, spatial distributions of polar bears (see Amstrup et al., 2008; Derocher et al., 1992; Derocher et al., 2013; Gormezano & Rockwell, 2013), human-bear conflict (Towns et al., 2009; Lunn & Stirling, 1985), and responses to conflict (see Clark et al., 2010; Laforge et al., 2017; Lemelin & Weirsma., 2007; Schmidt, 2017;

Schmidt & Clark, 2018). Black bear studies are non-existent in the Churchill area, but the species has been thoroughly researched across the rest of its range and for the specific purpose of ameliorating human-black bear conflicts (see Bonin et al., 2020; Herrero et al., 2011; Popp et al., 2018). Grizzly bears, however, have been examined only recently, and these studies have been limited (Harding & Clark, 2022; Clark, 2019).

### 1.2 Research Gap and Contributions of Thesis

The human-bear social-ecological system on western Hudson Bay is in a state of change. Two interrelated phenomenas are occuring in the Churchill, Manitoba area: First, the return of the barren-land grizzly bears to Manitoba has created a functionally 'new' or novel ecosystem (Morse et al., 2014). Second, although novel ecosystems have been explored in academia in a biological context of wildlife being re-introduced to their previous historical range through human interventions (Polak & Saltz, 2011), this situation is different: The barren-land grizzly bears are re-establishing themselves in the region on their own. The unique context to this situation is an opportunity to explore how Churchill community members feel about the re-establishment of the grizzly bears and their perceptions of risk involved with the bears' return.

The broader contributions of this research to theory about novel ecosystems are understanding the two interrelated phenomena of 1) risk perceptions with a 'new' species and 2) knowledge transfer between different bear species. The pre-existing human-polar bear relationship in Churchill, Manitoba has been stable in recent decades with community members being aware of potential bear-related risks and consistent intervention of bears entering town and exploring the locals' attitudes and perceptions of risks involving grizzly bears provides unique

insight into how community members view the different bear species and how knowledge of one bear species can be applied to different species, if at all.

I filled the research gaps by assessing community members' tolerance for coexisting with grizzly bears and by exploring the influencing factors of age, education and training, activities, and regions frequently travelled in. My findings make clear that the species' near-century of absence from the province has led to a loss of intergenerational knowledge on both the human and grizzly bear side of the relationship. While human-polar bear conflict has been steadily declining after significant exploration and investment into reducing incidents, improving infrastructure, and advancing public education, the potential for human-grizzly bear conflict has momentum and is in the omega (release) phase of the adaptive cycle loops. In other words, changes in a system can be viewed in four stages: exploitation of a resources/situation, leading into conservation and preparing for the change, followed by a release stage where there is an opportunity to change initiating radical innovations to navigate the transition into the conservation efforts, leading into reorganization of systems and requiring the development of resilient systems to support before starting the cycle all over again (Briggs et al., 2010). Community members have already begun to innovate and adapt in preparation for an increasing grizzly bear presence and are in a state of feedback to figure out what is effective defence and how to manage interactions with grizzzly bears. The curiousity and interest from community members is key as the cycle continues with the next phase focused on developing resiliency in the new systems and infrastructure to support human-grizzly bear encounters. The relationships between Churchill community members and the different bear species are in different stages in the adaptive cycle. The adaptive cycle is described in greater detail in section 1.6.2 of this chapter. Based on my conversations with community members, it became apparent that black,

polar, and grizzly bears exhibit both similar and different behaviours, including the damage they cause.

This research has already been incorporated into management applications. The Canadian government is working on a national grizzly bear conservation plan. I contributed to the state of knowledge report for Manitoba in 2020, as well as to the published version in the journal *Arctic* in 2022 (Clark et al., 2022). I also participated in the Prairie Grizzly Bear Threats Assessment in the summer of 2021, presenting my findings on the current human-grizzly bear relationship in Manitoba. I travelled to Churchill in May of 2022 to present my findings in both a formal presentation and a walk-up booth in the community complex. Both formats for dissemination were effective, with over 20 community members attending the formal presentation and many other people stopping by the booth to chat and follow up with questions. Some community members were unable to attend the presentation or to see us at the community complex but were still curious to find out more, so I plan to create a short video recording of my presentation and to post it on youtube for easy community access.

The timing of my research is opportune, as the findings can be applied to make a difference in addressing the human dimensions of human-grizzly bear coexistence. If the grizzly bear population or human-grizzly bear encounters continue to increase, the status of the grizzlies will change and a new grizzly bear wildlife-conservation plan will need to be implemented. While my research cannot and does not answer all the questions that a new conservation plan might ask, I do make recommendations for further research and existing human-bear conflict reduction resources in the community that can be adapted to grizzly bears and be amended as more Manitoba barren land grizzly bear data emerges. Advocating for local engagement and

inclusion can help guide community-supported coexistence and improve the human-grizzly bear relationship.

### 1.3 Study Site

Located approximately 1500 km north of Winnipeg, Churchill, Manitoba is home to approximately 900 people (Statistics Canada, 2017). The town is situated at the mouth of the Churchill River along the southwest coast of Hudson Bay. This positioning is unique not only due to the geographical location but also the intersection of the Caribou Inuit, Sayisi-Dene, and the Swampy Cree Indigenous peoples' traditional territories (Groulx et al., 2014). Along with Indigenous peoples, a significant number of Metis people settled in Churchill after the establishment of the fur trade (Brandson, 2012). The local population consists of long-term residents (some of whose families have lived in and around Churchill for generations) and transient residents (typically working in the tourism sector, regional Health Authority, or for the Port of Churchill). Since the city was established, its population has fluctuated, being measurably impacted by the phasing out of the Fort Churchill military base in the 1960s and more recently by the temporary discontinued service of the VIA rail train.

Churchill has been marketed as the "polar bear capital of the world" since the 1970s; each year, approximately 6,000-10,000 tourists visit the region to see the polar bears (Dawson et al., 2010). Tourists travel to northern Manitoba every fall to catch a glimpse of bears congregating along the shores of Hudson Bay as they test the shore ice in hopes of heading out onto the bay to hunt for the winter (Lemelin, 2006; Lemelin & Weirsma, 2007). This period in the fall is referred to as "bear season," lasting approximately six weeks from early October to mid-November, but it varies depending on seasonal ice patterns.

Interactions and conflicts between humans and polar bears in the Churchill region have long been documented (Kearney, 1989; Stirling et al., 1977; Struzik, 2014). The local and Indigenous populations have long found subsistence, cultural signifigance, and value in their dynamic relationship with the wildlife in the region, but it was not until the 1960s that human-polar bear conflict emerged when military activities were reduced and bears began to regularly visit the community garbage dump in the centre of town (Stirling, 1977). This problem grew throughout the decade until it was intolerable for locals (Kearney, 1989; Struzik, 2014). This timeline coincided with the emergence of the International Agreement for the Conservation of Polar Bears, signed by the Arctic countries in 1973 (Struzik, 2013). Consultations took place between local, provincial, and federal governments to balance interests, resulting in 1969 with the provincially run Polar Bear Alert (PBA) program (Kearney, 1989; Struzik, 2014).

Throughout the years PBA, operated by Manitoba Conservation, has gone through various revisions and innovations, but its mandate—to protect people from polar bears, to protect personal property from damage, and to protect bears from undue harrassment— has remained the same (Manitoba Conservation, 2014). Today, the PBA program entails patrols to deter or remove bears from inhabitated parts of town (Manitoba Conservation, 2014). Residents of Churchill have experience with polar bear encounters and have not had a bear-inflicted death since 1983. However, in the fall of 2013, there was a close call as well as a multiple-victim attack, with two people requiring hospitalization. After the incidents, the community responded in a fashion similar to how it had to previous incidents—by forming committees to address proximate causes and re-examining existing management strategies (Struzik, 2014). The citizens of Churchill have proven that they are committed to working together to develop co-management strategies for coexisting with bears. The grizzly bear population opens up a new opportunity to be pro-active in

risk management and for the grassroots and local innovations to lead the way in provincial and federal co-management plans.

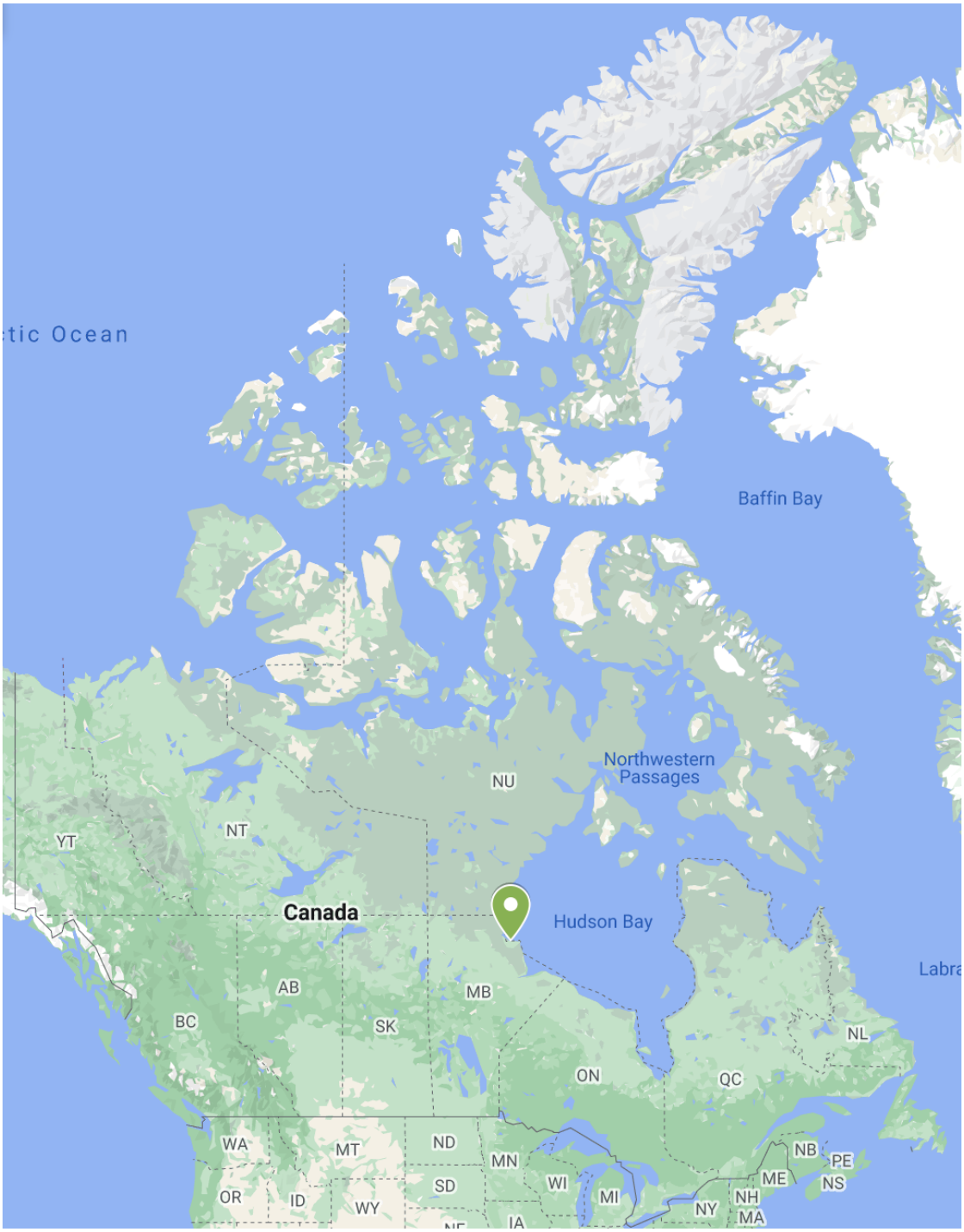


**Figure 1: Map of Canada with Churchill pinned in green (Google Maps, 2022)**

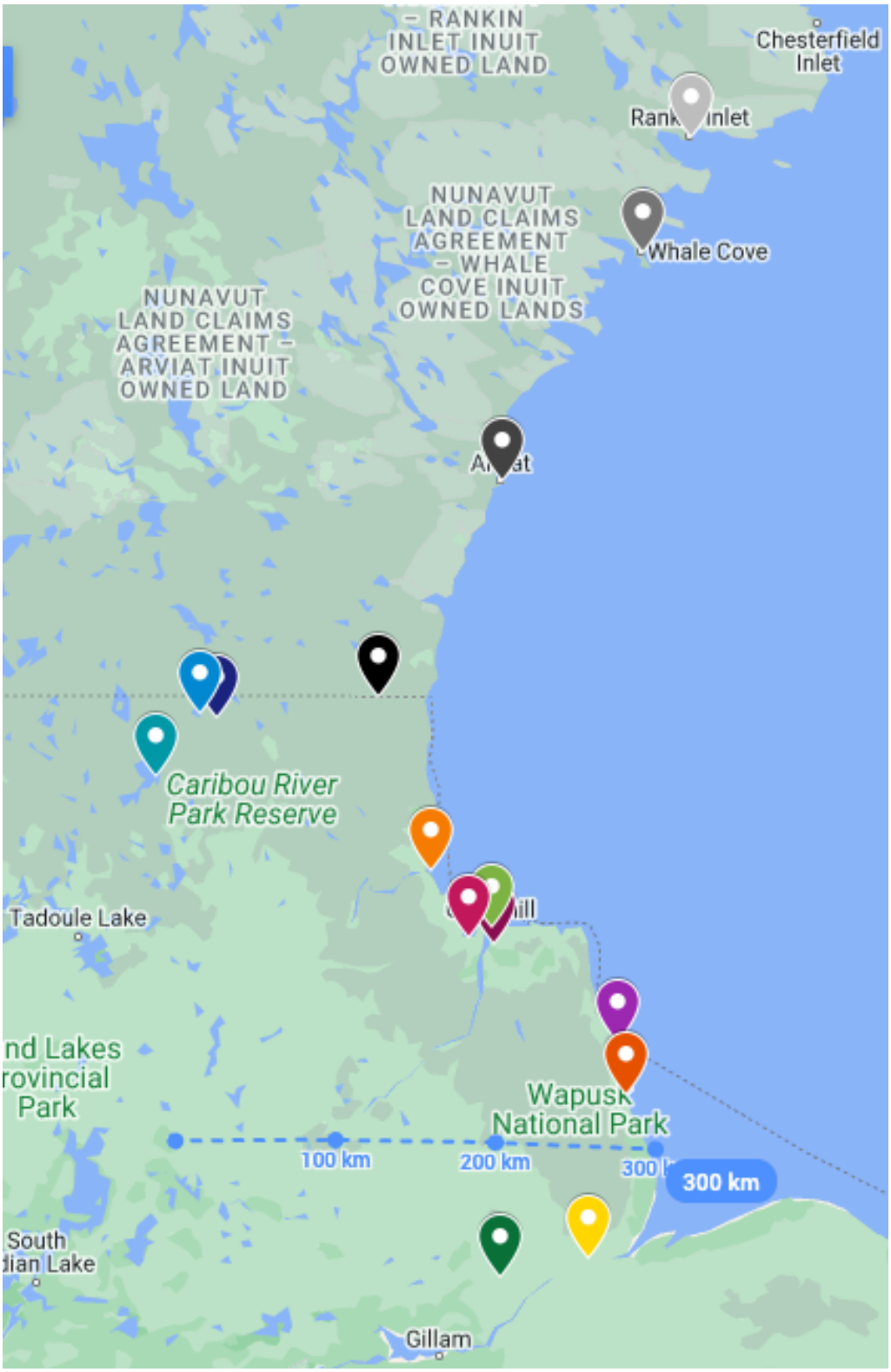


**Figure 2: Map of Churchill and Manitoba's west coast of Hudson Bay (Google Maps, 2022).**

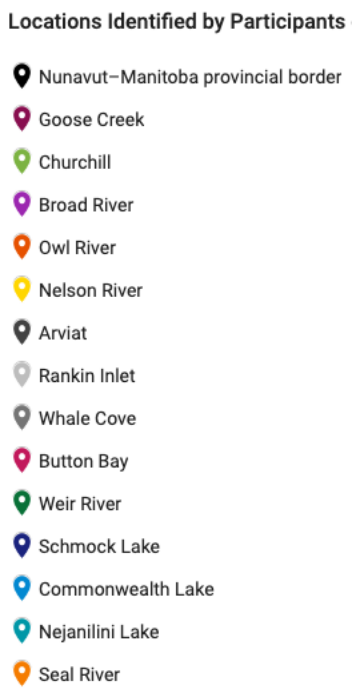


**Figure 3: Pinned locations identified during interviews**

### 1.4 Purpose and Research Questions

The western Hudson Bay polar bear population has been extensively researched in relation to economics (see Russell & Hodson, 2002; Schmidt & Clark, 2018; Struzik, 2013), climate change (see Peacock et al., 2011; Stirling et al., 1999), biology (see Stirling et al., 1977), social dimensions (see Clark et al., 2018; Lemelin & Weisma, 2007; Schmidt & Clark, 2018), and risk (see Schmidt & Clark, 2018). While Churchill residents are well-versed in human-bear encounters and conflicts, the characteristics of one bear species, or even the same species from a different region, cannot be blindly transposed onto the returning grizzly bear population in the province (Herrero et al., 2005). The increasing documented presence of barren land grizzly bears in northern Manitoba marks a changing social-ecological system (Clark et al., 2022). At present, there are no completed Manitoba-based scientific data studies on grizzly bears. Meanwhile, Environment and Climate Change Canada has acknowledged the shift in habitat ranges through

funding state of knowledge reports and traditional knowledge studies. This investment into understanding the Manitoba barren land grizzly bears is significant as the designated status of the species may change from extirpated once there is proof of year-round residency and evidence of denning in the province (Clark et al., 2022).

If the grizzly's designation changes, a new species-specific wildlife conservation plan will need to be introduced. Wildlife conservation plans are more successful when local community members and stakeholders are included in their development, and their opinions and feelings are heard and respected (Herrero et al., 2011). The power dynamic between local community members and external policy makers is a long-standing battle in communities like Churchill, and the local people must live with the consequences.

As the human-grizzly bear situation develops, wildlife managers can develop policies with local attitudes and perceptions at the forefront to identify and prioritize positive outcomes and increase the investment for human-grizzly bear coexistence on western Hudson Bay. The challenge is to understand local attitudes towards and perceptions of grizzly bears and species-specific knowledge to reduce future human-grizzly bear conflicts and support the Churchill community in protecting property and respecting their traditions and rituals on the land. The larger practical application of this research is that the re-establishment of grizzly bears in western Hudson Bay in Manitoba marks a functionally new and unique ecosystem due to their extirpated status (Morse et al., 2014). This re-establishment is not a re-introduction by humans, and this uniquely human interference with wildlife populations offers insight into temporal trends and should be addressed (Polak & Saltz, 2011). The relationship between humans and grizzly bears is social (Clark & Slocombe, 2009), and the absence of grizzlies for nearly a century from the region has resulted in loss of intergenerational knowledge on both the human and bear side.

The purpose of this research is to understand how Churchill community members' familiarity with a species (polar bear vs. grizzly) influences their perception of risk. By building on such insights, I can explore what local knowledge can be used to prevent and mitigate future conflicts with grizzlies in this functionally 'new' social-ecological situation. The research questions intended to fulfill the purpose are:

1. Does bear species impact community members' perception of risk (including both likelihood and consequences) of human-bear conflict?
2. Is local knowledge (LK) species specific among the three bear populations found in the study area?
3. Do Churchill's bear management institutions have gaps or limitations when it comes to addressing human-grizzly bear conflict in the region?

### 1.5 Overview of Methodology

The point of my research is to empower and capture local knowledge and perspectives on the three bear species that occupy Churchill. Identifying and exploring local knowledge and attitudes towards the emerging grizzly bear population in Manitoba is important as a national grizzly bear conservation plan is being developed through Environment Canada, and knowledge about human-grizzly bear interactions in the province is lacking. Previous wildlife management plans in the area have prioritized biological data and dismissed the social dimensions in human-bear conflict mitigation. Community members are invested in and eager to find opportunities for successful coexistence with bears, but they need opportunities to be engaged and to share their observations, ideas, and innovations. The results and recommendations of this research can be used to increase community support for grizzly bear conservation planning that addresses concerns about human-grizzly bear coexistence.

To accomplish successful engagement and harness local knowledge while being reflexive and addressing the historical researcher-community relationships in Churchill, I used

community-based participatory action research (CBPAR), social innovation, and Indigenous Methodology. CBPAR addresses local problems by engaging and empowering the local community in collaboration with researchers to find invested solutions (Wilmsen, 2019). It is connected to the larger evolution of research called 'mode 2' science, defined by the involvement of non-academic actors in research to form a two-way feedback system (Norström et al., 2020). CBPAR challenges the traditional belief that knowledge only resides in formal institutions of policy and academia and that an objective standpoint is possible, which can be measured, analyzed, and predicted by only qualified individuals (Kindon et al., 2007).

CBPAR is an orientation to research and inquiry (Kesby et al., 2005; Kindon et al., 2007; Reason, 2004**)** intended to correct the extractive approach to research **(**Wilmsen, 2019**)**. It is founded on the primary ethical elements of reciprocity, mutual learning, and action between the researcher and community (Kesby et al., 2007; Wilmsen, 2019;). Successful CBPAR is driven by representation, accountability, social responsiveness, agency, and reflexivity (Kesby et al., 2007). The objective is to bridge differing social worlds of stakeholders and researchers (Kindon et al., 2007). Success in accomplishing such a large feat depends on all groups involved being committed and creative and communicating with each other to reach appropriate expectations and common goals for the research (Kindon et al., 2007). According to Kindon et al. (2007, p. 2), "PAR emphasizes dialogic engagement with co-researchers, and the development and implementation of context appropriate strategies oriented towards empowerment and transformation at a variety of scales." These features make it ideal for geographically unique locations, circumstances, case studies, and targeted solutions where local concerns and social and ecological situations are prioritized to find ground-up solutions and processes (Kindon et al., 2007).

CBPAR typically involves a researcher who is based in the community. Although I had originally intended to reside in Churchill while collecting my data, this was not possible due to COVID-19 and the resulting travel restrictions and provincial health regulations. I was fortunate that my research community partners at CNSC (Churchill Northern Science Centre) are based in Churchill and serve as a constant fixture in the community for my lab group's ongoing research and projects. We were able to do this by the science staff at the CSNC were the first points of contact with community members to identify and recruit participants for interviews and for dropping off the hard copy kits created for data collection. This method was not ideal, but as a recent "Careers" publication in *Nature* makes clear, the pandemic has forced scientists to adapt to circumstances and to respect community and individuals wishes for public safety during the global pandemic (Forrester, 2021). I implemented CBPAR by seeking out local knowledge holders that had been previously identified in the Transforming Arctic Communities through Social Innovation (TACSI) project and applying a snowball sampling method for more referrals. Shifting away from the western science view that only individuals with academic credentials know best (Berkes, 2012). My research builds on my supervisor's and previous student work and recommendations for further research needs in the region. The study was designed to be timely because of the development of the new national grizzly bear conservation plan and to prioritize local interests and perspectives and social dimensions instead of having them viewed as an afterthought by federal agencies.

Churchill is an eager and invested community in grizzly bear research (Harding & Clark, 2022), even using social media websites like TikTok to capture and share observations (Leroy Whitmore [@Sub_arctic_explorers], 2022). Social innovation is an emerging methodology that explores a problem or situation from a non-linear perspective as multiple stages of development

can be addressed and the system is looked at in a cylical format instead of from an outcome-oriented approach to prioritize learning and increased interaction across actors (Lundvall, 1992; Vasin et al., 2017). The process of social innovation (Holling, 2001; Gunderson & Holling, 2002) is depicted as an adaptive cycle by some, with two key dynamics phases: the front-loop, which focuses on conservation, and the back-loop, which explores the reorganization of materials, information, and energy to create an intersection of opportunity, emergence, and deliberative action that can be implemented to alter the current socio-ecological system (McCarthy et al., 2014). Much like CBPAR, the design of social innovation emphasizes respect among all involved and capitalizes on grassroots' initiatives, which have been found to increase the public's trust in government, to improve decision-making processes by managing authorities, and to foster the development of new social values, norms, and practices that promote investment in systems and future innovations (Vasin et al., 2017). Social innovation is valuable and most effective in communities that have untapped capacity and are actively working on shifting their historical, political, and institutional structures (Vasin et al., 2017). CBPAR is appropriate to my research objectives because it emphasizes community interests, insights, and independent learning that already exists in the community. The historical devaluing, discrediting, and disregarding of local voices in northern research (Lankshear, 2013) is being addressed in my research through engagement with individuals to determine the current state of bear behaviour in and around Churchill. The outcomes of this research directly apply to the development of the provincial and national grizzly bear conservation plan, and they strengthen the community-researcher relationship because researchers listen to what communities need rather than dictating locals' quality of life and management decisions.

Relying on mutual respect, reciprocity, and overall support of projects, good researcher-community relationships are core tenets of Indigenous methodology (IM). IM was drawn on throughout the research process, and, while I am not Indigenous, abiding by the principles of IM of respect, reciprocity, and responsibility, known as the 3 R's (Weber-Pillwax, 2001; Willson, 2008). The three R's foster relational accountability and strengthened my approach and mindset when working in the community as an outsider. The historical marginalization of the Churchill community was the impetus for community-engaged research. Co-creation and collaborative approaches are required to move away from the harm that been caused by research done *on* Indigenous peoples rather than *with* or *by* Indigenous peoples. Designed to be completely voluntary, this study capitalizes on the interests of Churchill residents. This research does not distinguish between local (LK) and Indigenous knowledge (IK), as the population of Churchill has long been diverse and does not prioritize these distinctions within the social hierarchy. It is important to note that there are large differences between these types of knowledge but in my research, I chose not to make that distinction following prevailing local preference to not separate or delineate between knowledge based on an individual's background. Participants were selected because they are local experts, and their knowledge holds value and weight regardless of their heritage. Many Indigenous groups have different customs and norms when it comes to speaking about the land and wildlife, all of the participants were aware of the topics to be discussed prior to interview and had full autonomy in what they chose to answer or share in an effort to accommodate different comfort levels. The recruitment and sampling method ensured that participants were respected and trusted, and to avoid limiting their application and devaluing them, I took care not to divide or label the types of knowledge they shared. Stories told and shared are never decontextualized by the sharer, whose experience emphasizes the relational

world and is a powerful tool for gaining insight into a phenomenon (Kovach, 2019). Wilson (2008) and Chanteloup et al. (2019) maintained that this relational accountability is a strength that can improve the practice of all research. Drawing on IM situated me as the researcher and outsider in the community in a place of curiosity rather than coming in as the expert and allowed me to accept what participants shared without trying to make their observations and stories fit into preconceived ideas or notions. IM was an appropriate tool to achieve the goal of my research—to learn about the locals' experiences and explore the nuances of human-bear relationships in this community.

### 1.5.1 Researcher Standpoint

My standpoint as the researcher influenced every aspect of this research. From the beginning, it was important that the study be pragmatic, with practical applications and results for Churchill community members. I was initially drawn to the overlap of the three bears and what that means for people that live on western Hudson Bay, and I approached this phenomenon with much curiosity. Although I, in almost no way, identify with my participants, I have experience living and working in remote communities where outside influences and decisions carry greater weight than the community's own. The situation in Churchill was particularly interesting to me because the community is remote, new policy development was likely needed, and the locals know the grizzly population is increasing, but their options for managing conflict and encounters will remain limited until the grizzlies' designated status changes.

My hope is that my work contributes to improving locally based plans to address and mitigate human-grizzly bear conflict and to finding a coexistence plan that is specific to the Churchill's community needs and increased community support. The practical applications are to

share the insights and knowledge that already exist within the community to reduce potential conflicts, so people can continue to live their lives. Hearing community members respond to my findings and begin to think of areas of vulnerability and opportunity to adapt to grizzly bears was a highlight of my trip to Churchill in 2022. I discuss it in further detail in Chapter 4.

### 1.5.2 Data Collection Methods

My research builds on the work of my supervisor Dr. Douglas Clark and his former students who have all explored various components of the polar bear-human conflict relationship as a part of the larger TACSI (Transforming Arctic Communities through Social Innovation) project. My research builds on their work by examining how risk perceptions are influenced by bear species and by exploring what is species-specific and what is not as the human-grizzly bear relationship is emerging. I was able to travel with Dr. Clark in the fall of 2019 to Churchill and to meet potential participants, many of whom had participated in Aimee Schmidt's PhD research between 2013 and 2017. Following her lead, I used a targeted snowball sampling technique to locate local hunters, trappers, and traditional and local knowledge holders. During interviews, I asked individuals to suggest or identify other relevant community members (Taherdoost, 2018) and aid in reaching saturation of information and overall streamlining of the process (Kuzel, 1999), ensuring that reliable and useful information was collected (Newing, 2011). This approach was beneficial in supporting the co-creation process, as local knowledge about grizzly bears was identified. Looking to community-trusted authorities to validate and verify findings could continue to strengthen the community perspective and buy-in on similar research projects.

### 1.5.3 Semi-Structured Interviews

Semi-structured interviews were conducted with local hunters, trappers, and local and traditional knowledge holders in Churchill. Interview topics focused on personal experiences and interactions with grizzly bears and/or polar bears, and I guided the responses using both open-ended questions and general topics for discussion (Newing, 2011). The semi-structured interview format is ideal as it permits follow up with participants' initial responses through comments, props, and other questions to allow a more natural flow to the discussion while also ensuring that the required information to fulfill research objectives is captured. A structured interview follows a prescribed list of questions that must be asked in a specific order and limits participants' opportunity to elaborate or speak on matters that they feel are relevant. The semi-structured approach is flexible, offering more insight and depth than questionnaires and providing me, as the interviewer, with the opportunity to explore relevant information as it comes up (Huntington, 1998; Newing, 2011). Semi-structured interviews provide an integrated approach to understanding the changing social-ecological systems of human-wildlife coexistence (Teel et al., 2018). This method has been found to be effective for documenting local perspectives and positions by researchers in a variety of settings (see Bennet & Lantz, 2014; Castleden et al., 2012; Chanteloup et al., 2019; Huntington, 1998; McCarthy et al., 2014; Sieber, 2017; Wong et al., 2016) and for studying human-wildlife interactions with specific species (Clark & Slocombe, 2009; Schmidt & Clark, 2018).

This method also aligns well with my chosen methodology as it follows Wilson's (2008) three 'Rs' of research: respect, reciprocity, and responsibility. While there are many Rs that could be addressed, these three Rs are the core tenets of my methodology. There were questions prepared for interview use intended to incorporated various topics and probes but questions were not necessarily asked in that specific order and I as the interviewer adapted to what participants

shared. (See Appendix A for the complete interview guide used to address my research questions.) Questions and topics were created to explore participants' experience with grizzly, polar, and black bears, their perception of risk associated with the new grizzly bear population, the challenges they perceive in grizzly bear management, and the resources and structures in town that can assist in human-grizzly bear conflict. Interviews were conducted over the phone or through Webex. Ideally, interviews would have happened on the land and in person, but this was not possible due to COVID-19. All nine interviews were recorded with participant consent.

The use of semi-structured interviews allowed me to cover the relevant points of discussion that emerged from reviewing the literature and to provide participants with the opportunity to share and lead the conversation in a way that was meaningful to them. Semi-structured interviews have been used by previous members of our lab group, and many participants were familiar with the format even if the interviews were conducted over the phone and internet for my research. After transcribing and analyzing the interviews, I identified several trends, consistencies, and inconsistencies on the research topic. I used Q methodology to present a list of statements, sentiments, and impressions from the interviews and then asked participants to review and rank the statements in order of agreement to disagreement. Next, I analyzed all participants' arrangements using statistical analysis to identify people who sorted similarly to one another. This mixed-methods approach both provided this research with rigour in the academic realm and illuminated commonalities and influencing factors on how people view human-bear interactions.

### 1.5.4 Q Methodology

I used Q methodology because it is an effective triangulation method. By using statements, sentiments, and uniquely shared bits of knowledge and sharing those with the participants, I highlighted patterns of thinking and emergent trends and determined how prominent certain knowledge and beliefs are within the community. I was able to reach these conclusions confirmed through statistical analysis to find consensus (agreement) or dissensus (disagreement) in arrangements sorted by individuals. A full description of statistical methods is described in Chapter 3. Kits were made available both online and in-person. Kits contained a full set of instructions, risk and species-specific statements, and the post Q sort survey to allow participants to conduct the method at home without the use of technology. The participant that chose this method then took photos of their completed Q sorts and emailed them to me. Q methodology is an effective method as it is robust regardless of sample size. This was the first-time participants had used Q methodology, which challenged them to think in a new way as they ranked their feelings about the statements. Participants mentioned that the forced distribution where participants are given limited options of where they can place and sort statements in a pyramid like graphic was particularly challenging, but the influence of force distribution does not have significant impacts on findings (Watts & Stenner. 2012). Q methodology was first developed for understanding a holistic qualitative exploration of viewpoints about a topic rather than for generalizing results from a small random sample to a larger population (Lee, 2017). It was an appropriate method as the number of community members with experience with all three bears is still minimal and part of our inquiry was to document current attitudes and perceptions.

Q method's strength as a research method is in permitting structured investigation of subjectivity. Q method allows researchers to highlight and compare "different individuals in relation to a specific psychological trait or characteristic" (Ramlo, 2015, p. 10) instead of

applying the values and perceptions of one individual to an entire population (McKeown & Thomas, 1988; Stephenson, 1953). Essentially, Q method not only identifies a trend in community members' thinking and perspectives but also quantifies it within the sample to highlight mainstream, emerging, and previous notions. Factor analysis highlights subjectivity within a target population (McKeown & Brown, 1998; Watts & Stenner, 2012) as compared to other forms of analysis that generalize and can over apply the findings from a small group to the entire population. The use of subjectivity in research has been found to be effective in exploring controversial issues (Lee, 2017) about which there is debate and divergent opinions, as it highlights not only what views are held but how consistent they are among individuals (Eden et al., 2005). Inclusion of subjectivity opens the door for local knowledge to be incorporated into resource management (Kamal et al., 2014) and to uncover overlooked components of a research topic (Mair & Whitford, 2013).

Q methodology is a mixed-method approach as it overlaps with the themes of qualitative work and incorporates various types of statistical analysis used in quantitative work (Ramlo, 2015). Q methodology addresses common criticisms of objective quantitative studies by incorporating the depth and diversity of the human experience (Brown, 1980). Q methodology is intended for exploratory research as it offers intensive analysis (Lee, 2017) requiring only a small number of participants (Lee, 2017; McKeown & Thomas, 1988). Participant selection is not random in supporting the goal of identifying emerging patterns in people's perspectives (Lee, 2017). Q methodology allows for multiple realities and makes the participants "the experts," as they sort based on their own knowledge and understanding of the topic (Hesse-Biber, 2010). Q methodology is commonly informed by interviews that are conducted until a saturation point is reached, similar to grounded theory, to ensure that a full range of perspectives is captured (Eden

et al., 2005; Glaser & Strauss, 1967). Statements, quotes, and themes from interviews are then used to make up the concourse (in my case, a list of statements), which is used directly in the sorting activity (Eden et al., 2005). The finished configuration of the concourse reveals individuals' subjectivity and personal viewpoints (Lee, 2017). The method is gaining popularity in the field of conservation (Hermelingermeier & Nicholas, 2017; Mattson et al., 2006; Rastogi et al., 2013; Read et al., 2019; Rust, 2017; Sandbrook et al., 2013) based on its ability to explore variation within people's beliefs (Eden et al., 2005; Read et al., 2019). It is important to recognize that one's beliefs are personal and are never right or wrong (Lee, 2017).

**Table 1: Research objectives and data collection methods**

| Objective | Data collection method |
|---|---|
| 1. Does bear species impact community members perception of risk? | Semi-structured interviews, Q methodology |
| 2. Is local knowledge (LK) applicable to the other bear species found in the area? | Semi-structured interviews, Q Methodology |
| 3. Do Churchill's bear management institutions have gaps or limitations when it comes to addressing human-grizzly bear conflict in the region? | Semi-structured interviews |

### 1.6 Conceptual Frameworks

During the interviews, two major themes emerged that I then clarified through Q Method for triangulation. The emergent themes were risk and species-specific knowledge. My intention was to identify and define the different perspectives of Churchill community members on each of these topics. Using my mixed-methods approach, I collected qualitative and quantitative data and found frameworks that allowed me to explore both types of data at the same time. I chose Frank's conflict-to-coexistence continuum framework (2016) and the adaptive cycle of innovation framework (Gunderson & Holling, 2002; Holling, 2001). Both frameworks enabled

me to visually represent the participants' unique perspectives on risk and species-specific knowledge identified in the Q sorts. I was then able to use both quotes and statistics to further define and describe each position for a robust exploration of the phenomenon. Both the frameworks and their applications are described in greater detail below.

### 1.6.1 Conflict-to-coexistence Continuum Framework

The conflict-to-coexistence continuum is a tool that helps to determine the degree of conflict, coexistence, and tolerance related to human-wildlife interactions (Frank, 2016). The relationship between wildlife and humans is mapped onto a continuum—from positive to negative—based on an assessment of humans' attitudes and behaviours (Frank, 2016). Frank (2016) highlights the need for reframing and exploring how to transition human-wildlife conflicts to coexistence, or tolerance. Zimmerman et al. (2001) explore the formation of predator acceptance, specifically of large carnivores, in a community. Exploring components like species-specific differences, experience with and fear of a species, and the role that knowledge plays in the relationship (Zimmerman et al., 2001) can offer a new perspective on human-wildlife coexistence and risk mitigation (Frank, 2016). Frank's conflict-to-coexistence framework is used to identify and describe how community members feel about human-bear coexistence and examine patterns in these beliefs. The framework offers invaluable information to Churchill residents in allowing them to voice their opinions and values to Environment Canada in the establishment of a formal grizzly bear management plan. I used the conflict-to-coexistence continuum framework as a tool for interpreting the four unique perspectives that emerged from the Q sort focused on risk. I looked at statements indicating consensus and dissensus to examine what types of statement elicited strong emotions and what people were unsure of. I referred to

Frank's description and used on consensus and dissensus statements to orient where their values and attitudes on the continuum. I expand on the influences to community members perceptions and beliefs surrounding human-bear conflict and risk can be found Chapter 3 in the results section.

### 1.6.2 Adaptive Cycle of Innovation

Social innovation is recognized as an "initiative, product, process, or program that profoundly changes the basic routines, resource and authority flows or beliefs of any social system" (McCarthy et al., 2014, p. 1). Social innovation aims to develop new approaches by engaging the public in combatting social problems with innovation rooted in collaboration and cooperation (Vasin et al., 2017). Social innovation as a framework has been a successful tool for others conducting work in which society, the economy and ecology overlap (e.g., Biggs et al. 2010; Clark & Slocombe, 2009; Hillgren et al., 2011; McCarthy et al., 2014; Sorice & Dolan, 2015). I used this framework to examine current local bear management strategies and identify opportunities for creating new resources to address any gaps and/or limitations found in the investigation. I also used social innovation to understand and document the current polar bear- and black bear-related training, education, and community infrastructure and to identify which of these are already being developed by individuals and what they would like to see in the future. Details can be found in Chapter 4 of this thesis.

## 1.7 Organization of the Thesis

This thesis has been arranged in a manuscript-style format and includes four chapters. The first chapter provides a description of northern Manitoba's changing environment and the current state of human-bear conflict, examining both polar bears (*Ursus maritimus*) and grizzly

bears (*Ursus arctos horribilis*). Chapter One provides the reader with a broad sense of the research problem, research context, and research objectives. I then outline my methodology, methods, and frameworks used to investigate and address the research objectives. Chapter Two reviews the literature previously published about bears in and outside the study region, and the current local and provincial wildlife management policies that are applicable. Chapter Two expands on the literature review to properly orient the reader to the research by exploring the human-bear relationship for the polar bears, black bears, and polar bears, while exploring the influences of government institutions on formal bear management. I also review the literature on risk and factors involved with perception of risk, as these are foundational to my study and to how my research questions relate to coexistence and risk. Chapter Three is the data chapter. It is written in a manuscript journal article format and is intended to be published in a refereed journal. I am currently targeting *Conservation and Society*. In Chapter Three, a brief overview of the research process orients the readers and prepares them to understand and situate the findings as they are identified and discussed. Chapter Four presents the findings of this research. In this final chapter, I reflect upon the initial literature exploration and whether it addressed the gaps in the literature. I also discuss whether my research objectives have been adequately explored and whether this study is consistent with the published literature. I then present recommendations for further research, provide reflections on the overall research process, and discusses the limitations of this study.

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# CHAPTER 2: A LITERATURE REVIEW OF HUMAN-BEAR INTERACTIONS


## ABSTRACT

The human-bear relationship in Canada's Arctic and sub-Arctic has entered a state of change. The return of the barren-land grizzly bears (*Ursus arctos*) marks a novel ecosystem and change in the social-ecological system. This literature review lays the foundation for the following research questions: 1) Does bear species impact Churchill community members perceptions of risk of human-bear conflict?, 2) Is Local Knowledge (LK) of the three bear species polar bears (*Ursus marimitus*), grizzly bears (*Ursus arctos),* black bears (*Ursus americanus*), species specific, and 3) Are there gaps and/ or limitations in how Churchill's bear management institutions address human-grizzly bear conflict. This chapter defines the current relationship between humans and the three bear species on the west coast of Hudson Bay. I begin by presenting literature on the human dimensions of bear conflicts, defining the local, national, and international institutions for bear management, and outline current monitoring and management strategies for each bear species beginning with polar bears, then grizzly bears, and finally black bears. I then present literature on the topic of risk exploring how emotions, cognitions, and values are the major influences on individual's perceptions of risk. These factors can be useful to understand what the current social-ecological system is in northern Manitoba and how new risk, like the re-establishing grizzly bear populations in Manitoba, can be managed for successful human-bear coexistence.



KEYWORDS: Human-bear conflict, Local and Traditional Knowledge, Social perspectives, Sub-Arctic, Risk, Polar bears (*Ursus marimitus*), Grizzly bears (*Ursus arctos),* Black bears (*Ursus americanus*).

## 2.1 Introduction

This literature review was prepared primarily in the first year of my master's research. The purpose of this literature review was to familiarize myself with the dimensions of my research—the topic of risk and, specifically, influences on perceptions of risk—and to identify gaps in the literature on bear species and perceptions of risk. This literature review lays the groundwork to address the following research questions: 1) Does bear species impact community members' perception of risk (including both likelihood and consequences) of human-bear conflict? 2) Is local knowledge (LK) of the three bear populations—polar, grizzly, and black—found in the study area species specific? 3) Are there gaps and /or limitations in how Churchill's bear management institutions address human-grizzly bear conflict? In addressing these research questions, the topics covered in this review include environmental changes in the Churchill and the Arctic, human dimensions of human-bear conflict, and an overview of the three bear species found in the study region.

Search terms to identify relevant articles, books, and grey literature to be reviewed included the following: "bears," "polar bears," "black bears," "grizzly bears," "human-wildlife conflict," "human-wildlife coexistence," "human-wildlife relationships," "diet," "denning," "climate change," "risk," "risk perceptions," "perceived risk," "arctic," "sub-arctic," and "northern communities." I searched for the sources cited in the initial papers and found other material to fill the under-researched areas.

The Arctic is experiencing unprecedented warming as a result of anthropogenic activities (Fyfe et al., 2013). Polar bears have been identified as one of the most vulnerable and susceptible species to climate change (Peacock et al., 2011). Declines in the species population numbers prompted the signing of an international agreement for the Conservation of Polar Bears in 1973

(Peacock et al., 2015). Hudson Bay in Canada had been, and continues to be, of particular interest and focus for polar bear research because it is home to three subpopulations that roam the ice and land (Peacock et al., 2015). Canada is a significant actor in polar bear survival and well-being as it is home to about 16,000 polar bears, approximately two thirds of the world's population (Polar Bears International, 2016). However, polar bears are not the only bear species in the Arctic as the grizzly bears also inhabit the northern regions and are altering their behaviour in attempts to meet their needs (Clark, 2019).

Grizzly bear habitat range expands into the northern parts of Manitoba, but they are currently classified as extirpated, meaning locally extinct (Clark, 2019). Churchill community members have identified and expressed concern of increasing presence, damage, and evidence of their time spent in and around the town. The community is not the only interested group and Environment and Climate Change Canada (ECCC) have begun to examine the topic by commissioning a state of the knowledge report as well as traditional knowledge studies for the province of Manitoba and for Nunavut. Grizzly bear sightings in northern Manitoba were largely undocumented until the mid 1990s Clark (2000).

Black bears also inhabit the northern edge of boreal forest, and this region overlaps around Churchill causing an overlap in all three bear species (Clark, 2019). The black bear population has maintained a population within the province, but it is more concentrated in the southern portion (Pacas & Paquet, 1994). Black bears may be perceived as less charismatic as the other two species but are actors on the landscape and cause significant damage to property on western Hudson Bay.

In academic literature, there are varying levels of discussion on the environmental factors, human dimensions and governance effects on three species. While this literature review

is included in my thesis as a separate chapter, there are no current plans or intentions for publishing it at the current time. This literature review is organized to provide the reader with a broad understanding of the how the three bear populations (polar, grizzly and black bears) are reacting to a changing environment, current conflicts with humans, and what formal management programs exist. Then the topic of risk is explored to understand the nuance of how local support and involvement in conservation planning needs to be targeted to public needs. Risk has been examined in a number of ways by researchers, but my literature is scoped to the influences on emotions, cognitions, and values on risk perceptions.

### 2.2 Polar Bears in a Changing Environment

Polar bears roam Canada, the United States of America, Russia, Greenland and Norway's northern Arctic regions. While for the majority of the year polar bears hunt, travel and exist on ice, they return to land each spring to begin their fasting period awaiting the fall freeze (Peacock et al., 2011). Environmental factors such as earlier sea ice break up (Peacock et al., 2011), delayed freeze (Laforge et al., 2017), rising air and water temperatures (Regehr et al., 2007), changing sea levels and habitat decline (McCall et al., 2015; Comiso, 2002; Parkinson and Cavalieri 2002; Walsh 2008; Palmer et al., 2011) are contributing to extended fasting periods and decrease in prey abundance, resulting in food stress (Peacock et al., 2011), increase in mortality rates (Laforge et al., 2017), and decrease in reproduction rates (McCall et al., 2015). These factors and changes are negatively stressing polar bear populations and habitats (Struzik, 2013); however, there is some disagreement in how polar bears are responding to such diverse stressors across sub-populations.

Some argue that polar bears are resilient and can adapt to the changing dynamics of their environment. LaForest et al. (2018) found that some polar bears are capable of hunting while swimming and mimicking the habits of black bears (*Americanus ursus*) while on land but this behaviour likely could not support the polar bears long term. Meanwhile, Stirling et al., (1999) found that one short ice season will have no lasting impacts on most polar bears, but consecutive seasons will result in cumulative stress and jeopardize the health of the whole species (Stirling & Parkinson, 2006). The cumulative stress is impacting not only polar bears but also their food sources and habitat resources, creating a negative feedback loop (Stirling & Parkinson, 2006). The fluctuation and observed overall decrease of sea ice in the Arctic is concerning, based on scientific data (Peacock et al., 2011; Stirling & Parkinson, 2006; Schmidt & Clark, 2018; Wong & Murphy., 2016; Struzik, 2013; Regehr et al., 2007). Climate changes impact sensitive areas for biodiversity, and shore ice that is habitat for ringed seal (*Phoca hispida*) birth lairs (Kelly 2001, Stirling and Smith, 2004); ringed seals are the primary food source for polar bears (Stirling & Parkinson, 2006). These environmental changes result in altered body condition, habitat, and general behaviour changes of polar bear populations. Interannual fluctuations of polar bear body conditions are a normal trend as a result of fasting periods (Stirling, 1999; Laforest et al., 2018); however, a continuous decline in body condition has been correlated with drop in reproductive success (Stirling & Parkinson, 2006). Derocher et al. (1992) posit that a female polar bear weighing less than 189 kilograms is unable to reproduce, meaning the future of the species is at risk if females are underweight.

Along with concerns about viable reproduction, there is also concern from the scientific community regarding reduction of genetic diversity: habitat ranges are changing and less interaction is possible between subpopulations (McCall et al., 2015). Habitat changes are

generally leading to behaviour changes, including a perceived increase in human–polar bear conflicts (Laforest et al., 2018). These conflicts are partly attributable to change in diet. As fat reserves become exhausted, polar bears are readily approaching human settlements (Laforest et al., 2018). Human attractants such as garbage (Schmidt & Clark, 2018; Laforest et al., 2018; Lunn & Stirling, 1985, Dyck, 2006) as well as caribou, snow goose, eggs, and other terrestrially based subsistence (found in polar bear scat) has increased on the Cape Churchill Peninsula in Manitoba compared to initial analyses from Ontario in the 1960s (Laforest et al., 2018). Residents of three Cree communities in the Eeyou Marine Region in northwestern Quebec, (Wemindji, Chisasibi and Whapmagoostui), have observed a dietary and habitat characteristic shift in polar bears throughout their lifetime that is similar to the American black bear (*Ursus americanus)*, owing to the exploitation of non-traditional food sources on land (Laforest et al., 2018). Other community members have refuted the idea that polar bears depend on the sea ice for seal hunting and instead believed that the species were in fact "adept" swimmers and very capable of hunting in open water and would not be adversely affected by the loss of sea ice (LaForest et al., 2018).

The Arctic's environmental trends suggest there are cumulative effects impacting polar bear health which presents risks to the polar bear population over the long-term. These pressures are expected to magnify as climate change continues to warm air and water temperatures, causing reduction in sea ice cover with consequences across all Arctic species. Consequences of such trends are expected to be experienced first in southern Arctic regions before progressing north (Regehr et al., 2007; Derocher et al., 2004; Aars et al., 2006). Communities populating southern regions of the world's polar bear range are naturally key players in identifying the trends and issues related to polar bear survival.

### 2.2.1 Human Dimensions of Polar Bear Conflict

#### Livelihood and local perspective

Citizens of the Arctic have lived amongst polar bears for many generations. Traditionally important aspects of the human relationship with the polar bears include subsistence, hunting, trade, cultural connections, and job security (Wenzel & Freeman, 2006). Today, the role of the polar bear in society includes economic benefits (Wenzel & Freeman, 2006; Schmidt & Clark, 2018; Schmidt et al., 2022; Lemelin & Weirsma, 2007) and symbolic representation as the wildlife "face" of climate change (Peacock et al., 2011). Meanwhile, the polar bear still plays a significant role in Inuit culture (Wong et al., 2017). The historic challenges and risks for human-bear coexistence remain, local's perspectives are unique and remain rooted in their own encounters and are useful to shape conservation plans.

Research studies monitoring polar bear populations in Canada's north are depicting a different story than what locals are experiencing. Laforest et al. (2018), Dowsley and Wenzel (2008), Peacock et al. (2012), Stirling and Parkinson, 2006, Lokken et al. (2019), Schmidt (2017), Wenzel and Freeman (2018) and others report that Churchill community members believe there has in fact been an increase in population size over the monitoring time to inform the Inuit *Qaujimajatuqangit* report. Many of these communities are engaged in co-management style arrangements with western scientists and government institutions to adjust harvesting quotas, but the tendency to accept western science as the primary reference for population changes in response to management efforts remains (Clark et al., 2008; Lokken et al., 2019). In some cases, such as Dowsley and Wenzel's (2008) examination of the Nunavut co-management system, harvesting quotas were increased solely based on the Inuit perspective of a population

increase. There had been an increase in bears sightings in three Baffin Bay communities, and in the Western Hudson Bay (WHB), however, the action to increase quotas was criticized for lack of scientific evidence backing population estimates. The government's decision to increase tag numbers was not retracted, however, as it lacked community support.

The polar bear population estimation is divisive due to difference in opinion of biophysical changes causing more bears to in a particular region, or an actual increase in numbers (Lokken et al., 2019; Stirling & Parkinson, 2006), creating tensions amongst stakeholders, decision-makers, scientists and northern communities (Wong & Murphy, 2016; Tyrrell & Clark, 2014; Clark et al., 2010; Clark et al., 2008; Tyrrell, 2006; Derocher et al., 2004). The Inuit have a long-standing tradition of independent species monitoring that allow identification and classification of polar bear populations similar to Western scientific methods (Wong & Murphy, 2016). Therefore, locals can identify characteristics such as sex, age, body size, and health status as well as habitat changes (Dowsley, 2009) that provide immediate and inexpensive data to research programs (Wong & Murphy, 2016). Some community members in Arviat, Nunavut, also believe that they are able to identify traits of an aggressive or dangerous bear (Wong & Murphy, 2016). This unique skillset means that Inuit community members are frequently employed as guides and research assistants in polar bear surveys. Hiring Inuit began in western Hudson Bay (WHB) after the inclusion of aerial surveys (Wong et al., 2011; Van Coeverden de Groot et al., 2013) providing opportunity to practice and reinforce traditional skills (Wong & Murphy, 2016). However, a decrease in harvesting tags to communities limits the opportunity for the experiential knowledge to be learned and passed down between generations. The use of moratoria and absolute bans on hunting, risks the loss of hunting practices and ethics being passed down and taught to the younger generations (Gómez-Baggethun et al., 2013).

Changes to traditional patterns of interaction with polar bears in Arctic communities has impacted not only social and cultural arenas but also the economic landscape (LaForest et al., 2018; Clark & Schmidt, 2018; Dawson et al., 2010).

**Tourism**

The role of the polar bear has adapted and evolved in both small scale community and larger societal views. Cultural swings related to animal rights have limited the economic opportunity for Inuit communities that have in the past been the basis of their income from hunting activities. The anti-ivory and anti-seal hunt campaigns in the 1980s prescribed major economic diversification for communities as the international markets for ivory and seal had effectively collapsed (Wenzel & Freeman, 2006). Sport hunting for polar bears in Nunavut have created some positive social and cultural benefits as the requirements include using traditional means of travel (dog team and toboggan), as well as the products of a hunt tend to remain locally providing meat for meals, hides for tanning and opportunity for traditional gatherings. Sport hunting in Nunavut had employed many Inuit community members but dropped after the 2008 species classification and regulations were implemented creating little incentive for sport hunting due to the associated costs (e.g. physical goods and time) and limited number of tags leaves little potential economic benefit (Wong & Murphy., 2016). Sport hunting tags are controlled by regional hunters and trappers organizations requiring outside hunters to hire a private Inuit-owned or an HTO outfitter (Wilder et al., 2017). Despite the current lack of incentive, sport hunting is recognized as potential opportunity requiring minimal infrastructure and amenities for participants by communities (Wenzel & Freeman, 2006; Lemelin & Weirsma, 2007**;** Notzke, 1999). The decision to continue with a tag system is the best action for polar bear conservation as

it does not exclude locals from conservation initiatives, is more effective than trade bans and permits decentralized population management (Weber et al., 2015). Current tag systems are dynamic and can be traded with neighbouring communities to prevent over hunting and defense kills (Dowsley, 2010) as well as be adequately distributed to communities based on need like subsistence and cultural value (Weber et al., 2015).

An alternative source of economic revenue for Arctic communities is wildlife viewing. Polar bear viewing has a growing demand making towns like Churchill a prime destination for international tourism (Struzik, 2013; Schmidt & Clark, 2018). Studies and media coverage have led to between 6,000 and 10,000 tourists annually (Dawson et al., 2010) to Churchill and the Churchill Wilderness Management Area (CWMA) (Lemelin & Weirsma, 2007). The educational opportunity created by tourism is seen as the greatest asset (Russell & Hodson, 2002) with participants and locals believing that maintaining the accessibility of places like Churchill is worth the cost associated to the bears as long as the benefits (awareness to environmental issues through first-hand exposure, introduction to environmental ethics, and implementation of regulations and industry standards) continue to outweigh the damaging effects (Lemelin & Weirsma, 2007). Tourism as industry is also preferred by locals as it is seen as a better alternative to the environmental impacts associated with introducing extraction—based industry like mining, gas, or hydroelectric (Lemelin & Weirsma, 2007; Wenzel & Freeman, 2006). Community members have and continue to assess the cost–benefit analysis of industry and its larger impacts for the bears and citizens (Lemelin & Weirsma, 2007).

**Risk Perception**

The social dimensions of human–polar bear relationships remain a priority research area. Various researchers acknowledge the safety concern for places like Churchill, Manitoba and coastal towns in Nunavut, as more bears are killed in acts of human self-defence due to prolonged ice-free periods and bears spending longer on land with limited food sources (Peacock et al., 2011; Stirling & Parkinson, 2006). Despite a known connection between ecological and anthropogenic stressors as sources of human–polar bear conflict (Peacock et al., 2011), a significant number of community members in Churchill still want to find a way to live more harmoniously with the bears (Struzik, 2013). Lokken et al.'s (2019) study found that some communities blame hunting quotas for the high polar bear population, believing that more kills may happen with a tag system as a result of pressure to use them instead of on an 'as-needed' basis. Community participants also saw polar bears as more than just a nuisance but dangerous (Lokken et al., 2019). Community members in three Nunavut communities felt that they were restricted by the current polar bear quotas and frustrated that self-defense kills are accounted for in tag limits that would otherwise be designated for subsistence or sport hunting (Lokken et al., 2019). They believe that the current harvestable allowance is too low and prevents them from eliminating potentially dangerous bears that could create hazardous situations and ultimately risking community members lives (Lokken et al., 2019). The current quota system creates a division amongst older and younger generations. Younger community members were found to typically have higher education levels, were more understanding of the current quota system and its goals (Lokken et al., 2019). Meanwhile, older community members with typically less education, are less understanding and feel more strongly that the quota should be removed entirely as opposed to simply reduced. The nuances of this relationship should be explored further as gaining the support of community elders at the local level will increase support for

wildlife management decisions in Inuit and trust in co-management institutions (Lokken et al., 2019).

Communities with multiple large carnivorous species were also found to hold different attitudes towards management effort based on species-specific regulatory regimes. Some communities in Nunavut where both polar bears and grizzly bears were present believed that if a problem grizzly bear presented itself, it would be dealt differently than a problem polar bear (Lokken et al., 2019). These communities have polar bear quotas and tags but not for grizzly bears. Participants also stated that it was not that they were less concerned with grizzly bears but were more confident in safety and species management actions (lokken et al., 2019). The need for recording and monitoring of temporal trends of human–polar bear conflict is a known gap in the research field (Laforge et al., 2017). The only identified correlation in human-bear conflict is the involvement a subadult polar bear (Laforge et al., 2017; Clark et al., 2012; Townes et al., 2009). Wilder et al. (2017) addressed the knowledge gap by developing the Polar Bear–Human Information Management System (PBHIMS) that was populated with range-wide data for analysis of human–polar bear conflict. When exploring documented attacks from 1879-2014, Wilder et al. (2017) found that nutritionally stressed adult males were the most likely to pose a threat to humans, attacks by adult females were rare but were often related to defense of cubs and that nearly all attacks polar bears were in the role of predator and almost all involved 2 or less people. Despite the insight gained through the PBHIMS there is still a need to improve human–polar bear conflict through improved bear safety messaging and mitigation strategies conveyed to the public. Schmidt & Clark, (2018) found that community responses to human–polar bear conflict were effective in mitigation of procedural errors but overall fall short of consistent contributing factors (ex. improper garbage/attractant management, risk-taking by outsiders, risk-

taking by locals, risk-taking due to alcohol consumption, lack of bear safety, bear behaviours, see Schmidt & Clark, 2018 for others). By offering short term solutions and management strategies they are not combating the ongoing and persistent contributing factors. This combined with Laforest et al.'s (2018) findings of a lack of consensus on localization of the western Hudson Bay subpopulation points to oversights, over confidence in self or management agencies, and perceptions being misaligned with what the reality human-bear relationships overall.

### 2.2.2 Institutions of Polar Bear Management

#### International Management Programs

The world's polar bear population may predominantly live and travel in Canada's Arctic (Polar Bears International., 2016), but some individuals have been known to travel between subpopulations and to travel across territorial borders into other countries (Amstrup et al., 2008). As a result, Canada, United States of America, Russia, Norway, and Greenland began negotiating an international agreement that was officially signed in 1973 (Struzik, 2013) and continue to work together on the specie's management (Wenzel & Freeman, 2006; Dowsley & Wenzel, 2008). Language set in the introduction of quotas in 1968 bound signatories to use conservation practices based on the highest quality of scientific data available to produce guidelines, monitor and conservation efforts (Peacock et al., 2011). This agreement also mandated that national research programmes be established to focus on conversation and management of polar bears. These efforts were well-intentioned but lacked some basic logistics, like poor communication between countries surrounding harvesting numbers which led to a 'tragedy of commons' scenario in 2005 (Peacock et al., 2011). During that time, the Canadian government underestimated Greenland's harvesting rate of the subpopulation that travels

between Baffin Bay and Greenland which led to an overall decline in polar bears. This led to a tag system for polar bear hunting in Greenland as well as the installation of a regulation system in the country. This is not the first time that other countries have pushed for different management decisions compared to Canada. In 2008, the US designated polar bear as threatened under the US endangered species act (Clark et al., 2010) and ended the highly profitable sport hunting in Alaska (Wenzel & Freeman, 2006). Some provinces and territories followed suit in proactive management strategy and upholding the species designated status, whereas Nunavut based on the Inuvialuit Final Agreement and consultation with local's opinions did not. Canada's management strategy is diverse due to the inclusion of various stakeholders and jurisdictions recognized in the wildlife management process.

**National Management Plans**

Nation-wide polar bear management efforts in Canada include four provinces, three territories, national parks and Indigenous treaties involved with land claims (Peacock et al., 2011). Under international agreement, Canada interpreted the language of 'sound conservation practices', as means for inclusion of Indigenous peoples' perspective and traditional ecological knowledge (TEK) (Stirling & Parkinson, 2006). The knowledge was used in establishment of sustainable hunting quotas and cross-referenced with scientific population assessments; however, there are still large gaps in Canada's species-specific information. Across all Parks Canada jurisdictions, systematic mapping of terrestrial denning areas, feeding sites and migration patterns is incomplete (Peacock et al., 2011). The parks have protected some known areas, but it was more happenstance than a strategic population management or conservation effort. In fact, other

countries have mortality and reproduction failure management plans in place in case they are needed while Canada has none (Peacock et al., 2011).

Although Canada lags behind the international curve in some capacities, it leads in others. Canada has worked hard to develop and educate relevant communities in prevention and mitigation of human–polar bear conflict. The Polar Bear Alert (PBA) programme is recognized as the most intensive and effective programs in the Arctic (Derocher et al., 2013**;** Schmidt & Clark, 2018). The PBA programme emerged in response to an incident in 1968 and was a creation of the Manitoba Government to reduce future human-polar bear conflicts and is has been viewed as a strength to local management and education strategies (Schmidt & Clark, 2018).

**Local Management Plans**

Local efforts in species management have not always been successful. Federal funding for polar bear studies has been allocated since the initial discussions in the 1960s, with western Hudson Bay receiving specific funding for long-term focused research (Peacock et al., 2011; Regehr et al., 2007; Stirling et al., 1977). A criticism associated with co-management efforts is when communities do not understand or care about federal obligations and treaties that are binding Canada's decisions populations may feel marginalized (Peacock et al., 2011). The increasing prominence of Traditional Knowledge (TK) in conservation management has helped to reshape power dynamics (Clark et al., 2010), helping to bridge gaps between federal, provincial, territorial, treaty, stakeholders and co-management boards (Peacock et al., 2011). As such, conservation efforts are strengthened when communities accept and acknowledge the roles of western science and appropriate application of TK in management decisions. TK as stand-

alone information is context specific and biased by the perspectives of the knowledge creator and sharer (Wong & Murphy., 2016; Dowsley & Wenzel, 2008). It is *a priori* accepted as true and in Inuit culture stories are shared and individuals build on one another knowledge with each experience recognized as fact (Dowsley & Wenzel, 2008). Meanwhile, western science seeks to identify larger trends and system interaction. This dichotomy of extends beyond belief alone to epistemologies creating turmoil between stakeholders.

Management strategy transitions have harmed local perceptions on polar bear species management. The greatest concern voiced by locals was that management decisions are being made by people from other countries based on what they hear without having any personal experience or knowledge (Lokken et al., 2019). A shift to a "top–down" with a "grassroots" approach was looked down upon by community members because of its oversimplification and devaluing of the existing management systems (Clark et al., 2010). This is seen in the altering of the Inuit representation in wildlife management, who have been overlooked for their contributions and significance in the Arctic's polar bear conservation (Clark et al., 2010; Suluk & Blakeney, 2008). Lokken et al. (2019), argues that the Inuit who live in regions with polar bears and base part of their lifestyle off of traditional practices are likely the largest stakeholders in management efforts. An example of this is boards like Nunavut Wildlife Management Board ensure decisions on quotas are overseen by hunter and trappers' organization (HTO) at local levels. Empowering local communities in species management strategies is one aspect in fostering collaborative and future focused efforts.

**Monitoring and Management Strategies**

Species monitoring and management has evolved over the years. Opinions on invasive and non-invasive monitoring methods are divisive across the Arctic communities (Wong & Murphy., 2016; Tyrell, 2006). Although, there is significant indication that non-invasive methods are preferred out of respect and concern for the polar bears (Wong & Murphy., 2016; Laforest et al., 2018). A majority of concerns surround overall bear health and the potential for monitoring to altering bear temperament leading to behaviour changes (Laforest et al., 2018). Historic invasive methods involve deployment of telemetry collaring to provide intel on polar bear movement and habitat selection preferences (Laforge et al, 2017). In the future, standard mark–recapture methods could become more difficult as ice conditions deteriorate and bears are under more stress and underweight, which could see a spike in mortality rates (Derocher et al., 2004; Derocher et al., 2013)). Overall, there is a need for further integration of habitat type and projections with demographic productivity typically gathered by invasive measures (Peacock et al., 2011).

Non-invasive methods are often associated with being more fiscally possible (Dowsley, 2009a) and are less time intensive (Stapleton et al., 2014). Remote field cameras are an example of non-invasive methods integrated as a result of species-specific concerns (Laforge et al., 2017). In fact, much of the same data can be replicated from invasive methods including "monitoring biodiversity (Ahumada et al., 2013, Gessner et al., 2014) estimate population density (Carbone et al., 2001; Rovero & Marshall, 2009) and quantify activity patterns. (Bridges et al., 2004; Cambell et al., 2006; Suselbeek et al., 2014; Stole et al., 2015)" (Laforge et al., 2017, p. 1662). While invasive and non-invasive population monitoring techniques remain to each have their place in current polar bear data collection there are a variety of management strategies that are also debated.

The use of different population management strategies is a divisive topic. One strategy is conservation hunting which is rooted in the idea that a population decline due to lack of resources will increase environmental degradation and therefore perpetuate species deterioration (Wenzel & Freeman, 2006). The management strategy promotes short and long-term viability of a population and its habitat ensuring that the target species and its environment are in proportional health to one another. It has also been recognized to encourage compliance with regulatory systems and prioritizes appropriate land use in conjunction with wildlife management.

Current polar bear management strategy attempts to quantify a sustainable harvest level, yet accurately predicting population numbers is challenging and in effective in the long-term. Historically the largest factor on polar bear survival has been the harvest (Peacock et al., 2011), whereas today, the superseding primary concerns and factors for the species are a result of climate change effecting the ecological, behavioural and habitat of the polar bears. The negative effects will soon impact the viability, distribution and genetic diversity of the polar bears and is projected to increase the conflict with humans and their encroachment communities (Stirling & Parkinson, 2006). As a result, Stirling and Parkinson (2006) highlight a need for climate change to be recognized in future polar bear population management plans. Setting 'sound conservation practices' for polar bear management involved assessing the sustainable harvest by Indigenous people regulated through a quota system that had been estimated scientifically through mark-recapture analysis. Schmidt & Clark (2018) however advocated for a higher involvement of community members as only they can determine what is sufficient and adequate for mitigation of human–polar bear conflict (Schmidt & Clark, 2018). The differences in researcher suggestions speaks to what relationship is being assessed. While Stirling and Parkinson look solely at the viability of the polar bear population, Schmidt and Clark consider what co-existence can look

like between the polar bears and humans. However, the impacts of climate change in the Arctic are not limited to the polar bears. The grizzly bear habitat expansion is of particular interest and concern for the residents of Churchill. The town is now not only the polar bear capital of the world but can also state that it is the only documented home of all three North American bear species (Clark, 2018).

### 2.3 Grizzly Bears

The emerging presence of barren-ground grizzly bears in Manitoba is another facet of the changing Arctic landscape. Initial documented sightings of the species in Churchill are from 1998 (Clarket al., 2022) but has changed to be regularly observed (Rockwell et al., 2008). The presence is believed to be an expansion of the Nunavut and Northwest Territories populations, however historical distributions are not well understood (Clark, 2019). There is a general lack of understanding of consequences of the grizzly bears large-scale population expansions across the Arctic and sub-Arctic (Doupé et al., 2007; Clark, 2019) and little information is known about the ecology and potential interactions for the grizzlies in western Hudson Bay due to their long absence (Clark, 2000).

#### 2.3.1 Grizzly Bears in a Changing Environment

Habitat ranges of the grizzly bear species has shifted drastically over the last 100 years. Habitat expansion of the grizzly bears followed the ice sheet recessions covering much of North America (COSEWIC, 2012; Clark et al., 2018; Clark & Rutherford, 2012). Recent shifts in human settlement have largely favoured historical grizzly bear habitat (Mattson, 1989). A major factor in the decrease the grizzly bear population is as result of human management decisions in the 1920s and 1930s leading to extirpated status (locally extinct) in much of their range (Sutton,

1967; Mattson & Merrill, 2002; Cowan, 1972; Burk, 1979), primarily in the prairies and boreal plains in Manitoba, Saskatchewan, and Alberta (Schwartz et al., 2003) as well as most of the United States lower 48 states (Mattson, 1989). Desirable habitat for human and bear often overlap as bears are adaptive to various environments **(**Elfström et al., 2014; Cristescu et al., 2016). Today grizzly bears must re-enter areas as their progenitors have been killed by humans (Mattson, 1989). The primary management decision was hunting the bears, indicating a high degree of human-bear conflict and low desire for co-existence (Mattson, 1989).

The emerging pattern of co-occurrence and recolonization of large carnivorous species is not limited to North America (Wikramanayake et al., 2011; Lamb et al., 2020). In fact, Elfstrom et al. (2014) findings affirmed Craighead et al.'s (1995) proposition that close proximity of humans and bears is not 'unnatural' but is an example of adaptive behaviour. Humans altering their behaviour is often credited for successful human-wildlife co-existence (Chapron et al., 2014; Lopez-Bao et al., 2015; Sawaya et al., 2014) but that theory assumes compliance by wildlife populations and neglects intentional behavioural changes (Lamb et al., 2020). Lamb et al. (2020) found that carnivores specifically have been found to limit or reduce their home ranges to avoid human settlements (Tucker et al., 2018) and adjust to a more nocturnal cycle to avoid humans (Gaynor et al., 2018, Carter et al., 2012). However, not all human activity can be eliminated by simply shifting their active periods to the night.

Human development, infrastructure and altering of landscape have drastic impacts on the grizzly bear population. McLoughlin et al. (2002) assert that the central Arctic population is at particular risk due to the limited connectivity to other grizzly bear populations as they are located furthest north and east in the habitat range. Grizzlies located on tundra are also more likely to be displaced than individuals situated in forested landscapes (McLellan, 1990), therefore have a

lower population density than other North American populations (McLellan, 1994), and have larger spatial requirements based on food source availability on the tundra (Ballard et al., 1993; Clarkson & Liepins, 1989; Nagy et al., 1983; Reynolds, 1980**)** increasing the likelihood of human interaction taking place considerable distances from expected home ranges (McLoughlin et al., 2002).

Large scale land conversions and altering of waterways have been ongoing and continue to expose wildlife to ecosystem shifts as well as the introduction of exotic pathogens (Mattson, 1989**).** One example of human interference in ecosystems is the development of hydroelectric dams and fisheries management resulting in the reduction and/or the elimination of salmon spawning areas and consequently the same outcome in grizzly bear populations that depend on the fish as a primary food source (Lazarev, 1978; Davis et al., 1986; Mattson, 1989). A second example of human impact on an ecosystem is a result of modern agricultural, industrial, and human inhabitation of space where human interests have altered wetlands and drainage areas reducing important foraging and refuge areas for all wildlife (Mattson, 1989). Human disturbance on forest have not only influenced regeneration cycles but also what type of forests are present. An increase in intensity and frequency of wildfires in most ecosystems (Wilhelm, 1973; Russell, 1983; Christensen, 1988; Peet, 1988) in the North Cascades and Northern Continental Divide region of the United States have been found to cause an increase in natural food source and habitat for the grizzly bears prior to human settlement (Dahlberg & Guettinger, 1956; Cronon, 1983; Whitney, 1987; Mattson, 1989).

In the central Arctic specific impacts on grizzly bear habitat are commonly a result of extractive practices and developments related to mining for diamonds, gold, and base metals (McLoughlin et al., 2002). These developments fragment habitat with all-weather roads altering

the topography of land (McLoughlin et al., 2002). These changes impact the eskers, glacial river, break up important soil layers that the grizzly bear population relies on for suitable denning habitat. While the denning ecology of grizzly bears in boreal and mountainous ecosystems is well studied (Vroom et al., 1980; Sahle´n et al., 2011; Libal et al., 2012; Pigeon et al., 2016), the northern and eastern extent of the bear range has not been (Harding, 1976; Smereka et al., 2017). McLoughin et al. (2002) study examined denning habitat of the barren-land grizzly bear population in the Northwest Territories and Nunavut. They found 56 dens that were believed to be new that year with none being re-used or re-visited by individuals. They found that bears avoided denning in "tussock-hummock meadows, wetlands, or boulder and bedrock fields" likely connected to soils poor draining and digging qualities, while heath tundra with >30% bedrock is avoided due to limiting den depth (McLoughlin et al., 2002:195).

In McLoughlin et al. (2002) study by midsummer 44 out of 56 dens had partially or fully collapsed with preference of den entrance to be south, west, east and lastly north, and all located on steep slopes. Other commonalities in den preferences were root networks from dwarf birch trees, or low shrubs primarily willow with alder (Smereka et al., 2017), creating a ceiling for den entrances acting as stabilizers for the soil and a single entrance instead of two. Dens were also located near tundra berries (crowberries, cranberries, and blueberries) as well as several types of grasses and sedges, often in visible sight of the den cavities (McLoughlin et al., 2002). Denning ecology is also impacted by gendered and reproductive status. Males entered later than females and existed first, non-gestating females exited shortly after, followed by females with the previous year's cubs of the year, while gestating females entering earlier and emerge much later (Craighead & Craighead, 1972; Craighead et al., 1995; LeFranc et al., 1987; Reynolds et al., 1976; Schoen et al., 1987; Van Daele et al., 1990; McLoughlin et al., 2002). Nelson et al. (1983)

found that upon exiting their dens adult grizzly bears may be in an 'anoretic' state for up to three weeks. Selecting the appropriate denning habitat limits the amount of energy lost to environmental factors during an individual's dormancy period known as torpor or hibernation. Aspects such as slope and habitat characteristics like vegetation cover and soil substrate influence an individual's overall health and success through reducing the likelihood of premature arousal (Harding & Nagy, 1980; Tietje & Ruff, 1980; Speakman et al., 1991; Linnell et al., 2000; Boyles & Brack, 2009; Smereka et al., 2017; McLoughlin et al., 2002). A bear's time spent in their den has been connected to both latitude and elevation gradient (Smith et al., 1994), as well as be influenced by environmental factors. Pigeon et al. (2016) found that den entry was correlated to food availability, especially berries, and exiting was connected to the weather.

Grizzly bears ecological flexibility and dietary plasticity have been linked to cultivate different behaviours within the broader species (Gordon, 1991). Grizzly bears although categorized as generalist omnivores (Hilderbrand et al., 1996) and capable of thriving in diverse habitats (Servheen et al., 1999; Belant et al., 2010; Hilderbrand et al., 2018) with a range of food resources. Research shows that bears within the same range and population can have variable or extremely specialized diets based on available resources, energy requirements (Lafferty et al., 2015; Costello et al., 2016; Mangipane et al., 2018), as well as population densities (Smith et al., 2005; Herrero et al., 2005). Factors like short growing seasons and available terrestrial meat resources can lead to a primarily herbaceous diet dependent on geographical location (Gasaway et al., 1992; Mangipane et al., 2020). A mixed diet has been identified as beneficial for most grizzly bears (Robbins et al., 2007), it poses potential negative outcomes for larger individuals who are less likely to achieve bio-chemically optimal diet than small-bodied individuals who can maintain energy reserves through foraging as a primary food source (Welch et al., 1997; Lamb et

al., 2020). Larger body size has been correlated to bears with diets abundant in animal proteins like salmon (Hilderbrand et al., 1999), and ungulates (Persson et al., 2001**)** and default to energy-maximizing strategies where they prioritize meat consumption (Hilderbrand et al., 1999; Costello et al., 2016; Mangipane et al., 2018; Mangipane et al., 2020).

Maximizing energy efficiency in both diet and daily expenditure can provide a series of benefits to an individual like reproductive viability through increased access to a potential mate (Noyce & Garshelis, 1994; Zedrosser et al., 2007; Hilderbrand et al., 2019), and general survivorship by a decrease in intra-species predation (Mangipane et al., 2020). A flexible and dynamic diet can also reduce conflict in one population by individuals alternating food sources and relying on a variety of herbaceous and carnivorous nutrients to make up their diets (Mangipane et al., 2020). Grizzlies in the central Arctic have been linked to a dependency on blueberries, cranberries, crowberries (Gau, 1998) and a terrestrial protein source of ungulates; in particular caribou (McLoughlin et al., 2002).

### 2.3.2 Human Dimensions of Grizzly Bear Conflict

For communities like Churchill, grizzly bears still remain novel and exciting (Clark et al., 2022; Clark et al., 2018). On a broader scale, bear populations are managed based on the species inherent value to ecosystems and people, but also pose potential interspecies risk and conflict (Herrero et al., 2005). Gunther et al (2009) emphasize the need for hunter education courses to include information on grizzly bears in areas where future population expansion predicted rather than simply where the bears currently are. By not educating the public, bear mortality is elevated as well as increasing the potential for human–grizzly bear conflicts to occur and diminish public interest in wanting to endorse a formal conservation plan (Gunther et al., 2009). Historically, a

lack of the local engagement and inclusion of perspectives is common in highly scientific studies in Canada's north (Lankshear, 2013). Public meetings have been viewed as a 'nicety' and a check mark on a list rather than true collaboration and engagement (Lankshear, 2013). This perpetuates the colonialist hierarchy and devalues the local perspective and voice leading to a decrease in wildlife acceptance and co-existence.

Habituation of wildlife and tolerance by humans can lead to complex human–wildlife dynamics (Samia et al., 2015; Cristescu et al., 2016). Anthropogenic factors like garbage, food, improper disposal of hunting remains, and increased risk to humans and property (Smith et al., 2005) resulting approximately 90% of adult bear deaths due to Defense of Life or Property (DLP) kills (Dyck, 2016; Schwartz et al., 2003), human injury, and or bear removals (Herrero, 1985; Gunther, 1994; Gniadek & Kendall, 1998; Herrero & Higgins, 2003). Studies have shown that translocation of problem bears only provide temporary solutions if at all, as movement of the correct bear is not guaranteed and does not address driving factors (Gunther et al., 2009; Cristescu et al., 2016) and has historically led to a spike in new conflicts and/or an increase in bear mortality (Riley et al., 1994; Blanchard & Knight, 1995; Cristescu et al., 2016). Prevention is preferred and boasts a higher success rate than attempts to alter existing bear behaviour (Cristescu et al., 2016). Gunther et al.'s 2009 study found that conflicts increase in late fall as bears enter hyperphagia in preparation for hibernations (Schwartz et al., 2003). The study also found a correlation was also drawn to the availability of resources to the amount of property damaged and anthropogenic food drivers (Gunther et al., 2009). The variability of food sources in the fall along with the quality of habitat effect the observed annual range for grizzly bears (Schwartz et al., 2003; McLoughlin et al., 1999). Other factors of grizzly bear range variation

include “kinship, density, and population structure” (pp. 265) all of which are influenced by population turnover rates (natural or human related) (Schwartz et al., 2003).

The grizzly bear–human relationship is dynamic and unique to each region based on ecological and social factors. Interactions between humans and bears cannot be transposed from one population to another. Geographic factors like bear density significantly impact bear behaviour meaning that bear behaviour cannot be predicted across different regions (Herrero et al., 2005). For example, the grizzly bears consistency in fall range is dynamic and based more on the abundance and availability of foods versus traditional habitat (Schwartz et al., 2003). The impact of human activity on bear denning and presence is also dependent on the location. In western Montana, Schwartz et al. (2003) found no noticeable effects of snowmobiles within two kilometres of denning areas. Whereas Gibeau et al., (2002) found that in the Bow Valley watershed in Alberta, females were more willing to inhabit high-quality habitat located in spaces during times with or without the presence of humans, versus males that would only without human presence. As bears exposure to humans increases the likelihood of them being killed also does (Gibeau et al., 2002). Humans are currently the greatest threat to grizzly bear survival. The largest hurdles that must be overcome for co-existence are fostering the social and political clout to implement seasonal restrictions on human behaviour to ensure enough high-quality habitat so that bears are not tempted to acclimatize to areas near human settlement (Gibeau et al., 2002). Lamb et al. (2020) found that while human conflict remains the largest influence on bear survival rate also found that bears with increased nocturnality (approximately 75%) reduces conflict and increases likelihood of survival.

### 2.3.3 Current Institutions for Grizzly Bear Management

Unlike polar bears, there is no national formal grizzly bear management plan in Canada or even provincially in Manitoba due to their extirpated status. Environment Canada is actively beginning to make strategic moves towards formalizing institutions for population management, education, and assessment but local strategies are needed now. Exploring other provinces and territory's plans can be useful but it is critical remember that "every northern community is distinctive from the next, despite similarities in basic ecosystem properties (TUNDRA Crosscut, 2013). Differences between territorial and provincial procedures require navigation and communication with the public. In Nunavut, use of bear deterrents is taught as primary defense during conflict but are not required (Dyck, 2006). One influencing factor for policy and best practice adaptation to Churchill is the lack of cooperation between government, corporations, and co-management board (one does not currently exist) on agreements like there is in Nunavut (Lankshear, 2013). While Nunavut allows for hunting with a tag and limit system similar to polar bears, while also encouraging hunting in specific areas to limit population numbers (White, 2006; Gearhead & Shirley, 2007; Dowsley & Wenzel, 2008; Dyck, 2006). In areas with grizzly bear hunting tags, DLP kills are the first to deducted from limits (Schwartz et al., 2003), meanwhile Churchill can only act in DLP.

Churchill is in some capacities more prepared to deal with the incoming grizzly population due to the infrastructure and investment into bear-proofing (garbage bins, building requirements, waste management, etcetera), and limiting bear attractants in town as a result of polar bear presence and tourism industry. This industry provides the platform to further develop bear viewing as recreation which can increase habituation which provides increase grizzly bear–human interactions that either contribute positively or negatively to co-existence (Wheat & Wilmers, 2016). Local citizens comfort with and known understanding of polar bear defense

such as using rubber bullets, keeping a safe distance, limiting anthropogenic factors and more (Herrero et al., 2005) are an asset to public safety and education, but there are still bear behaviours, deterrence tactics, and risks to interacting with the grizzly bear population. It would be naïve and incorrect to believe that the community does not need new policy, practice, public education and investment into understanding the current situation in Churchill and the western Hudson Bay in general. Strategy can be adapted from existing grizzly bear education organizations like Bear Aware and Bear Smart which have identified successful strategies to minimize food conditioning and habituation of bear populations (Herrero, 1985; Herrero & Fleck, 1990; Herrero & Higgins, 2003; Herrero et al., 2011; Stringham & Bryant, 2015; Bryant, unpublished; Stringham & Rogers, 2017; Stringham et al., 2017), but when these fail focus is place on implementation of strategy as opposed to the strategy itself (Stringham et al., 2017; Schmidt & Clark, 2018).

Conservation planners and researchers need to explore the ways in which habituation and food conditioning of any species is actualizing in expected and unexpected ways (Stringham et al., 2017). The changing social-ecological scene in Canada's North warrants investment into precautionary measures as well as inquiring into the current dynamics are in the human–bear relationship as well as bear to bear interactions (Stringham et al., 2019). The nuances to this situation contribute to one of the largest obstacles for managing human–bear interactions that resources managers, wildlife and conservation biologists, politicians, the public as well as local, national, and international stakeholders are facing (Schwartz et al., 2003). As Lankshear (2013) and Schmidt (2017) found, residents of the town are often left out of the discussion when it comes to bear population and species management. As the grizzly bears begin to re-establish a

population in northern Manitoba an opportunity to engage locals in decision-making and inform policy that directly impacts and influences their day to day lives.

### 2.4 Black Bears

Black bears (*Ursus americanus*) are the third bear species my study participants discussed in the northern Manitoba and Churchill region. Black bears, like the grizzly bears, have had a fluctuating population within the region (based on participant observations and Clark et al., 2018). Unlike the grizzly bears however, black bears have maintained a consistent population within the province (Pacas & Paquet, 1994), however most interactions and human-wildlife conflicts documented occur in the southern portion of province and have been addressed with ample tags for hunters and extensive public education and information to reduce likelihood and frequency of encounters. Black bears are a culturally significant species to the region and communities as they connect to local culture and relied upon as a food source but did not elicit strong reactions from participants or contradictory findings to the literature. A brief overview of their biology and dimensions of conflicts with people are discussed and reviewed literature was limited to boreal forest and Alaska.

Black bears are opportunistic in their feeding and foraging tactics (see Bastille-Rousseau et al. 2011). The flexibility of their diet has allowed them to expand their geographical range and into higher latitudes as climate change impacts the land (Bonin et al., 2020). The expansion of their range as omnivores is significant and critical to understanding wildlife-human dynamics and how environmental factors influence population distributions (Bonin et al., 2020; Morris, 2005). The diet of a black bear is primarily plant-based relying on berries, grasses and vegetations in the summer and fall (Bonin et al., 2020; Lesmerises & St–Laurent, 2015; Mosnier

et al. 2008; Popp et al., 2018), but they are classified as omnivores and their diet varies seasonally as they may hunt or scavenge ungulates, small mammals, insects, and fishes when available (Baldwin & Bender, 2010; Bonin et al., 2019; Brody and Pelton 1988; Fox et al. 2015).

Black bears living north of 50°N latitude tend to compensate for a lower diversity of food resource by relying heavier on animal proteins during their active seasons (Bonin et al., 2019; Popp et al., 2018). Black bears' caloric needs are tied to body condition, building up fat reserves in the fall for hibernating over winter and attempting to replenish them in the spring (Bonin et al., 2019). Black bear hibernation and duration is connected to climatic conditions and food availability (Bonin et al., 2019; Delgado et al. 2018; Evans et al., 2016; Pigeon et al., 2016). Bears in more northern latitudes tend to spend more time hibernating as they have shorter seasons to replenish calories through foraging (Krofel et al., 2017; Swenson et al. 2007). Black bears are more likely to scavenge in the late summer when cubs are more mobile (Popp et al., 2018). Rogers (1987) found that males begin mating as early as 4.4 years old, whereas females had their first litters on average at the age of 6.3 years but within the ages of four to eight. Males tended to disperse before reaching sexual maturity at two while female cubs later and tended to remain in their mother's territory (Rogers, 1987). Males tend to have a larger range than female black bears and mating occurs typically in June or early July (Rogers, 1987).

Black bear-human interactions have been extensively documented and explored in the context of conflicts, public education, and wildlife management. An analysis of all human fatalities from black bears by Herrerro et al. (2011) between 1900–2009 in North America determined that 63 people were killed in 59 incidents involving non-captive black bears. Fatal attacks in Canada and Alaska accounted for 49 of the 63 deaths with three attacks occurring in Manitoba and two in the combined NorthWest Territories and Nunavut (Herrero et al., 2011).

Fatal black bear attacks were not found to be associated with a particular region, geographical area, habitat, or population but that attacks may be more likely in areas that bears predate on moose calves (Herrero et al., 2011), which is probably in northern Manitoba. The risk of a black bear encounter resulting in human fatality remains low as millions of interactions occur each year without documented human injuries. However, the consequences between an encounter and a fatality are varied and black bear encounters should be taken seriously and managed accordingly to minimize negative outcomes.

### 2.5 Risk Perception

This section of the literature explores how emotion, cognition, and values influence the assessment of risk in a new situation that can inform the new socio-ecological situation in Churchill. Understanding the nuances of how individuals understand risk and perceive wildlife interactions is crucial to examining the social-ecological system in Churchill and the status of human-bear relationships in general. The well documented history of human-bear coexistence in Churchill has been effective for managing and mitigating conflicts and has been assessed thoroughly by the academic community (see Clark et al., 2022; Schmidt & Clark, 2018; Schmidt, 2017; Wong & Dyck, 2017). The learnings and systems cannot be blindly applied to the grizzly bear population and because the situation is still new and a novel ecosystem the natural scientific data and studies have not been conducted to examine actual risk of human-grizzly bear coexistence in northern Manitoba. Assessing community members perceptions of risk and willingness to coexist with the grizzly bears can be used by researchers to guide future studies to address community questions, concerns, and explore the overlapping knowledge and risk between the three different bear species.

Risk assessment emerged as a discipline as a means to identify, characterize, and quantify risk (Covello & Abernathy, 1984; Slovic, 1987) and can be explored examining various factors. Gore et al's (2009) calculation is often used following the format of RISK= probability x consequences x outrage. Risk can also be explored in a technical assessment form, examining both the desired and undesired outcomes and impacts (Kolluru & Brooks, 1995), or involve a value-based judgement, exploring perceptions influenced by attitudes, behaviours, norms and dangers (Gore et al., 2009). While the discipline of risk overall has many facets for exploration this literature review focuses on the perception of risk. The fields of risk perception and acceptance of risk have emerged from sociology **(**Short, 1984**)** and anthropology (Douglas & Wadivsky, 1982) due to their context-dependency in both social and cultural situations (Slovic, 1987). It is in fact this situating and grounding in a particular region that has caused common criticism of early human–wildlife interactions.

Exploratory and unique regional human–wildlife relationships meant that the field of human dimensions in wildlife management lacked foundational footing as a result of largely empirically focused studies with a lack-of generalizability (Jacobs et al., 2012). As the field progressed, the complexity of sociocultural (Skogen & Thrane, 2008) and psychological factors (Manfredo, 2008; Teel & Manfredo, 2010**)** were identified as significant factors for human–wildlife acceptance (Johansson et al., 2012). The acceptance of human–wildlife interactions is a term commonly used across literature to describe the tolerance, acceptance or conflict experienced by both humans and wildlife (Hudenko, 2012). The term is also used to explore the circumstances, expected and unexpected ways, in which the interaction contribute to risk of a situation (Hudenko, 2012).

**Emotion**

Emotion in relation to wildlife management has received an increase in attention and exploration in recent years due to the gap in understanding how risk and emotion are influencing human–wildlife conflicts (Hudenko, 2012). In order to effectively managed this interspecies interaction, human emotions need to be explored (Johansson et al., 2012) to understand the situation and develop successful mitigation strategies (Hudenko, 2012). Emotions impact people's perception of control surrounding large carnivores (Lescureaux & Linnell, 2010), relationship and trust with management authorities (Ericsson & Heberlein, 2003; Linnell et al., 2003; Sjolander-Lindqvist, 2008; Skogen & Thrane, 2008), their individual values and orientation (Bisi et al., 2007; Bjerke & Kaltenborn 1999), as well as general attitudes (Williams et al., 2002). Human emotions drive not only the human behaviour during, but also after in their understanding and interpretation of the encounter which directly impact human response and support of conservation (Hudenko, 2012).

Jacob's and Vaske (2019) discovered a number of insights after conducting a review of current literature and practice of human dimension of wildlife conservation. They found that people are more likely to support co-existence with species that do not induce a fear or disgust response and there for are placed further along the conflict-to-coexistence continuum. They also affirmed Johannsen et al.'s (2012) findings that species that fit into fear related emotions category resulted in a lower willingness to pay for policy and management. Jacob's and Vaske (2019) identified that there was a correlation among studies that beliefs may influences individual's or community's emotional dispositions to large carnivorous animals, but it is not thoroughly researched enough to determine if it is a cause–effect relationship. This gap highlights the need for further research to experiment with how interpretation and beliefs effect

emotions toward species as well as continue to explore how human emotions across species (Jacobs & Vaske, 2019).

Emotion needs to be explored as a continuum. The tradition lens used creates a dichotomy of conscious and unconscious but overlooks that different levels could exist (Tsuchiya & Adolphs, 2007). The development of a continuum could include different emotional dispositions (Ellsworth & Scherer, 2003; Frijda, 1986; Sander et al., 2005; Scherer, 1999) and acknowledge that any individuals experience can be a product of biological evolution (as our ancestors relied on wildlife for sustenance), through learned experiences (in one's own life-time and practices) (Jacobs, 2009), or through a combination (Jacobs et al., 2012). Some seek out wildlife interactions in the form of recreation and interactions that form conscious emotional disposition (Jacobs et al., 2012). Unconscious emotional disposition can also be learned through forms of conditioning (Jacobs, 2009; Öhman & Mineka, 2001). While species specific emotional dispositions could be addressed through empirical research, the majority of previous work has measured fear towards some species while broader systematic knowledge on emotional dispositions towards wildlife is lacking (Jacobs et al., 2012). It has been well documented that people tend to hold strong dispositions to species that are considered dangerous, but culture also plays a large factor due to historical role of the species in the culture and heritability of the people (Jacobs et al., 2012).

Individuals can hold conflicting feelings towards animals. Researchers have found that emotional dispositions towards animals are not discrete often encapsulating a number of emotions and dimensions of the interaction (Jacobs et al., 2012). However, some researchers still choose to use a discrete organization system to easily classify emotions and the 'core affect' on people (Barrett, 2006; Russell, 2003; Russell &Barrett-Feldman, 1999**)**. Jacobs et al. (2012)

argue that both discrete and core affects need to be included to thoroughly address emotional disposition. Beyond the emotional disposition there is also the factor of cognitive disposition towards wildlife. The relationship between these two components explores one's dynamics of emotional disposition (fear of an animal), and that of the situation (getting bitten) (Jacobs et al., 2012). Izard (2007) postulated that the two are a product of previous experiences rather than being related.

As discussed previously, human emotions are heavily influenced by cultural influence, genetic evolution and personal experience. Yet, human emotions have been largely ignored by wildlife management authorities (Carrus et al., 2008**)** especially surrounding large carnivore species (Zimmerman et al., 2001). These species as Manfredo (2008) points out are primarily associated to fear, and fear is a fundamental psychological construct that effects the public's response to wildlife management, and without assessing a community's fear, you cannot determine their willingness to pay (Johansson et al., 2012).

Human emotions play a significant role in both our interactions with and attitudes towards wildlife. They are both built into us and learned over time. Understanding individual's emotions can help us to predict future interactions and contribute to mitigation of risk for humans and wildlife species (Jacobs et al., 2012). Emotions are powerful and impact nearly all aspects of our cognition through attention (Öhman et al., 2001), perception (Dolan, 2002), motivation (Izard, 2007), and memory formation (Talarico & Rubin, 2003). Emotions are central to the human existence and experience (Dolan, 2002) as they are used to appoint meaning and value to places, objects, and events (Jacobs et al., 2012). Cognition has emerged in the field to understand the effects of mental dispositions on people beliefs, values, and norms in relation to wildlife (Jacobs et al., 2012). A majority of the studies conducted have focused on fear as the

single measure, but the capacity of human emotion remains largely unexplored. Arguably, that acceptance and understanding of a new carnivorous species like the grizzly bear also falls into that category.

**Cognition**

Unlike emotional disposition cognitive understanding and assessment of risk is rooted in logic and reasoning to determine a rational decision. The dichotomy in thinking is overlapped in both literature and practice to form integrated theories and models that incorporate both cognitive and emotional dispositions (Hudenko, 2012). Slagle et al. (2012) found in their study on public attitudes towards wolf conservation, that both dispositions had significant impact on how people choose to act and support efforts. As discussed in regard to emotional disposition, confirmation bias or learned experience can also influence cognitive assessment as a result of culture, upbringing, and personal experience (Bernstein et al., 2006; Hudenko, 2012). A second form of bias known as optimism bias is pertinent when examining human–wildlife interactions (Gilovich et al., 2002) as individuals can overestimate positive outcomes and underestimate risks leading to conflict (Hudenko, 2012). If this is misjudged and then a negative experience occurs, individuals are less likely to support co-existence and conservation efforts for the particular species (Decker et al., 2010). Researchers have found that emotional reactions are more vivid and are more easily coded than context neutral cognitive reactions (Bernstein et al., 2006), yet the research completed on human–wildlife relationships has focused solely on the cognitive elements (Jacobs & Vaske, 2019).

Cognition and its influence on risk can also be explored through individual and sociocultural differences (Gore et al., 2009). Chauvrin, Hermand, and Mullet (2007) found that

personality traits directly influence one's assessment and predisposition to a situation, which was added to by Lerner and Kelter (2000) who found that participant's resting state also influenced their perception of risk. However, according to Slovic's psychometric paradigm **(**1987**)** that the presence or absence of specific factors can also largely influence people's perceptions. Factors influencing risk included: perceived control, degree of trust in authorities, perceived inequity of impacts, and serious consequences (Gore et al., 2009). Sjoberg (2000) argues that one's perception of risk is a function of hazards and combined with other properties of risk we can model risk, but it is primarily driven by the stimulus response. Those that claim to be less exposed or vulnerable to risk are in denial which in itself is also a function of hazard (Sjober, 2000) and can lead to unrealistic optimism (Weinstein, 1987).

Wildlife managers desire to operate with rational decision-making to make the best choices based on science and objectivity (Bies, 2011), while simultaneously hoping that stakeholders and citizens also base their action on factual and best practice standards is wishful thinking (Slagle et al., 2012). Although it is the ideal that decisions can be made separate from bias, experience, conscious and unconscious influences, it's unrealistic to expect and ask people to disassociate their emotional and rational thinking and contrary to scientific evidence (Slagle et al., 2012). In fact, the concept of "objective, scientifically informed, knowledge-based decision making may not be possible" (Slagle et al., 2012: 44).

**Value**

Acceptable levels of risk are influenced by the value of what is stake. Heightened consequences do not necessarily mean that the public requests paralleled levels of risk management (Sjoberg, 2000). In fact, trends in perception of risk are often homogeneous among many people in

communities of similar development and characteristics due to media outlets and accessible information (Slovic, 1987). From the information available people will develop norms and judgements about what can be considered appropriate to a situation or circumstance (Whittmann et al., 1998; Zinn et al., 1998), or the level to which is acceptable (Vaske & Whittaker, 2004). Exploring risk perception through sociocultural theories identifies the patterns and structures between and within individuals, organizations, and groups (Marris et al., 1998; Sjoberg, 1998, 2000; Slovic & Peters, 1998; Gore et al., 2009). While other theories have focused on factors such as contextual (Guagnano et al., 1995), personal capacity (Stern, 2000), and habitual (Dahlstrand & Biel, 1997) influence on behaviour and 'wildlife values orientation' (Whittaker et al., 2006).

Wildlife values orientation is generally more easily predicted to broad acceptability of human–wildlife interactions than in response to specific conflict (Whittaker et al., 2006). This is especially significant for wildlife that is categorized into fear-relevant (Davey et al., 1998) or high-predatory species (Ware et al., 1994) and in countries that conservation is funded by taxes (Johansson et al., 2012). In a quantitative study Johansson et al (2012), found that an individual's willingness to pay into governmental policy reduced when related to carnivorous species. They also found in the same study that one's affiliation to a conservation group and gender were significant factors. Johansson et al (2012) were not conclusive in their findings if fear and willingness to pay was a direct-cause or if indirect psychological factors were also influencing the relationship. They suggested looking at the work of Manfredo (2008) as well as Skogen and Thrane (2008) to develop a more accurate model for plotting wildlife attitudes into psychological frameworks.

Understanding a human population's values and general attitudes towards wildlife requires more intentional investigation. Value's orientation is merely one of the variables that holds potential insights and knowledge within the field (Manfredo et al., 2003). Future research and risk assessment needs to more holistically attempt to understand people's attitudes, norms and potential responses in relation to wildlife, which cannot be done without further conceptualization, measurement, classification, and arranging of variables (Whittaker et al., 2006). And by exploring these variables, researchers can assist policymakers by improving communication flow between themselves and the public with the development of targeted educational efforts, predictive response plans, monitoring, and new risk management strategies (Slovic, 1987).

### 2.5.1 Assessing New Risk

A new risk brings many unique factors that must be assessed appropriately. People may have learned experience from different previous interaction that they deem similar but the emotional and cognitive dispositions are in not influenced by some of the normal factors. While an experimental system emphasizes the affective and emotional side of interactions, an analytical system draws on knowledge and cognitive beliefs (Jacobs, 2012). As discussed throughout this section a hybridized assessment is required which involves prioritizing the means over the end objective (Gore et al., 2009). Keeney's (1992) suggestion on how to do this was to place the values and interests of those effected in the decision-making process at the centre to ensure that non-technical and scientific objectives be included. Including all information of human–wildlife conflicts create more useful and promising frameworks for decision-makers (Hudenko, 2012), as

emotions and cognitive understanding were found to be related not isolated factors (Jacobs, 2012).

Risk perception remains a bit of a mystery to researchers. Models created can only speak to a small fraction of the variety of influences that effect individuals (Sjoberg, 2000). While expressing concern for particular risk can provide tangible action steps in communities (Slovic, 1987), it can also be vehicles for ulterior motives to promote hidden agendas (Edwards & von Winterfeldt, 1987). While non-experts can lack the breadth of information on a hazard, what they do have is a rich more contextual and situated understanding of risk that is commonly dismissed by assessment experts (Slovic, 1987). To combat this issue, leaders in the field suggest a two-way process for understanding, addressing and mitigating risk concerns that is rooted in respect otherwise decisions are doomed to fail (Slovic, 1987; Gore et al., 2009; Knuth et al., 1992).

Assessing the risk for a population goes beyond looking at probability and severity of consequence. To truly understand the relationship in human–wildlife interactions researchers must also explore perceived risk as it largely impacts acceptance, demand, and commitment to management plans influencing the public's interest in wildlife co-existence (Decker et al., 2002; Kellert, 1985; Gore et al., 2009). The role of humans plays a significant role on both a large and small scale. Impacts of decision may be a result of larger overarching bodies to implement management plans, food conditioning and hunting limits, while smaller individual decisions during interactions like emotional state and decision-making can lead to habituation and human intrusion into wildlife habitat (Hudenko, 2012). Habituation goes both ways influencing wildlife and humans alike (Zinn et al., 2008). Consistent exposure of seemingly inconsequential individual's decisions has been linked to diminished fear responses (Hudenko, 2012).

In North America, wildlife is managed by governmental institutions and considered a public trust (Musgrove & Stein, 1993). Institutions play a significant role in the public's perception of risk of co-existence with wildlife through their formal assessment, management, and communication. (Gore et al., 2007). By engaging stakeholders to develop targeted management plans, institutions can more effectively educate and communicate with the public to gain public acceptance and support mutually beneficial human–wildlife co-existence (Gore et al., 2007).

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# CHAPTER 3: A NOVEL ECOSYSTEM OF THE THREE BEARS ON WESTERN HUDSON BAY- An investigation of polar bears (*Ursus maritimus*), black bears (*Ursus americanus*), and grizzly bears (*Ursus arctos*) sharing habitat with each other and humans


## ABSTRACT

Social-ecological systems in Canada's Arctic and sub-Arctic are changing. Although community members in Churchill, Manitoba have long co-existed with polar bears, increasing interactions with grizzly bears are complicating the human understanding of the human-bear relationship and exposing adaptation needs. By combining semi-structured interviews and Q methodology in a mixed methods approach, I explore the relationships that people in Churchill have with the three bear species found locally (polar bears, black bears, and grizzly bears), focusing on local knowledge of the three bear species and how individuals' familiarity with these species influences risk perceptions for coexisting. I found that local perceptions of risk and species-specific knowledge have been influenced by generational knowledge, the geography of land activities, previous educational training, interaction experiences, and more. A total of four unique perspectives emerged based on the theme of species-specific knowledge, as well as three distinct perspectives on the theme of risk. In general, locals indicate that they possess limited options and knowledge to protect their property and themselves in from bears. This chapter concludes by describing resources that community members require for mitigating and managing human-grizzly bear interactions and questions they identified for further research.



KEYWORDS: Q method, Semi-structured interviews, Mixed methods, Local and Traditional Knowledge, Social perspectives, Sub-Arctic, Risk, Community-based, Polar bears (*Ursus marimitus*), Grizzly bears (*Ursus arctos)*, Black bears (*Ursus americanus*).

## 3.1 Introduction

On the western coast of Hudson Bay in Northern Manitoba, human-bear relationships are changing (see Schmidt & Clark, 2018; Wilder et al., 2017). Shifts in social-ecological dynamics are being influenced by anthropogenic factors like global warming (Fyfe et al., 2013; McCall et al., 2014; Regehr et al., 2007; Stirling & Parkinson, 2006), wildlife displacement (Gormezano & Rockwell, 2013), and alterations to the landscape (Derocher et al., 2013; Castro de la Guardia et al., 2013). Southern Manitoba was once home to the plains grizzly bear, which was likely extirpated in the 1800s (Sutton, 1967). In the last 40 years, barren-ground grizzlies (*Ursus arctos horribilis*) have established a population in northern Manitoba: a region which has been previously excluded from habitat range maps (Banfield, 1977; Banci, 1991; Ross, 2002; McLellan et al., 2017) with the exception of the COSEWIC (2012:8) species status assessment, representing a change in the Arctic landscape (Clark et al., 2022). The current distribution of the grizzly bear species in Manitoba is not well understood and is believed to be the expansion of the Nunavut and Northwest Territories populations (Clark, 2019). The apparent increase in the barren land grizzly bear population marks a shift in the ecosystem and a 'new' species composition on western Hudson Bay (Clark et al. 2018) as the grizzlies coexist with the black bears *(Ursus americanus*) and polar bears (*Ursus maritimus*).

The Western Hudson's Bay region in Northern Manitoba is the only documented area of overlap for North America's three bear species (Clark et al, 2018). This new combination of species should be viewed as a 'novel ecosystem,' defined by Morse et al. (2014) as a "unique assemblage of biota and environmental conditions" (p.1) and is a direct result of intentional or unintentional human alterations to the ecosystem can remain self-sustaining. Lugo and Helmer (2004) argue that for an ecosystem to be novel, first, human impacts must have altered the ecosystem's trajectory over time and, second, change must have been initiated by human activity in the ecosystem. MacDougall and Turkington (2005) add a third criterion: the establishment of a new species composition.

Research has found that humans are generally hesitant to accept new large carnivore species (Zimmerman et al., 2001) as they often elicit strong emotions of fear (Johanssen et al., 2012) and have implications for human lives, livelihoods, and conservation efforts across broad social and ecological contexts in developing and developed nations (Schmidt & Clark, 2018; Treves and

Karanth 2003; Thirgood et al. 2005; Packer et al. 2011; Barua et al. 2013; Penteriani et al. 2016). When humans are unaccepting of a new, potentially dangerous, animal, conflicts may arise. To address human-grizzly conflicts, Gunther et al. (2009) found that potential for human--grizzly bear conflicts was higher in communities in which there had been little public education about co-existing with grizzly bears. In these communities, there may be little local support for formal management options, and individuals may be unwilling to co-exist with bears. The authors found that public education is not only critical but also that it needs to extend beyond communities where grizzly bears have been seen to areas to which they might expand. Other research has pointed out that human-bear interactions and relationships cannot be transposed between bear populations because the environment influences bear behaviour, foraging habits (Herrero et al., 2005), and their responses to being near humans (Schwartz et al., 2003). To better understand place-based human-wildlife relationships, research on human dimensions of these relationships includes sociocultural (Skogen & Thrane, 2008) and psychological factors (Manfredo, 2008; Teel & Manfredo, 2010).

Among psychological factors, emotions—particularly fear— are prominent in most wildlife-human interactions. Assessing actual and perceived risk are both important to effectively addressing concerns and while human-grizzly bear encounters in the region remain statistically low, pre-emptive management will be key to properly informing and educating the public. Exploring emotions on a continuum prevents a binary analysis of an interaction (Tsuchiya & Adolphs, 2007) and is useful to identify the many emotions that an interaction elicits (Jacobs et al., 2012). Emotional dispositions about wildlife encounters can differ based on a variety of factors (Ellsworth & Scherer, 2003; Frijda, 1986; Sander et al., 2005; Scherer, 1999), and an individual's experiences are formed through biological evolution, learned experiences, or both (Jacobson et al., 2012). The historical role of the species and the history of people's coexistence with the species also influence human perceptions (Jacobs et al., 2012), including those of risk. Gore et al. (2009) found influences on risk cognition include perceived control, degree of trust in authorities, perceived inequity of impacts, and serious consequences. Whereas human-wildlife interaction values tend to be more accepted and predictable over time, not reactive to a specific conflict (Whittaker et al., 2006).

Understanding the grizzly bear-human relationship dynamics in Churchill is crucial for human and wildlife safety. Churchill residents have been successful in managing their interactions with polar bears and black bears, little knowledge has been generated and circulated in the community about their interactions with and management of grizzly bears. This knowledge gap is important as a new national grizzly bear conservation plan is being developed by Environment and Climate Change Canada but opportunities for local input about northern Manitoba human-grizzly bear coexistence have been constrained by the pandemic. Nevertheless, facilitated workshops with Indigenous communities began in 2021 and continue. Without inclusion of local knowledge and experiences, coexistence efforts are less likely to succeed because of different power dynamics and governmental influences causing a lack in place-based solutions (Carrus et al., 2009; Johanssen et al., 2012).

My paper aims to explore local attitudes and tolerances of co-existing with a 'new' bear species on the west coast of Hudson Bay. I explore local inhabitants' relationship with, and knowledge of, the three bear species that roam western Hudson Bay. My research addresses the following questions: 1) Does bear species impact community members' perception of risk (including both likelihood and consequences) of human–bear conflict?; 2) Is local knowledge (LK) species-specific among the three bear populations found in the study area?; 3) Are there gaps and /or limitations in Churchill's bear management institutions to address human–grizzly bear conflict? By exploring these research questions, I hope to provide documented interactions between barren land grizzly bears and humans in Manitoba and to increase understanding of the species. The goals are to assist wildlife managers in controlling human-bear interactions, to maximize the likelihood and depth of community support for future approaches to grizzly bear management, and to suggest polar bear-specific education materials and strategies that can be adapted to promote successful human-grizzly bear coexistence.

### 3.2 Methods

To document species-specific knowledge and to understand local's perspectives and perceptions on human-bear coexistence I applied Frank's (2016) Conflict-to-Coexistence framework. The adaptive cycle of innovation (Holling, 2001; Gunderson & Holling, 2002) is used to expose the opportunities to adapt bear education materials, mitigation strategies, and resources to support

community members. This study is novel research based on location and study species, exploring attitudes and tolerances of a species re-entering a region.

Due to COVID-19 restrictions, I conducted fieldwork remotely with assistance from the science team at the Churchill Northern Studies Centre (CNSC). Data were collected through semi-structured interviews and Q sorts with an optional survey at the end to give notes to the researcher, over the summer of 2020 and the spring of 2021, respectively. Participants were selected using snowball sampling. Initial participants were identified through previous involvement with the Transforming Arctic Communities through Social Innovation (TACSI) project or by my supervisor in conjunction with science staff at the CNSC. Participants were identified as experts and evaluated on their relevant experience based on experience on the land hunting and trapping, polar bear tourism operators, and those with known interactions with grizzly bears within the province. Additional purposive sampling was carried out for Q sorts to address the gender imbalances in the initial contact sample set. Recruitment was open between the two data collection methods, and participants were invited to participate in both methods. Interviews and Q sorts were collected under the authorization of the University of Saskatchewan Behavioural Research Ethics Board, application number BEH-35. The research complied with the CNSC's COVID safety protocols.

**Table 2: Gender of participants**

| Method | Male | Female | Total |
|---|---|---|---|
| **Semi-structured Interview** | 8 | 1 | 9 |
| **Q sort** | 7 (1 new) | 4 (3 new) | 11 |

**Table 3: Ethnic background of participants and age range**

| Ethnic Bacground/ Age range | Inuit | Metis | Cree | Unknown/ Undisclosed |
|---|---|---|---|---|
| 20 to 34 | 0 | 0 | 0 | 3 |
| 35 to 49 | 0 | 0 | 1 | 3 |
| 50 to 64 | 1 | 1 | 0 | 4 |
| 65+ | 0 | 0 | 0 | |

### 3.2.1 Collection

I conducted nine semi-structured interviews with local and Traditional Knowledge holders, hunters, and trappers. Interview questions addressed participants' experiences with, knowledge of, and perceptions of black bears, polar bears, and grizzly bears, as well as perceived challenges with grizzly bear management. An interview guide was created (see Appendix A), and all topics were covered throughout the informal and conversational interviews to capture individuals' unique perspectives. Interviews ranged from 30 to 90 minutes in length and were audio recorded with permission. These interviews were primarily conducted over the phone, with a few done over the video conferencing platform, WebEx.

Themes emerged from the interviews that were guided by the research questions. Two statement concourses were created to explore participants' perceptions of risk and species-specific knowledge. The species-specific knowledge concourse (see Appendix D) contained 36 statements that aimed to cover the full range of participant knowledge of the three bear species, while the risk concourse (see Appendix E) contained 28 statements that aimed to explore the personal, local, and external risk influences. Concourses were intended to be kept small, so not to overwhelm participants as this was a new data collection method used for research within the community (Zabala et al. 2018; Bavin et al., 2018). Participants sorted statements into forced quasi-normal distribution, where +5 was 'most agree' and -5 was 'most disagree' (see Appendix I). Participants first sorted statements into three piles of 'agree,' 'neutral,' and 'disagree.' They

were asked to place the statements into 'agree' or 'disagree' pile, leaving the 'neutral' pile for last. Once all statements were placed, participants were asked to review their arrangement. At this point they were also offered the opportunity to complete the optional survey (see Appendix E) to offer feedback and insights into their choice of placement before submitting. The survey was available per Q sort and were used to accommodate the remote data collection, provide researchers with insights, and contextualize participants' choices. If in-person completion had been possible, the surveys would have been done as a post Q sort discussion.

### 3.2.2 Analysis

Interview data were organized, transcribed, and coded by the primary author based on emergent themes and categories using NVivo Mac v.12 as a data management tool. Rather than attempting to fit responses to a prior list of codes, the author completed the coding inductively. Data were also explored in a visual medium by using three large poster boards with research questions at the top and Venn diagrams or frameworks. Q sorts were accessible over the platform Qmethod Software or through hard copy. Kits with contactless delivery also included an optional survey for feedback. Analysis was conducted using the Qmethod Software. Principal component analysis (PCA) was used to identify a maximum of seven significant factor loadings. These loaded factors for extraction passed Kaiser-Guttman criteria (Eigenvalues > 1) and/or Humphrey's Rule and were run through a parallel analysis of study and random data. Varimax rotation was used as is standardized practice in research over hand rotation of the factors (Watts & Stenner, 2012). Significant factors that are explained below in the results section and denoted with an * in the tables were in the $95^{th}$ percentile ($p<0.05$).

A total of 10 participants the completed the Q sorts. Nine completed the method online and one individual chose to use a hard copy kit. It was not possible to extract the data of one participant due to technical problems, and the individual declined to retry or switch to a hard copy kit. A total of 10 participants' sorts were used for analysis. Interview transcripts and optional post-Q Sort survey data were incorporated during the interpretation phase and are discussed in the discussion section.

All participants were given choices about how they would like to be acknowledged in published work and that they had the right to withdraw from the research at any time. All quotes were

reviewed by individuals, and clarification was provided to ensure that their words were not taken out of context and that all details were correct. Interviewees provided verbal, informed consent, and those participating in the Q sorts gave implied consent by completing the activities.

### 3.3 Results

Q methodology identifies factors that are a minimum of one individual's Q-sort and that are similarly organized and found to be statistically significant ($p<0.05$) (Watts & Stenner, 2012). The researcher then interprets the Q-sort factors to expose a shared perspective, belief, or understanding of a topic. I describe my interpretations of these factors as "perspectives," aligned with Bennett's (2016) definition, which refers to the way "the way an individual observes, understands, interprets, and evaluates a referent object, action, experience, individual, policy, or outcome" (p. 4). Factors were extracted for both Q sorts, each of which identified an individual's unique perspectives and experiences with the three bear species (Knowledge Perspectives I, II, III, and IV) and willingness to co-exist (risk perspectives A, B, and C). Factors were labelled with a short descriptive title based on distinguishing characteristics that emerged to give readers a dynamic and nuanced understanding of local peoples' opinions and knowledge.

**Table 4: Species-specific knowledge Q sort factors**

| Sort (participants) | Factors for Species-specific Knowledge Perspectives | | | |
|---|---|---|---|---|
| | 1- All bears can be Dangerous | 2- Ghastly Grizzlies | 3- Familiar confidence and Competence | 4- Cautious and Aware |
| 1 | 0.68* | 0.41 | 0.19 | -0.03 |
| 2 | 0.06 | 0.78* | -0.12 | 0.05 |
| 3 | 0.20 | 0.74* | 0.15 | 0.12 |
| 4 | -0.08 | 0.38 | 0.11 | 0.81* |
| 5 | 0.07 | -0.42 | -0.60 | 0.48 |
| 6 | 0.25 | -0.16 | 0.79* | -0.03 |

| | | | | |
|---|---|---|---|---|
| 7 | 0.58 | -0.35 | 0.14 | 0.56 |
| 8 | 0.70* | 0.17 | 0.20 | 0.26 |
| 9 | 0.88* | 0.02 | 0.01 | -0.17 |
| 10 | 0.09 | 0.09 | 0.79* | 0.27 |

*Identifies significant sorts

**Table 5: Risk Q sort factors**

| Sort (participant) | Factors for Risk Q Sort Perspectives<br>1- Neutral/Co-existence 2- Conflict/ Co-existence 3- Keen to Co-exist | | |
|---|---|---|---|
| 1 | 0.10 | 0.70* | -0.28 |
| 2 | 0.72* | -0.20 | 0.47 |
| 3 | 0.55* | 0.42 | 0.15 |
| 4 | -0.56* | 0.47 | 0.17 |
| 5 | 0.59* | 0.17 | 0.18 |
| 6 | 0.82* | 0.01 | 0.10 |
| 7 | 0.30 | 0.14 | 0.59* |
| 8 | 0.26 | 0.11 | 0.83* |
| 9 | -0.04 | -0.07 | 0.84* |
| 10 | 0.01 | 0.84* | 0.33 |

*Identifies significant sorts

### 3.3.1 Species-Specific Knowledge

Ten participants sorted the 36 species-specific statements (see Table 7 in Appendix G), and four factors accounting for 71.78% of the variance were extracted (Table 4). Each factor corresponds with a distinct perspective, and from here on is referred to as 'Knowledge Perspective I, II, III, IV.' Each perspective has been given a descriptive title and is summarized below. Across the four perspectives, grizzly bear-related statements comprised 12 of 18 distinguishing statements and 9 of 26 consensus statements.

**Knowledge Perspective I: All Bears Can Be Dangerous**

This perspective was loaded onto by three individuals (Sorts 1, 8, 9): two females and also one male who was interviewed, meaning that there was a pattern in how they organized statements similarly and dissimilarly. They negatively sorted most black bear statements, demonstrating that their experiences with black bears was different than what was emphasized during interviews (rejecting [-2 and -3] (statements 5, 2, 1; Appendix G), influenced by the location of two participants' cabins in an area with no known grizzly bear sightings and minimal polar bear activity evidence, but documented black bear activity. Similarly, this group agreed with some of the current species-specific property damage and effective defence measures identified in interviews (strongly affirming [+2, +3, +4] statements 25, 15, 35, 12, 36; Appendix G). Based on sort arrangement, participants who loaded onto this perspective had a high degree of experience and familiarity with all three bear species, suggesting that some habits and characteristics of a bear species may be generalized to the whole population, while others cannot without further investigation, especially for the grizzly bear population (strongly rejecting [-3, -4, and -5] statements 14, 8, 19, 16, 18, 32; Appendix G). The participant that was both interviewed and participated in the sort was one of four individuals interviewed who had personal experience deterring all three bear species from an area he was in. This perspective was held by individuals with a range of experiences with all three bear species. There was agreement that some behaviours may be more consistent with one bear species but it is not always that way and so people must be prepared at all times for a negative interaction.

**Knowledge Perspective II: Ghastly Grizzlies**

This perspective was held by individuals with significant first-hand grizzly bear encounters and do not feel that current polar bear property deterrents equally as effective on the grizzly bears. This perspective was loaded onto by two participants (Sorts 2, 3), comprising two males, both of whom were interviewed. They sorted grizzly bear statements into both extremes. Positively sorted statements addressed some grizzly bear behaviours and habits as well as species-specific property damage (affirming [+2,+3, +4, +5] statements 9, 13, 15, 12,19, 20; Appendix G), while negatively sorted statements addressed grizzly bear effect on humans and other bear species, as well as the frequency of damage and the effectiveness of current property defence measures (strongly rejecting [-3, -4, -5] statements 32, 7, 17, 10; Appendix G). Both participants that loaded onto this perspective discussed the extent of grizzly bear-related damage and destruction during their interviews and the solutions they have begun implementing to deter all three bear species. Polar bear and black bear statements were predominantly sorted into the neutral range, perhaps because of a higher degree of comfort with the familiar bear species (strongly affirmed [+4] statements 30), whereas the 'new' grizzly bear population had already started to disrupt the existing human-bear relationship for these two.

**Knowledge Perspective III: Familiar, Confident, and Curious**

This perspective was held by two individuals who have significantly travelled within WNP and hold a high degree of confidence and competence in managing interactions with polar bears and black bears, but are concerned about appropriately and safely managing a grizzly bear encounter. Two sorts loaded significantly onto Perspective 3 (Sorts 6, 10), comprising one male and one female, both of whom were interviewed. People with this perspective positively sorted most polar bear and black bear statements, affirming these individuals' comfort in reading and understanding these two bear species' body language and behaviour (affirming [+2, +3] statements 4, 27; Appendix G). Grizzly-related statements were predominantly sorted negatively, and both indicated in their post-sort surveys that some of the statements could be answered through scientific study and that they were not feel confident answering based on their personal perceptions (rejecting [-2, -3, -4, -5] statements 8, 32, 20, 7, 13, 9; Appendix G). They felt strongly about cabin cleanliness (strongly affirmed [+5] statement 34; Appendix G) and indicated that the damage caused to property is distinguishable between the species (strongly

affirming [+4] statement 11; Appendix G). Notably, both participants represented their personal views during this study and not their professional affiliations as responses representing their professional affiliations would likely be based on their affiliation's stance and values rather than their own experiences and perceptions. Both previously employees for Parks Canada, they had likely travelled to similar regions for work and had similar formal bear education as a result.

**Knowledge Perspective IV: Cautious and Aware**

One sort loaded significantly onto Perspective 4 (Sort 4), comprising one male who was interviewed. This person strongly sorted almost all grizzly bear statement (strongly affirming [+1, +2, +3, +4, +5] statements 13, 14, 18, 15, 9, 20, 19, 30, 16). Statements related to property defence measures and species-specific damage were negatively sorted (rejecting [-2, -3, -4, -5] statements 24, 36, 11, 26, 1; Appendix G), which makes sense as they no longer participated regularly in hunting and trapping and did not own a cabin on the land to experience some of the damage described. This participant had the least personal experience (sightings and encounters) with each bear species but also shared personal observations of other species (bald eagles and black bears), returning to the western Hudson Bay (WHB) region and the ongoing ecosystems shifts and wildlife population dynamics. This perspective is significant because this individual, like many other members of the Churchill community, had heard from other people of human-bear encounters and narratives about the three bears species' behaviour, body language, and damage they had caused. Thus, this individual built knowledge about the grizzly bears based on others' experiences and secondhand stories. This perspective was held by an individual who represents the knowledge and activities of locals who are not engaged in hunting and trapping on the land but will be hearing stories in town from those that do. This participant is an example of how attitudes and norms in town can be formed through social contagion and still need to be accounted for when exploring willingness to coexist, education materials, and species conservation plans.

### 3.3.2 Risk

Ten participants sorted the 36 species-specific knowledge statements (See Table 8 in Appendix H), and three factors accounting for 62.45% of the variance were extracted (Table 5). Each factor

corresponds to a distinct perspective, and from here on is referred to as 'Risk Perspective A, B, C. Each has been given a descriptive title and is summarized below.

**Risk Perspective A: Neutral/ Co-existence**

Five sorts loaded significantly onto Perspective A (Sorts 2, 3, 4, 5, 6), comprising all males, four of whom were interviewed. Participants who held this perspective positively sorted being prepared to handle an encounter with any bear species but were most confident in encountering a polar bear and the potential consequences of shooting it (strongly affirming [+4, +5] statements 9, 7; Appendix H). They identified their own perceptions: In their view, grizzly bears were more dangerous than other bear species (strongly affirmed [+3] statements 25; Appendix H) and were considering (or had already started) implementing new and/or more defence methods to protect cabins/property from the 'new' grizzly bears (affirmed [+2] statement 28; Appendix H). And while they were concerned about the return of the grizzlies, they were overall neutral about co-existing (neutrally [0] statement 23; Appendix H). Significantly, those who held this perspective sorted statements related to their personal encounters and management ahead of the community management or resources (affirming [+1, +2, +3, +4 +5] statements 10, 22, 28, 6, 8, 11, 9, 7; Appendix H) but did indicate that Polar Bear Alert should remain in charge of managing all three bear species (affirming [1] statement 20; Appendix H). Unique to this perspective was the local versus external values for bear management on WHB, which was highlighted when the value of a bear's life was sorted over the value of a human's (strongly affirming [+4] statement 14; Appendix H). Those with this perspective rejected other themes, indicating that local opinions and interests were not being outweighed by outside money and influence (strongly rejecting [-4] statement 13; Appendix H). They also believed strongly that some of the current safari-styled tours were not habituating the bears to people (strongly rejecting [-5] statement 18; Appendix H). Notably, several participants who loaded onto this perspective were tourism operators in the region.

**Risk Perspective B: Conflict/ Co-existence**

Two sorts loaded significantly onto Perspective B (Sorts 1, 10), one male and one female, both of whom were interviewed. Themes of local versus external values also emerged as a significant

theme but presented differently than Perspective A. Those that sorted into Perspective B, believed that safari style tours were negatively habituating bears in town and that outside money and opinions were overpowering local interests in bear management (strongly affirming [+3, +5] statements 13, 18; Appendix H). Those who had Perspective B believed similarly—that lacking personal experience with grizzlies made them seem scarier (strongly affirming [+3] statement 26; Appendix H) and were not keen on the return of the grizzly population (strongly rejecting [-4] statement 23; Appendix H). These participants were more neutral about their confidence to handle and encounter a polar bear (neutrally [+1, 0, -1] statements 7, 9, -1; Appendix H) and less confident in handling a grizzly bear encounter (rejecting [-2] statements 6; Appendix H). During interviews, both individuals who subscribed to Perspective B were the most vocal about the impacts of bear management from a financial and environmental standpoint. Both also had had personal experiences in encountering and innovating defence methods against all three bears and emphasized during their interviews that they were concerned for larger community implications and risk because of the returning grizzly bears.

**Risk Perspective C: Keen to Co-exist**

Three sorts loaded significantly onto Perspective C (Sorts 7, 8, 9). All three were local women working in science-related jobs. They represented their own perspectives and views. This perspective represents a high degree of confidence in managing and co-existing with all three bear species (affirming [+2, +3, +4, +5] statements 6, 3, 23, 8, 7; Appendix H), but less confidence in handling the consequences of shooting black bears and grizzly bears (neutrally [0, +1] statements 10, 11; Appendix H). These participants also indicated that they were neutral about outside influences and opinions on bear management (neutrally [+1] statement 13; Appendix H), while disagreeing with the sentiment that bears lives are valued above humans (strongly rejecting [-3] statement 14; Appendix H). Participants who subscribed to this perspective emphasized the need for new and updated grizzly bear education for the community and public to address those who were not prepared or informed (strongly rejecting [-4] statements 12, 16; Appendix H). Participants with this perspective had the highest confidence and willingness to co-exist with grizzly bears but rejected statements about confidence in the community in the risk Q sort.

To interpret the finding of risk tolerance and willingness to co-exist I used the conflict-to-coexistence continuum identifying where I believe each risk perspective aligns on the continuum in Figure 4 below.

**Figure 4: Community members' willingness to coexist with bears?**

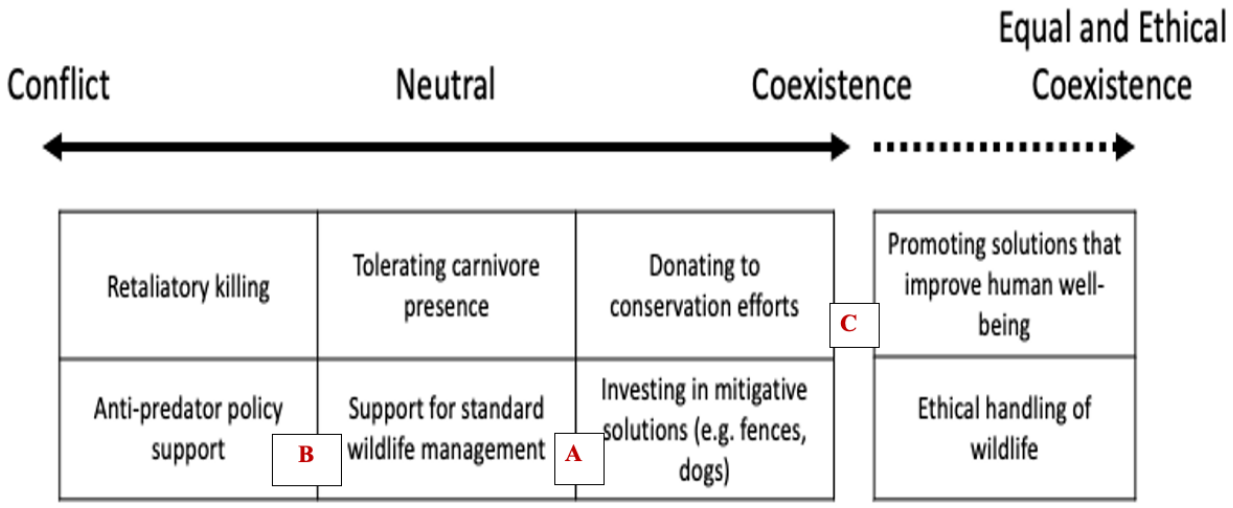


*Figure adapted from Frank, 2016 & Frank & Glikman, 2019, by Doney, 2020*

### 3.4 Discussion

Q methodology paired with semi-structured interviews allowed a deeper understanding of community members' perspectives, as identified in the results section above on and perceptions of bear–human interactions on the WHB. Methodological triangulation through the application of a mixed methods approach allows research to overcome limitations of a singular method (Bennett et al., 2014; Hicks & Cinner, 2014; Bennet et al., 2017), ensures the validity of findings, and highlights unique perspectives on a topic (Neuman, 2000). The three major influences on community members' species-specific knowledge and risk perceptions were found in the results: generational thinking, first- versus second-hand knowledge/experience, and geography of participants recreational habits.

#### 3.4.1 Influences on Perspectives

**Generational Thinking**

Generational thinking and knowledge emerged early in interviews and was affirmed throughout the subsequent Q sort analysis. The older generation of participants, categorized by age and life stage, remembered growing up and co-existing with the grizzly bears in their youth living north of Churchill in Nunavut. Although the middle generation of participants did not grow up in the north, they had heard stories of grizzlies either from friends and family further north or from before they were extirpated in the province. The middle generation knew the grizzlies more as stories. The younger generation of participants lived in the community and had either experienced encounters or interactions with grizzlies or knew of trusted community members who had. Brendan McEwan, who fell into the youngest generational thinking perspective and is a former employee of Wapusk National Park, shared his thoughts on the likelihood of encountering a grizzly bear:

*"It's just a matter of time, I think. Just hearing about all the sighting around town and from helicopters that some of the sightings are becoming less out of the park, well not less out of the park but I feel like some of the sightings are coming from more the Nunavut side of the border or between Churchill and the Nunavut border whereas before were out in the park."*

He expanded with this:

*"I don't see them coming into town at the rate that polar bears are… But the first time a grizzly shows up in town maybe people will be a little more mindful of that and keep their kids in a little more or stuff like that right."*

As the novel ecosystem (Morse et al., 2014) is shifting due to the return of the barren land grizzly bears, temporal context is key to defining and understanding social-ecological system shifts and set appropriate conservation desired outcomes and goals (Lewis et al., 2018; García-Llorente et al., 2008). This context and relationship of the bears with the ecosystem is significant and highlighted by the "familiar confidence and curious" perspective, as these participants were the youngest and had lived the majority of their lives, or most of their adult life in Churchill, with the understanding of potential human-grizzly bear conflict. In contrast, those embracing the knowledge factors—"all bears can be dangerous" (Perspective I), "ghastly grizzlies" (Perspective II), and "cautious and aware" (Perspective IV)—were older participants who had been in Churchill when grizzly sightings were only hearsay and more

recently, when community members had personal first-hand experiences and observations (Clark et al., 2022).

**First Versus Second-Hand Knowledge**

The second influence on community members' perspectives is the role of first- versus second-hand knowledge in encounters and experiences with the bears. Human-grizzly bear interactions and encounters are increasing, and this research addressed the perceptions and understanding of human-bear coexistence. Seven of the 13 participants that took part in at least one of the data collection methods had first-hand experience with grizzlies: Four participants had encountered a grizzly bear, and a further three had seen confirmed grizzly bear damage or experienced "near misses" in encountering grizzlies. Risk Perspective A: "neutral/co-exist" exclusively comprised of participants who had had human-grizzly encounters. One individual with human-grizzly experience sorted into Risk Perspective B: "conflict/neutral" with participants with confirmed grizzly bear-related damage and near misses. None of the participants that loaded into Risk Perspective C: "co-existence" were interviewed, and it is unknown if they had had any first- or second-hand encounters with grizzly bears.

Brendan McEwan, a local polar bear tourism operator and former Parks Canada employee, who had travelled extensively over the region and had second-hand knowledge of grizzly bears said,

"*just because I haven't seen one doesn't mean that they're not there, right?".*

He continued to comment on grizzlies:

"*I think… that they are more of a wild card. No has seen their charges, no one has seen what, or around here, know what they're going to do next. I have 30 years' experience with polar bears and their interactions, but I have zero with grizzlies. And in my lifetime, I am not going to get the same as with the polar bears."* This comment aligns with Jacobs' (2009) findings —that lived experience alone or in combination with ancestral evolution influence individual's perceptions of risk.

Participants with first- and second-hand grizzly bear experience spoke passionately about their concern, distrust, and dislike of potential interactions identifying ways the grizzly's presence would impact them personally and professionally. Mike Reimer who owns and operates

polar bear tours on western Hudson Bay and has personal experience interacting with grizzlies and repairing damaged caused had this to say,

*"[f]or the last five years or so the big headache has been these bloody grizzlies that are starting to come around." … "But as far as the grizzly thing goes, we're not, we're not that interested in seeing them or having them around. Not that we're not set up for it, we're prepared for any kind of aggressive encounter with the deterrents we carry but uhh, yeah. I'd probably prefer to not ever have them around, they're just, their too destructive, they're too aggressive, too different. We're quite happy to just keep it as polar bears*."

Dave Daley, owner and operator of Wapusk Adventures, who had had multiple grizzly bear encounters shared the sentiment with more northern communities:

*"Well from my friends in the north, like from Arviat and Rankin. Their policy is no grizzly bears. They are just too dangerous. So I'm of the same mind"*

And expanded with:

*"[T]hey are very dangerous. They are like wolverines on steroids. I know that there is a lot of grizzly bears around here now because in all my years I have never had my cabins broken into by black bears, ever, and in Button Bay, in North River and up the river, every cabin every spring is broken into. And one of the Hudson Bay rail workers, that drives a truck up here about two years ago said he saw a mother and two cubs at Weir River, grizzly bears. So, they are coming back".*

All participants also spoke of the grizzly bears return to the landscape as natural and acknowledged the bears historical home range. As one participant, Parker Fitzpatrick shared,

*"Yeah, but I mean I'm glad that they are able to rebound and come back. I know some people aren't too happy about it but I think they are a natural animal around here and you just have to co-exist."… "I'm just concerned with implications of bear-human conflicts but don't want to see them kind of close to town where they're going to end up getting shot."*

Participants that had dealt with confirmed grizzly bear damage aligned emotionally and assessed the risk of human-bear interaction similarly to those who had had human-grizzly bear encounters. Knowledge perspective IV—"cautious and aware"—is significant because this participant had limited interactions with any bear species but was very well connected and in the social circles of those who had. During his interview, he spoke at length about the changes in the

larger ecosystem, commenting specifically on the return of bald eagles, black bears, and other wildlife over the past 30 years and connecting them to previous wildlife management tactics. Aware and observant of his surroundings, he was a prime example of social contagion, where the diffusion of opinions and understandings is shared by community members through common actors (Rogers, 2003). Carter et al. (2020) argued that social contagion occurs when risk perceptions are shared and correlated with tightly knit social communities. During interviews, five participants spoke of using phones and social media when a bear was in the area to alert neighbours, as well as to confirm bear sightings and damage by a specific bear species. Jill Larkin had a bear break into her cabin and initially thought it was a black bear because a friend had posted a photo on Facebook the same day of a black bear:

*"I just assumed it was that [photographed brown-black bear] bear… [but] the way that we know it was a grizzly was because that same day it broke into [a friend's] garage and Conservation put a trap there and they caught a grizzly bear"*

All participants interviewed knew people who had personally seen grizzly bear and tracks or had had interactions, but the tone and emotion with which participants spoke about a potential grizzly bear encounter was different if they themselves had had an encounter or experience. First-hand experiences remain connected to individuals and are contextually stabilized, meaning that they are less likely to be distorted or misrepresented in retellings than to be embellished and exaggerated with every retelling of an interaction (Agrawal, 1995). The distinction between first and second-hand knowledge is significant and has been used as a standard for exploring local and traditional knowledges in both analyses and applications of findings. Second-hand knowledge can be influenced by several external factors, such as social dynamics, norms, values, beliefs, collective attributes, paralleled personal experience, preferences, education levels, and motivations (Munhall, 2008; Bennett, 2016). How second-hand knowledge is accepted, disseminated, and influences perceived risk within the community is dependent on where people are sourcing information from and how contextually relevant to a situation is.

Community members with first-hand experience dealing with polar bears may be overly optimistic about an interaction and may predict a positive outcome of a human-grizzly interaction. However, individuals with second-hand wildlife knowledge are likely to affirm a learned bias (Bernstein et al., 2006; Hudenko, 2012). Such a bias would manifest against

grizzlies by anticipating worse interaction outcomes and making fear-based judgements. Academically, risk is often assessed from a technical perspective (Covello &Abernathy, 1984; Slovic, 1987) or increasingly through the exploration of value-based judgement to explore the human dimension of human-wildlife conflict (Gore et al., 2009). Emotional dispositions encompass many elements of risk assessment and are best represented on a continuum (Ellsworth & Scherer, 2003; Frijda, 1986; Sander et al., 2005; Scherer, 1999), and species that are larger and considered more dangerous tend to elicit stronger feelings (Jacobs et al., 2012). Gilovich et al. (2002) argued that individuals with first-hand experience are more likely to be optimistic about an interaction. Hudenko (2012) built on this by maintaining that people tend to overestimate their own knowledge and experiences.

**Familiarity with Bear Habitats**

The third major influence on locals' perspectives is the geographic regions that participants travel and recreate in. The region was found to be more distinct and significant at influencing participant perspectives than the type of activities engaged in and correlated to higher levels of formal education. The regions in which participants frequented, overlapped with the likelihood of encounters with specific bear species. "Ghastly grizzlies" (Knowledge Perspective II) was comprised of owners and operators of local tourism and discussed significant time spent north of town, between Churchill and Nunavut, as well as east of town, between Churchill and Wapusk National Park during their interviews. The areas East and North of Churchill are more commonly noted and verified locations of polar bear and grizzly bear habitat (Clark et al., 2022). The area north of town to the Nunavut border was consistently identified by participants as having a lot of grizzly bear activity and sightings because the terrain allows the bears to cover a lot of ground quickly. As Mike Reimer who owns a series of outpost cabins in that region noted, *"[w]e have camps up on the border in a place called Schmock lake and Commonwealth lake and north of Nejanilini about five miles north of the Nunavut border. We do see more of a sign of them [grizzlies] up there than we do on the coast"*. This comment is consistent with Clark et al.'s findings (2022).

Participants in the "grizzly knowledge gap" (Knowledge Perspective III) were two former employees of Parks Canada, both of whom spoke about their extensive experience

working in Wapusk National Park. It is likely that they had achieved similar levels of formal education, as well as received identical bear training for the job. They also both own or frequent cabins by Goose Creek, which has started to have grizzly bear break-ins in cabins and property damage. Brendan McEwan noted that the areas where the bears are being spotted has changed over the last 30 years:

*"[j]ust hearing about all the sighting around town and from helicopters that some of the sightings are becoming less out of the park, well not less out of the park but I feel like some of the sightings are coming from more the Nunavut side of the border or between Churchill and the Nunavut border whereas before [they] were out in the park".*

Both members of this perspective were very well travelled, held much knowledge about the land around Churchill, and spoke of the damage caused by grizzly bears, as well as the innovations to keep them out of personal cabins.

Knowledge Perspective I, "all bears can be dangerous" is significant as two participants shared a cabin with a trapline approximately 72 miles southwest of town in a more interior inland area. However, only one participant was interviewed. The geographic location of their cabin is unlikely to overlap with the territory of grizzly or polar bears. There was a remote camera set up at the cabin for other ongoing research, which had only captured black bears gnawing on wood piles and other outside items. The interviewed participant shared that they had seen the tracks of a female polar bear with two cubs 18 kilometres south of their cabin but also that the tracks had been the only evidence of any polar bears in the area. The participant who participated in both methods of data collection was one of the four participants with first-hand knowledge of a grizzly bear encounter and is a member of the older generation with experiences of growing up in Nunavut. This participant made keen observations on how three bear species responded to human presence and pushing tactics differently.

*"I find that that's the interesting thing is like, we have actually come across [polar and grizzly] bears in the same area and as soon we start chasing them. Like the polar bears will automatically start heading out the ice and be gone, that seems to be where their preference is. Like we don't even have to force them, they just go and out they head. And 'cause I've thought that was kind of an interesting thing that the grizzly bear wouldn't do that. He was almost like the opposite. He wanted to go inland and didn't want anything to do with going out on the ice*

*but the polar bears umm, they, you don't even have to guide them. They'll just run and head out that way."– Anonymous participant*

### 3.4.2 Species-Specific Knowledge and Knowledge Overlap

#### State of Grizzly Bear Knowledge

The novelty of the social-ecological system is emphasized in the polarization of distinguishing statements of the Q sorts. Distinguishing statements are useful as they denote how individuals thought about each of the statements was distinct (Zabala, 2014). Two thirds of the statements were grizzly bear-related. This tells us that the state of grizzly bear knowledge held by community experts is inconsistent and that multiple unique perceptions and understanding of the species exist. Schmidt et al.'s (2022) definition of a local expert is defined by longer-term residence in the community (multi-years, year-round) and is associated with specific social standing that is usually attained from demonstrating competency in on-the land settings. Local experts' perceptions and experiences are not necessarily aligned because of differences in personal encounters (including human-grizzly encounters, known damage from a grizzly, and tracks), and the emotions' feedback loop could be influenced by historical and second-hand knowledge experiences as they are being shared in the community. This inconsistency may also be a result of Knowledge Perspective III, "familiar confidence and curious." Participants who fell into this category sorted some grizzly bear statements negatively and noted in their post- sort surveys that statements about grizzly bear population increases and habitat range expansions could and should be addressed through scientific studies. Their previous professional affiliation to management agencies may have influenced their perceptions of grizzly bears because management decisions have historically prioritized natural scientific data in the region, as described by Wenzel and Freeman (2006). These participants' familiarity with one type of data may influence them, helping them to feel comfortable understanding what is going on and how to appropriately interpret findings.

Participants consistently self-identified that of the three bear species, they had the least first-hand experience with grizzly bears. However, the generational knowledge and lived experiences with grizzly bears in the landscape may be entering a rapid state of development.

Despite the range of personal experiences, species-specific knowledge about grizzly bears was captured across all four of the identified locals' perspectives. Locals found that if the shutters extended significantly over the window frames, the traditional bear proofing measures on their buildings were useless against the grizzlies. The extra coverage over windows and doors allowed the grizzlies to grab onto the edges with their nails. Typical reinforcements against polar bears' pushing force were not adequate for the direction change of the grizzlies because grizzly bears used a pulling or peeling force to gain entry. Proponents of the "ghastly grizzlies" knowledge perspective also noted that bear boards on steps and decks were ineffective against grizzly bears. Locals noted that grizzlies often investigate buildings when there is substantial snowpack in the spring after emerging from their dens, while polar bears are typically on land in low snow periods and over the summer.

The knowledge and stories of personal and second-hand stories of grizzly bear encounters emphasize the species' volatility. Interviewees recounted second-hand stories of individuals being chased down by mother bears from over 400 meters away, noting the bears can close the gap on people riding snow machines. One recounted an incident in which a grizzly in Nunavut had chased teens on snow machines for 20 kilometres or more. Encounters with grizzlies and signs of their presence may not be as frequent as those with other bear species in Churchill, but the locals are on high alert for the potential severity of an encounter.

**Species-Specific Knowledge**

During the interviews, participants indicated that polar bears were the only species that all participants had first-hand knowledge and experience with. It is common for polar bears to enter town limits in the fall, waiting for the ice to freeze up before they can head out on the bay to over winter (Rockwell et al., 2011; Gormezano & Rockwell, 2013). As noted, participants from the Knowledge Perspective IV, "cautious and aware," identified the geography of town as a cause of this phenomenon. The town of Churchill is situated between the Churchill River on the west and Hudson Bay on the east. The land comes to a point where the town is, creating a bottleneck that polar bears are funneled into until the bay freezes. Participants with all perspectives viewed the presence of polar bears in town as understandable and had developed a tolerance for this species. Those subscribing to Knowledge Perspective III, "ghastly grizzlies," noted that polar bear

behaviour had changed over the last 30 years because rules and regulations for polar bear tourism had been formally established, spurred on by the innovations and infrastructure created to keep bears out of the dump.

Within the broad theme of property protection against polar bears, a widespread subtheme was the direction of force that bears apply to break into cabins and buildings. Polar bears tend to push and pound to break into buildings, so community members have reinforced windows, doors, and walls to withstand the inward direction of force. Those who subscribed to Knowledge Perspective I, "all bears can be dangerous," preferred to use only protection on shutters. Deterring polar bears or pushing them out of an area is a common practice in town and on the land as a form of personal protection. Participants indicated that polar bears may claim an area, maintaining that bears communicate body positioning and attitudes during encounters. Locals communicate back to the polar bears by using pushing strategies like guiding the bears on sleds, trucks, and/or helicopters to a different area or with the use warning shells. People found that the polar bears typically retreat onto the ice or into the bay or a river as they are natural swimmers. Pushing strategies have been used successfully by individuals, as well as by bear patrol and conservation officers to manage interactions (Schmidt & Clark, 2018; Stirling et al., 1977; Kearney, 1989).

Unlike the polar bears, grizzlies avoided going into the water or out onto the ice when being guided out of an area to avoid an interaction with locals. One of the members of Knowledge Perspective I, "all bears can be dangerous," had personal experience pushing all three bears species out of an area. He shared his experience when attempting to push a grizzly bear out while on a goose hunt:

*"[we] could see this grizzly bear coming along down the shore and we were all sitting in our little spots hunkered down and shooting geese, having a great day and he got closer, and so we got on our snow machines and figured well we'll chase it away. So, we proceeded to chase it and figured let's see what happens if we chase it out onto the sea ice because we were right on the shore there. And we tried to do that, and it refused to go to the sea ice. It kept dodging around and finally it got around us and headed inland but it was a good-sized bear and it was quite fat".*

Of all the species, black bears were the least talked about and were only discussed after participants were asked during interviews to share their experiences with and knowledge of all

three bear species. Black bears were most consistently discussed in relation to the other two bear species, with minimal insights, stories, and observations about black bears themselves. Participants may not have been as interested in black bears because they considered them to be the least 'exciting' of the three bears species. However, those who fell under Knowledge Perspective IV, "cautious and aware," identified an overall population increase in the Churchill area over the past 20 years, noting that the damage to property and encounters with humans remained negligible. Property damage was the primary focus of black bear-related discussions during interviews. When asked how they would manage an encounter with a black bear, participants unanimously shared the strategy of scaring the bear away, indicating that, in their experience, black bears run off to avoid an encounter with a human. Participants commented that they would also expect the bear to return to an area, likely to just nibble on things around the cabin or pick away at the exterior of buildings. These comments align with Scharhag et al.'s (2021) findings on human-black bear encounters. Not all participants felt confident reading black bear body language, and a few participants commented on experiences with black bears charging unprovoked. Black bears tended to be viewed as part of the ecosystem, and community members felt prepared and competent about co-existing with them. Damage mitigation and defence measures focused on keeping a clean cabin and waiting to pull gear and items outside until the last moment to minimize bears' opportunities for chewing on them.

**Trans-Species Knowledge**

Some knowledge and insights were specific to a particular bear species and others were associated with more than one species of bears. One of the most significant and widely discussed areas of species' knowledge overlap was the importance of keeping a clean cabin for the physical protection of cabins. All participants shared and emphasized the importance of leaving a clean cabin when not present, including the removal of all scented items. Those subscribing to Knowledge Perspective III, "familiar confidence and curious", and Knowledge Perspective IV, "cautious and aware," all tried to remove sweet and sugary items to minimize a bear's potential interest. Subscribers to these two perspectives commented that both polar bears and grizzly bears targeted sugary liquor in cabins they had broken into, leaving the plain versions untouched. Another noted dietary preference of polar and grizzly bears is their aversion to spices, noted both

by those who hold Knowledge Perspectives II, “ghastly grizzlies” and Knowledge Perspective III, “familiar confidence and curious.” Evidence of the preference for sweet liquor and the aversion to spices was discovered by one participant, Jill Larkin, after a bear who had broken into a friend’s cabin, bit into a bottle of cayenne pepper and left immediately. She noted this observation a second time while working in Wapusk National Park, when a polar bear was suspected of having broken into the Nestor 1 cabin. Large items like peanut butter and other sugary treats were untouched, but the cayenne pepper from the spice rack at the door had spilled all over the ground. Having tasted the cayenne pepper, the bear appeared to have immediately left the cabin. Jill subsequently incorporated this knowledge into her defence strategy for her cabin. After sprinkling cayenne pepper at the entry ways, she had not experienced a polar or grizzly bear break. When a grizzly broke into her cabin at Goose Creek, the bear bit and broke a bottle of cayenne pepper on the windowsill and did not go any further into the cabin.

Other common knowledge about the three bear species includes the habits that bears form in a region. Participants commented that some cabins are broken into by both polar and black bears while other cabins are left untouched. Bears’ tendency to target the same cabins was identified as a problem in town and in other areas like Seal River, Button Bay, and Goose Creek. Button Bay was mentioned several times by various participants as it had frequently been used for problem bear relocation. Cabin owners in the area were frustrated with this practice as it placed the bear in an area where it can wreak havoc and reinforce the break in patterns. As discussed in the species-specific knowledge section, cabin owners’ practices are effective at deterring more than one bear species. However, the defence layers needed to protect against grizzly bears were greater than those for polar and black bears. And multiple participants commented that any bear that is determined will find a way in no matter the efforts to keep them out. When this research was carried out, several individuals subscribing to Knowledge Perspective II, “ghastly grizzlies”, and Knowledge Perspective III, “familiar confidence and curious,” were contemplating or had started to integrate electric fencing and buffalo fencing into their home protection systems.

### 3.4.3 Current Gaps and Limitations in Churchill’s Formal Grizzly Bear Management

Current strategies and efforts to mitigate human-bear encounters and bear-related damage were discussed in-depth during interviews. Participants shared what they had been trying out, what had succeeded, and what had failed. Although many locals are innovating and adapting, insights and knowledge were not widely shared within the community. Locals were eager to learn from other communities that overlap with other grizzly bear habitat ranges. Participants discussed watching documentaries, educational programming, and doing online research to begin to educate themselves on grizzly bears, emphasizing that the barren-land grizzly population expanding into Manitoba is very different from the North American west coast grizzly bears that they may more readily find information about. One gap in locals' knowledge is what food sources the grizzlies were relying on. Unlike west coast grizzly bears, there are no salmon spawning rivers to keep the bears occupied and nourished (Lazarev, 1978; Davis et al., 1986; Mattson, 1989). Some participants indicated that there might be overlap between the polar bear and grizzly bear diet, noting the pillaging of eggs from goose nests in Wapusk National Park and suggesting that other food sources are also likely being shared (Barnas et al., 2020; Clark et al. 2022). One participant witnessed five or six polar bears feasting on a whale carcass and spotted a grizzly bear waiting for its turn when he entered an area to go goose hunting.

Successful innovation and reliable knowledge about deterring grizzly bears are neither consistent nor widely shared within the community. Participants sorted their need for new or more defence measures widely in the Q-sorts. Those with less experience deterring all three bears had more questions about how to prevent break ins and damage and sorted the need for species-specific measures as higher. When referring to interviews, I found that those who had already started experimenting and implementing more and multiple bear defence measures sorted their interest as having lower importance or less agreement. While some participants wondered about the effectiveness of electric and buffalo fencing (consisting of five strands of barbed or high-tensile wire), others had implemented multi-layered defence systems successfully for years. However, the use of electricity is not an automatic solution as it adds another challenge for many cabin owners who do not have reliable or consistent electricity on site when humans are not there.

A third element that stood out was the variation in confidence levels between individuals, among the general community, and in current management institutions. Perspectives were varied

among participants, but gender played a significant role in my findings. Men tended to have a higher confidence in themselves, then in management institutions, and lastly in the public, while women sorted a higher confidence in management institutions, then self, and then the public. This pattern of confidence aligns with Clark's (2008) findings on the influence of gender. Men prioritized and felt confident in themselves first, and in interviews they spoke of personal protection items to defend against bears. Protection was predominantly identified as firearms but also included rocks, shouting, and pushing/guiding bears using vehicles. When discussing the possibility of an encounter, one male participant said, *"It's either the bear lives or you live and in nature you always want to win, and we have the advantage of firearms."*

The one female interview participant did speak about firearms and personal protection as bear management but also spoke of personal actions to avoid encounters and defuse situations. This strategy was reinforced by the other female participants in the Q sorts who strongly rejected statements about community education and preparedness in the risk sort. The roles of psychology, wealth, occupation, and gender dynamics have been found to correlate with attitudes and behaviours towards wildlife (Kellert, 1985; Peyton et al., 2007; Dickman, 2012; Lindsey et al., 2013; Bhatia et al., 2021). During interviews and in Q sorts, men spoke about respecting the bears. When asked how they would handle an encounter, they spoke of claiming a space, establishing a hierarchy and dominance, whereas women tended to question why the bear was in the area and whether it should be there, or, if the bear was there first, whether they should remove themselves. A second similarity across all the female participants is that they all held community- and education-oriented roles working for organizations in Churchill. The men, who were predominantly small business owners in the community, oriented and sorted differently. Thus, the roles that individuals played inherently influenced their perspectives and priorities in how they began to comprehend or approach the grizzly bear population. Insights and learnings from this research can be applied to other areas entering a social-ecological dynamic era (Bennett et al., 2017).

### 3.5 Conclusion

Understanding the experiences and perceptions of Churchill residents can provide valuable insight into how the return of the grizzly bears is impacting the social-ecological system of

human-bear interactions on western Hudson Bay (Smith, 1990). When there is understanding of what people are already doing to keep themselves and their property protected, future management direction and possible solutions become clearer. The implications of this exploratory research are relevant for local wildlife management officers and community residents and have broader applications for other communities that are entering a state of social-ecological change and individuals adapting to a functionally novel ecosystem, as it takes shape. Also, relevant and applicable to any ecological system going through a change, this research provides ideas on how to engage locals in wildlife coexistence efforts.

The three biggest influences on locals' perceptions of risk and species-specific knowledge are generational knowledge, first- versus second-hand knowledge, and familiarity with bear habitats. The community has three unique generations of experts with knowledge of living with grizzly bears. I found that the amount of first-hand knowledge of grizzly bear encounters is increasing, that confirmed grizzly bear related damage is increasing, and that those with first-hand knowledge represent a range of acceptance for coexistence. Moreover, locals with first and second-hand knowledge of grizzly bears are aware that in their lifetime they will not be able to match their living knowledge of polar bears with that of grizzlies. Finally, I found that individuals who are familiar with certain regions on the land hold similar beliefs and have similar observations of the different bear species.

Grizzly bear sightings and encounters, as well as evidence of their presence, in northern Manitoba has been increasing over the last 30 years, and it is clear from my findings that locals have already begun adapting for coexistence (Clark et al. 2022). Conflict interventions are expected to be more effective when they are informed by scientific (Sutherland et al., 2017) and/or local ecological knowledge (Sterling et al., 2017). Local experts concur that there is a need for grizzly-specific education and training materials for locals, tourism operators, and cabin owners. As this research was exploratory, a knowledge gap of grizzly bears remains in the province of Manitoba. To understand what is happening on the land, documenting the knowledge of Local and Traditional Knowledge holders and of hunters and trappers in the community is an accessible and empowering step forward in northern community-based research, but there is still much more work to be done (Clark et al., 2022; Harding & Clark, 2022).

Participants are keen to learn more from scientific study and hope that such insights can be used collaboratively to adapt the community's robust polar bear safety education training program and create widespread channels for grizzly bear information.

Recommendations for addressing Churchill's gaps and limitations in managing and mitigating grizzly bear-specific concerns identified in the research are organized into three themes: education, documentation, and protocols and legal repercussions. A desire for grizzly bear-specific education was identified and discussed by almost every interview participant. A potential first step is to adapt the polar bear education materials for grizzly bear-specific courses, company training, and bear behaviour information. Increasing access to and availability of these resources could help promote bear awareness in the community beyond the typical summer/fall polar bear season. Building awareness in the community would also create opportunities for inter-community knowledge sharing, where people come together and share problems and solutions and collaborate. Many participants are already innovating and adapting while others are just beginning to deal with grizzly bears. Embracing and sharing what is working may reduce the reduce the incidents of bear encounters and damage.

Documentation of grizzly bear sighting, interactions, damage, and behaviour emerged as the second theme and would be beneficial to community members as well as to government officials, as they continue to weave together local area knowledge and ongoing scientific studies to make well-informed management decisions and to engage the public effectively. Documentation of Local and Indigenous Knowledge can be captured and shared routinely at community inter-learning workshops and then be used to identify patterns, address consistent problems, and find community supported mitigation strategies.

The final theme, protocols and legal repercussions, is the most dynamic of my three recommendations. Based on the grizzly bears' extirpated status in Manitoba, locals are unsure of what this label means for them, and they are concerned about how an interaction could impact them socially in the community, as well as legally. There are currently no grizzly bear-specific protocols for any business, government agency, or tourism group in Manitoba. This gap can be partially addressed through the first two themes by creating grizzly bear-specific education and training materials and by integrating them into protocols for Churchill's bear patrol, Parks Canada, and the CNSC. The lack of approved protocols, research and monitoring standards, or

relocating practices leaves locals with limited options. Churchill community members have advocated for minimally invasive wildlife interventions, and locals have concerns for how polar bear methods may impact a grizzly bear. The legal repercussions' component is perhaps the most dynamic of the three recommendations. Depending on how the grizzly bear population continues to exist within the province may impact their provincial status and different regulations and management options may become available.

The residents of Churchill are experiencing changes on the Western Hudson Bay coast. The community is in various stages of gaining confidence and learning practices in managing and mitigating risk and damage involved with coexisting with grizzly bears. Some polar bear-related resources and infrastructure that already exist within the community can be adapted to educate the public, but community members are interested in learning more and are asking for further tools to coexist with grizzly bears. The social-ecological relationship between humans and grizzly bears has already begun to change and will continue to do so. As grizzly bears continue to establish a presence in Manitoba, rules and regulations may change. Local experts have been underused to understand and manage human-wildlife coexistence in the area. The success of wildlife management depends on the level of community support, especially with large carnivores (Zimmerman et al., 2001; Johanssen et al., 2012). Engaging with locals and documenting their insights is the first step to building relationships and trust between management institutions and communities. Already having adapted to its surroundings out of necessity, Churchill can lead other communities and regions by demonstrating how to innovate and evolve in novel ecosystems and by being valued and acknowledged for its expertise, knowledge, and experience of living with the bears on western Hudson Bay.

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# CHAPTER 4: CONCLUSIONS, RECOMMENDATIONS, AND REFLECTIONS

## 4.1 Dissertation Summary

This dissertation explores human-bear interactions on the west coast of Hudson Bay. I explored what local and traditional knowledge holders know about each of the three bear species and begin to examine how they feel about each of them. My dissertation research was guided by the following research questions: 1) Does bear species impact community members' perception of risk (including both likelihood and consequences) of human-bear conflict? 2) Is local knowledge (LK) species-specific among the three bear populations found in the study area? 3) Are there gaps and/or limitations in Churchill's bear management institutions to address human-grizzly bear conflict?

Chapter One described the research problem and knowledge gap before outlining the methodologies, methods, and analysis used to address the research gap. Chapter Two oriented the reader to the literature and context of the research and laid a foundation to understand the findings in the following data chapter. Chapter Three provided the results to the research questions and discussed their relation to previous research, blending findings from semi-structured interviews and Q-methodology to identify unique perspectives in the community on the themes of risk and species-specific knowledge. These perspectives were discussed and enriched with the inclusion of interview data and direct quotes through research interpretation. This chapter proposed three perspectives held by local and traditional knowledge holders on their willingness to coexist with bears ("conflict/neutral", "neutral/coexist", and "keen to coexist") and presented four differing perspectives on species-specific knowledge ("all bears can be dangerous"; "ghastly grizzlies"; "familiar, confident and curious"; and "cautious and aware"). And, finally, here in Chapter Four, I reflect on my research process and how effectively I addressed my research questions, discuss my findings in relation to the body of literature, and offer recommendations for further research.

## 4.2 Current Gaps and Limitations in Knowledge of Human-Grizzly Bear Conflict

Throughout the interviews, participants were asked to identify what they view as Churchill's current gaps and limitations in addressing human-grizzly bear encounters. Some suggestions were repeated by many participants while others were stand-alone comments. It was

evident that community members are in different stages of knowledge about how to effectively manage and mitigate grizzly bear damage to cabins and property. Some of the recurrent suggestions included the development of grizzly bear specific training materials, continued documentation of grizzly bears and behaviour, and development of grizzly bear specific protocols and legal repercussions.

Churchill already has robust polar bear education and training materials for individuals, tourists, wildlife tourism, and companies in town, which could be used to create similar grizzly bear specific materials. The adaptive cycle for social innovation created by Holling (2001) and amended by Gunderson & Holling (2002) is an efficient and effective framework to harness the relationships, channels, and bear management infrastructure (e.g., polar bear jail, bear alert, and general bear awareness) that already exist in town and create a road map for grizzly bear specific materials that need to be created or at the very least assessed. I have amended a visual of this process, including the current and potential future opportunities for managing human-grizzly encounters. One benefit of creating these materials would be to increase community awareness of the grizzly bear population. During the interviews, it was clear that not all participants were sure if the increase in sightings was due to a population increase or to people encountering grizzly bears more often. The perceived increase has serious implications for management as, no matter the reason, it will influence how and where people are spending time out on the land and could result in more grizzly bears being lawfully and unlawfully killed.

Regardless of why human and grizzly bears are experiencing more interactions, the presence of grizzlies requires the locals to change their thinking, which, at present, is focused on polar bear behaviour. Polar bears are expected to be around town when ice is degrading, forming, or is absent, with a higher concentration of activity in the fall around Churchill (Wilder et al., 2017). The tourism industry has capitalized on this pattern to offer polar bear viewing trips in October and November each year. Although locals know that occasionally unhealthy polar bears have been known to enter the community in winter when they should be out on the Bay, the grizzly bear population will require them to remain bear aware and alert to potential encounters year-round. Documenting sightings, encounters, damage, and behaviour of the grizzly bears in Manitoba will help the locals to monitor changes, update educational materials, and inform management options. The inclusion of local area knowledge in grizzly bear specific information

and resources that document the experiences of Churchill residents will better represent human dimensions in decision making. Hosting consistent community workshops can help individuals, researchers, wildlife managers, and policy makers identify patterns of bear behaviour, address consistent and developing bear-related issues, and identify community supported mitigation strategies.

**Figure 5: Applying social innovation on adaptive cycle framework**

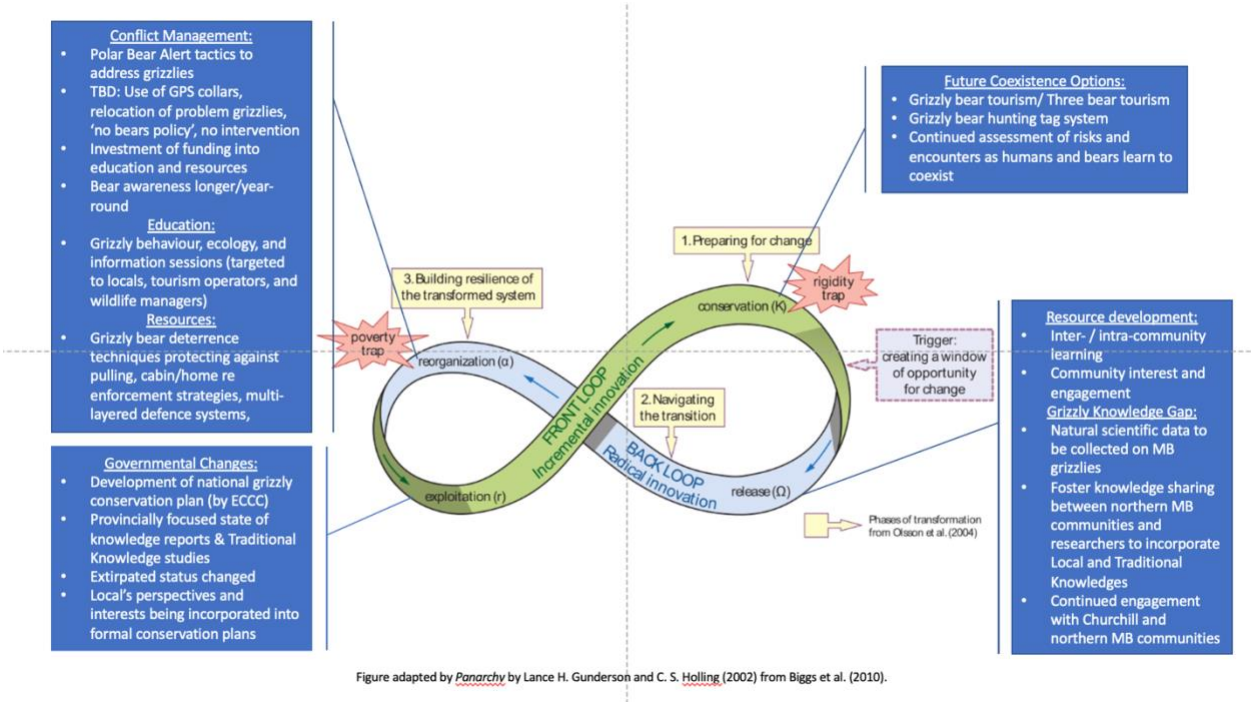


Figure adapted by *Panarchy* by Lance H. Gunderson and C. S. Holling (2002) from Biggs et al. (2010).

Throughout my thesis I have described how the social-ecological system in Churchill is in a state of change marked by the return of the grizzly bears to their Manitoba habitat range. I have also outlined why the grizzly bear presence marks a novel ecosystem and the overlap of the three bears species and humans in this region is a new dynamic with a lack of generational knowledge and coexistence strategies for all species. In my research objectives I set out to explore how prepared community members of Churchill as well as the formal bear management and wildlife managers were prepared for the increase in human-grizzly bear interactions. I compiled and synthesized what I believe the current and potential future of human-grizzly bear interactions

could look like and identified what steps can be taken in the various phases to ameliorate conflicts.

**Release (Ω) Phase**

I would place Churchill currently in the release phase of the feedback loop entering the reorganization (α) phase. I believe that Churchill is in between these two phases as community members are interested and implementing their own innovations to address grizzly bear damage and are actively seeking out opportunities to educate themselves in the event of an encounter. My research has shown that there is a perceived discrepancy whether there is an increase in grizzly bears within the province, or if there is an increase in encounters and interactions. This research has begun to tackle and address some of the items identified in the release phase items in Figure 5.

Two major themes of the release phase for navigating the situation on western Hudson Bay involve development of educational resources within the community and with other communities that coexist with barren-land grizzly populations. While behaviours and habits cannot be applied generally between grizzly bear populations or regions there are lessons that locals can benefit from by sharing their own experiences and sharing talking with community members from Nunavut (NU) and the Northwest Territories (NWT). Throughout data collection, many participants shared stories and first-hand experience with grizzly bears from time spent living in the two territories. Others shared stories from friends in more northern communities and it is clear that there is potentially for learning between these communities.

The second theme is knowledge gaps within the community and academic bodies of literature. By creating a dialogue in and with other northern communities there is an opportunity for local engagement and better understanding to what is happening on Western Hudson Bay. It is not feasible for researchers to monitor or investigate what is happening in the northern region of the province due to climate, conditions or travel and lack of infrastructure but many locals and First Nation communities travel farther and have in depth knowledge of the area and take note of changes. Fostering relationships like these can support the inclusion of Local and Traditional Knowledge into reports and wildlife conservation plans and potentially species management plans once the grizzly population warrants management. To supplement the social science and locally-engaged research methods there is also a need for more scientific research in general to

be conducted on the Manitoba grizzly bears. Specifically identifying their current habitat ranges, denning habits, food sources, activity patterns. Many of these were also identified by Clark et al. (2022) with the addition of temporal significance of habits and the need for larger patterns in den distribution. All of this information is beneficial as the next stage of the cycle for Churchill is marked by entering the reorganization phase.

**Reorganization (α) Phase**

The reorganization phase can be denoted by the town of Churchill, conservation authorities and larger policy makers to address the grizzly bears by developing systems and structures to support coexistence. I have synthesized the themes of this phase into conflict management, education, and resources. This phase is what locals expressed interested in wanting and needing to feel more knowledgeable about the future of human-grizzly bear encounters in Manitoba.

Conflict management was discussed by participants as creating mirrored tactics and resources to that of polar bears and black bears specific for the grizzly bears. Key elements to the success of this is understanding the habits and tendencies of the Manitoba grizzly bear population and how they are different from the other two bear species. Investing in the scientific research from the previous phase will be critical to investing effectively into training and educating locals, tourism operators, and wildlife managers.

This stage also requires some commitment from policy makers and wildlife managers as to what is acceptable means of management as well as outlining effective deterrence measures to protect property and reduce the likelihood of negative encounters for both bears and humans. This should include best practices and strategies for locking up and leaving your cabin, trap lines, hunting spots to reduce interactions and not habituate the grizzlies to humans.

**Exploitation (r) Phase**

Exploitation is the next phase and is dependent on action from government level institutions. Part of these steps are underway with the development of the national grizzly bear conservation plan but that won't affect the legal designation of grizzly bears within the province. Environment and Climate Change Canada (ECCC) commissioned State of Knowledge reports and Traditional Knowledge reports for the province (Harding & Clark, 2022). These reports documented the historical and present species ranges within the province and provide an

opportunity to include historically excluded and underrepresented forms of knowledge in wildlife management and social dimensions of human-wildlife interactions (Harding & Clark, 2022).

The biggest things that could come out of this stage is if there was a consistent grizzly bear population and evidence of reproduction within the province then the grizzly's status could be changed from extirpated and officially acknowledge as a constant species in the region. If this happens a provincial grizzly bear management plan would need to be created. Wildlife managers and researchers have found that the success of a wildlife management plan relies on the inclusion of local perspectives and interests (Herrero et al., 2011). Once again this is an opportunity to capitalize on the positive relationships within the region between formal bear management institutions and community members and managers need to explore the human-grizzly relationship separately and not blindly apply the same rules and regulations to them as polar or black bears.

**Conservation (K) Phase**

Once the grizzly bear population is more stable within the province and human-grizzly bear relationship has had time to evolve there is opportunity to explore how a conservation plan can look within the province or within smaller regions. Participants acknowledged the potential of grizzly bear tourism similar to polar bears, but tourism operators were not interested in pursuing that in the near future. There is also the opportunity to institute a grizzly hunting tag system to manage the population once it is appropriate but integrating that system brings up a number of other social dimensions as charismatic megafauna tend to (Meek et al., 2011). Meek et al. (2011) discussed how international support for northern species can create large implications for policy in northern communities. This could again involve a tourism element like polar bear hunting in Nunavut employing locals and ensuring resources of a hunt are done respectfully and without waste. However, the biggest components to supporting this new ecosystem is continuing to assess the risk and types of encounters between human and grizzly bears as all three bear species and humans learn to coexist on the landscape together again.

Mattson (1989) found that bear population survival is strongly linked to and dependent on social tolerance.

The future of the human-grizzly bear relationship on western Hudson Bay remains in a state of change. I cannot predict that my suggestions on this framework will happen in the way I have outlined but I see this as a tool to identify what is happening in this social-ecological system and work to identify opportunities for human-wildlife coexistence. Changes to habitat ranges, species expansions, and novel overlaps between species will likely increase due to global warming and using frameworks like this one can help serve as a resource to help communities and wildlife managers identify and address needs as situations emerge.

### 4.2.1 Current Knowledge Gaps and Conflict Management Limitations

The gaps and limitations in local knowledge in Churchill can be attributed to protocols, especially legal frameworks, that address grizzly bears. Grizzly bears are classified as extirpated within the province (Sutton, 1967), a classification that means more complicated than handling and management options for polar or black bears during an encounter. There is not only the legal aspect of this designation to consider but also the social components involved with killing a grizzly bear. Legally, there are no current grizzly bear specific protocols for businesses, government agencies, or tourism groups in Manitoba. Addressing legal protocols should be done by creating grizzly bear specific education and training materials that can be integrated into existing protocols for Churchill's bear patrol, Parks Canada, and the Churchill Northern Studies Centre (CNSC). Including locals' perspectives and insights is important to addressing the social taboo of doing big carnivore research in the area. All interviewed research participants expressed concern about the lack of protocols, research, monitoring standards, and/or relocating practices. Churchill community members have long advocated for minimally invasive wildlife interventions, and locals have concerns for how the current polar bear methods if used on grizzlies may impact them. The respect and connection people have with the polar bears extend to the grizzly bears, and they want to ensure that their management choices are not harming or hurting the bears. There would be negative repercussions in the community if anyone killed a grizzly bear without legal justification—or even any justification. The formal grizzly bear conservation plan, currently in development and there is currently no provincial planning process

underway. My recommendations are to address the gaps and limitations to Churchill's grizzly bear management and are summarized in table 6 below. My recommendations are divided into who should be in charge based on who has the capacity and resources to address the recommendations. Recommendations emerged throughout my research process from individual's requests or expressing interest during interviews to interpretations of findings by me and understanding who has influence and power within the community to combat issues and concerns.

**Table 6: Recommendations for future work**

| **Who's in Charge** | **Recommendation** |
|---|---|
| Researchers | • Continue to harness and engage northern communities and First Nations in Manitoba (Split Lake community, Fox Lake Cree Nation, and York Factory Cree Nation), using social science methods to understand the grizzly bears' past and present history in the region.<br>• Conduct studies on the Manitoba grizzly bears to understand denning areas, food sources, seasonal patterns, and genomic and bear lineage.<br>• Assess and take action to address community members' interests and needs for future grizzly bear research.<br>• Mobilize findings of research: host community nights with practical components to teach findings in inter- and intra-community settings. Presence in Churchill in formal and informal formats are an effective way to increase awareness, engagement, and share findings. Can also be done through Youtube videos that community members can access and have up to date information. |
| Wildlife Managers | • Define acceptable methods for managing conflict (options identified by participants are: no bad habit bears, no bears, a three-strike rule, collaring notable problem bears, minimal intervention for up to three years to |

| | |
|---|---|
| | assess the rate and type of encounters), or introduce a tag system if the population could support it.<br>• Determine acceptable interventions for grizzly bears entering the town or near town limits. Describe grounds for lethal action against the bear and develop protocols to capture and relocate bears (including an appropriate distance/location for relocations).<br>• Create targeted grizzly bear education materials for locals, tourism operators, and government agencies covering both natural scientific data as well as information on how to mitigate and minimize risk.<br>• Establish safety guidelines for mitigating human-grizzly conflict through safety distance recommendations, determining how to grizzly bear proof buildings and property, and educating people on the consequences of defence of life and property kills. |

### 4.2.2 Acceptable Management Strategies and Actions to Mitigate Human-Grizzly Bear Conflict

While discussing the gaps and limitations in Churchill's grizzly bear management, participants discussed ideas for mitigation and management options. Successful coexistence depends on many factors, and a supportive and engaged community plays a key role in how the social-ecological system adapts to a novel ecosystem. To manage human-grizzly bear encounters and reduce potential conflicts, participants suggested developing criteria to dealing with problem bears parallel to the ones already established for polar bears. Some participants were open to a three-strike rule, where after three offences by the same bear (monitored through tagging and identification efforts), the bear is relocated or killed. Other participants pondered what the full extent and behaviour of the grizzly bears will be and wondered about giving the bears some time to exist in the area, while locals, and researchers observe and monitor them before implementing any management efforts. Some fear that doing nothing would put locals into a reactive position

to deal with bad habits formed during this grace period for the grizzly bears. Finally, some participants spoke of a no bad habits rule, opting instead to eradicate or stop issues before grizzlies can build human-endangering habits or pass them down to their cubs. This fear is rooted in the long history of problem polar bears at the old town dump, where a particularly stubborn polar bear known to locals as "Linda" became dependent on the dump. She continued to bring her cubs back year after year, passing down the easy food source to her cubs, who, in turn, passed this knowledge to the next generations.

Participants discussed the opportunities that grizzly bears might bring to the area, which is known as the polar bear capital of the world. Some wondered about expanding tourism to include grizzly bears. The idea of grizzly bear viewing tourism was only suggested by those not in the wildlife tourism industry and was strongly opposed by those working in the industry. All interviewed participants in the tourism industry maintained that although grizzly bear tourism would be unique and an opportunity, grizzly sightings are not consistent enough to market to tourists. Furthermore, the risks associated with grizzly bear tourism were not worth it for them to try. Another participant brought up the potential for creating a grizzly bear tag system to create an opportunity for grizzly bear sport hunting. This opportunity exists in Nunavut, but again locals were wary of the grizzly bear numbers and the potentially negative population impacts of a sport hunt. Developing a tag system and limits would also require a designation status change for the grizzly bears in the province. It is currently not legally an option and would require a lot of investment from local hunters and tourism operators to establish, as well as high levels of monitoring and oversight by government agencies.

Questions remain about what ethical and fair treatment for grizzly bears looks like. Participants discussed both hands-on and hands-off approaches to shape the future of human-grizzly coexistence in Manitoba. While the current polar bear systems and infrastructure have been successfully used to manage and hold grizzly bears, some participants were worried about their safety. For example, a grizzly bear was captured and held in polar bear jail for a short period of time. Although it was cared for by veterinarians and was monitored by staff, some participants wondered about the bear's physical and psychological wellbeing while in captivity. Biological questions about being supplied with the right diet and if the bears could safely be restrained in the cells were all concerns, as well as if there are any long-term effects of sedating

and relocating a grizzly bear to a different area. Participants wondered about what the most effective monitoring options for grizzly bears would be. Locals have advocated for minimally invasive monitoring efforts, but some asked if radiotelemetry equipped collars would be safe for grizzly bears based on their body builds and the option to have a looser fitting collar without it slipping off a grizzly bear's neck. Researchers have successfully used GPS equipped collars and medications to subdue grizzly bears and manage conflict (Proctor et al., 2019) but relocations have rarely been successful (Spencer et al., 2007; Kermish-Wells et al., 2018), which is mirrored in participants own experiences with relocating problem polar bears and in the literature (Derocher et al., 2018). This option would be best once problem grizzlies are identified and could be used to track and intercept them before they reach town. While community members are open to the options mentioned above, there is a strong desire for decisions made on grizzly conflict management to be closely monitored and interventions implemented swiftly.

### 4.2.3 Local Interest and Engagement for the Future of Human-wildlife Research

It is clear from my research that there are steps and efforts that need to be taken to support human-grizzly bear coexistence on the west coast of Hudson Bay. My recommendations come from policy makers, individual community members, and wildlife managers who to close the continuing research gaps on the human dimensions of grizzly bear presence within Manitoba.

First and foremost, grizzly bear specific education materials need to be developed for community members, tourism operators, and tourists. Materials should include both biological data and behaviour information to inform people of seasonal habits, hibernation patterns, diet information, body language. Participants are already looking towards outside resources such as documentaries focused on west coast grizzly bears and northern grizzly bears in the Yukon, but there is a desire to learn about the local bear populations because the landscape is different—eliciting different responses, behaviours, and stressors from the grizzly bears. Participants were interested in learning directly from other communities that are coexisting with grizzly bears. While this has been discussed with previous researchers, it would rely on relationships between communities to establish and initiate the engagement for intra-community learning opportunities. Locals want to avoid re-inventing the wheel when it comes to grizzly bear management. In the Churchill community, there are different levels of understanding and experimentation for

deterring grizzly bears and protecting property. Capitalizing on the community's knowledge is a potential first step for inter-community learning, as is identifying tactics specific to the Manitoba grizzly bears. Hosting a grizzly bear education night in Churchill would be a convenient way for researchers to share academic findings, document local and traditional knowledge holders' insights, and identify a network of local people with experience adapting and innovating infrastructure in remote settings to protect property and stop unwanted bear behaviours before they are engrained and passed down.

Investing in knowledge sharing through inter-community learning not only fosters the relationship between community members and grizzly bears but also between researchers and the residents of Churchill. My master's research would not have been possible without the long-standing relationship between my supervisor Dr. Clark and Churchill residents. When researchers attend and present their findings at community meetings, an opportunity is created for knowledge dissemination and for future research interests to be identified and prioritized by locals. Community meetings as venues for knowledge dissemination and local involvement aligns with best practices for community-based research (Wilmsen, 2019). During my interviews, participants vocalized their appreciation for the inclusion of local voices and perspectives and spoke of the mistrust between outside researchers and community members. One participant stated, "You're talking to me, you're talking to people in town. That's a good thing, I think that's a good thing. More of a connection and maybe more a trust for that information that comes out of it in the end." Including locals in wildlife management decisions and discussions increases their acceptance and willingness to support policies and management decisions (Gore et al., 2007).

My final recommendation is that just as more qualitative and community-based research efforts need to be carried out, so are more quantitative studies on the Manitoba grizzly bears, a point reinforced in the interviews. Participants wanted to know more about grizzly bear biology and physiology, their hibernation patterns, and their eating habits on western Hudson Bay. To make decisions without an investigation into these topics would be short sighted and could be harmful to both humans and bears. Quantitative, natural scientific data are important for locals as they want more than one type of data to guide population management decisions. Locals are looking for a hybrid approach and the incorporation of local needs into policy and decision

making to ensure that community voices are included and that management choices are properly informed.

### 4.3 Challenges and Limitations

Although the research objectives were addressed throughout this study, a variety of challenges presented themselves. First, this research is unique to the changing human-wildlife dynamics on western Hudson Bay. Because this area is the only documented location of habitat overlap of all three North American bear species (Clark, 2019), it is a novel ecosystem (see Lugo & Helmer, 2004; MacDougall & Turkington, 2005). While some of the bear species coexist in other Arctic regions, management options differ based on legislation and governance due to the establishment of Land Claims between Indigenous Peoples and the Canadian Government and the wildlife management strategies of the organizations of different hunters and trappers.

Community members of Churchill, Manitoba experience different situations than other northern communities due to the town's economic dependence on wildlife tourism and lack of Land Claim institutions. Tourism is one of the community's main economic drivers (Lemelin & Weirsma, 2007). Churchill's is famous for being the polar bear capital of the world, and for approximately two months each fall, travellers from all over the world come to see polar bears. Wildlife tourism in the area also occurs during the summer months, when tourists come to see the Beluga whales in the Churchill River estuary. The changes occurring to the region's ecosystem are likely to have impacts beyond the bear species alone and threaten the financial stability of individual's and the community.

My research may be viewed by some as having limited application and generalizability to other ecosystems and regions. While this study does have some unique aspects to the human-bear relationship and species overlap, bear behaviours and human interactions are more complicated and complex that how it appears at a glance (Schmidt et al., 2022). If one is looking for exact matches in explorations of social-ecological systems, then this is likely true. However, outcomes of this research from exploring human attitudes in a novel ecosystem can apply directly to other communities entering a phase of instability in human-wildlife systems. This novel ecosystem is unique as it is one of the rare instances where humans are not driving the re-introduction of the species to the landscape (Morse et al., 2014). Many of my participants were

already adapting and evolving their tactics to mitigate the impacts of grizzly bears and assessing their knowledge overlap between the black bears and polar bears. During interviews, they discussed educational outlets and resources that they were independently looking at for support, including other remote communities both north and west of Churchill. They were also learning about strategies that are effective in managing and deterring interactions with the grizzlies.

A second seeming limitation of my study is the sample size of 13 participants. However, qualitative research relies on influences other than sample size to indicate robust data collection and representation of findings compared to natural scientific research. Qualitative inquiry relies on reaching a point of saturation in your data where no new content is being shared by participants indicating that you have a range of perspectives represented from the community in your findings (Eden et al., 2005) instead of misapplying findings from a small random subset to the community at large. Q method specifically is useful in smaller studies as it is robust and data rich in even small numbers (Watts & Stenner, 2012). The Q method portion of my research had a higher participation rate than expected and provided me with high-quality data to explore and understand the nuances of the different perspectives of Churchill's community members. A unique expectation of community-based and northern research is the capacity and engagement of participants. In an ideal world, locals would be consulted and included in all ongoing research in the area, but this would demand capacity that is not always feasible. My sample size was appropriate to the community and research style, especially under pandemic conditions. My goal during data collection was to reach saturation, where no new information or perspectives were emerging from the interviews and Q sorts with the Local and Traditional Knowledge holders. I hit this point and was even able to identify an emerging perspective on species-specific knowledge. Between the two perspective themes of risk and species-specific knowledge I identified a range of experiences and was able to identify influences to individual's understandings.

While recruitment was an open process throughout all stages of my research, participant largely self-identified as Inuit (one participant), Cree (one participant), and Metis (one participant) or Unknown/ undisclosed ( ten participants), likely leaving Indigenous Peoples' perspectives – Dené in particular – underrepresented in my findings. Interviews were conducted until saturation, meaning that no new or differing insights were emerging and that we had

captured a range of perspectives and opinions. Interviews are rich and contextually dependent. To explore the data and complement my interview method, I then implemented Q methodology.

Q methodology was the best choice to pivot from the originally intended workshops (which did not happen due to the pandemic) because it allowed people to participate safely and in a format of their choice while still providing triangulation and validation of my findings from interviews. The interview transcripts helped to provide depth, richness, and clarity that is missing from quantitative methods alone and, like interviews themselves, are robust in small numbers (Watts & Stenner, 2012). Q methodology was then used to assess consistent beliefs and perspectives within the sample population. Direct quotes and sentiments were sorted by participants in what is called a Q Sort to display their agreement and disagreement on a particular theme. New to the participants, Q methodology elicited some strong emotions. Emotions emerged because of participants wanting to freely distribute the statements into a more agreement/disagreement orientation instead of being asked to sort statements into the forced distribution structure (see figures 6 and 7 in Appendices I and J respectively). Using a forced distribution structure has not been found to impact findings of research but requires participants to evaluate and sort in a more nuanced and scaffolding beliefs (Brown et al., 2015). Almost all participants that took part in the interviews were willing to try the Q sorts. Some found them awkward or limiting, but this is a common experience for people as they have to choose and rank statements. One participant declined, explaining that they did not have the time to conduct a sorting activity but offered to do another interview if required.

Conducting Q sorts also allowed me to address the gender imbalance from the first phase of data collection. I interviewed eight men and only one woman, and successfully recruited three more women to participate in the Q sorts. All participants were asked to participate as individuals representing their own views and beliefs, and these female participants loaded onto the same factors for perspectives both on species-specific knowledge and risk. Interviews were conducted until I reached a point of saturation while being aware of the capacity of individuals to share their personal knowledge and expertise. The recruitment process for this research began with local and traditional knowledge holders as well as hunters and trappers. While community members of all genders take on these roles and participate in these activities, the initial list of people invited to participate in this study, who had been previously involved with Transforming

Arctic Communities through Social Innovation (TACSI) research prioritizing cabin and trapline owners experience and knowledge in the region which happens to be predominantly male.

A mixed-methods approach was advantageous because it allowed for in-depth and complex insights from the interviews and because triangulating findings using Q-methodology uncovered the unique perspectives held in the community, revealing where the dominant and subcurrent trends in thinking exist. Understanding what is influencing people's knowledge and perspectives can be a useful access point to seeking clarification and working within pre-existing social networks to gain local support and awareness of human-wildlife conflicts. Although qualitative semi-structured interviews are commonly used by researchers and many participants had been interviewed previously, Q-methodology was new to them. Participants commented that Q-methodology was uncomfortable in some ways, but many understood why the forced-distribution mattered and indicated that it made them think about where they would sort items. This research was exploratory in subject matter and in methods, allowing it to be relevant to and influential in different regions, species, and communities.

### 4.3.1 COVID Impact

Due to the COVID-19 pandemic, my research plan changed many times as the implications of the virus changed almost every aspect of people's lives. Initially I had planned to travel to Churchill to meet with participants in person to conduct interviews and run workshops. For a brief moment in late February and early March 2020, I had planned to move to Churchill until the fall, but this plan was scrapped when it became apparent that it was no longer a viable option, neither socially nor logistically. The impacts of the Spanish influenza are still in community living memory for Churchill residents. To enter Churchill at the beginning of spring 2020 would have been putting my wish to conduct in-person research ahead of the community's needs. If I were to respect these needs, I could not forge new relationships. Instead, I had to rely on relationships previously established by my supervisor, as well as his social currency. Thankfully, he has continued to foster his own personal and professional relationships with community members since he worked at the CNSC. I was able to further these relationships and develop my own during interviews, Q sorts, and approval of quotes.

Some research programs have been hit hard by communities shutting their borders and refusing research permits (Forrester, 2021). Researchers with long standing community relationships and connections to research centres and local groups have been successful in finding another way. Researchers, primary investigators, and private sector companies have had to lean on and train research centre staff, community members, hunters and trappers' organizations (HTO), and local groups to carry out their ongoing projects. Research funders also have had to pivot to support ongoing projects throughout the pandemic, and crowd sourcing has become more popular in the scientific community to share data and resources to protect ongoing projects (Walker et al., 2022). I was fortunate enough to work with Erica Gillis, the scientific manager at CSNC, throughout my data collection process where she acted as the first point of contact with participants. Gillis summarized her learning and involvement with research in general and specifically my research during the pandemic in *Nature* (Forrester, 2021).

Researchers were worried about a lack of connection and personal involvement between researchers and community members, but my experience was quite different and arguably better than it would have been had I conducted formal in-person interviews. My participants welcomed me into their homes and businesses through video conferencing and phone discussions. Some participants made time to chat with me while on their lunch break from doing dog chores. Others sat at the kitchen tables, and we chatted like old friends, or paused our conversation, so they could check in with their staff in the morning.

There are a few things that I believe worked in my favour in conducting rich remote interviews and in trouble shooting I figured out along the way. Initially, I tried connecting primarily over Webex, but this technology was only successful for one participant, and it was not as seamless as I would have hoped. It was clear from one interview that the bandwidth required for videoconferencing would be an issue, as well as the privacy and space for participants to conduct the interviews, so I quickly pivoted to interviewing people over phone. Talking over the phone allowed for a more informal and conversational tone, removing some of the sterile and procedural elements that in-person interviews can unintentionally create. Rather than interviewer and interviewee sitting across a table from one another and making intense eye contact, with a recording device pointed at or placed near the interviewee and the interviewer scribbling furiously, we were just having a conversation. Second, I believe being a friendly and inquisitive

female disarms participants. I asked questions for clarification on the things they were sharing, demonstrating that they were the experts and that I was not trying to uphold any social or gender roles or suggest that I knew more than they did about what was going on out on the land or in the community. I let the participants lead on bear topics and tried my best to ask open-ended questions to let them guide me through their experiences. We talked about more than people and the bears though. We chatted about the on-going work projects in town, how the pandemic was impacting their business and their friends and family in other areas of the country, and how things have changed since they were children.

My experience doing research throughout the pandemic was different than that of researchers in other programs because I had been able to visit Churchill before the pandemic and meet people. Because of my supervisor's longstanding personal and professional relationships in the community, I leaned on research infrastructure and collaborative efforts with the CNSC to be the first point of contact with participants, and I maintained the relationships throughout my writing and disseminating process. For many students, relationships forged during the research process end when the thesis is completed, but this has not been case for me. As other projects have continued with Churchill community members, I was told by our partners at CNSC and lab mates that participants were curious about how things were going for me and wondered if they would get to hear the results. To address this wish for a continuing relationship, our lab group conducted a symposium with participants and community members to thanks them and to share what emerged from our research. Changes to the Northern Scientific Training Program's funding support have allowed students to use funding to disseminate research and return to communities—a step forward in making the end research effective, relevant, and useful for communities.

### 4.3.2 Churchill Research Symposium

In the first week of May 2022, Dr. Lauren Harding and I, working with Dr. Clark on the Traditional Knowledge report for Manitoba (Harding & Clark, 2022) and Nunavut (in preparation by Harding & Clark), travelled back to Churchill for a week to present findings from our work and inquire about community members' interest in future research efforts in both formal and informal settings. Dr. Harding and I set up a booth in the community complex with

posters and maps, so we could chat with people as they walked by for two days. Many people visited us, and the casual nature of a table with maps and photos of grizzlies brought people in who likely would not have talked to us in a different setting. We hosted a formal information session to share both of our projects, and another lab mate joined virtually to present her work as well. Approximately 20 community members attended, including Wapusk National Park staff, new community members, tourism operators, and local hunters and trappers. The formal presentation took place in the evening between the two informal days, and a significant number of attendees visited our booth on the final day to hear more, ask further questions, and bring friends who were unable to attend the day before. It was a highlight for me to hear about lightbulb moments from people who had connected what I shared in the presentation with their own reflections about how vulnerable the town is to grizzly bear damage. During my presentation, I demonstrated the push (typical force exerted by polar bears to break into a cabin) versus pull (typical force exerted by a grizzly bear to break into a cabin), and a Parks staff member commented that his mind started racing when I did this, identifying all the places in town that are not prepared.

### 4.4 Significance of the Study

The broader significance of this research is in the social process and context of the novel ecosystem. Churchill residents find themselves inhabiting a new social-ecological system (Clark et al., 2018). Humans and bears have lost their relationship and now must reestablishment social norms and patterns for coexistence (Clark et al., 2018). This study is significant because to address the situation and identify the source of the problem and initiate decision-making requires a nuanced understanding of the context of activities on the western coast of Hudson Bay (Clark, 2016).

This research has explored the human dimensions of human-bear coexistence in western Hudson Bay. Due to the unique overlap of all three North American bear species and lack of research on Manitoba grizzly bears, this study has set the stage and opened the door for more qualitative and quantitative research to follow. Human-bear interactions have been explored in other regions and have been highly focused on bear activities and characteristics, omitting how humans influence interactions (see Dyck, 2006; Laforge et al., 2017; Schmidt, 2017; Towns et

al., 2009). As the grizzly bear population remains classified as extirpated in Manitoba, little biological and scientific research has been conducted and no thorough qualitative research. Clark et al. (2022) have published a state of the knowledge report for Environment and Climate Change Canada (ECCC) (Harding & Clark, 2022) as a part of the development of a national grizzly bear conservation plan. My interviews for this thesis contributed to this work and were the first qualitative data to be collected on grizzly bears in Manitoba. The success of this larger work has led to traditional knowledge studies being contracted by Environment and Climate Change Canada for Manitoba and Nunavut. This research builds upon the work of Dr. Schmidt in her doctoral research and is being continued by Dr. Harding—all supervised by Dr. Clark in our lab group. This research builds upon non-invasive data collection methods, human dimensions of wildlife research, and participatory community-based research.

This project had to adapt to the demands of a global pandemic that threatened, halted, or sparked innovation on how research can be conducted. Researchers everywhere had to put their work on hold or make massive pivots to keep projects running. Conducting this research during the pandemic demonstrated that there is a way to move forward and collect rich data while fostering community-researcher relationships and abiding by travel restrictions. The source of this research's success was my lab's ongoing relationship with the CNSC as lab members were my ambassadors in the community, along with the 25-plus year relationship that my supervisor has built and maintained since his days working at the CSNC and in Wapusk National Park. Although it would have been enriching for me as the researcher to spend more time in the community and learn the nuances of the social-ecological systems in Churchill, it would not have been what was best for the community. Conducting remote interviews allowed me to engage with participants differently than in-person and still produce valuable insights and revelations about bears and people on the land.

Exploring the overlap of knowledge systems and interactions between the three bear species is significant and will evolve overtime. Having information about how the bears are learning, adapting, and sharing the landscape will prove vital for future bear management decisions. Looking at the human dimensions of each human-bear relationship provides policy makers and wildlife managers with advice on how to best include, engage, and continue to foster a sense of trust with locals. I view the traditional and local knowledge gathered in this research

as landmarks for future work to be built upon and added to. The novel ecosystem is changing, and while people are evolving with it, not everyone is doing so at the same rate. There is an opportunity to actively choose to invite Churchill locals to participate in what human-bear coexistence will look like in the future. Documentation began with the state of knowledge report (Clark and Brook 2022), and this work has added qualitative data to enrich and illuminate the current human-grizzly bear relationship.

### 4.5 Conclusions and Suggestions for Further Research

This research makes significant contributions to understanding the human dimensions of novel ecosystems and social-ecological systems in a rapid state of change. The geographic region and human-bear relationship explored provide insights and knowledge for wildlife managers and policy makers to create formal management plans. Including local and traditional knowledge in plans not only increases local support but also provides untapped knowledge, observations, and influences, which researchers can miss when collecting data using traditional formats. As findings from this thesis illuminate, residents of Churchill are in various stages of innovating to protect life and property from the grizzly bears. There are many questions that need answering, and the participants identified gaps, areas in which locals acknowledge the limitations of their experiences and knowledge, as well issues with community infrastructure and resources. Furthermore, the documentation of grizzly bear behaviour and activity in the province is beneficial to the evolving status and management plan. Understanding the consistency, frequency, and nature of grizzly bear related encounters and how they differ from black bear and polar bear encounters in Manitoba will impact future decisions and education strategies. Although this research is exploratory, it includes accessible first steps that can support people in managing human-grizzly bear interactions and set the community on the trajectory for successful coexistence.

By using a mixed-methods approach, this thesis highlights the nuances in individuals' experiences through interviews and reveals how community members have different perceptions of human-bear coexistence. Chapter One laid the foundation and methodological process that informs this research. Chapter Two addressed my research questions about how familiarity with bear species influences risk perceptions and if bear knowledge is species-specific or overlaps

between species. Chapter Two was prepared in a manuscript format to be published and targeted for the *Conservation and Society* journal. In Chapter Three, I discussed the research process, including limitations, learnings, and opportunities for further research.

My recommendations for further research are to continue to engage with local communities to develop effective and supported wildlife management plans. Specifically, I suggest that future researchers look at where and when the grizzly bears are currently living, denning, and travelling within the Manitoba. Secondly, I think there is a lot of work and exploration that can be done on how grizzlies react to other deterrents like motion lights and how to set up consistent negative reinforcement for interactions with cabins and property (likely using electrical fences) or other accessible options for community members. Thirdly, it was evident to me throughout the research process that there is so much local knowledge, interest, and innovation already happening in Churchill to mitigate human-grizzly conflict and encounters. Capitalizing on this grassroot community engagement is critical to safe and successful coexistence between people and all wildlife so empowering locals and the community to have a voice, be involved, and educated on the conservation plan and any potential management plans will be critical to any level of success and maintaining trust between policy makers, local management institutions, and community members. Locals want and need to participate and share their knowledge with researchers, but this knowledge has previously been discredited and systematically undervalued in northern communities. Continuing to explore the grizzly bear presence and its impacts in Manitoba using both qualitative and quantitative methods can document grizzly bear behaviours and encounters and help develop grizzly bear specific educational materials to be widely shared.

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# APPENDICES

## Appendix A: 2019 Interview Guide

1) Start off with how long have you lived in town? Do you belong to any organizations (HTO, BearWatch, etc.)?
2) Can you tell me about your time on the land? Typical area, activity, time, owner, hunting, trap line? Has that changed over time? Do you want to describe why? (e.g. Churchill River diversion, changing travel conditions, work/family obligations)
3) Tell me about your bear interactions? (with any of three species) Where have you had them? By yourself? With family? Personal property damaged?
4) What are some other's experiences you know about? (may need to explain you're not asking the participant to speak for those other people)
5) What do you think about grizzly bears being seen more frequently in northern Manitoba? What about them coming around and into Churchill?
6) How would you feel about interacting with a grizzly bear? Describe a situation that is too close for comfort? Would this be different than with a polar bear or a black bear? How?
7) How do you think the town overall would interact with incoming grizzly bears? Benefits? Consequences?
8) How do you think Churchill should address grizzly bears in the future? What about Manitoba as a whole? How should the community deal with a problem grizzly bear? Does it need to be different than a polar bear?
9) What gaps do you see in town or on the land for dealing with grizzlies?

**Appendix B: Interview Transcripts**

**Appendix C: Q Sort Consent Form**

# *Participant Consent Form*

**You are invited to participate in a research study entitled:**

TACSI: Transforming Arctic Communities Through Social Innovation

**Researcher(s):** Katie Manning, Graduate Student, School of Environment & Sustainability, University of Saskatchewan, (306) 221-1991, katie.manning@usask.ca

**Supervisor:** Dr. Douglas Clark, School of Environment & Sustainability, (306) 966-5405, d.clark@usask.ca

**Purpose(s) and Objective(s) of the Research:**

- To identify how familiarity with a species (polar bear, black, bear, and grizzly bear) influences Churchill community members perceptions of risk.
- To identify what knowledge holds true across all bear species in the study area, specifically:
    - What polar bear knowledge is applicable to grizzly bears?
    - What are the current gaps and/or limitations in Churchill's bear management institutions to address human–grizzly bear conflict?
    - What are considered acceptable management strategies and actions to mitigate future grizzly bear conflict?

## Procedures:

- Data collection will be conducted through online software (https://qmethodsoftware.com/) or if desired a hard copy, instructions, and components will be delivered through contactless drop-off by the research partners at the Churchill Northern Studies Centre.
- Participants will be asked to complete two sorting activities, arranging a series of statements pulled from the interviews conducted in the first phase of data collection. Statements will be sorted into strongly agree, agree, neutral, disagree, strongly disagree and then be organized into a pyramid like shape, not just piles.
- Please feel free to ask any questions regarding the procedures and goals of the study or your role.

**Funded by:** *Social Sciences and Humanities Research Council (SSHRC), Northern Scientific Training Program (NSTP).*

**Potential Risks:**

- There are no known or anticipated risks to you by participating in this research.
- Risk(s) will be addressed by double password protected data storage. Participants will be asked to share basic information for the purposes of processing honorariums, ensuring that sorts are not being completed multiple times by the same person and verification with participants prior to dissemination. Involvement can be terminated at any time without explanation and no negative impacts regarding future research.

**Potential Benefits:**

- This research is intended to contribute to the theoretical and applied aspects to both formal bear management and grizzly bear local knowledge in Canada and across the circumpolar north. Specific contributions include (1) Improve understanding of how familiarity with a "new" wildlife species impacts risk perceptions; (2) Increase understanding of what knowledge about polar bears is transferable to grizzly bears in northern Manitoba; (3) Document local knowledge about the grizzly bear population; and (4) improve understanding of community-engaged and community-based research in Canada's north through sourcing local perspective, insights, and knowledges on what the community needs are, and to identify community supported methods for grizzly bear research/management.

**Compensation:**

- Participants will be offered an honorarium of at the appropriate rate ($100). Honorariums will be processed through the Churchill Northern Studies Centre so no social insurance numbers of government related identification required. Cheques will be received by mail to the location that is identified by participants.

**Confidentiality:**

- All data shared with the research team will remain double password protected. Data collected through the online platform will be removed from the platform with the raw data sets to be retained by the researchers in accordance with University time requirements.
- Participation is completely voluntary; participants have the right to withdraw from the research project at any time with no penalty or rescinding of honorarium. If someone chooses to withdraw and can be identified, all of their associated data will be deleted from the research project and destroyed, if desired.
- Identifying information (master lists of participants) is stored separately from the data collected. When the data collection is complete, and the master list is no longer required it will be deleted and destroyed. A master list will be required to provide honorarium as well as to ensure no one is completing the activity twice potentially influencing findings and to verify details and potentially ask if/how participants would like to be identified in dissemination. In previous studies participants have opted to be attributed. Identification of participants is more relevant to the interview phase of this research than the q-sort method.
- **Storage of Data:**
    - Data collected on the online software is housed in a GCP data centre in Montreal, Canada. All data is 100% isolated between users (and researchers), all data is encrypted

at rest, all communication between the participant and the system are fully encrypted as well. All personal personally identifying data is easily removed and can be done at any time. QMethod Software does not record IP addresses in the application logs.

- When the data no longer required, the data will be destroyed

**Right to Withdraw:**

- Your participation is voluntary and you can answer only those questions that you are comfortable with. You may withdraw from the research project for any reason, at any time without explanation or penalty of any sort.
- If you choose not to participate in this phase of data collection it will not limit continued or future involvement with other phases of data collection under the larger research project.
- Should you wish to withdraw, please contact Katie Manning (katie.manning@usask.ca) or Dr. Clark (d.clark@usask.ca) and any identifiable data related to your participation will be deleted and removed from the data set.
- Your right to withdraw data from the study will apply until results have been disseminated. After this date, it is possible that some form of research dissemination will have already occurred and it may not be possible to withdraw your data.

**Follow up:**

- To obtain results from the study, please stay posted as results and articles will be made available through the Churchill Northern Studies Centre. Potential other locations of sharing are on the Polar Bear Alert website, local facebook page or email the research team to request a copy of the documents produced.

**Questions or Concerns:**

- Contact the researcher(s) using the information at the top of page 1;
- This research project has been approved on ethical grounds by the University of Saskatchewan Research Ethics Board. Any questions regarding your rights as a participant may be addressed to that committee through the Research Ethics Office ethics.office@usask.ca (306) 966-2975. Out of town participants may call toll free (888) 966-2975.

**Consent:**

By completing and submitting the questionnaire, YOUR FREE AND INFORMED CONSENT IS IMPLIED and indicates that you understand the above conditions of participation in this study.

## Appendix D: Species-Specific Knowledge Q Sort Concourse

1 Black bears do less damage to cabins and property than other bears.

2 Black bears are easy to scare away, they are scaredy cats.

3 Black bears are persistent and keep coming back to get into things.

4 I find black bear body language/behaviour is easy to read.

5 Black bears charge people without warning.

6 The black bear population has increased over the last 20 years.

7 I think grizzly bear body language/behaviour is easy to read.

8 Grizzly bears cause the worst damage to cabins and property.

9 The grizzly bear population is increasing.

10 Typical cabin protection (nail boards and shutters) used to protect property is effective against grizzly bears.

11 Grizzly bear damage to cabins and property is different than polar or black bears.

12 Grizzly bears mostly pull and peel back to get into cabins.

13 The grizzly bear habitat range is expanding.

14 Grizzly bears are the more persistent than other bear species.

15 The barren-land grizzly bears around Churchill are different than the west coast salmon grizzly bears.

16 Grizzly bears are the most dangerous bear species.

17 Grizzlies cause the least frequent damage to cabins and property.

18 Grizzly bear behaviour is predictably mean.

19 Grizzly bear behaviour is more of a wild card and unpredictable than any other bear.

20 Grizzly bears charge without warning.

21 Polar bear behaviour has changed over the last 30 years.

22 Polar bears have become more curious about humans and buildings.

23 Polar bears used to be scared of humans.

24 Polar bears cause the most frequent damage to cabins and property.

25 Polar bears typically push and pound to get into cabins.

26 Nail boards and flush shutters are effective to keep polar bears out of cabins.

27 I think polar bear body language/behaviour is easy to understand.

28 More than one polar bear can inhabit the same area.

29 Polar bears are attracted to sweet and sugary things.

30 The geographic location of Churchill is why polar bears hang out in and around town.

31 Polar bears have cultural, economic, and geographic significance.

32 The grizzly bear presence will push black bears out of an area.

33 Pushing a bear away from an area needs to be specific to species.

34 An unclean cabin is asking for it.

35 Each individual bear has its own way of getting into things and causing damage.

36 I can tell which bear species broke into my cabin by the damage it causes.

**Appendix E: Risk Q Sort Concourse**

1 Bears have become more aggressive over the past 10 years.

2 People have become complacent about bear encounters.

3 Summer is the highest chance of a bear encounter.

4 People are bear aware year-round.

5 Using defence methods on personal property reduces bear invasions/damage.

6 I feel prepared to handle a grizzly bear encounter.

7 I feel prepared to handle a polar bear encounter.

8 I feel prepared to handle a black bear encounter.

9 I know how to handle the consequences of shooting a polar bear.

10 I know how to handle the consequences of shooting a grizzly bear.

11 I know how to handle the consequences of shooting a black bear.

12 Current community educational training for encountering black bears and polar bears is immediately transferable to grizzly bears.

13 Outside money and opinions have more influence than local interests for bear management.

14 A bear's life is treated as more valuable than a person's.

15 People are most upset by property damage caused by bears.

16 Everyone is well trained and informed about bear behaviours in town.

17 The seasonal Churchill population is a threat to successful human-bear coexistence.

18 On the ground safari style of bear tourism done in town negatively habituates bears to people.

19 Addressing problem bear behaviour should be done immediately.

20 Polar Bear Alert should be in charge of educating the public about all bear species.

21 Tourism operators and property owners need training and education specific to grizzly bears.

22 People who are uneducated about bears are more likely to shoot them.

23 I am fine with grizzly bears coming back.

24 Grizzly bears are more unpredictable than any other bear.

25 I perceive grizzly bears to be more dangerous than black bears or polar bears.

26 My lack of experience with grizzly bears makes them seem scarier and more unpredictable.

27 Grizzly bears should be managed in a similar way to polar bears.

28 I am considering new/more defence methods to protect my cabins/property.

**Appendix F: Optional Q Sort Survey**

1. What did you think overall about the sorting activity?

2. Were there any statements that were unclear? If so, please identify which and explain your interpretation of them.

3. Are there any statements that you would like to explain why you sorted into a particular spot?

4. If you were given a blank card to write a statement on what would it say? Where were you sort it?

## Appendix G: Species-Specific Knowledge Factor Loadings and Z Scores

Summary of a Q-method analysis of perspective of local knowledge holder's species-specific knowledge on western Hudson Bay. A Q-set of 36 statements were sorted by 10 participants. The eigenvalues and percentage variance explained are provided for each of four significant factors. The statement scores for each factor represent a weighted average derived from the contributing sorts. Distinguishing statements for each factor are denoted with an asterisk.

**Table 7: Complete species-specific knowledge factor loadings and Z scores**

| Statement Number | | Factors | | | | z score | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| **1** | Black bears do less damage to cabins and property than other bears. | -2 | -2 | 1 | -5 | -0.88 | -1.21 | 0.47 | -2.04 |
| **2** | Black bears are easy to scare away, they are scaredy cats. | -2 | -1 | 2 | -3 | -0.87 | -0.22 | 0.72 | -1.22 |
| **3** | Black bears are persistent and keep coming back to get into things. | 0 | -1 | 0 | 2 | -0.09 | -0.27 | -0.01 | 0.82 |
| **4** | I find black bear body language/behaviour is easy to read. | -1 | -3 | 2 | -1 | -0.48 | -1.21 | 0.49 | -0.41 |
| **5** | Black bears charge people without warning. | -2 | -1 | 0 | -2 | -0.77 | -0.81 | -0.24 | -0.82 |
| **6** | The black bear population has increased over the last 20 years. | -1 | 1 | -1 | 0 | -0.48 | 0.54 | -0.71 | 0 |
| **7** | I think grizzly bear body language/behaviour is easy to read. | 0 | -4 | -4 | 0 | -0.20 | -1.48 | -1.45 | 0 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **8** | Grizzly bears cause the worst damage to cabins and property. | -3 | -2 | -2 | -1 | -1.07 | -0.90 | -0.95 | -0.41 |
| **9** | The grizzly bear population is increasing. | -2 | 2 | -5 | 3 | -0.68 | 0.81 | -1.92 | 1.22 |
| **10** | Typical cabin protection (nail boards and shutters) used to protect property is effective against grizzly bears. | 0 | -5 | 0 | 0 | -0.28 | -1.80 | 0.22 | 0 |
| **11** | Grizzly bear damage to cabins and property is different than polar or black bears. | 0 | 1 | 4 | -3 | 0.19 | 0.32 | 1.67 | -1.22 |
| **12** | Grizzly bears mostly pull and peel back to get into cabins. | 3 | 3 | 1 | 0 | 0.96 | 1.13 | 0.47 | 0 |
| **13** | The grizzly bear habitat range is expanding. | 1 | 2 | -4 | 1 | 0.30 | 0.86 | -1.67 | 0.41 |
| **14** | Grizzly bears are the more persistent than other bear species. | -3 | -2 | -1 | 2 | -0.96 | -1.12 | -0.24 | 0.82 |
| **15** | The barren-land grizzly bears around Churchill are different than the west coast salmon grizzly bears. | 3 | 2 | 0 | 3 | 1.54 | 1.12 | 0.24 | 1.22 |
| **16** | Grizzly bears are the most dangerous bear species. | -4 | 5 | 3 | 5 | -1.45 | 1.71 | 1.20 | 2.04 |
| **17** | Grizzlies cause the least frequent damage to cabins and property. | 1 | -4 | -1 | -1 | 0.39 | -1.53 | -0.49 | -0.41 |
| **18** | Grizzly bear behaviour is predictably mean. | -4 | 1 | 1 | 2 | -1.74 | 0.72 | 0.24 | 0.82 |
| **19** | Grizzly bear behaviour is more of a wild card and unpredictable than any other bear. | -3 | 3 | 1 | 4 | -1.35 | 1.21 | 0.26 | 1.63 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **20** | Grizzly bears charge without warning. | 1 | 4 | -3 | 3 | 0.56 | 1.21 | -1.21 | 1.22 |
| **21** | Polar bear behaviour has changed over the last 30 years. | 2 | 0 | -3 | -1 | 0.58 | 0.18 | -0.96 | -0.41 |
| **22** | Polar bears have become more curious about humans and buildings. | -1 | 1 | -2 | -3 | -0.40 | 0.49 | -0.95 | -1.22 |
| **23** | Polar bears used to be scared of humans. | 0 | 0 | -2 | -4 | 0.09 | 0.18 | -0.73 | -1.63 |
| **24** | Polar bears cause the most frequent damage to cabins and property. | 1 | 3 | -1 | -2 | 0.58 | 1.17 | -0.25 | -0.82 |
| **25** | Polar bears typically push and pound to get into cabins. | 4 | 2 | 1 | -1 | 1.83 | 1.08 | 0.24 | -0.41 |
| **26** | Nail boards and flush shutters are effective to keep polar bears out of cabins. | 0 | 1 | -1 | -4 | -0.09 | 0.49 | -0.71 | -1.63 |
| **27** | I think polar bear body language/behaviour is easy to understand. | 1 | 0 | 3 | -2 | 0.49 | 0.18 | 1.20 | -0.82 |
| **28** | More than one polar bear can inhabit the same area. | 4 | -1 | 2 | 1 | 1.55 | -0.27 | 1.19 | 0.41 |
| **29** | Polar bears are attracted to sweet and sugary things. | -1 | -1 | 0 | 1 | -0.68 | -0.86 | 0.01 | 0.41 |
| **30** | The geographic location of Churchill is why polar bears hang out in and around town. | 2 | 4 | 4 | 4 | 0.68 | 1.48 | 1.68 | 1.63 |
| **31** | Polar bears have cultural, economic, and geographic significance. | 5 | 0 | 2 | 1 | 2.04 | 0.22 | 0.97 | 0.41 |
| **32** | The grizzly bear presence will push | -5 | -3 | -3 | 0 | -1.83 | -1.44 | -0.96 | 0 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | black bears out of an area. | | | | | | | | |
| **33** | Pushing a bear away from an area needs to be specific to species. | -1 | -3 | 0 | 0 | -0.58 | -1.26 | -0.24 | 0 |
| **34** | An unclean cabin is asking for it. | 2 | -2 | 5 | 2 | 0.96 | -0.99 | 2.16 | 0.82 |
| **35** | Each individual bear has its own way of getting into things and causing damage. | 3 | 0 | 3 | 1 | 1.26 | 0.22 | 1.19 | 0.41 |
| **36** | I can tell which bear species broke into my cabin by the damage it causes. | 2 | 0 | -2 | -2 | 0.87 | 0.04 | -0.94 | -0.82 |

## Appendix H: Risk Factor Loadings and Z Scores

Summary of a Q-method analysis of risk perceptions of local knowledge holders on western Hudson Bay. A Q-set of 28 statements were sorted by 10 participants. The eigenvalues and percentage variance explained are provided for each of four significant factors. The statement scores for each factor represent a weighted average derived from the contributing sorts. Distinguishing statements for each factor are denoted with an asterisk.

**Table 8: Complete risk factor loadings and Z scores**

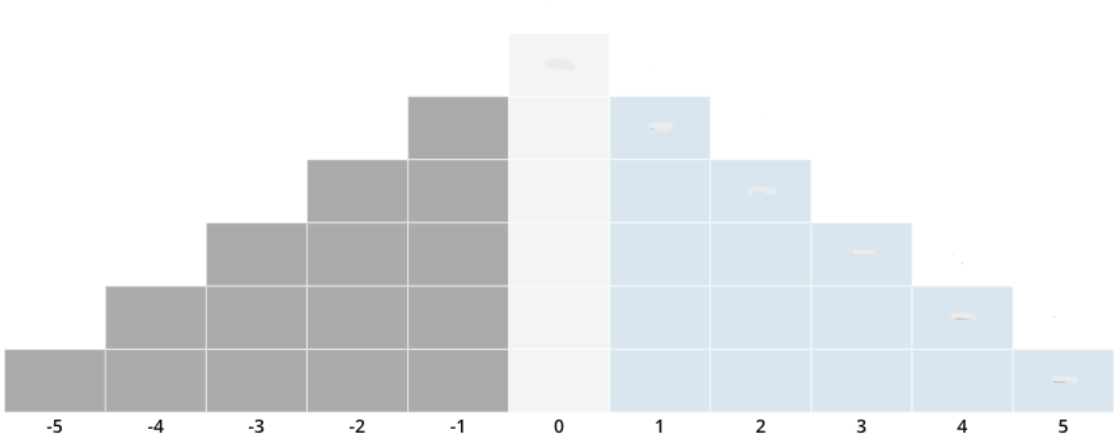
| Statement | | Factor | | | z score | | |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 1 | 2 | 3 |
| **1** | Bears have become more aggressive over the past 10 years. | -1 | -1 | -5 | -0.18807 | -0.16646 | -1.87713 |
| **2** | People have become complacent about bear encounters. | -1 | -4 | 1 | -0.72494 | -1.49737 | 0.47049 |
| **3** | Summer is the highest chance of a bear encounter. | -3 | -2 | -1 | -1.17059 | -1.03734 | -0.24862 |
| **4** | People are bear aware year-round. | -1 | -1 | -2 | -0.70766 | -0.59698 | -0.57647 |
| **5** | Using defence methods on personal property reduces bear invasions/damage. | 1 | -1 | 2 | 0.51727 | -0.4502 | 0.80342 |
| **6** | I feel prepared to handle a grizzly bear encounter. | 2 | -2 | 2 | 0.75792 | -0.90039 | 1.01537 |
| **7** | I feel prepared to handle a polar bear encounter. | 5 | 1 | 5 | 1.50302 | 0.60682 | 2.27349 |
| **8** | I feel prepared to handle a black bear encounter. | 2 | 2 | 4 | 0.84703 | 0.60682 | 1.42752 |
| **9** | I know how to handle the consequences of shooting a polar bear. | 4 | 0 | 3 | 1.29462 | -0.13695 | 1.25812 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **10** | I know how to handle the consequences of shooting a grizzly bear. | 1 | 0 | 0 | 0.4449 | -0.13695 | 0.02167 |
| **11** | I know how to handle the consequences of shooting a black bear. | 3 | 1 | 1 | 1.06315 | 0.30341 | 0.02167 |
| **12** | Current community educational training for encountering black bears and polar bears is immediately transferable to grizzly bears. | -3 | -3 | -4 | -1.20145 | -1.05701 | -1.44331 |
| **13** | Outside money and opinions have more influence than local interests for bear management. | -4 | 3 | 1 | -1.2707 | 1.49737 | 0.20607 |
| **14** | A bears life is treated as more valuable than a persons. | 4 | -5 | -3 | 1.48681 | -1.66383 | -1.35901 |
| **15** | People are most upset by property damage caused by bears. | 0 | 2 | -1 | 0.32236 | 0.73393 | -0.22775 |
| **16** | Everyone is well trained and informed about bear behaviours in town. | -2 | -1 | -4 | -1.05885 | -0.30341 | -1.49095 |
| **17** | The seasonal Churchill population is a threat to successful human-bear coexistence. | -4 | -2 | 0 | -1.50524 | -0.77328 | -0.12686 |
| **18** | On the ground safari style of bear tourism done in town negatively habituates bears to people. | -5 | 5 | 1 | -2.11104 | 1.81062 | 0.41723 |
| **19** | Addressing problem bear behaviour should be done immediately. | 0 | 4 | 3 | 0.42702 | 1.80078 | 1.07372 |
| **20** | Polar Bear Alert should be in charge of educating the public about all bear species. | 1 | 2 | -2 | 0.5477 | 0.90039 | -0.71832 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **21** | Tourism operators and property owners need training and education specific to grizzly bears. | 0 | 1 | 2 | 0.19718 | 0.14679 | 0.7242 |
| **22** | People who are uneducated about bears are more likely to shoot them. | 1 | 0 | 0 | 0.45346 | 0.00984 | -0.18011 |
| **23** | I am fine with grizzly bears coming back. | 0 | -4 | 4 | 0.09335 | -1.36042 | 1.31137 |
| **24** | Grizzly bears are more unpredictable than any other bear. | -1 | 1 | -1 | 0.00923 | 0.14679 | -0.43891 |
| **25** | I perceive grizzly bears to be more dangerous than black bears or polar bears. | 3 | 4 | -2 | 1.18578 | 1.50721 | -0.78763 |
| **26** | My lack of experience with grizzly bears makes them seem scarier and more unpredictable. | -2 | 3 | -1 | -0.91124 | 1.05701 | -0.39636 |
| **27** | Grizzly bears should be managed in a similar way to polar bears. | -2 | -3 | -3 | -1.01994 | -1.19396 | -1.01029 |
| **28** | I am considering new/more defence methods to protect my cabins/property. | 2 | 0 | 0 | 0.71893 | 0.14679 | -0.14265 |

## Appendix I: Species-Specific Knowledge Sorting Distribution Area

**Figure 6: Species-specific knowledge sorting distribution**




## Appendix J: Risk Sorting Distribution Area

**Figure 7: Risk sorting distribution**