Learning from our Elders

Aboriginal perspectives on climate change and reindeer/caribou habitat in the circumboreal forest

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Content

Executive Summary

The northernmost regions in the world are projected to suffer the most severe consequences of climate change. Natural resource-based communities and Indigenous peoples have been identified as particularly susceptible and research efforts are increasingly directed at exploring the potential consequences of climate change on the livelihoods of Indigenous peoples. Using Indigenous (IK) or Traditional knowledge (TK) as a "canary" or early warning for climate change as well as a complement to 'western scientific knowledge' or to supplement the lack of observational and diachronic data is also gaining increasing popularity. However, whereas interest in IK /TK has grown exponentially over the last two decades, research has tended to neglect taking a critical perspective on learning processes and knowledge transfer mechanisms. Research has treated IK/TK more as an artifact handed down through generations or as information to be automatically appropriated when spending time on the land.

With rapid changes in their environments, Indigenous peoples and communities with close connection to the land will face the most severe challenges. How a changing climate is viewed by the people and how they adapt, will be learned, in part, through trial and error. These newly-learned experiences will be understood, transmitted, communicated and translated in their first language. New terminology in that first language may evolve to help identify and explain climate change phenomena. New practices will have to be developed to help people cope with these changes. The connections between climate change, livelihood, and survival are thus highly significant culturally in addition to those identified through statistics and numerical trends.

Against this backdrop, in view of the complexity and severity of potential climate change ahead, we recognise the need for in-depth studies, unveiling people's own conceptions and understandings of their livelihood situations and possibilities to adapt to climate change (cf. Keskitalo 2008). We also recognize an empirical need to strengthen our understanding of those residing and acting within forested ecosystems in the Circumboreal North.

By exploring two Indigenous communities, one reindeer (*Rangifer tarandus tarandus*) herding community in northern Sweden and a woodland caribou (*Rangifer tarandus caribou*) hunting community in Saskatchewan, Canada, this research project aims at partly addressing this knowledge gap. These communities are linked by the key species of reindeer/caribou (culturally and ecologically) and shared climatic challenges. Each locality is also embedded within a model forest and the two regions have become partners in order to share learning and practice with each other. To date, they have initiated cultural collaborations and exchanges among elders and youth and have committed to conducting research and other activities that support mutual learning.

The purpose of this study has been to link understandings of species distributions of reindeer/caribou based on Indigenous observations of climate change and habitat conditions to herders' and hunters' adaptive strategies in two model forest regions: Prince Albert (Canada) and Vilhelmina (Sweden) Model Forests. As we conducted the research, it became clear that it is also important to consider how these changes link to learning processes and how learning is layered within these communities. For example, which different knowledge transfer mechanisms are activated? Which are the most important learning arenas? And can different types of learning and adaptive decision-making (such as ad hoc, contextual, 'on the spot' decision-making; thumb-rules; and more value-based, normative understandings) also be linked to different mechanisms

and arenas? By exploring these dimensions, the research explicitly addressed the relationship between individual and collective learning about climate change in the two model forest regions. In summary, the research attempted to give voice to northern Indigenous residents and their descriptions of a rapidly changing world, particularly in terms of climate change, and present an analysis of the challenges and opportunities to securing the flow of Indigenous knowledge by exploring inhibitors and opportunities to learning in a climate change context.

Our study shows that changing weather patterns is a major concern of Indigenous residents in the circumboreal forest region. In Sweden climate testimonies concern a range of observed environmental changes; extreme weather events, long-term cycles and shorter-term cycles in weather patterns and vegetation. Whereas these observations cannot be directly seen as consequences of global climate change, they are strikingly similar to effects as projected by for instance the Intergovernmental Panel on Climate Change (IPCC).

In the Prince Albert Model Forest, climate testimonies concern changes in weather patterns, extreme weather events, and shifting climatic conditions. The testimonies suggest observational changes such as limitations in vegetation growth, loss of species, new migratory species, impacts on insect cycles, fatalities in small fur-bearing animals, changes to fish migrations (possibly interfering with spawn), and loss of amphibians.

Drawing on the accumulation of experiences and observations stored within these two cases of Northern Indigenous communities we argue that these serve well as canaries of potential climate change. Furthermore, as exemplified in the Swedish case, not only may Northern Indigenous communities function as valuable qualitative and local information sources, they may further act as active stewards of combating negative effects of climate change in how they adjust land use activities over large areas.

The study also shows that the current observed changes in weather patterns as well as contemporary social structures (e.g. “westernized” forms of education) pose serious threats to Indigenous Knowledge practices; partly in content and partly in the reduction of opportunities to transfer that knowledge across members of a community, including to future generations.

In order to understand impacts of climate change on reindeer and woodland caribou populations and the adaptive capacity of Indigenous people, we relied on observational and qualitative methods and suggested some differences and similarities across the two regions. Comparisons relate to climate and climate change, increasing anthropogenic and industrial activities, impacts of local and regional governance, and long and short term changes in culture (see Section 4). We note that northern Indigenous communities are not standing passively, they are proactive and it is in their nature to be stewards of the land. The study shows that they have adopted a range of strategies and approaches in dealing with impacts associated with climate change, drawing on a combination of tradition, previous experiences and modern technology. Climate change may not be the greatest threat in the regions at this point; however, the implications of climate change compound other issues such as increased competition from other land users and losses associated with the imposition of western cultural values.

Acknowledgments

Funding and support for this study comes from many sources. The Model Forest Circumboreal Initiative of Natural Resources Canada provided financial support and impetus to undertake this comparative project. Environment Canada provided funding through their *Aboriginal Funding for Species at Risk* program. The research relies and builds on relationships established between the Prince Albert Model Forest (Canada) and the Vilhelmina Model Forest (Sweden). The Model Forests also provided financial and logistical support. We are also grateful for funding and in-kind support provided from the Canadian Embassy in Sweden, the Department of Political Studies at the University of Umeå, the International Centre for Northern Governance and Development and the School of Environment and Sustainability at the University of Saskatchewan, the Social Sciences and Humanities Research Council of Canada, the Swedish Forest Agency, and the University of the Arctic. In Sweden, the study has been conducted parallel and partly in collaboration with a climate and reindeer herding focused project entitled "Renskötselns anpassning till klimatförändringar: Utveckling av planeringsverktyg baserade på traditionell kunskap och modern fjärranalys", financed by Sametinget (the Sámi parliament).

We thank the advisory team including Ryan Brook, Susan Carr, Douglas Clark, Hayley Hesseln, Mark Johnston, Leif Jougda, Carina Keskitalo, Vladimir Kricsfalusy, Micheline Manseau, David Natcher, Maureen Reed, Camilla Sandström, and Per Sandström. Finally, we thank all the people in the communities that have assisted us during this study, who have helped with logistical matters, interpretation and housing, and to all who have invested their time and energy in participating in the study. Thank you.

Special thanks to the participants, including Elders, Youth, knowledge keepers and helpers who accepted us and guided us through all stages of our learning process. We would especially like to acknowledge the late Oscar Beatty. His participation was monumental and we will always be grateful for your teachings, TINIKI!!

1. Introduction and rationale

In this report, as a basic point of departure, we are concerned with how *a northern Indigenous perspective can add to our understanding of climate change.* We aim to address this concern using a twofold approach, well aligned with contemporary climate research. First, we consider how northern Indigenous perspectives and observations may complement other available data and information on climate and environmental change. Second, we aim to increase our understanding of how climate and environmental change may challenge and impact northern Indigenous livelihoods.

Over the past few years, climate change has moved to the top of the global policy arena. There is recognition that the challenges it poses are urgent, substantial and currently on-going (IPCC 2007). Whereas future wellbeing hinges on more than the complex task of successfully combating the causes and effects of anthropogenic caused climate change, leading researchers suggest that climate change indeed qualifies among the nine key earth system processes posing the greatest challenges for humanity's future prosperity (Rockström *et al.* 2009). In addition to occupying a topical position in policy and research communities, climate change is also a key concern for local communities and grassroots around the world (see e.g.FOE 2007; Gordon *et al.* 2008). Whereas in its advent, climate change was largely a technical and mitigation-oriented issue, it has evolved into becoming an issue of *adaptation* (Schipper and Burton 2009). This development has been sketched as three partly overlapping shifts: first, from single-focused *impact* assessments to *vulnerability* assessments including *multiple* stressors and potential *responses*; second, to assessments which in addition take *adaptive capacity* into account; and third, to more recent (but not yet commonplace) developments of *policy-oriented risk reduction measures* and *adaptive capacity building* (Füssel and Klein 2006). Thus as we understand climate change, it is largely a multi-faceted issue with a human face, its consequences visibly linked to local contextual conditions and livelihoods. Hence, climate change is often best understood by departing from local contextual conditions and understandings (Keskitalo 2008).

Vulnerability to climate change will vary, over both temporal and spatial scales. Communities and livelihoods that depend directly on natural resources have been recognized as especially vulnerable (e.g. Agrawal and Perrin 2009; Anaya 2011; Johnston *et al.* 2006). Still, our knowledge remains limited on how physical change may be translated and filtered through human activity and interaction at the community level (Duerden 2004). It is thus an empirical-analytical matter of assessing the *relative* vulnerability of different individuals, groups and communities. However, also *exposure* to climate change is projected to be unevenly distributed (IPCC 2007). Northern latitudes are identified as especially impact prone (ACIA 2005). The IPCC (2007) states that warming will most likely be exacerbated over land in higher altitudes, snow cover is likely to diminish, and tundra and boreal forests are among the systems most likely to be affected by the projected changes. Physical evidence of these suggested trends have already been reported (e.g. Chapin III *et al.* 2000; Comiso 2003; IPCC 2007). The IPCC further identifies potentially detrimental impacts on traditional Indigenous ways of life in the Polar Regions (IPCC 2007). Therefore it is not surprising that increasing efforts have been directed at exploring the potential consequences of climate change on northern Indigenous livelihoods (e.g. Berman and Kofinas 2004; Ford *et al.* 2007; Keskitalo 2008).

Overall, incorporating Indigenous perspectives and Indigenous ways of knowing into general understandings of environmental change, vulnerability and adaptability in a northern context has recently gained currency (see e.g. ACIA 2005; Ford *et al.* 2006; Ford *et al.* 2007). Intertwined with these initiatives is the increasing popularity of using so called Indigenous knowledge (IK) or traditional knowledge (TK) as a 'canary' or early warning mechanism for climate change (Riedlinger and Berkes 2001). IK and TK have been recognized as complementary knowledge sources to the western scientific knowledge paradigm, especially valuable where observational and diachronic data is lacking (ACIA 2005; Berkes and Berkes 2009). The 'TK' concept is the one most commonly used for exploring alternative knowledge systems. It is commonly defined as "a cumulative body of knowledge, practice and belief, evolving by adaptive processes and handed down through generations by cultural transmission" (Berkes 1999:8). TK is often used synonymously with IK (e.g. Berkes 2009). We find it somewhat problematic that the prefix *traditional* may reinforce the view of Indigenous peoples as backward and passive recipients of European knowledge (Battiste 2005). Thus, whereas each qualifier has its own associated drawbacks and benefits, in this report we adopt the term IK.

Despite the growth of research addressing climate change from an Indigenous or northern Indigenous perspective, we identify at least two gaps. The first gap concerns the empirical dimension: Indigenous experiences of climate change in *forested ecosystems* in the Circumboreal North are largely omitted. Studies instead tend to focus on Arctic, coastal and near-coastal communities (see e.g. Berkes and Jolly 2002; Ford *et al.* 2006; Ford *et al.* 2007; Kofinas *et al.* 2002). Whereas some experiences may be shared across different biomes in the North, residents and land users in forested ecosystems are likely to also face particular and localized challenges. For instance, in many regions forestry is an expanding activity and conflicts over competing land uses are expected to increase (e.g. Widmark 2009), likely due to both direct and indirect effects of climate change. We thus recognise a need for more in-depth studies of climate change in (multi-use) forested regions. The circumboreal forest zone, includes all biomes within the boreal forest, is dominated by coniferous forests (Spribille and Chytrý 2002) and spans across North America and northern Eurasia. Whereas in general the circumboreal forest region is relatively sparsely inhabited, Indigenous communities have lived here for millennia. Despite a limited resource base due to the low productivity and short growing seasons, northern Indigenous residents have developed locally adjusted and sustainable livelihoods. Recent research also takes the position that northern Indigenous communities have not only successfully adapted to harsh conditions (e.g. Kofinas *et al.* 2002; Turner and Clifton 2009) but have also been taking an active role in shaping and modifying the landscape functions among which they reside (e.g. Miller and Davidson-Hunt 2010; Sayles and Mulrennan 2010). The potential benefits and actual extent of this active stewardship is, however, marginally explored.

The second gap identified concerns the potential problem of *fragmentation* or *misinterpretation* of IK, which may become manifest if research questions are too narrowly defined. IK may be misinterpreted and de-contextualized if only knowledge *content* (or worse, only part of the knowledge content) is analysed, reported and disseminated. Whereas discussed further below, many studies that incorporate IK have failed to explicitly recognize (or have taken for granted) the role of *learning processes* and *knowledge transmission* – which are both critical components inherent in understanding IK.

1.1. Purpose of the study

This study focuses on how a northern Indigenous perspective may add to our understanding of climate change. In order to meet this broad purpose we have identified three, partly overlapping aims. First, we aim to document Indigenous perspectives and observations of climate and environmental change in the previously understudied circumboreal forested region. In our view this represents an untapped potential for Indigenous communities residing in these areas to act as canaries and provide complementary information sources about observed changes in the environment and weather patterns. Second, we aim to shed light on how climate and environmental change may challenge and impact northern Indigenous livelihoods. This means unpacking the complex of challenges currently facing northern Indigenous residents and their livelihoods by using climate change as a way of entry. We believe that this question can only be meaningfully answered if approached from an IK perspective. Recognizing a gap in previous accounts we approach the role of IK in this process from a learning process perspective. That is, we will focus on *how* knowledge is learned rather than *what* knowledge is learned. Last, and pragmatically, we aim to contribute to community capacity building, by raising awareness and enhancing information sharing. Our methodological approach is thus strongly influenced by collaborative and participatory techniques. In this report, most focus is placed on the first two aims but more information about capacity building efforts can be found in Appendices C and D. The location of our research – two Model Forest regions – also reflects an attempt to contribute to shared learning between the Model Forests that have been engaged in on-going efforts to learn from one another through cultural exchange.

1.2. Research design: Two case studies in the circumboreal forest region

We have already underlined the fundamental qualitative nature of this study, emphasizing the need for contextual empirical explorations and methods that focus on the perceptions, understandings and experiences of northern Indigenous residents in relation to climate and environmental change. As such we have no ambitions to generalize our results to cover all northern Indigenous communities or residents. Nonetheless we believe there may be lessons that can be shared between different locations in this region. Our study is based on two cases from geographically distant locations; woodland caribou hunting Cree in northern and central Saskatchewan, Canada and the reindeer herding Sámi in Vilhelmina Norra Reindeer Herding District (VNRHD), Västerbotten, Sweden.

The selection of cases is instructive in several respects. Across the forested circumboreal north reindeer [*Rangifer tarandus tarandus*] and woodland caribou [*Rangifer tarandus caribou*] are held in high regard culturally and are also known to perform important ecological functions. Reindeer have been identified as a *keystone species* (Soppela 2002) which, in the original meaning, denotes a species which performs key functions maintaining the ecosystem in a particular structure (or basin of attraction). Others, such as Forbes and Kumpula (2009) suggest that based on the abundance of reindeer in Fennoscandia, the species should instead be regarded a *dominant* species. Garibaldi and Turner (2004) have developed the concept of keystone species further, adding a cultural and subsistence dimension, arguing that cultural keystone species are "culturally salient species that shape in a major way the cultural identity of a people, as reflected in the fundamental roles these species have in diet, materials, medicine, and/or spiritual practices" (2004, unnumbered online-article). This usage of the concept keystone species has been criticized (Davic 2004) with referral to the already existing flagship species concept, which already highlights cultural dimensions over ecological ones. Without necessarily adopting either

one of these discourses, these concepts provide insights into different dimensions of importance – ecological, structural and cultural – that we argue characterise both of our cases. In Sweden, reindeer herding is a principal component of the Indigenous Sámi livelihood and is recognised as a strong, perhaps the strongest, bearer of Sámi culture. Reindeer herding is an extensive and partly nomadic land use activity, practiced in the northern half of Sweden from the mountains on the Norwegian border to the forested lands towards the east coast. Among active reindeer herders, herding is the primary livelihood activity and is supplemented by hunting (primarily moose) and fishing. In Canada, hunting of caribou and other animals is a traditional activity that, together with fishing and trapping, represents the three major components of traditional Indigenous livelihoods and subsistence (harvest of animals for food, clothing, tools and artwork). However the populations of woodland caribou have dropped significantly in the past few decades and there is an acute need for an enhanced understanding of the complex interplay between environmental change and caribou habitat and behaviour. Consequently the case of reindeer herding and caribou hunting has symbolic, instrumental, as well as economic and cultural dimensions (e.g. Kendrick and Manseau 2008; Nordin 2007).

Some have argued that the enduring and close connection of Indigenous peoples to land and natural resources can contribute to an enhanced capacity to account for complex ecological processes that unfold across temporal and spatial scales (Riedlinger and Berkes 2001; Brook and McLachlan 2005). Such accounts may be 'invisible' with scientific (snapshot-type or synchronic) data gathering techniques. Thus, a focus on IK and Indigenous perspectives may provide new information or complementary sources of information with regards to environmental change playing out over longer time periods or geographic scales (see e.g. Berkes and Berkes 2009; Gadgil *et al.* 1993). This is particularly relevant in the case of reindeer herding and woodland caribou hunting for subsistence. Consequently, these cases are also likely instructive as potential canaries for climate and environmental change in the circumboreal forest region. Finally these cases are vertically connected through the International Model Forest Network (http://www.imfn.net) and previous exchanges and collaborations have already taken place between Vilhelmina and Prince Albert Model Forests. Hence there is already shared experience and infrastructure from which to draw. More importantly, the model forests are also committed to undertake shared research and learn from one another and these cases represent a willingness and openness among the communities to share their knowledge and experiences with others.

1.3. Research questions

This study is based on addressing three research questions:

- What are the observations of herders, hunters and Elders of climatic and environmental change?
- Related to climate and environmental change, which are the major challenges to the livelihoods of herders and hunters?
- What are the main vehicles and arenas for IK transfer identified in the communities?

2. Climate and environmental change in a northern Indigenous context[1]

Voices from around the circumboreal forest region are testifying to the serious threat climate and environmental change is posing to their livelihoods (e.g. Forbes *et al.* 2006; Krupnik and Jolly 2002; Mihlar 2008; Oskal *et al.* 2009; Turner and Clifton 2009; Tyler *et al.* 2007). As already mentioned, climate change impacts are projected to be more pronounced in boreal regions compared to the global average (e.g. ACIA 2005; IPCC 2001; IPCC 2007). According to climate change modelling, most impacts are expected during the winter season. Several locations are already reporting marked temperature increases and loss of snow cover (ACIA 2005; Forbes and Stammler 2009; Post *et al.* 2009). According to climate change forecasting and so called global circulation models (GCMs) future exacerbation of these trends is to be expected (e.g. ACIA 2005; IPCC 2007). Other climate change related impacts of particular relevance for the circumboreal forest include projected increases in frequency and severity of forest fires (Flannigan *et al.* 2009) and the possibility of substantial and rapid vegetation change (Chapin III *et al.* 2004). Some data suggest that due to the sensitive nature of northern ecosystems, these areas may also be particularly vulnerable to exposure (e.g. Huntington *et al.* 2005; McBean *et al.* 2005).

2.1. Climate change and caribou/reindeer habitat

A number of ecologically-oriented studies explore potential climate change impacts on both reindeer and caribou habitat and behaviour (see e.g. Arlt and Manseau *in press*; Tyler *et al.* 2007; Vors and Boyce 2009). Whereas levels of uncertainty are relatively high, previous research indicates a range of possible direct and indirect impacts. In the Swedish context, availability of winter forage is considered the most crucial factor for reindeer survival (Moen 2008; Roturier 2009). Consequently, the potential impacts of changing winter conditions have received more attention than potential impacts occurring during the summer season.

In the winter, reindeer and caribou feed mostly on ground lichen and have to dig through the snow. Snow conditions (depth, timing, consistence etc.) are thus critical in order for the reindeer to be able to graze. Problems with 'locked in' grazing grounds due to ice on the vegetation or ice layers in the snow (Roturier 2009) which prevents the animals from digging are expected to increase in the future as a consequence of expected temperature increases and increased frequency of warm periods during winter (Moen 2008). Additionally, although observational data present somewhat ambiguous results, it is likely that places with remaining spring snow cover may experience increased frequency of rain-on-snow events (McBean *et al.* 2005:43-44). Moen (2008:308) argues that this "may severely decrease forage availability for the reindeer and have negative effects on survival" although the author also recognises that it may also led to reduced dependencies on lichens and shifts towards other forage such as grasses.

Grazing conditions seem to be a shared problem across the northern hemisphere, as Elders in Yukon similarly express their concern about freezing rains that lock pastures (Huntington *et al.* 2005:87-88). Case studies from northwest Alaska and Finland have, moreover, noted that extreme shifts in temperature have become more frequent, adding to weather unpredictability and posing great challenges to 'traditional' livelihoods (Huntington *et al.* 2005:73-78). Indirect

[1] For a more thorough review of the research gaps identified, please see the working report from year 1, available at http://homepage.usask.ca/~mgr774/Research.php

impacts of climate change such as increased land use competition may adversely impact reindeer herding. As summarised in the Swedish Governmental Official Report "Sweden facing climate change - threats and opportunities" (SOU 2007:60:375):

> *The conditions for conducting reindeer herding in Sweden will be seriously affected by climate change. The growing season could be extended and plant production during the summer grazing is expected to increase. Insect plagues could become worse and the snow conditions in the winter will become more difficult. The bare mountain areas above the tree line are expected to decrease, which could lead to more frequent conflicts of interest with other sectors.*

In the Canadian context, the woodland caribou live in peatland bog areas and require large tracts of undisturbed areas (Rettie *et al.* 1997; Trottier 1988). The consequence of climate change in northern Saskatchewan is expected to relate to forest fire frequency (Bergeron *et al.* 2004), snow depth (Mayor *et al.* 2009) and ice conditions on lakes and rivers (Carriere 2010). Data for woodland caribou has been identified for recruitment (Rettie and Messier 1998), habitat selection (Rettie and Messier 2000) and predator prey dynamics (Rettie and Messier 1998). Considerably less attention has been given to the relationship between woodland caribou ecology and how people are affected by the changing food web. In northern Saskatchewan, with encroaching industrial development and changes to the natural cycles, combined with sudden climate change factors render the future of woodland caribou and the people who rely on this animal, speculative.

In sum, the resulting cumulative interactions, impacts and responses of reindeer herders or caribou hunters are conditioned by multiple factors. These effects can only be understood by explicitly addressing Indigenous perspectives, ways of knowing and strategies in reindeer herding and subsistence on woodland caribou, taken in response to both perceived climate change impacts and other drivers (Forbes and Stammler 2009; Kofinas *et al.* 2002).

2.2. Indigenous knowledge from a learning approach

The exploration and exploitation of 'non-scientific' sources of knowledge have virtually exploded since late 1980s. "Non-scientific" or other ways of knowing are commonly taken to include traditional knowledge, traditional ecological knowledge, Indigenous knowledge, Aboriginal knowledge and wisdom, and local ecological knowledge. Definitions are often fuzzy and overlapping. They all share the common characteristic of being 'something other' than a western concept of scientific knowledge. Thus, embedded in the concepts lies a dichotomy of paradigms: scientific versus the non-scientific; the Eurocentric versus the Indigenous. Such differentiation implies hierarchies and underscores potential difficulties in combining different knowledge systems. Whereas some scholars, both Indigenous and non-Indigenous, seek to reaffirm differences through binary 'either-or' approaches (e.g. Nadasdy 1999), others seek rather to explore the common ground (e.g. Barnhardt and Kawagley 2005). Others again argue the inherent flaws in separating knowledge types into 'past' and 'modern', 'scientific' and 'non-scientific' 'Indigenous' and 'non-Indigenous.' They argue that whereas qualitative and epistemological differences likely exist among all different kinds of knowledge systems, these differences are inherently interlinked through dynamic exchange and interaction, neither frozen in time nor space (Dei 2000). These authors, therefore, suggest that the perceived differences simply "represent conceptual formations that are internally fractured and categorically indistinct" (Agrawal 2009:157).

Thus, despite a clearly growing documentation of traditional, local, indigenous and ecological knowledge and wisdom as sources for improving local management practices (Berkes and Davidson-Hunt 2006; Berkes *et al.* 2001; Elmqvist *et al.* 2004; Houde 2007; Leroux *et al.* 2007; Peloquin and Berkes 2009), neither documentation nor usage is uncontroversial. Whereas some argue that the increased attention to alternative knowledge systems signals a shift from an exclusive western notion of scientific knowledge to a more inclusive and broader understanding, others disagree and claim that this process has nothing to do with Indigenous decolonisation. Rather they see it as an enforcement of uneven power relations and consequently a *re*-colonisation of IK and Indigenous practices (Nadasdy 1999; Simpson 2004). Consequently, the problematic integration of IK and science may have less to do with knowledge incommensurability as a technicality (compare e.g. Berkes and Berkes 2009; Huntington 2000) and more to do with the hierarchies and power relations embedded in the concept(s) and their definitions (see e.g. Nadasdy 1999; Simpson 2000). In the same vein it has been argued that only Indigenous researchers should be conducting IK research (e.g. Simpson 2000). This concern may be valid in cases where the researcher is viewed as an 'outsider' and therefore unable to fully comprehend the cultural reality within the scope of his/her research (Walker *et al.* 2006).

Some scholars within this field also report facing suspicion, distrust and an unwillingness of the communities to participate (Kofinas *et al.* 2002). Academic researchers may also actively advocate this strategy. Simpson (2000:144), for example, explicitly argued for "non-participation as a form of resistance." She bases this notion on the argument that:

> *We do not want other people deciding which components of our knowledge are important and which are not. We do not want scientists interpreting our knowledge, when it has been removed from the values and spiritual foundations that give it meaning. The processes of documenting and integrating remove knowledge from the people. When the knowledge is removed from our people, the power of knowledge is lost. (Simpson 2000:140)*

These matters cannot be taken lightly and are likely the result of complex, contextual and historical processes. In Canada, for instance, the distrust and lack of participation can be remnants of soured historical relationships, such as Nation-to-Nation agreements that date back to the signing of treaties between Europeans and Indigenous peoples. This leads us to the related concern of intellectual property and the idea of ownership of knowledge. Loss of meaning creates a sense of unease within many communities and may led to Elders refusing to take part in research and collaborative projects.

Without necessarily aligning ourselves with either of these discourses, or proposing to solve all controversies associated with IK, we argue that in order to document the observations of climate and environmental change, as well as give voice to the challenges facing northern Indigenous livelihoods, IK is a necessary component. We cannot understand and analyse the experiences and understandings of northern Indigenous residents unless we try to depart from their perspectives. That said we are still aware of the difficulties of navigating within this terrain. One of our strategies to tackle some of the associated problems is to employ a learning perspective to IK. By the phrase "a learning perspective," we mean placing focus on the processes and arenas where learning and knowledge transfer occurs. Thus, instead of trying to discuss solely the *content* of IK, we focus on the *processes by which IK is transmitted.* Another strategy we employ is to

discuss the diffuse nature of IK together with the partaking community members. We ask them how *they would define* the knowledge types they hold, what knowledge they deem important, if any particular knowledge keepers can be identified, and how the nature of knowledge and learning processes are changing.

Nonetheless, our understanding is influenced by the academic discourse which holds that IK is defined according to its temporal dimensions (long-during, passed down through generations (e.g. Gadgil, Berkes, and Folke 1993), its spatial dimensions (local connection to the land and geographically bound characteristics (e.g. Nichols *et al.* 2004) and its empirical dimension (so called learning-by-doing and extensive observation of an area or species (e.g. Huntington 2000). Our basic point of entry aligns with Berkes and Berkes (2009:7) who stated that "As a knowledge-practice-belief complex, indigenous knowledge includes an intimacy with local land, animals, and plants. It also includes institutions (rules and norms) about interacting with the environment, and it includes worldview, as the worldview shapes the way people make observations, make sense of the their observations and learn." However, IK should also be understood as "an adaptable, dynamic system based on skills, abilities, and problem-solving techniques that change over time depending on environmental conditions, making the taxonomic approach difficult to justify or verify." (Battiste 2005:6). That is, just as with any type of knowledge, IK is a diverse, dynamic and changing cluster of ideas, experiences, stories and memories which adapts and co-evolves together with a changing environment (see e.g. Barnhardt and Kawagley 2005; Simpson 2004).

2.3. Learning arenas and learning tools

Our approach can partly be seen as a response to the tendency of approaching IK simplistically; focusing only on the empirical content aspects without recognising its multidimensionality (Bonny and Berkes 2008). This has led to a development of turning IK/TK into a narrow field of study, where its identity - being First Nations, Indigenous, or Aboriginal – is lost and its purpose may be redirected to suit the need of western science and academic pursuits (Battiste 2005). Just as is found in the language of the woodland Cree, knowledge can itself lose meaning and value, making the knowledge inanimate or 'non-living', whereas animate objects are considered alive and thus change. The linguistic terms used to define objects in the Cree language, and correct usage and meaning of the Cree language will be critical to understand the knowledge in terms of the Canadian research project. Consequently Elders' consultation and Cree language expert inclusion will be vital. IK is dynamic and living within the memories, stories and tools Elders and communities hold; through the activity of hunting or herding knowledge is transmitted by knowledge keepers and shared with the community. The knowledge itself should therefore be a living entity or 'animate'.

Whereas attempts have been made to diversify the transmission of, and explore different media for mapping and communicating distinct types of knowledge (e.g. Bonny and Berkes 2008), we recognize that to a lesser extent has research explicitly explored the dynamics and process of creating, maintaining, adapting and relearning IK. The efforts that have been directed at learning processes and IK often focus on storytelling and learning-by-doing as the primary knowledge transfer mechanisms (Bonny and Berkes 2008). Quite often, despite reports on the 'unique character' of IK, learning is simply assumed to occur. That is, knowledge transfer is automatic, regardless of place, time and social specific factors and occurs "in the same manner as scientific knowledge" or as "rules of thumb" (Gadgil *et al.* 1993:154). As there is still debate within the

literature with regard to learning processes, there is much to be learnt from the inherent knowledge of First Nations writers and academics in the field of Traditional and Indigenous Knowledge. Gender aspects or other differentiating structures of IK are also likely decisive (Sillitoe 1998: Reed and Mitchell 2003) but vastly understudied.

Some identified mechanisms and arenas for IK, learning and knowledge transmission include spending time on land (particularly as an indicator for assessing the transmission of knowledge to younger generations) (Kofinas *et al.* 2002:68) or "through direct experience in the natural world" (Barnhardt and Kawagley 2005: 11). Reindeer herders and caribou hunters can as such be regarded as both (dynamic) keepers and transmitters of knowledge, and as local experts (cf. Davis and Wagner 2003). Gadgil and colleagues (1993) emphasise "social" and "cultural transmission mechanisms" as a component of the dynamic nature of traditional ecological knowledge, including moral, religion, belief and practices (Gadgil *et al.* 1993: 151, see also page 154). Battiste (2005) indicates that maintaining ceremonies, customs and traditions, and integrity as well as access to land are important components in IK transmission. Simpson (2000:142) states that knowledge "sharing [from Elders to younger members] follows cultural protocols". IK is also seen as orally communicated, transferred and acquired (e.g. Dei 2000). This underlines language as a universal and important tool in understanding and transmitting IK and perspectives, and moreover seen as a way to maintain Indigenous ownership and interpretation (see e.g. Barnhardt and Kawagley 2005; Simpson 2004; Walker *et al.* 2006).

3. Methods and case descriptions

We apply a qualitative approach, focusing on the experiences, perceptions and observations of climate change and environmental change by community members in Vilhelmina Norra Reindeer Herding District in the Vilhelmina Model Forest region in Västerbotten County, Sweden, and Cree communities in Prince Albert Model Forest region, Canada. Whereas we believe that there are lessons and information that can be shared across these jurisdictions, we do not conduct a comparative study in the orthodox sense. Rather, we see these cases as complementary and instructive, as examples of northern Indigenous experiences of climate and environmental change. This approach allows us to use each case as a reference against which we can better understand the other. Thus, the cases are not designed to be empirically representative of northern Indigenous perspectives and we do not attempt to generalize our findings to the entire forested Circumboreal North.

We also recognize that it is not possible to single out climate change as a driver in isolation from other on-going large-scale environmental, social or economic change. We agree with Huntington *et al.* (2005:15) that "the degree to which people are resilient or vulnerable to climate change depends in part on the cumulative stresses to which they are subject through social, political, and economic changes in other aspects of their lives. It also depends in part on the sensitivity of social systems and their capacity for adaptation." Thus, we do not regard climate as the only or assume that it is the most important driver in this context.

A more difficult consideration has to do with *what* climate change really is. As all researchers within the field are aware, it is impossible to determine if a particular weather event or phenomenon is caused by climate change (whether natural or anthropogenic) or if it is a mere manifestation of climate variability. There is a fundamental difference between weather and climate. Climate refers to the patterns playing out over long time periods (a climate 'normal'

stretches over 30 years) whereas weather is what is occurring every day. Hence, we cannot and do not claim that our results are either all-encompassing (i.e. accounting for all possible direct and indirect effects of climate change) or caused solely by climate change. Instead, we regard observations of *changes in weather* ***patterns*** (rather than changes in weather) as possible representations of climate change.

Drawing on the discussion above, in discussing the difficulty of isolating direct and indirect drivers and events from each other, we also found it useful to sometimes talk about climate and environmental change as one complex. That is, we spoke about changes occurring both in the land and in weather patterns. We also used previous research and climate change projection models as a reference guide to what type of events and occurrences may represent climate change. Recorded observations that fall outside this range can be seen as a source of IK-based *complementary* information. These can be categorised into three groups: long-term, slow variable change (visible only over 20-30 years or more), shorter term, faster variable change (repeated events or patterns in the last 10-20 years) and extreme events (single events which stand out as extreme or 'unheard of'). In the first category, we can expect to find changes in natural fire cycles, tree line shifting, snow conditions and seasonal temperature changes. In the second category, we can expect to find observations regarding snow conditions, temperature, vegetation etc. In the last category, we can expect to find observations regarding rain-on-snow events, early springs or late snowfall, rapid temperature change etc. These categories overlap and primarily fill a presentational as well as analytical role in structuring the observations recorded.

In order to reduce our influence on the research participants[2], we apply an open methodological approach. Thus, we let people in the communities decide what changes (whether climatic, weather-oriented or environmental) they deem important and identify as impacting their life situation. Our first question in the interviews and focus groups ask the participants to describe themselves, in relation to their environment and surrounding. Next, we ask if this relationship has changed in any way, and if so how. As shown in the results section, observations that could be connected to climate change appeared often in the first sentences exchanged. However, if we did not obtain this information, our interview guide posed questions related to any changes in the weather patterns, either in the long or in the short term, or if there were any particular weather events that they remembered (See Interview guides in Appendix A). Thus, we use *open* weather proxies when posing questions about climate change. It is noteworthy that weather variability is considered the norm among Sámi reindeer herders. The well-known saying 'One year is not another's brother' (Jahki ii leat jagi viellja) (Tyler *et al.* 2007:196) clearly represents this notion. Hence, one could expect that this understanding and experience of weather variability may act as a filter to sort 'normal' variability from that possibly induced by climate change.

3.1. Analysis

The analysis of data was standardized between Sweden and Canada, in order to enhance comparability. In both cases interviews and focus groups were recorded and transcribed. The Canadian case interviews were also translated into English. The transcriptions were manually categorized according to the research questions (i.e. observations of climate and environmental change, livelihood impacts, and arenas and tools for IK transmission). Subsequently climate

[2] We use the term participants (as oppose to e.g. informants) to refer to the people partaking in the process of co-creating this report through interviews, discussions, observations and other types of interactions.

change observations were divided into the three categories presented in the previous section; long-term and short-term changes, and extreme events. Indications of how long these changes had been observed for, or how quickly they were unfolding were used to help sort each observation in respective category.

3.2. Reindeer herding and the case of Vilhelmina Norra Reindeer Herding District

Reindeer husbandry (following Tyler *et al.* 2007) is a general term, inclusive of the policy, possession, maintenance and management of reindeer. Reindeer herding, on the other hand, is the subset active management strategies of keeping and moving the reindeer. Reindeer herding is currently practiced across the Circumpolar North by more than 20 different Indigenous peoples in Sweden, Norway, Finland, Russia, Mongolia, China, Alaska, Canada and Greenland (Oskal 2008) (as well as by some non-Indigenous peoples). It is estimated that the livelihood occupies about 100,000 herders and entails approximately 2.5 million semi-domesticated reindeer (Eira *et al.* 2008).

In Sweden, wild reindeer are extinct and all reindeer are semi-domesticated. Every reindeer is thus actively herded, and the herds' movement through the land is thus dependent both on reindeer habitat preference, other land uses as well as on the herders' strategies. The relationship between the reindeer herding Sámi and the reindeer is thus fundamentally different from that between Cree hunters and caribou. The close interaction between humans and reindeer render a very strong knowledge base about habitat and behaviour, particularly in comparison to the woodland caribou about which our knowledge is scarce and fragmented.

Reindeer herding is considered a principal ('traditional') livelihood for the Sámi, and according to the Swedish Reindeer Husbandry Act, reindeer husbandry is also the exclusive right of the Indigenous Sámi. "The Act gives the Sami the right to use land and water for their own maintenance and that of their reindeer. This right is based on tradition from time immemorial and is protected in the Swedish Constitution" (Ministry of Agriculture 2009)[3]. Membership in a reindeer herding district (RHD) is however a prerequisite in order to be able exercise this right. Whereas some RHDs are relatively open in terms of membership, others are more closed leading to accumulating numbers of membership applications. Only about 2,500 of the 20,000 Swedish Sámi are currently members in a RHD. Most of them practice reindeer husbandry as their main livelihood. Reindeer husbandry is organized into 51 reindeer herding districts (Swe: *samebyar*). A reindeer herding district refers both to the extensive geographical areas covering the grazing grounds (all-year land and winter grazing grounds) as well as the *sameby* as an economic association. Reindeer herding districts can also be understood more loosely, in the collective community sense, especially since reindeer herding to a large extent is a collective activity, occurring at the family, 'winter group' (Sámi: *siida*) or community level (e.g. Roturier 2009). About 40% of the Swedish land surface is classified as reindeer grazing land, meaning that the right to graze and herd reindeer is usufructuary. That is, the land is not owned by the Sámi; rather member of RHDs have the right to use it for herding. Grazing thus takes place more or less across the entire northern half of Sweden; on state-owned land (mostly applicable to the all-year land and also subject to some controversies regarding land ownership) on private land, and on commons.

[3] Different correct spellings of Sámi exist in Sweden. Reference to the Act uses the spelling of the Act.

Vilhelmina Norra Reindeer Herding District (VNRHD) is one of the 51 RHDs in Sweden and a so-called mountain RHD. Of all the seven RHDs in Västerbotten county VNRHD has the largest area, covering over 14 000 km^2. As opposed to forest RHDs (which are smaller in size and less frequent) the reindeer in VNRHD migrate from the summer lands in the mountains on the Norwegian border to the forested winter grazing lands on the eastern coast, a distance of approximately 350km. Reindeer herding here is thus a (semi-)nomadic activity. The fragmentation of the landscape, largely due to large-scale hydro power, forestry, roads, railroads, mining and more recently wind power which has restricted the use of traditional migration routes, has together with technological development led to a situation where reindeer herding is a hi-tech activity, dependent on snowmobiles, helicopters, motorbikes and to some extent GPS-collars on the reindeer.

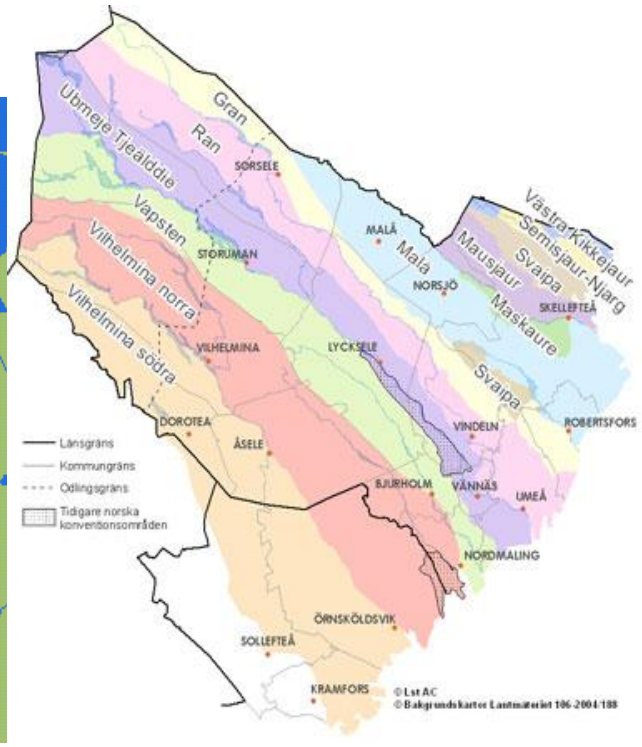

Figure 1. Map over Sápmi, the Sámi homeland and Västerbotten County encircled (from http://www.fjallen.nu/3index.htm)
Figure 2. Map over Västerbotten county RHDs, VNRHD in pink second to the bottom (from http://intranet.ac.lst.se/ren-_o_fjallfragor/samebyar).

VNRHD has about 20 registered reindeer husbandry businesses, which means approximately 20 reindeer husbandry families. In 2007 VNRHD had 65 members, including everyone from children to elderly. Since the income from reindeer husbandry usually is insufficient to provide for a whole family it is not uncommon that one or several family members have other part- or full-time employment (Nordin 2007). Hunting and fishing are also important sources of income and subsistence. There are about 15 active herders in VNRHD, divided into two *siida* (herding groups), Vardofjäll and Marsfjäll. The siida have both separate winter and summer grazing land. In the fall-winter-spring period (from approximately November to May) which is the most work-intensive part of the year, the two siida herd their reindeer as separately as possible. In the

summer, when the reindeer roam more freely in the mountain range, the siida collaborate more frequently as a community around events such as calf-marking (June-July).

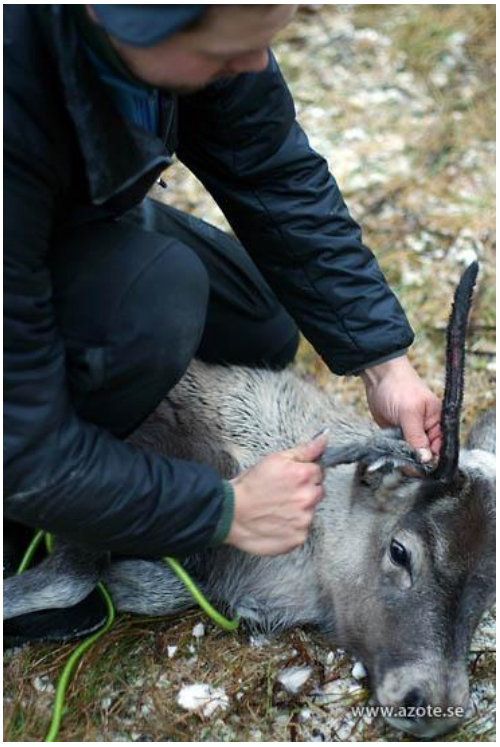

Figure 3 – This photo shows a Sámi reindeer owner marking his unmarked calf in each ear according to his individual ownership marking during the fall separation. Usually this takes place during the summer calf markings but any 'whole-eared' calves are marked during the fall/winter separations.

Photo by Annette Löf, www.azote.se

3.3. Methods used in Sweden

The empirical data collection in VNRHD has been conducted using a range of methods. Some of the empirical work has also been conducted in collaboration with another closely related research project exploring how technology and GPS-transmitters on the reindeer can enhance herders' livelihood strategies in a changing environment. The methods and research guide have also been developed in close collaboration with representatives of VNRHD community.

The principal methods used include participant observation (taking part in reindeer herding activities such as the winter separation (see figure 4), information meetings and community meetings), semi-structured interviews (we conducted three interviews with Elders[4], two male and one female, who had direct experiences of herding before the technological revolution in the 1970s), focus groups (7 in total, 3 each with the active herders in respective siida and 1 with the youth in the community), and a capacity-building workshop where we triangulated the results from the focus groups and worked with climate scenario exercises (Table 1). Finally we have held several semi- and unstructured conversations with active herders, the VNRHD chairwoman (chief) and other community members. Interviews, focus groups and conversations were conducted in Swedish with the exception of the youth focus group that was partly conducted in English and the interviews that, to a small extent, contained episodes or words in Sámi. In total, we estimate that between one-half and two-thirds of the members in VNRHD contributed to the data collection. Semi-structured interviews refer to interviewing which follows a generally set

[4] Elder is here thus interpreted both in terms of knowledge and age dimensions.

guide but which allows for follow-up questions and lets the informant guide the direction of the interview (as opposed to a structured interview which is more rigid in performance). The length and depth of the interviews comes close to what Kvale (1996) would consider deep-interviews. In contrast, we refer to semi- and unstructured conversations as events that were not conducted according to a preset guide and were not held in the "formal setting" of an interview. These conversations were instead spontaneously ignited and carried out as a response to something being or perhaps not being discussed, such as during meetings or gatherings. Notes were taken and questions were posed. Conversation is a more interactive technique than participatory observation. Finally, focus groups resemble group interviews with 5-8 participants wherein a theme is introduced and discussions are allowed to develop freely, rather than a situation where specific questions were introduced.

Figure 4 – In the 'sift' during the fall/winter separation. At this time the reindeer are separated according to which reindeer herding district and which siida they belong to (determined by their ear markings).

Photo by Annette Löf, www.azote.se

Table 1: Data collection in Sweden

Type	Number	Comment
Deep interviews	3	1 female and 2 male Elders; in two cases younger relatives participated in the interview (including helping with some interpretation from Sámi) and in one case the wife alongside another community member was present and assisted with some translation.
Focus groups	7	3 each with the active herders in respective siida, 1 with the youth
Semi- and unstructured conversations	7	3 female and 3 male, including Elders, the chairwoman, active herders and family members to active herders.
Collaborative community workshop	1	12 participants, 5 female and 7 male (3 had not previously participated in the focus groups)

In total we have about 800 pages of transcriptions from the focus groups and interviews. Due to this extent of the material, no full record of all the quotes and mentions of observations that the analysis is based on has been provided (compare to Appendix B).

3.2 The case of Prince Albert Model Forest region: Hunting, fishing and trapping

Woodland caribou is part of the Indigenous diet and in northern Saskatchewan, hunting caribou remains part of an inherent treaty right. However, since the 1970s there has been a dramatic drop in the population of woodland caribou (Rock 1992). Subsistence hunting still occurs but woodland caribou is not a primary food source. Woodland caribou is primarily used for the meat and the hide. Many Elders and knowledge keepers prefer woodland caribou hides to moose hides. Woodland caribou hides are smaller and thinner, making them easier to handle and stretch and easier to sew. Growing concerns by Indigenous people has led to on-going participation of First Nations and Métis people in stewardship and conservation of woodland caribou (Carriere 2010).

For Indigenous people in Canada, such as Woodland and Swampy Cree, who continue to practise subsistence activities such as hunting, fishing and trapping, access to traditional food is vital. Active First Nation hunters are linked to leadership in their community, providing food and sustenance for Elders, the community and their families. Subsistence fishing is an activity that is commonly linked to the spawn and migrations for several key species such as walleye, suckers, whitefish, goldeye, lake sturgeon and lake trout. Trapping is an activity that provides a means for passing on IK within the family unit. Trapping can be linked to predator management and maintaining ecological health of the ecosystem. Combined threats to Cree livelihood activities such as hunting, fishing and trapping will impact Cree culture, language, diet, sense of community, and retention of IK.

3.2.1. Methods used in Canada

Interviews were the principal means of data gathering in Saskatchewan. Six interviews were conducted in four communities of the Model Forest region (Figure 5). Participants were selected if they were active trappers, hunters and/or fishers and/or they were identified by key informants as an Elder or leader in their community. Specific individuals were chosen based on information gained through previous research (Carriere 2010). The role of key informants to qualitative research is a flexible designation: it may refer to someone that provides insight to the researcher, without direct involvement (i.e. not being interviewed), but may be a translator or someone that provides information informally.

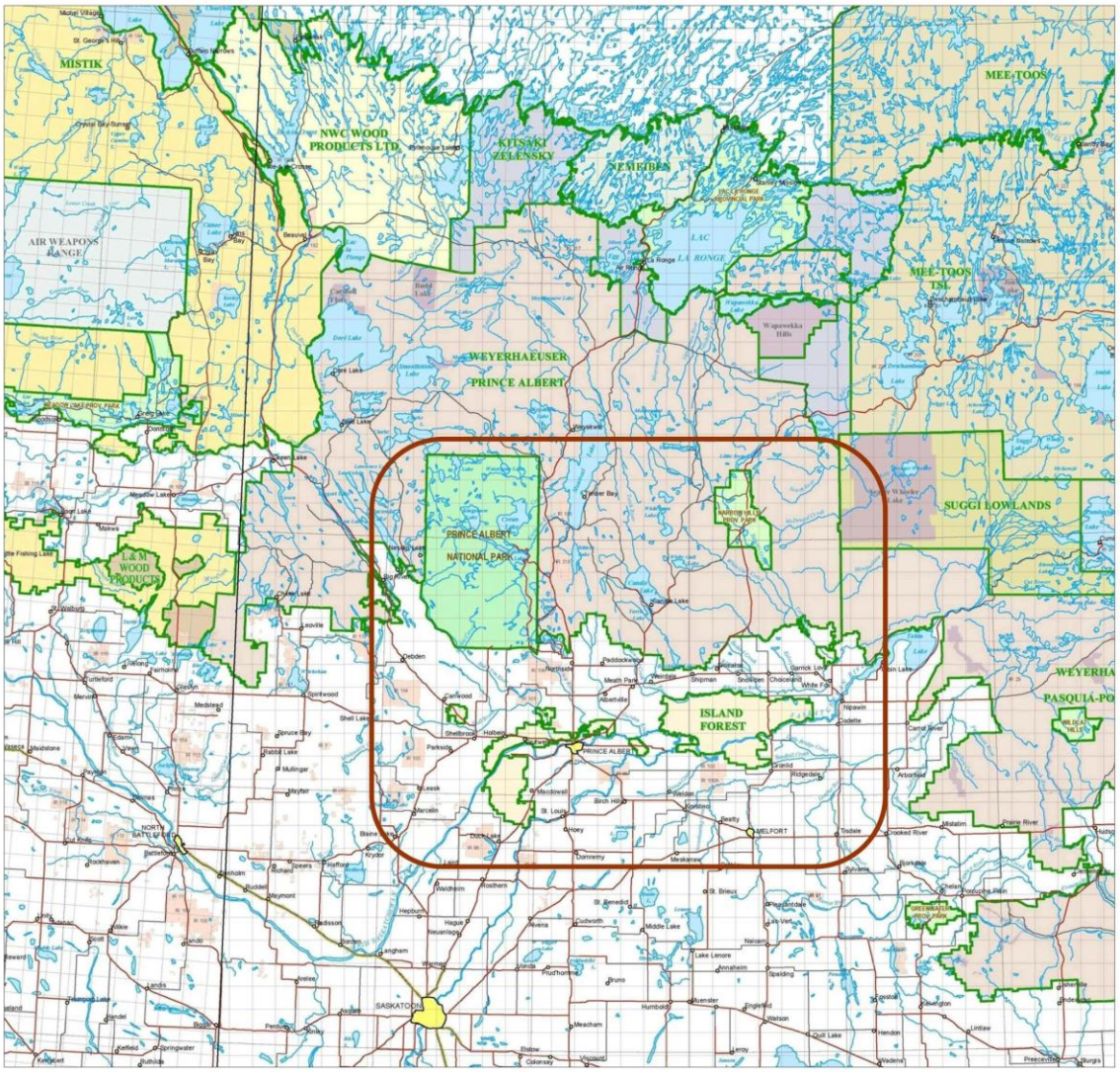

Figure 5. *Map of Prince Albert Model Forest* from Forest Communities Program Strategic Plan, November 28th, 2007.

Six male Elders and one female Elder were interviewed (Table 2). The term, "Elder" is used to describe a person who is respected in their community for his/her ethic and knowledge (not based on age). The communities where interviews were conducted include Sucker River, Deschambeault Lake, Beaver Lake, and Cumberland House (see Figure 5). Interviews ranged from 0.75 hours to 3 hours in length. Four interviews were conducted in English, one interview was a combination of Cree and English (translator was present) and one interview was all in Cree (translator was present). In three cases, the two principal investigators led the interview. In five of the interviews, additional observers were present but did not take part in the discussions. These included family or friends of the interviewees or interviewers. Two interviews were interrupted and took part in several sessions; however, in these cases the interview was completed the same day.

Table 2 – Summary of Canadian Interviewees								
Set	Interviewee	Community	Interview Length (minutes)	Language	Translator	Interviewers	Observers	# of sessions
1	Male Elder	Sucker River	60	English	No	2	2	1
2	Male Elder	Cumberland House	45	English	No	2	1	1
3	Male Elder	Cumberland House	120	English	No	2	1	1
4	Male Elder	Beaver Lake	180	Cree & English	Yes	1	2	3
5	Husband & Wife Elders	Deschambault Lake	60	Cree	Yes	1	0	1
6	Male Elder	Cumberland House	150	English	No	1	2	4

Unlike our Swedish counterparts, no focus groups were conducted with youth in the communities. Although three attempts were made to conduct a focus group, unforeseen events, a lack of interest or bad timing resulted in the cancelation of the focus group.

As part of our research objectives, in Canada two workshops were also conducted to train youth (referred to as trainees) in various communities to interview Elders in their community. Here, the term "youth" refers to people who are in the process of learning knowledge from Elders (not based on age). The trainees were selected based on their fluency in First language and culture (through hunting, trapping or fishing). The first workshop introduced the trainees to qualitative methods and definitions, interviewing techniques, consultation and duty to consult, and participant selection. The second workshop was designed to help the trainees with First language, translation of scientific terminology into First language, consultation and duty to consult, and TK. As a result of the training workshops the trainees carried out 31 interviews conducted in eight northern communities in Saskatchewan and Manitoba. The interviews were carried out in either all Cree or a combination of Cree and English. More detailed information can be found in Appendix C and a report from a workshop held with youth (based on age) in Sweden can be found in Appendix D.

3.4. Validation of data

Validation of data and data interpretation took on slightly different guises in Canada and Sweden. In Canada, once a document is created we will provide an opportunity for the interviewee to verify the accuracy of the information, transcriptions and analysis. For verification the interviewee must be seen in person and provided a full text document, or in cases where Cree is their First Language it must be interpreted for them. Due to timelines, the follow-ups will be done over the following year. Verification of the information will ensure the knowledge we have been privy to is not distorted or misinterpreted. In Sweden, a basic verification of the interpretation of interview data was carried out on the spot during the interview, using 'control' questions such as "Do you agree with this interpretation…?" and "If I say… have I understood you correctly?". Each interviewee were also sent a copy of the transcription and a copy of the recording and asked both to listen and read the interview anew. They were then given the opportunity to complement

or add new information or make any clarifications they felt necessary, either directly to the researcher or to a contact person in the community. Focus groups were initially validated in the next-coming session (i.e. each focus group began with a summary and interpretation of the previous meeting). A preliminary analysis of all the focus groups was also presented and discussed at the collaborative workshop community meeting. Finally each participant received copies of the transcriptions of the focus groups they had participated in and had the opportunity to provide comments, corrections and clarifications.

3.5. Research exchange

A research guide was developed between the two primary participating researchers. This guide was adjusted to fit the different local contexts. In order to enhance comparability and understanding of the two different cases, our study was based on initial research exchanges between the Swedish researcher, Annette Löf, and her fellow Canadian researcher, Naomi Carriere. Each made visits of approximately 10 days to the research areas in Canada and Sweden. These visits included formal meetings with Chiefs, Councils and community meetings as well as site visits, participant observations, collaborative or focus groups, workshops, structured conversations, and deep-interviews.

3.6. Approach and limitations of the research

The approach to research does not provide a methodology by which results can be used as generalization for all northern Indigenous communities. Our objectives are inquiry-based, interpretive, and not strictly comparative. Rather, we used the research exchange and an exchange of results between the two countries to enrich our understanding of the situations in each locality rather than to strictly compare one locality to another. Although we invested purposefully in creating a common understanding and methodological approach, our respective backgrounds, entry positions in the community and various contextual differences (e.g. institutional, ecological and socio-political contexts of each model forest region) have influenced the data collected and the analysis completed. A key distinction is that although caribou have been identified important to the Woodland Cree, their reliance on this species and their activities associated with it are quite different from the types of reliance and activities reported by the Sámi engaged in reindeer husbandry.

4. Findings

The observations on environmental and climate change that this study has documented show strong support for the climate projections made by scientists, for instance the IPCC. That change is occurring is evident – although it is not possible to say with any certainty if observed changes are the result of climate change or not. It is also clear in both cases that the community members are concerned about these changes. In VNRHD concern is largely directed at changes in weather patterns and less so at changes in animal behavior. However, it is clear that ongoing environmental changes are challenging reindeer herding and requiring new strategies in order to maintain their livelihood.

4.1. Findings from Sweden

Data from the interviews, focus groups and meetings revealed that reindeer herding is a livelihood under pressure from a number of different drivers. A male reindeer herder in Marsfjäll siida succinctly stated "Our land is changing." (Personal communication 2011-01-24). Whereas direct climate change impacts were not necessarily the major concern of active herders and Elders, changes in long-term and short-term weather patterns, and the frequency and extent of extreme events surfaced early and often during interviews as well as focus groups. In our view it was noteworthy that the concerns about the future of reindeer herding were very similarly expressed in the youth focus group as in the discussions with the active herders. The concern about the future thus begins at a very early age. In this section, the findings are organized according to the three research questions. A comparison with the Canadian case follows after the next section.

4.1.1. Climate and environmental change testimonies from reindeer herding Sámi

Directly or indirectly, all participants show various degrees of concern about the changes in weather patterns they are observing. When asked if there is anything the youth worry about when it comes to the future, their immediate answer was "Global warming" (Youth focus group). When asked if they have noted any changes in the land, all Elders responded with weather related statements about increased bush growth on the mountains and a sense that it is getting warmer (Elder interview 3), how the seasons have changed "the fall is warmer, it didn't used to be, it used to freeze. […] And when it froze, it froze. It's not the same"(Elder interview 2), "It's the weather, or the weather patterns that have changed. It's the way it is. And it's a problem it has changed. The weather, it is not the same anymore" (Elder interview 1). Also the active or recently active herders testify of "unique events" (Focus group Marsfjäll siida) and "more rapid shifts" (Focus group Vardofjäll siida). Both siida identify winter as the 'bottleneck' or most difficult season. "We're living under constant weather concern, always worrying about the weather. During winter you're always worrying." (Focus group, Vardofjäll siida).

Thus weather, weather variability and possible impacts of climate change are very much a reality in the lives of reindeer herders and their families. Noteworthy also was the discussion that surfaced with the youth, the herders and with two of the Elders about the recent two winters in Västerbotten. The past two years 2009/2010 and 2010/2011 have in this particular region been colder and have had more snow than recent years. Consequently they have not followed the general trend of warmer winters. Thus on a number of occasions the participants stated that "perhaps our story had looked different had you asked us the year before" (Focus group 1, Marsfjäll) and "this winter [09/10] has been cold, like it should be" (Focus group 1, Vardofjäll). Several expressed doubts of climate change in view of these winters, perhaps it wasn't too bad after all now that they had had two "normal" winters again (Focus groups with both siida, Youth focus group and Elder interview 1 and 2). We interpret these statements in the opposite direction. When the weather has changed so much that "normal" conditions and normal variability stands out as something exceptional and worth mentioning, it is a token as strong as any that ongoing changes are fundamental in their nature. Below, we have listed in more detail the different testimonies concerning weather related change according to the three categories introduced in the method-section. Observations are listed in descending order under each of the categories. That is, observations or themes that were most frequently mentioned are listed at the top of the list. All observations were mentioned by more than one individual (either two or more interviews and/or

focus groups and the collaborative workshop). To illustrate the observations and make them more vivid some quotes are used (with the source of the quote stated). This is not to be mistaken for the observation only being mentioned in a particular interview or focus group, rather it should be seen as a way to give voice to the participants also in the final report. Finally special importance is given to the collaborative workshop as the results and information from the herder's focus groups were discussed and further developed here.

Long-term changes:

- New snow conditions, development observed by the herders over the past 20-25 years (e.g. earlier snow cover detraction) and by the elders over more than 50 years (e.g. later snow fall and different kind of snow)
- Open streams and weak ices which have led to changing migration routes (and to transportation by truck) over the past 20 years
- Warmer temperatures overall (and more air moisture) "the coastal weather have moved here now, I saw this coming for more than 20 years ago" (Focus group 1, Marsfjäll)
- Warmer falls and fewer frost nights
- All seasons have changed, the weather is more unstable now and variability is greater. "Before when you put on your Sámi shoes you didn't take them off until spring, now you don't have time to change shoes before the weather changes again. One day boots and one day Sámi shoes." (Elder interview 1). The interviewee identified this as the greatest threat to reindeer herding.
- No 'stenskare' (a very hard ice crust formation on the top snow layer which was important to be able to migrate during the spring). "None of us can remember when you last could drive a truck on the snow. But you used to, in the old days." (Focus group 1, Marsfjäll)
- Earlier spring migrations "My father would turn in his grave if he knew that we moved on March 20th." (Focus group 2, Vardofjäll)

  Less frequently mentioned observations
- Later fall migration (Elder interview 1)
- Shifting tree line. Based on stories from their Elders and their own observations the youth draw the conclusion that the tree line is shifting upwards

Short term changes:

- Increased shrub growth, primarily in the mountains but also in the forest land. "It's more jungle now" (Focus group 2, Vardofjäll)
- Some insects have come earlier during the summer (observed over the past 10 years)
- Earlier foliation in the spring
- The reindeer flock structure is partly changing and the calves are increasingly found in separate groups. The herders are uncertain what could be causing this.
- More slush in the falls

Extreme events:

- Winter grazing more often becomes locked
- Not any really cold winters any more (-40 degrees)
- More rapid shifts from cold to mild weather "It can be -25, -30 degrees one day and +10 the next […] it's unique that we haven't had a thaw yet since January until today" (Focus

group 2 Marsfjäll, mid-February 2010). The quote refers to present conditions, that this stability is unique today. However, seen on a longer time scale rapid shifts were uncommon and this increase in variability is also noted as a key concern (see the quote from Elder interview 1 under long-term changes).

In the collaborative workshop, with all community members invited, there was a general agreement that snow and snow crust conditions had changed. Increased variability, such as snowfall one day and thaw the next, was also raised as a concern. When asked to collaboratively rank different identified difficulties and drivers of different types, grazing access, land use conflicts, and worsened winter conditions were identified among the most difficult. Overall, the concern over weather-related events was substantial and was also identified as something completely out of their control.

4.1.2. Indigenous knowledge and learning in an environmental change context from Sweden

Although IK – whether related to herding strategies, knowledge of the past or particular places or circumstances, histories, thumb rules or traditional activities – was always present in the discussions in one way or another, we found it very difficult to approach and discuss directly. Perhaps the most obvious, but not necessarily surprising, finding is that the role of knowledge seems to have changed alongside changing land use practices. Technological developments and infrastructural demands (such as water dams etc.) have led to different and faster movements through the landscape. This increased pace is recognized by two of the elders as well as by some of the active herders to impact the content, form as well as transmission of knowledge. As one of the Elders explained:

> *"Back then, when we migrated, we only spoke Sámi. Every word, and we learnt every hillside, every stream, every marsh, every mire and every mountain. They all had their names. But if you ask one now [herder], they are not migrating any longer [by foot], now they sit in the helicopter. So I wonder. I don't think it is so strange that they don't know, know the names of different things. They don't have to. They don't need to know, but back then, then it was a must. […] And the grazing conditions, that's something I ask about "how's the grazing"? "It's ok", that's all they tell me, but back then when you asked then you could tell how the snow conditions were, how the ground conditions were, and the words that they used then, they are gone, no longer exist. That's just the way it is." (Elder interview 1, translated from Swedish)*

This episode represents several findings. Firstly, it concurs with previous research the importance of language and emphasizes the experienced sadness and sensation of poverty when losing words, as well as the language itself. Secondly, it shows how the shift from manual, by-foot migration to snowmobiles, helicopters and transports via trucks has led to a different focus on what counts as important knowledge and information. The active herders testify to the increasing demands placed on a reindeer herder today – administrative and formal (such as responding to land exploitation demands) – and simply state that time is not always enough to do as in the old days or even to listen to the stories of the Elders or learn the words and language. Thirdly, it shows the importance of "learning-by-doing," that the IK that is important and kept is usually shared and transferred by activities.

The youth similarly recognized the importance of language and regretted not being able to speak Sámi (at all or more fluently). One teenage boy explained: "And the stories from the oldest people are getting lost, because they die. […] And it's few left, especially the language. I think I should talk to my grandfather and record it, because he knows a lot of words. He's Sámi." (Youth focus group). During the interviews at times the Elders also wanted to speak Sámi as they felt that they could not purvey the same message in Swedish, firstly because it's not their first language and secondly because there simply are not any words to translate to. Sámi is by all participants perceived as a 'richer language'.

We have already touched upon the subject of learning and how learning takes place by doing. The most important arena that all informants mentioned was taking active part in the reindeer herding activities. "We hear stories a lot when we are moving the reindeer, when we eat we talk a lot and we hear stories from another time." (Teenage boy, youth focus group). Also the oral and place-based elements of IK were supported:

> *"Before we always used to tell stories orally, you never wrote it down, so it became like a habit. Like my mother, she has always told me, each time you pass a place she tells the same story, so that I can remember these things and remember these stories. And now I find, that if I pass by a place where my mother has told me different things, I share it with the one who is sitting next to me. […] So I think that really repeating is very important." (Young woman in her 20s, youth focus group, translated from Swedish)*

Alongside the role of stories, repetition was another aspect emphasized as an important mechanism for learning and teaching. When asked if there were any particular knowledge keepers in the community no clear answers could be provided. "You just participate in the work, you learn it from different ones. It is not like there is a master or anything… you have to learn for yourself." (Elder interview 2). It is noteworthy that whereas the youth thought they had little knowledge to contribute, the Elders did not see the value of the knowledge they kept and felt that it was not relevant for today's conditions. Active herders, in their turn, felt they had neither enough time to teach the youth nor to share stories with the Elders. It was also interesting that Elders as well as youth (as well as some of the herders) pointed to the fact that knowledge is sometimes more easily shared with others who are not one's own parents or children. This emphasizes the need to purposefully create arenas and activities where all generations and community members have a chance to meet and learn from one another.

In terms of learning inhibitors and learning opportunities language stands out as important in both aspects. It is obvious how much experience and richness sits within the language. Language is more than just words. Equally obvious is that the Sámi language[5] is being lost quickly; it is used more rarely than in the past as fewer people speak it. For instance, within the VNRHD community only a handful are still able to speak South Sámi. At the same time it was obvious how keen, particularly the youth, were to learn and start using Sámi language again. "I wish we could speak Sámi. […] Yeah, all the time, when we are moving in the forests for instance. That

[5] There are actually several Sámi languages or Sámi dialects as it is sometimes called. In Sweden there are five major language areas: North Sámi, South Sámi, Central Sámi, Ume Sámi and Lule Sámi. North Sámi is the dominating language whereas for instance South Sámi and Ume Sámi are only spoken by around 500 people each. (see http://www.samer.se)

would be so much fun." (Teenage boy, youth focus group, translated from Swedish). So the need to revive the language is recognized by all, but has not yet been implemented. Another identified inhibitor of learning was actually the formal school system. Both youth and Elders remarked that the school's attendance requirements prevented the younger from participating in some of the most important herding activities such as the reindeer migrations and moves.

4.1.3. Challenges to reindeer herding as a livelihood from Sweden

Many challenges to continuing reindeer herding were identified. Feelings of hopelessness outweighed those of hopefulness but were not exclusive. For instance, most of the youth could picture no other future than in reindeer husbandry and even though they recognized many difficulties, not least the uncertainties of the future climate, they also expressed eagerness and joy about continuing in their parents or grandparents footsteps. In terms of climate and environmental change, most attention and discussion were on the indirect effects (such as impacts on migrations and move patterns, and competition from other land uses). Winter was identified as the bottleneck season and considerably more observations and discussion concerned fall-winter-spring seasons rather than spring-summer-fall. Whereas climate projections to a large extent were supported through their observations (although some skepticism of climate change was also aired) it was obvious that an IK or reindeer herder perspective focused less on direct and isolated effects (such as temperature or precipitation increase) and more on indirect effects and the complex interactions between human-reindeer-land relationships.

Overall there was the feeling of having less time, less land to access and less flexibility to act. Whereas climate and environmental change were not the factors directly identified having the greatest impact on the reindeer herding livelihood, the innate ability to navigate weather and environmental variability have become severely hampered through the fragmentation of traditional land and increasing competition from other land users, notably forestry, wind power (which ironically is a measure to mitigate climate change), tourism, mining and increasing populations of large carnivores.

4.2. Findings from Canada

4.2.1. Climate and environmental change testimonies from Elders in Canada

Since trappers, hunters and fishers are dependent on all types of subsistence, their observations relate to an ecosystem approach. By this we mean that there are multiple connections, factors or sources of change. In many cases, the interviewees were able to attribute their observations of change to climatic indicators. Despite language barriers, the Elders were able to describe a majority of the terms and translate them into Cree and express them in terms of their Traditional Knowledge and ways of knowing, thus providing a rich and complex dialogue.

Summary of long term changes (See Appendix B for direct quotes)

- Disruption in the emergence of mayflies (P. *Arthopoda* O. *Emphemoptera*) (Interview 1 & Interview 3)
- Disruption of fish migrations (Interview 1)
- Re-appearance of certain species, swans (*Cygnus buccinators*) (Interview 2)
- Ice break-up is one month earlier (Interview 4 & 6), but Elders still use predictors of when it will occur, accurate between 1 – 3 days (Interview 4 & 6). Ice break-up is a dangerous

time to travel (Interview 6). Historically early ice break-up would occur, but it would happen on a 10-year cycle (Interview 6).

- Ice-free water occurred one month early in 2010 (Interview 6)
- Timing of the geese is a predictor for spring's arrival, they no longer have stop-over's in the area as they migrate South (Interview 6)
- Thunderstorms and heavy rain occur less frequently (Interview 5)
- Forest fires are more frequent (Interview 5)
- Sturgeon (*Acipenser fulvescens*) spawn occurs in the Summer and is predicted by the blooms and buds (Interview 4), spawn is disrupted by early buds and water is still cold (Interview 6)
- Permafrost resulting in the muskeg drying up, this will affect the woodland caribou as they might acclimatize to the warm weather, succession of plants and insects (Interview 6).
- Accumulation of snow has been reduced by 63 – 70% from historical depths (Interview 3)
- Ice forms a month later (Interview 3), when the ice forms the wolves are able to hunt caribou (Interview 3)
- Fall occurs later (Interview 4), animals are calling later (Interview 6)
- Ice thickness has been reduced by 50% now, compared to historical thickness (Interview 1),
- Spring and summer early (Interview 3), these did occur historically on occasion (Interview 5)
- The location of the Northern Lights (*Aurora Borealis*) are not as close to the surface of the Earth, which affects the appearance of the Northern Lights, they are not as colorful and the sound of the Northern Lights, they are no longer heard (Interview 3)

Short term changes

Warmer temperature results in:

- Forest fires are more frequent (Interview 4)
- Warm temperatures stay longer (Interview 5)
- Rain can be predicted by the shape and color of the leaves, these predictions are no longer valid, the signs are observed and no rain comes (Interview 6)
- Ice no longer forms when it is predicted, this affects the way moose and woodland caribou migrate (Interview 3) and the way people use the land (Interview 4)
- Transitions in the fall are taking longer and this is affecting the plants and their ability to prepare for fall (Interview 4)
- Due to temperature, the fall is occurring one month later and this is affecting moose biology (Interview 4)
- Winter is warmer by about 20°C (-30°C historically, now averages are about -10°C), (Interview 3).
- There has been a loss of the muskrat species, and extirpation is due to warmer weather (Interview 3)

Extreme events

- Occurrence of a tornado (Interview 2 & 6), these are becoming more frequent 4 were observed in the last 10 years (Interview 6)

- Occurrence of drought were observed by several participants (Interview 4 & 5 & 6) and this can affect plant growth (Interview 2), and succession of plants along the river banks (Interview 6)
- Occurrence of rain and fog, it occurred once in the mid-1900s and again in 2000 (Interview 4)
- Winter rain results in fast ice break-up (Interview 4)

It is apparent that the Elders are concerned regarding seasonal changes and water. First, many of the Elders have revealed that there are noticeable differences between the seasonal changes of Fall to Winter and Spring to Summer. These transitional seasons are considered to be the fifth and sixth seasons in a Cree calendar. Ice is not forming when it is supposed to and this has created unsafe travel conditions, which is important as a majority of their travel is over water. The indicators or predictions within the seasons and the transitions between seasons (ice-forming and ice-melting) are the most comprehensive. The transition from Spring to Summer is occurring earlier. This is also impacting the amount of time to subsist on the land safely. The occurrence of people drowning and falling into the water is becoming more frequent; this is the result of changing ice conditions.

Second are the observations of water, the water table, the precipitation, humidity, and all indicators associated with these phenomena. Importance of water in this area can be attributed to the wide usage of water for safe travel to trap lines and fishing camps. In addition, many of the habitats for fish and small fur-bearing animals relates to the water levels and conditions. Long-term changes are resulting in disruption of many animals' cycles, including woodland caribou. The arrival of these animals marks the time to harvest and in many ways the people are dependant on their arrival to survive. Certain of the species that are lost or severely diminished from a subsistence area could potentially impact human ability to access food at a critical time of year. Families depended on the known time of arrival of food species, since many of the species are migratory or seasonal in abundance, so they had to be harvested within a very specific time frame. For example, when fish are spawning, harvesting can take place on a large scale with very little effort. It would be the difference between feeding your family or starvation. When the fish are not in spawn chances of catching or finding fish are rare on the large lakes. Historically, people used to travel by dog team in the winter and in the summer they used canoes. As fishing technology changes, particularly to motor boats and computer technology, it could impact the traditional subsistence pattern.

Relevance of climate and weather patterns to woodland caribou were limited since they are reclusive and inhabit relatively inaccessible bogs and muskegs; Very few interviewees had intimate knowledge of climate change and how it is impacting caribou. In one case an Elder attempted to describe a good year for woodland caribou. *"A good year for the caribou would be a mild winter in the North, as the wolves would stay with the Barren-ground (*Rangifer tarandus*) and when they return they would prey on deer (*Odocoileus virginianus*). Thin snow for them to access food easily, such as moss and berries. Thick soft snow (not crusty) in areas to escape predation."* (Interview 6). The Elder was able to attribute very specific climatic conditions to the survival of woodland caribou, with regard to predation and food availability. In another interview, weather can be related to woodland caribou movements, *"A good year for woodland*

caribou is early frost and solid ice" (Interview 3). However, due to lack of caribou hunting, there is no clear relationship between changing weather and impacts on caribou: *"the hides need to observed"* (Interview 6). When people are no longer subsisting on traditional food sources, they are unable to gauge impacts, use predictors or gain knowledge. This would be cause for alarm in many communities, but there is a sense of survivorship with certain Elders, as long as they have access to subsistence food, *"Despite extreme events, people can survive through subsistence"* (Interview 6). This type of knowledge is more of a benchmark of conditions prior to recent climatic changes.

Since youth did not directly participate in a focus group we are missing their perspective on changes occurring now. Particularly significant, since many of the Elders that were interviewed are either limited in mobility and are physically unable to go out to the trap lines and hunting grounds or they are spend less time on the land. Although it was indicated twice (Interviews 4 & 5) that youth were transmitting knowledge of woodland caribou locations and abundance to Elders. In most of the interviews the impacts of changing climate on woodland caribou was not fully understood by the Elders, this might be attributed to the lack of clear communication between interviewer and Elder.

4.2.2. Indigenous knowledge and learning in an environmental change context from Canada

The Canadian research focused solely on the perspectives of Elders. In Saskatchewan, youth are not participating as much in the traditional livelihoods of hunting, trapping and fishing the way their Elders did. This gap was made apparent in the Elders' interviews. In all but one of the interviews, the Elders indicated that they prefer to speak in Cree, but the youth do not. This lack of language capability acts as a clear barrier to the transmission of knowledge across generations. The language barriers arrived shortly after the residential schools. Compounding the loss of language, the schools were often in a central location far away from the activities on the land. Hence, the youth lost both their language and their culture as it was expressed in land-based activities. Many of the Elders expressed the feeling that their children had been taken from them, physically and emotionally, by a language barrier.

> *"Language is one powerful thing that transpired. They were able to cut off the Elder with the young person… They (the youth) don't want to lose the old ways but you don't want to go back to the old ways but certainly you don't want to lose a language because a language is something that gives them information that the old people knew, respect for the land…So nowadays it's English, English, English everything is English and the poor elders he tries to come up with this good way of talking in broken English but they try their best." (Interview 3)*

The Elders were not taught English, and in many cases the First Language was never taught to the children when they returned. With the youth not able to speak Cree and many of the Elder's fearful of English, finding new ways to communicate is imperative.

One of major change that is apparent from the interviews is the way Elders and youth interact with the land. The change can be observed in modern technologies in transportation. Historically, in the winter and spring, people used to rely on dog teams (Interviews 3, 4 and 6). This was a significant part of the culture and many of the Elders reminisced of how fun it used to be, racing

and looking after their dogs. Some families continue to keep dogs for sledding either for recreational or for sport racing. Transportation has moved to snow-mobiles in some cases vehicles on ice roads. In the summer time, many families relied on canoes that were either man-powered (paddling) or equipped with small motors (3-10 horsepower). Many Elders and youth are now using high powered motors with in-board and out-board boats and airboats.

4.2.3. Challenges to hunting, fishing and trapping as livelihoods from Canada

The dependence on food availability and safe travel is directly related to seasonal predictors. In some cases, the predictions that have identified can be linked to changing climatic factors. For instance, spring is correlated with fish spawning and migrations (Interviews 1 & 4). However, in other cases it remains unclear. For instance, in Interview 6, the Elder had described times when muskrats are wiped out from an area, extirpated. Muskrats are dependant on ponds and shallow water, so this can be related to the increased observations of droughts in the area. However, it is unclear if other factors are also contributing the declining population. Muskrats are significant part of the diet and income to trappers in the spring. During the transitions between seasons, "*summer and fall are linked to the arrival of geese, sandhill crane (Grus canadensis), and moose, marks the time to hunt"* (Interview 6). However, the migration patters of waterfowl are changing, "*they (geese) no longer have stop-over's in the area as they migrate*" (Interview 6). The changed migration patterns of the waterfowl indicate another loss in subsistence.

As anecdotal evidence to the impact of this loss of waterfowl, an Elder from Stanley Mission provided me and my family some very startling news this past month. Last fall, my family travelled down south to hunt geese (over 600kms away from our traditional area). During our annual hunt we were able to get enough geese to feed our family and extended family. We had exchanged some moose meat for a few geese shortly after the fall hunt with an Elder from Stanley Mission. When we met up with him several months later he told us that he gave those geese to an Elder woman in Stanley. She made "Indian medicine" out of the geese and gave it to some community members that were infected with whooping cough, "you saved their lives". For me and my family to hear this news, and to find such a significant relationship between our subsistence geese and Indian Medicine was very surreal. Additionally, to relate his story to the potential impacts of livelihoods and access to traditional medicine becomes very emotionally moving.

5. Discussion: Commonalities and differences between the two cases

Our empirical data are rich and diverse. A number of differences and commonalities between our two cases – the Vilhelmina Norra Reindeeer Herding Community in Vilhelmina Model Forest, and Sweden and Cree communities in Prince Albert Model Forest, Canada – emanate strongly. Both in the results presented above and here in the discussion we have had to select some of the most interesting in order not to overwhelm the reader. We have chosen present and discuss these according to four categories; contextual differences and similarities, observations of climate and environmental change, barriers and bridges in IK transmission and learning, and challenges to Indigenous livelihoods.

5.1. Contextual differences and commonalities

In both Prince Albert and Vilhelmina Model Forest regions (hereafter referred to broadly as Canada and Sweden) market-based economies have and continue to develop. In Sweden, this process has more far-reaching historical roots. Reindeer herding takes place in a multiple use boreal forest, characterized primarily by extensive forestry (both state-owned and private). Hence there is a clash between reindeer herding activities (which are partly market-driven and partly value-driven) (Nordin 2007) and surrounding market-driven land-use and resource extraction. Whereas forestry is not practiced as intensively in the Canadian boreal forest, and hence forests here are less disturbed, the experience of increased pressure on the land is shared between both locations. That is, the traditional lands of First and Indigenous Peoples in both Sweden and Canada are increasingly becoming subject to competing land- and resource uses through for instance forestry, mining, wind mills, and oil and gas extractions. Lack of clear consultation processes increases the risk that Indigenous communities continue to lose influence over the development of these lands and resources.

In both Canada and Sweden, there has also been a significant loss of First language, isolating Elder from youth. Loss of First Language can be seen as the result of processes of colonization including required attendance at European-style schools, wherein speaking and learning of First Languages was not allowed and even punishable. Schools were often located (far) outside the community – a practice that isolated children and youth from First Language speakers and impaired them from participating in traditional and subsistence activities. This was particularly pronounced as both the Sámi and the Cree are nomadic land-users and the dependence on safe travel is strongly tied to spiritual beliefs and offerings, and sacred sites.

Large carnivore predation, albeit not directly linked to climate and environmental change but rather to socio-political change and institutions, was also a key problem recognized in common. Predation will always impact reindeer and caribou. But in both locations certain predators are becoming more abundant and consequently increases in kills has followed. The underlying reasons to the increase in carnivores are however different. In Sweden the ability to deal with this ‘disturbance’ has been hampered as carnivores are regarded as protected species (according to international conventions) and hence culling of predators is not allowed (unless under very specific circumstances). In Canada, the increased wolf population can be related to the lack of trapping and hunting (Carriere 2010).

In terms of contextual differences, there is a significant divergence of identities and rights between Indigenous or “First peoples” in Sweden (the Sámi) and the Cree First Nation in Canada. For instance, the Sámi have no treaties. Processes of colonization have occurred over the past 600-700 years (or even longer) and there have hence been more cultural and economic interactions between the Sámi and what today is the majority population. Hence *who is* Sámi is a contested issue. As we have seen, the rights to practice reindeer herding is also top-down constructed through required membership in a reindeer herding district (and thus not available to all who share a Sámi identity). In Canada, some people have lost their identity as First peoples because they have been excluded by government definitions and benefits, and have been subject to general policies of assimilation. These efforts have affected both official membership in Cree communities of northern Saskatchewan and their identity.

5.2. Differences and commonalities in climate and environmental change observations

The first common finding across both cases is that change – climate and/or environmental – that the Indigenous communities find troublesome, is occurring. Although dynamic change is innate in both Cree and Sámi worldviews (in Sámi there is no word for stability), the observations of change our participants have given voice to here is a different, faster and anachronistic kind of change. Although some skepticism also surfaced (for instance in the Swedish case) these testimonies are very real to the participants. They feel 'It's different now, it's just the way it is.'

In both cases discussions focused less on isolated and direct effects (such as temperature increase) and approached climate and environmental change from a more complex viewpoint acknowledging rather the indirect effects and interrelationships between different variables. In the case of Canada, one Elder "views" the temperature as a 20 °C warmer then expected. Rising temperatures have a profound effect on their perception of seasonal temperatures. Hence we strongly recognize the potential of Indigenous knowledge and perspectives to act as canaries when it comes to climate and environmental change. A difference we noted in regard to this is that in Sweden, the worldview and approach to IK is strongly linked to the reindeer and reindeer herding. Changes were thus observed through the eye of the reindeer and through their own potential to navigate herding activities in view of their observations of change. In Canada, the worldview of woodland caribou is partly based on subsistence as well as an understanding of the role of caribou in the ecosystem. This is visible in the observations reported which in the Swedish case are almost exclusively linked to reindeer habitat and behavior whereas Cree observations adhere to a more systemic or system-ecological perspective.

In terms of long-term and short-term changes and extreme events, both locations reported disrupted precipitation patterns, shifting of seasons, warmer falls and winters and increased weather variability. Rain-on-snow events were mentioned less frequently than expected. A difference in extreme events is that fire is recognized as a major source of large-scale disturbance in Canada, whereas (large-scale) forest fires are extremely rare in Sweden (in turn due to a largely controlled forestry sector).

5.3. Differences and commonalities in IK transmission and learning

An obvious difference and commonality between Sweden and Canada is the role First Language plays. In both locations the importance purveyed of Sámi and Cree cannot be overestimated. First Languages act both as a keeper and a vehicle of IK and are thus central in terms of learning processes. However, in Sweden, language acts both as a barrier and as a bridge, but in Canada language is mostly a barrier. The reason is that in both instances there is, as already mentioned, a documented and grieved loss of First Languages that acts as a powerful barrier in knowledge transfer and development. However, among the Sámi (especially among the youth but also the Elders), our findings revealed an eagerness and willingness to educate themselves and others and develop their language skills. In the Swedish case, we interpret this as an untapped potential and bridge to overcome some of the difficulties recognized in terms of IK transfer, learning and development.

Another commonality that we came across was the seemingly "under-valuing" of the knowledge one kept. In Sweden, this applied both to the youth and the Elders. Among the Cree, it is not possible to draw this conclusion as youth participants (here understood as based on age) were not

involved in the study. However, several of the Cree and Sámi Elders interviewed showed a tendency to downgrade the importance of the knowledge and information they kept. They questioned whether they had anything of interest to share. 'Will anyone want to listen?' They also argued that their knowledge was less applicable today as the land and/or the activities had changed so much. For instance, in Canada, many of the interviewees would simply say "I don't get it!" or "you should talk to _____, they would know more". In Sweden, it is the movement through and interaction with the landscape that has changed. These changes call for other, complementary types of knowledge. We recognize both these as major barriers that need to be actively and explicitly dealt with if learning processes and IK transfer are to be improved. Although we can simply interpret these types of answers as a "self-evaluation", in some cases it can also be an attribute of IK, where knowledge is "lost in translation".

5.4. Differences and commonalities in challenges to Indigenous livelihoods

The ability of the Sámi and the Cree peoples to continue traditional activities is becoming increasingly challenging. These challenges relate to increasing management issues, increasing cost, and less returns. Thus, traditional activities are becoming less viable, although in Sweden not necessarily less appealing, to the youth (Figure 6). In both cases, Indigenous peoples rely on their resources for subsistence and income. At the same time 'traditional' ways of predicting weather is proving less accurate under a new and more variable climate. Transports and movement through the landscape is becoming increasingly difficult and even dangerous due to new snow- and ice conditions. Also the IK – its forms, contents and vehicles for transmission – is affected by the new ways of interacting with the landscape.

Figure 6 – In this photo, a Sámi youth, who is a local champion in "lasso-ing" is teaching a Cree youth his winning technique.

Photo by Naomi Carriere.

In Sweden, the reindeer herding Sámi are faced with a unique challenge as reindeer husbandry provides such a substantial part of their income (although hunting and fishing also play important roles). It is clear that the importance of a single species provides an urgent threat that naturally will focus efforts on this single species and single industry. The loss of reindeer due to climate change or from competing land uses would be devastating to the Sámi's subsistence and livelihood, culture, communities, and identity.

However, in the case of Canada, the Cree have three 'traditional' sources of income; hunting, trapping, and fishing. All three livelihoods, however, are equally threatened. If the woodland caribou were to succumb to climate change here in Canada, it would have a direct impact on the Cree's ability to hunt these animals, but not necessarily eliminate all of their potential livelihoods (Figure 6). Based on the interviews industries such as fishing and trapping might be threaten, with multiple key subsistence species being lost or extirpated in certain areas.

Figure 7 - During the research exchange in Canada, the researchers tour Reindeer Lake, SK. The host family is dependent on the fishing industry and during the trip, the family discusses their concerns regarding the future of this industry.

Photo by Naomi Carriere.

One of the most emotionally moving observations we made related to the situation for Indigenous youth in Sweden and Canada. These youth have unique challenges facing them. The youth must learn two languages, they have to learn to save livelihoods and knowledge, and they have to be proactive when it comes to facing problems within their community. In the case of Vilhelmina Norra RHD, the youth are extremely dedicated to retaining knowledge and livelihoods related to reindeer husbandry. Since reindeer husbandry is so closely linked with their identity, it is important for them to preserve this industry. Thus, Sámi youth are included in livelihood activities and they receive valuable IK from their Elders. As reindeer herding is turning into a more and more technical industry (with for instance GPS-collars on the reindeer) the youth are also identified by the active herders and Elders to possess important (new) knowledge in regard to for instance computers and are as such in a position to reciprocate the exchange of knowledge and information. In Canada, however, it is rare to find youth in a comparable age group who are able to problem-solve, take part in regular meetings, and are concerned with the environment. The Sámi youth have such passion and dedication and they desire to be included in activities with their Elders. In Canada, this level of commitment is very rare. A few may dream of becoming a trapper and wait to inherit the trapping cabin; *"Well they used to help me out in the trap line. The boys anyways, the girls didn't. Yeah we went out there for a couple of years after that they weren't too interested. They'd rather go work in the bush for themselves."* (Interview 4) Many of the youth are too busy with other ventures and career opportunities outside the community.

5.5. Conclusions, relating the findings from Sweden to Canada

Winter is one of the most important seasons for peoples in both locales. Disregarding the two most recent winter 'anomalies' in Sweden (with cooler winters), over the longer term our findings in both case study areas suggest warmer winters and non-analogous climate conditions. With increasing weather variability during the winter, the experiences and expressions of weather is very dramatic and controversial in both cases. Current trends are shifting, but with such rapid shifts in temperature and precipitation, it is becoming more difficult to predict "normal" conditions (if such a condition exists). Using historical climatic conditions as "normal" would be pragmatic, for these residents; however this makes their future seem more unstable or unpredictable, which can account for their sense of urgency to adapt. Therefore using long-term or short-term trends serves a dual purpose, where historical trends can account for "normal"

conditions, since normal conditions are occurring less frequently, it suggest adaptation will occur. Second, using current short-term trends may provide some clue how adaption must occur. For instance, in the case of Sweden adaptation seems mostly to take place through (new) technology as previous 'innate' flexibility (such as mobility and adjusting the herd structure) has become circumcised by other land-uses, infrastructural development and decreasing marginal returns.

When relating IK between our First peoples, juxtaposition becomes apparent. In the case of Sweden and Canada there seems to be only one emergent similarity, the loss of language. The loss of language can have devastating impacts on the ability to transmit knowledge between generations. Replacing "old" ways and languages, with more contemporary means, will impact the Elders and their ability to transmit their knowledge to their children. The knowledge becomes part of in the past, or in a "glass case". Elders in both locations express a sense of exclusion from their own children when First language is not a common thread. In Canada, the Elders try to see the positive side of this scenario by accepting the "Elders are past of the old way of life" and that the youth are better off in school, pursuing careers. Although, Elders are trying to find new ways of communicating with youth, suggesting the arenas are in the process of adaption.

Another component provides clashing comparisons. As mentioned in a precluding section, the attraction of youth to traditional livelihoods has not been entirely lost in either location. However, there seems to be a stronger connection to these ways of life in Sweden, then in Canada. With such a strong connection to reindeer in Sweden to self- identity and belonging to the community the youth have a much higher investment to participate. The youth seem to have a strong relationship between one another and within the larger community. In Canada, although the youth participate in the activities at a younger age, challenges exist to attract a full-time commitment after they complete secondary school. This might be related the idea of "a hard way of life". When many of the youth have many more opportunities then their parents did, in many ways the Elders approve of this change with a heavy heart.

6. Lessons Learned

6.1. Lessons learned about research practice

IK is a significant part of the culture, language and identity. The pursuit of knowledge is regulated by different protocols and norms in each of the countries. In terms of the research in Canada, there are strict guidelines for conducting research of this nature, relating to IK/TK. All of the research is outlined and templates are created well in advance of conducting interviews. Much of the ethics applications are based on research guidelines arising from the Royal Commission on Aboriginal Peoples. These guidelines make it very difficult to create posters and letters for consultation and interviews, if researchers are not familiar with the Cree language. There is no way to gain or access Cree IK without having transcriptions and translations of scientific terms. If one has these translations, Elders in the Prince Albert Model Forest area are more than willing participants. The Canadian portion of the research was governed by the Research Ethics Board (Behavioural) of the University of Saskatchewan. In the case of other research, there is no way to assess the motives or intentions of the research. This leaves the Elders in a vulnerable position. They want to record their information, yet they may be unaware of the purpose or use of their information by a researcher. Moreover, this research takes an oral tradition and converts it into a Western model through the written word. Their words have also been captured in recordings and

images in photos. Thus, there must be a high standard for protecting the integrity of the participants and understanding their vulnerabilities.

In Sweden, it is much harder to gain access to IK, as it is strictly regulated by the Sámi community, unlike in Canada. The Swedish University and CESAM (Center for Sámi Research) do not require exhaustive detailed applications and approvals in order to do IK-related research. The Sámi parliament is however in the process of developing some basic guidelines. If you are a non-Sámi researcher, however, access to the Sámi IK is never guaranteed as the Sámi have strict protocols on the sharing and usage of IK. Thus, it is important that individual researchers gain and maintain trust and acceptance of Sámi people throughout the research process. In this particular case, since this knowledge is forever written through this document, the researcher will always be linked to the Sámi community.

6.1.1. Shared lessons from both countries

In order to carry out this research it was very beneficial the have first-hand knowledge of the Canadian perspective, but this positioning also has limitations. Being an 'insider' means that the researcher is familiar with much of the knowledge that is being shared. It is hard as a researcher to observe people struggle with concepts, science and language barriers; especially as scientific terms are very difficult to translate into indigenous languages. Consequently, sometimes the researcher felt like she was a student giving the teacher an exam. The student knew the Elder knew the information, but the way questions are worded makes it difficult for the Elder to answer. In another example, Elders are to be respected. Thus, one does not want to put Elders in a position where they may sound silly, may provide the wrong answer, or embarrass themselves. In some cases, an Elder may not even attempt to answer a question, or more rarely, an Elder may refuse to participate altogether. These obstacles are always present and must be understood when considering the responses provided.

There were interesting responses to each of the researchers during the exchange. For example, when Annette visited Canada, she was regarded as friendly and respectful so that the Elders took to her right away. The Elders were very open with her, which sparked the exchange of knowledge, learning from one another.

Figure 8 - During the research exchange, a Sámi Elder (middle) heard of the Cree youths (left and right) from Canada. At the time we were in Klimpfjäll, Sweden. The Elder came to see us, while we were with a host family. During his visit we learn about settlement of this Sámi community, history of his family, Sámi language and he tried on a traditional Cree jacket.

Photo taken by Naomi Carriere.

In the case of Sweden, we had a non-Sámi researcher accessing knowledge from the Sámi community. During the exchange, the interviews revealed how guarded the Sámi are with knowledge. In a few cases, conflicting messages about how research was to be conducted, made

it difficult to pursue the work. For example, the two researchers had planned on doing an interview of an Elder, but there was a death in the community and one Sámi participant suggested that the interview be discontinued and the researchers should not visit the community. Shortly after, another Sámi participant informed them to discontinue the interview, but to visit the community. It is very hard in Sweden to be a non-Sami and be accepted fully into the community, making research very intricate. However, when Naomi visited Sweden, she was introduced as an Indigenous researcher from Canada. Many Sámi heard that a member of the Cree Family from across the Ocean was there for a visit. They often went out of their way to visit and exchange ideas, ways of life and history of the lands; the Sámi Elders came to see us (Figure 8). Naomi observed that the Sámi appeared to trust her because she was an Aboriginal person and she felt honoured to be accepted so easily. This trust might also relate to the protocols for the transmission of knowledge, where knowledge must be shared and verified between people before it is accepted and transmitted. Sharing is important.

6.2. Lessons learned about methodological approaches

As collaborators, we attempted to look at Indigenous ways of knowing and describing how climate change is impacting Indigenous livelihoods and knowledge. One researcher brought perspectives from within as an Indigenous researcher and the other from outside as a non-Indigenous researcher. They also brought together the complimentary backgrounds of natural and social sciences, which both apply to IK in the case of climate change. The combination of one non-Indigenous and one Indigenous researcher clearly broadened our scope of empirical data collected and the questions we posed. Each researcher had conducted research previously in our respective thematic and geographic areas; yet working together we found that the responses from our informants changed in the new constellation. For instance, in collaborative interviews undertaken in Prince Albert, interviewees seemed to put more effort into providing thorough explanations as well as describing the "basics." As a result, interviews felt richer and slightly more encompassing than the individual Canadian researcher had experienced before.

In the collaborative activities undertaken in the Swedish context, we found an increased tendency to describe spiritual and linguistic dimensions, which previously had not been as prevalent. As a result, exchanges became less instrumental in nature and more multidimensional. Our experiences with gathering data collaboratively do not provide far-reaching methodological conclusions; however, we believe that the blend of perspectives and backgrounds provided us with a methodological advantage as compared to other "either-or" approaches. We speculate that perhaps the differences we noticed could be attributed to a tendency of wanting to explain more to an "outsider" who is a visitor to the country than perhaps to one who has been resident in the region or country for some time.

Another obstacle that we came across and which partly hampered our comparison is that in Canada, the Indigenous worldview of "Elder" is based on one's role in a community and is not necessarily based on age. The concept "Elder" lacks an immediate translation into Swedish, but loosely alludes to someone with experience and has a stronger association with age.

7. Recommendations for future research

The comparative dimension between our two cases turned out to be even more complicated than at first anticipated. We strongly feel that the comparison served a very important purpose of

contrasting the cases against each other and hence enhancing the understanding of each. Alas, we could not have done without the comparative backbone of our study. However, the research design partly suffered from some incommensurability and hence we advise future researchers to caution their comparative ambitions. That said, we feel that each case not only made itself, but also the other.

In terms of approaching IK from a learning perspective we feel that we did in fact manage to avoid some pitfalls. However, as mentioned frequently, studying IK is difficult not only from a methodological but also ethical and operational perspective. Whereas we have begun to develop ways of mapping IK whilst giving voice to the communities' major concerns and perceived challenges, we also recognize that there is still a long ways to go. Based on our experiences, we recommend strongly that participatory techniques are used (throughout the research process) and argue that a diversity of backgrounds and perspectives is likely to enrich the research results.

Already at the outset of this research endeavour we recognized a knowledge gap in terms of gender dimensions in IK and IK learning processes. Although we initially aimed to address this gap, our design and results fell short in order to be able to state anything conclusively. Hence, we urge future research to continue to address this important dimension.

Our work and results transcend time. The words we have transformed from oral to written have been passed down since Time Immemorial, no beginning and no end. We have shared information and connections across the span of the Arctic Ocean. We were still able to convey messages with commonalities and some differences. However we are just beginning our journey into the cause and effect patterns of the Earth as a system. When looking at Knowledge between the Elders and the youth there was information not included in this report that needs to be researched and could benefit from future collaborations. Connection between the Cree and the Sámi knowledge can include Astronomy, predictions from the stars, Sun and Moon, the Atmosphere, through the Northern Lights, and not limited to biological indicators, woodland caribou and reindeer and boreal forest. The way youth and Elders in Canada view knowledge and prefer to communicate is changing; we can choose to ignore it or we can adapt to it. Despite these preferences, the knowledge always seems to persist and is always passed on to the next generation. In final summary, the Elders have given us strength by sharing with us very sacred information. In Canada, the Cree people have given us insight into the physical realm through the land and the processes but as well the spiritual realm through the Northern Lights the place where the ancestors are:

> *"Our old people knew that, and they used to say the spirits are dancing up there, they are happy. But now you don't see them anymore, where have they gone, but you just listen for them and if you are a little child they tell you don't get the spirits upset. Don't whistle, don't go out there too late, stay indoors as a child, so you knew that you had to go home early, it was just a way of making you listen. But yet at the same time they made you believe that there were spirits out there, and they always said if one little boy didn't listen and the spirits came down and picked him up, and he's out there now in their world, and we have never seen him again. So we always listen when we are told something" (Interview 3)*

Figure 9 – The researcher's Naomi (left) and Annette (right) first meet in Saskatoon, Saskatchewan. The exchange begins with an introduction to First people if Saskatchewan and a tour of Wanuskewin Heritage Park.

Photo taken by a Wanuskewin Heritage Park Employee.

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Appendix A: Interview guides

Interview guide for semi-structured interviews: Canada

Introduction

Interview questions

1) Describe yourself and your relation to the land/how you interact with the land?
2) Is this relationship changing in any way? How?
3) Do you notice any changes in the weather?

if the interviewee do not elaborate, or only cover a few aspects clarify the question by asking for changes in the following terms:

a) seasonal changes, summer, fall, winter, spring?
b) long term changes/slow or gradual change?
c) recent trends beginning only in the last few decades?
d) extreme events/entirely new phenomenon in terms of location, frequency and intensity?

4) These weather changes that you notice, do they affect your subsistence/livelihood?
a) do they impact your ability to predict weather patterns, animal behaviour or other events?
5) This knowledge you are sharing with us, such as being able to predict or read weather, would you consider this to be traditional knowledge?
a) how do you define TK?
6) Are there specific knowledge keepers in the community? Who?
a) how do you know or identify a knowledge keeper? what makes a person a knowledge keeper?
b) do people seek advice from you? who and concerning what matters? what kind of knowledge would you share with them?
7) How is knowledge shared in the community between individuals and between elders, adults and youth?
a) for instance, how do you teach your children or grandchildren?
b) are there specific places or activities that are especially important for sharing information and knowledge?
c) how and when, through what people or protocols is knowledge and information shared with people *outside* of the community?
8) Do you think that men and women or girls and boys hold different types of knowledge?
a) do you notice any differences in the way women and men, boys and girls are taught or learn?
b) what is the role of your first language in transferring knowledge and information?
9) One of the commonalities or things we share in both Sweden and Canada and the places where we are doing our research is a species that is known as reindeer in Sweden and caribou in Canada. That's why we are particularly interested in finding out about your perspective on the reindeer/woodland caribou. So from your understanding, what is the historical significance of woodland caribou/reindeer?
a) in your view what is the importance of reindeer/woodland caribou?
b) has the significance of the woodland caribou changed, if so when did this occur and how is it manifested, how do you see it?
10) If you compare with how things were in the past, do you notice any changes in the woodland caribou/reindeer?

a) changes in harvesting - the number of caribou harvested and the activities through which this take place?

b) what would be a good year for the caribou/reindeer?

11) If we look back to the changes in weather and weather patterns you have noticed, do you think that any of these changes in particular affect the habitat or behaviour of the woodland caribou?

a) the cultural aspects?

Do you have any questions?

Interview guide for semi-structured interviews: Sweden

Intervjufrågor

1. Beskriv dig själv och ditt förhållande till trakten och naturen. Hur interagerar du med den omgivande marken och naturen?
2. Upplever du att detta förhållande har eller håller på att förändras på något sätt?
3. Har du uppmärksammat några förändrade väderförhållanden? Om informanten inte själv utvecklar kan följande teman behandlas:
    a. Säsongsbundna förändringar; vår, sommar, höst, vinter?
    b. Mer långsiktiga förändringar, långsamma skeenden
    c. Nyliga trender, saker som har hänt under de senaste tiotal åren?
    d. Väderextrema händelser? Helt nya företeelser i förhållande till frekvens, intensitet, lokalitet
4. De här förändringarna i väder som du har uppmärksammat, påverkar de på något sätt din livsstil och försörjning?
    a. Påverkas på något din förmåga att läsa av naturen och vädret? Kunna förutse väderhändelser eller djurs beteenden t.e.x.
5. Denna kunskap som du nu delar med dig av, som att till exempel kunna läsa av och förutse väderhändelser, skulle du betrakta det som *traditionell* kunskap?
    a. Hur definierar du traditionell kunskap?
6. Går det att identifiera några särskilda kunskapsbärare i det samiska samhället?
    a. Hur skulle man identifiera en sådan person? Vad är det som gör någon till en särskild bärare av kunskap eller vishet?
    b. Söker folk råd hos dig? Vilka då och gäller det i så fall någon särskild typ av fråga? Vilken typ av kunskap delar du i så fall med dig av?
7. Hur överförs kunskap i samebyn? Mellan individer och mellan generationer?
    a. T.ex. vad och hur tycker du att det är viktigt att lära dina barn och barnbarn?
    b. Finns det några specifika platser eller aktiviteter som är särskilt viktiga för att bidra till kunskapsöverföring?
    c. Hur och när, genom vilka personer och särskilda sätt (om det finns några) delar man med sig av kunskap till personer utanför det samiska samhället och utanför den egna samebyn?
8. Tror du att män och kvinnor eller pojkar och flickor är bärare av olika sorters kunskap?
    a. Märker du några skillnader i hur flickor och pojkar lär sig eller hur de utbildas?
    b. Vad är rollen av det samiska språket i överföringen av kunskap och information?

9. Något som är gemensamt för både området vi studerar i Sverige och i Kanada är att det finns ren, eller caribou som den kallas i Kanada. Därför är vi särskilt intresserade av att utforska gemensamma utmaningar och möjligheter när det gäller renen. Hur ser du på renens historiska betydelse i din trakt?
    a. Vad är renens betydelse?
    b. Har renens betydelse på något sätt förändrats som du ser det? Hur? När?
10. Om du jämför med hur saker var förr, märker du några skillnader i renens beteende?
    a. Är renhjordarna större eller mindre än de var förr? Är hjordens sammansättning annorlunda? Hur har uttaget av renkött förändrats?
11. Om vi ser tillbaka på de väder förändringar du nämnde tidigare, tror du att någon av dessa påverkar särskilt renens marker eller dess beteende?
    a. Kulturella aspekter?
12. Övriga frågor?

Appendix B: Results and direct quotes from Canadian participants:

Interview #	Subject	Group	Season	Effect	Traditional Knowledge
1	Climate	Long term changes	Spring	Early Spring disturbes the emergence of mayflies (P. *Arthopoda* O. *Emphemoptera*) & fish migrations.	We have early springs and because of that the little things are confused even mayflies. Last year we had them in August they are confused because of the climate change the weather, sudden changes in the weather, even this early spring here the fish moved in and then it snowed they moved out, they are confused with the changes we are having;
2	Climate	Long term changes	Spring	Early spring results in the recovery of swan (possibly referring to the near extinct, but recovering trumpter swan *Cygnus buccinator*).	Yes, the weather goes crazy sometimes, like this spring you know, it come on snow and it's gone in a couple of days, three days, and then the weather came back, the cold weather. Sometimes big snow and rain, animals changing a lot of them gone already. I know there's one thing there, I don't know when they brought these swans here. They left this place a long time their food, I don't know what they left for, but they brought them back and I don't know if they'll survive. There's a lot of them in the lake and they dumped them there
4	Climate	Long term changes	Spring	Moose and woodland caribou arrive in the Suggi Lake area in March, this marks the season to hunt.	Moose... bush caribou's they're gone for all winter. They're all over there all winter. Then in the spring time they come through here in March...The caribou's are over there already by that Cumberland portage, there is lots of them over there...Yeah that's where them old people used to go hunting them. Is open bog yeah, it's bog, that's where they are in the bog, where it's boggy, boggy country... That's in Suggi, there in Cumberland area
4	Climate	Long term changes	Spring	Pickeral spawning occurs in the Spring and is important for subsistence and land-use.	For pickerel that's in the springtime. Where my cabins are that's where she showed me because she was there before. And the spawning season is right there. She told me all about it. Yeah! That's why I put my cabin right there. She said "New-sim" grandson, you'll never get hungry while you're here! You go fishing, you go hunting, go trapping, there's lots to do here. That's where my cabins are.

Interview #	Subject	Group	Season	Effect	Traditional Knowledge
4	Climate	Long term changes	Spring	Elders are still able to accurately predict ice break-up	Just like last spring, when they (Youth) were trapping here I told them, I said "You better hurry up the ice is good here, here in the lake and the next lake, but at Asini lake it's going to be full of holes pretty soon. Because once it thaws out, she (Asini Lake) honeycombs right away once the snow is gone. That Asini Lake it's different, it's not very deep and once the snow is gone it starts to make holes and the water runs into it...It could be two feet of ice yet till the ice starts moving. But up there I told them you better hurry up. They did (hurry up). They listened to me when I told them that. They brought up this big machine right up to Balsam (Lake) the day I told them and the next day they came over. They never went through the ice.
6	Climate	Long term changes	Spring	Despite the land changing, loss of species, people continue to be connected to the land.	The relationship to the land, to me hasn't changed, but the land has changed. I still believe in the relationship with the land. I still have a relationship in the spring time when I am trapping in the spring, for muskrat and beaver. Sometimes we don't have muskrats.
6	Climate	Long term changes	Spring	Early Spring is marked by the arrival of the geese from the North, Spring is the season to trap muskrat.	Spring, you wait until the blizzards and the big snow go away, and the cold weather, about the middle of March. If you hear the geese calling you know its going to early, if you don't then it stays cold…end of March is when you start trapping, and that is muskrat time. End of March is when you start trapping, and that is muskrat time. And that was one of the fun parts, because you left school. But you still had to do homework.
6	Climate	Long term changes	Spring	Ice break-up is a dangerous time to travel.	Ice break-up was dangerous, because we didn't really know. But we learned fast…I followed the old timers, like Peter Crane.

Interview #	Subject	Group	Season	Effect	Traditional Knowledge
6	Climate	Long term changes	Spring	Ice break-up predictions were very precise. Elders 35 years ago could predict within three days when the water would be open.	I notice when I last travelled to the Ferly's with my dad was 1974 we drove our dog teams across the lake, this was May 5th and we went across the Saskatchewan River with our dog team. And went across Egg Lake to the trapline. And set-up the tent and left me there with the boat, he said "I think Spring is finally going to come"...for at least ten days I was supposed to be alone. And he drove the dogs home that day...three days later it started thawing and that was it. And in the bogs that were the thaw came fast.
6	Climate	Long term changes	Spring	Ice break-up are earlier began to occur earlier in the 1980's. By 1990's, it was about one month earlier.	The change at that time, in the 80's all of a sudden I am not able to travel that late. When I took you guys out trapping muskrats and beaver, till you got one or two a piece. Some place there was open water that time. The open water was where the beavers were making holes...in the 90's things started to change, and I noticed when…my apprentice, Angus McKenzie, he went to light a fire on the cane grass and the grass along by the islands where they are thick. But him and Tom Stewart went to that one island and they fell in. That was the early 90's, the change happened earlier then we were expecting...in April.
6	Climate	Long term changes	Spring	Ice break-up occasionally would result in open water in April, these occurances were on a ten-year cycle.	Lately, in the last five years, we notice it's a month earlier now. It happened before, there was a few years that, April 10th or April 5th there was open water on the river already…but just the odd time….but ten years apart.
6	Climate	Long term changes	Spring	Ice-free water, occurred one month earlier in 2010.	This year, it is exactly one month earlier then in 1974, April 5th open water already. But the lake is still frozen. And then we look May 21st the lake was open. First time in my life-time that early.
6	Climate	Long term changes	Spring	Ice harvest would begin at the end of March.	Uncle Jim used to take us to Suggi Lake about the end of March, where it is not too cold and not too warm, but when your working with the ice (harvest) you are working in your tee-shirts…but its still cold and travelling with dog teams.

Interview #	Subject	Group	Season	Effect	Traditional Knowledge
6	Climate	Long term changes	Spring	The geese no longer have a stop-over in Cumberland as they migrate South.	(in the spring) The geese are not stopping in Cumberland like they used to they are only there for a little while, then they go South to the fields right away.
6	Climate	Long term changes	Spring	Sturgeon spawn are disrupted by the early leave buds and the water is still cold.	Our ability to predict when the spawning, like sturgeon, if the leaves sprout too early, and the water is still too cold, then they are not going to follow that pattern…same with the other species of fish that follow that kind of pattern.
6	Climate	Long term changes	Spring	Woodland caribou were harvested for subsistence, in the Spring.	And they (the Elders) were able to harvest them (woodland caribou) for their food….but Grandfather's and John Budd theory was you only take so many animals. You only take what you can eat, for so long. You don't throw it away. That was important food for them when they were travelling through the muskegs. But also in the Spring time when they were able to catch them in the lakes or in the bays. That is where they were (woodland caribou).
4	Climate	Long term changes	Summer	Sturgeon spawn and harvest is linked to Saskatoon berry blooms and fruit.	That's the knowledge I guess and like these fish at spawning season she (interviewee's grandmother) told me that too. She said if you're fishing for sturgeon you see these Saskatoon's these Saskatoon berries, them leaves, them flowers when they start to bloom, she says the sturgeon will be in the rivers. Once these things bloom the sturgeon are going towards the river. That's when you fish for Sturgeon. That's the knowledge you needed for sturgeon.
5	Climate	Long term changes	Summer	Thunderstorms and heavy rain are less frequent and there is an increase in forest fires.	One thing I remember, a strong forceful wind. Then all of a sudden, physical appearance of the sky would change, black clouds would show up. There would be strong winds, lots of lightning; that one thing now you do see as much, lightning…The thunder and lightning would always bring forest fires

Interview #	Subject	Group	Season	Effect	Traditional Knowledge
6	Climate	Long term changes	Summer	Summer predicts the season to harvest sturgeon, historically the middle of June.	Summer, supposedly starts June 21st. That's when things start, the new growth is coming. Before that's when things happened, middle of June…things were starting to sprout, and we had to work on the gardens as kids…we looked into fishing for sturgeon, the whole summer. We were out on the lake and out on the rivers, we went a long ways, nearly 80 miles to look for sturgeon.
6	Climate	Long term changes	Summer	Permafrost is less now, compared to historical. This will affect the woodland caribou, in the summer they might acclimatize to the warmer weather.	Talking to firefighters, digging in the muskeg, there is permafrost ice there and this day and age when you go out there, to the muskeg in my area, there is not that much permafrost. The permafrost is thin. And by June its thawed out already. There is no cold place for the caribou to lay on...this will relate to thinning of the hair.
6	Climate	Long term changes	Summer	The lack of permafrost results in the muskegs drying up and this led to succession of other plants.	When Sol (Carriere) talked about the muskegs near Big Eddy, he talked about the ground being "spongy" that was when the permafrost was melting. This day and age when he is walking there it is dry, so it is drying up…and what is going to happen, there is going to be a new growth of plants, new plants that come out.
6	Climate	Long term changes	Summer	The increase in forest fires and changing policy will impact caribou habitat, muskegs will undergo succession and new insects are appearing.	…I don't like that "let it burn policy", the government is lying when they say there is nothing (no such policy). They say there is no policy for "let it burn". Our president of the N-28 trapping area, he lobbied the government to stop using that policy for "let it burn". When they (the government) used that policy, North of Torch River, towards the muskeg, they let that burn. All of a sudden we get a bunch of new bugs into our area...they might bring some kind of disease...it could happen to people and it could happen to animals.

Interview #	Subject	Group	Season	Effect	Traditional Knowledge
3	Climate	Long term changes	Fall	Snow accumulation and depth has been reduced by 63 - 70% compared to historical.	Weather-wise, the amount of snow that falls, it's a small amount it doesn't fall like I said, it's extreme. It might fall just a little bit or might just fall a lot, but back then it just kept on falling, and kept on growing. Like when I was young, it would go about 6 feet 8 feet of snow, but all the time it would sink down, and it would seem like there was only about 4 or 5 feet of snow. Now, you know you are looking at metric; you're looking at about 1.35 m of snow (historically), now (presently) you're looking at about maybe 40 to 50 cm. It used to be high and it would fall early, it would fall about October 15...(cont'd)
3	Climate	Long term changes	Fall	Ice forms a month later compared to historical.	...(cont'd) Even the ice, it would stay really cold, once it came it stayed. Now it might get cold around then (October 15th), and then it will warm up and stay warm right up until November, even past November 11, it will go into mid-November and it will freeze, but an accumulation of snow you won't get it until December. And you're always wondering when is the snow? And so it affected our way of life too, but that's the weather. And it's not safe for us to travel on the ice anywhere around here, because we travel on the rivers and lakes, we travel on the muskeg's. You need extreme cold-weather to get the muskeg frozen too, that part you need at least -30, -20 weather, that even doesn't come right away. Our moose used to travel on the ice by mid-November. They don't even travel on the ice anymore until mid-December, so about a month, that's the difference...(cont'd)
4	Climate	Long term changes	Fall	Wolves migrate to hunt woodland caribou when the ice forms.	Usually (wolves) come down, when it's (the ice) strong enough for them to walk on, like I mean the wolves. They come from north. Yeah, they use the ice to travel as they go straight across to Cumberland portage to up to Suggi (Lake), I guess, to look for bush caribou's yeah, moose.
6	Climate	Long term changes	Fall	Warm winter are associated with the ppearance of the woodpecker (C. *Aves* F. *Picidae*) in the fall.	The misiw pah-pah-shess (big knocking bird, woodpecker), that big one, if he comes around in the…fall, its going to be a warm winter.

Interview #	Subject	Group	Season	Effect	Traditional Knowledge
6	Climate	Long term changes	Fall	Animals, are doing their mating call later.	Certain animals are calling differently, elk are calling a little later.
1	Climate	Long term changes	Winter	Reduction in the formation of ice by 50% now compared to historical.	Well this year we've hardly had any snow compared to other years and that's different and I guess that has happened, well way back I don't know how many years back, but when that happens the ice gets really thick that didn't happen over here this year it was really because we've had a short winter and I remember one year, because a long time ago all they had was chisels and it was about 6 feet of ice out here, that guy went in there well his head was out of the ice into the water that's how thick the ice was, but now you don't see that, it will go about 3 maybe 4 feet thick at the most that's what I've seen.
6	Climate	Long term changes	Winter	Winter travel was by sled dogs and the Youth also enjoyed the dogs.	Winter time, this is another interesting time for us. If dad left any dogs for us, it was not that much, maybe one or two dogs. So me and my brother had to race each other with one dog each… the dogs were our enterainment for us.
6	Climate	Long term changes	Winter	A good year for the caribou will be warm up North, the wolves stay with the Barren-ground caribou longer and then in the South the wolves go after deer. Woodland caribou are left alone.	A good year, is when it warms up, up North. This would have been a good year (2010). It wasn't that cold…it Southend it wasn't that cold, there was still open water in January I believe. The (barren-ground) caribou would stay up there. The wolves would stay with them. But also down here they are going after the deer. The woodland (caribou) would be saved...(cont'd)
6	Climate	Long term changes	Winter	A good year for caribou would be thin snow conditions so they won't have to dig through the snow (in the winter). And if they have moss and berries (in the fall and winter) to feed on.	(cont'd)…(what would be good for the woodland caribou), they wouldn't have to dig hard, in warm weather, they could sit around, they don't have to run. Nobody is bothering them. And they are able to eat the moss and other stuff, sometimes it is easier to pick berries in the fall, and in the winter time. There is new growth of plants in the muskeg, different colors, nice colors actually, purple, red, under the snow. If there is thick snow they won't grow, the Sun doesn't penetrate the ground right away. Good snow and warm weather is good for them...(cont'd)

Interview #	Subject	Group	Season	Effect	Traditional Knowledge
6	Climate	Long term changes	Winter	A good year for caribou is also thick soft snow that is not crusty, they can escape predators.	(cont'd)...Deep snow is good for (woodland) caribou too. Then the wolves can not catch them. Somehow with their feet they could travel good with that deep snow. But if it gets crusty it is no good for them too. Then the wolves can run on top of it.
6	Climate	Long term changes	Winter	How warmer weather is affecting woodland caribou and their habitat is not fully understood. This might be due to the lack of subsistance hunting, Elders have to observe the hides and fur thickness.	About 25 years of weather changes we observed, that's changing the weather patterns and also the warming up, I don't think we have learned enough to see the effect of it (on woodland caribou), we haven't really observed how their hair is, how the hides are. If their hides and their hair are thinning, because of the warm weather...that is what we have to observe and I haven't been able to...I might be able to this winter, to travel out there. And there is (woodland) caribou in my trapline.
3	Climate	Long term changes	Spring & Summer	Spring, marked by snow melt, arrives two months earlier. Summer is warmer and is longer.	...(cont'd) That's the changes I have seen, because our cold-weather always went right into March, now it warms up in January and February. With the Sun even, when I used to go to school as a young person, it remained dark at nine o'clock right up till about 9:30. Now there is light in the winter, you have gained more sunlight, that's another thing that we have gained. In the springtime you would see that the ground was free of snow way into May, now there is no snow in March, that's a big change, the first week, second week of March it is gone. We get earlier sunlight, long sunlight and it seems like when it hits its warmer. So now it looks like we've gained more sun and heat from the month of April, right all the way up until November. We would have the odd frost, but there is more frost free days in our area here now.
5	Climate	Long term changes	Spring & Summer	Occassionally, the Elders (Elders' Elders) did observe early spring and early summer, historically.	I used to hear them long time ago, they used to say spring is here early, too early and summer is here too early and sometimes it arrived late. That's what they said spring is too early, it would freeze and thaw, I used to record this on paper, for 20 years or so.

Interview #	Subject	Group	Season	Effect	Traditional Knowledge
6	Climate	Long term changes	Spring & Fall	Spring is linked to the arrival of the geese, sandhill crane and the moose. These mark the seasons to harvest.	The fall, because of the way we were raised, fall is one of the better times…that's when the music starts, you can hear all the birds, especially the geese, they start coming in, and you listen to them and watch where they are going, where they are fattening up and everything, so you can hunt them later on. You start hearing sand-hill cranes too. When the sandhill cranes starting calling you knew the moose would start calling.
6	Climate	Long term changes	All seasons	Spring is marked by the buds. Summer is marked growth of plants. Fall by marked the plants prepare for winter. Winter is marked by accumulation of snow.	…Also the immediate part like Spring, how plants are starting grow, in the summertime, their growing. And in the fall its like they are dying again, but actually the leaves are just falling. And then you look at wintertime and and it starts getting white, with snow. And then everything starts looking clean again. that's what we said anyways.
3	Climate	Long term changes	Atmospheric changes	Northern Lights are not as close to the Earth and they are not as vivid in color. People used to be able to hear them.	Being a young boy, I used to witness the Northern Lights in particular, the Northern Lights with all the trees being so big, you could just about see the Northern Lights comin as low as the treetops, and you could hear the static of the Northern Lights and it covers the whole sky, and ll the colors were so vivid. You could see them: yellow, green, blue, red and you could hear them cracking, of the Northern Lights...1967 I think it started to change in the 80's. Then the year 2000 now, you don't see Northern Lights they are just a small little band up there it's not like the whole sky; the whole sky was just dancing, and you don't even hear them any more

Interview #	Subject	Group	Season	Effect	Traditional Knowledge
6	Climate	Short term changes	Spring	Predictions of the weather based on the moon are correct now.	Just like this spring, he (his brother) predicted lots of rain, starting from March. For three months the moon indicating spilling
4	Climate	Short term changes	Summer	Forest fires, were less frequent historically. Prescribed burns were part of Cree management, these are no longer allowed.	When we were in Sturgeon Landing. I was around water all the time. It used to be hot. There was no fire that time. It was really hot. There was no forest fires. Sturgeon landing or Cumberland House! No forest fires unless somebody, lit a fire! But in Cumberland House when we were on the trapline by Max. I guess some traps down there towards the south; they would start the fire up. You would see the fires a long way. Max, he used to light it up from here and used to drift back. You would see that thing just a rolling and where it meets and your fire would go out. That's how they used to do it a long time ago.
5	Climate	Short term changes	Summer	Temperature is hotter and hot temperatures stays longer.	One thing is how the heat has changed. It gets hot in a hurry, and stays hot for long. July was hot the (hot) heat wasn't as hot or long.
5	Climate	Short term changes	Summer	Black clouds and strong wind are a prediction for a storm. These predictions are important for safe travel on the water.	Yeah, like that. That's how we knew. It was scary when the storm clouds would come, they knew how, when the wind was going to hit, how it was going to blow. A strong wind when the storm clouds, the darker the sky, guaranteed it was going to be a strong wind storm. Safety, Start motor and boat (35 HP) head straight for home. There was very strong winds then. Head home when signs of severe weather on horizon and always stay close to shore not too far outaway from shore, if the clouds are in the sky that will or carry a storm are visible it's a sign to stay close to the island to keep yourself safe. Elder taught us this method of predicting weather...When net fishing, keeping an eye on the surrounding sky is crucial not to get caught.
5	Climate	Short term changes	Summer	Early mornings are calm, this is the best time to travel safely.	Morning, early is the best time (to travel) while it is still calm.

Interview #	Subject	Group	Season	Effect	Traditional Knowledge
6	Climate	Short term changes	Summer	Rain can be predicted by the shape and color of the leaves.	...with the leaves…if you come in the evening or during the day, all of a sudden you will see the leaves will go down, but they will look kind of silvery, that kind of tells you its going to be raining that day…"the leaves are begging for water".
6	Climate	Short term changes	Summer	Rain predictions are no longer valid. People observe the signs and rain does not fall.	…sometimes (when the leaves are begging for water), there is just a gust of wind, and nothing comes with it (no rain), and the next day they still beg.
3	Climate	Short term changes	Fall	Ice formation in the fall is taking longer. Moose and woodland caribou are not able to migrate and run out of food.	Yeah I have looked at them (woodland caribou) and it will certainly impact them in a way that the moose move around too because they need that the bogs and marshes to be frozen really solid there are not moving or as solid as quick, they probably go in one area and they wait there and they eat these things out before they move into the other areas, so their food supply would certainly be affected and then they'd have to move to another place but before that has to happen they have to be solid. Any animal that's going to be moving at times when it's not solid is going to be running into trouble, they don't, they just go right up to the edge and they move right back. And that's the way they travel because we watched them.
3	Climate	Short term changes	Fall	A good year for the caribou will be cold weather with early frost and solid ice, so they can move around safely.	A good year (for woodland caribou) would be with early frost and it would stay frozen and it would freeze to a point where it could hold these animals up where it's safe to do a river crossing, lake crossing, swamp crossing, muskeg crossing because there are so many floating bogs. Because they just don't move from one place to another place. Like a moose will just move just a small little bit but caribou will move long ways and keep moving...

Interview #	Subject	Group	Season	Effect	Traditional Knowledge
4	Climate	Short term changes	Fall	Ice formation in the fall is taking longer and it is affecting the plant cycles, when they transition between fall and winter.	Yeah, in wintertime it is so warm you know when the wind blows, you know it's going to freeze or it's cold, it hit, but years ago it used to come gradually but in September it's cold already, long time ago but now you don't it's nice and warm in September. The leaves, even the leaves hardly turned in the fall you know when the leaves change colour. In the summertime you notice you get the wind in August. You get a big wind. After that the sap is gone from the trees at the end of August, the leaves are strating to turn color by September. All gold and everything. By the end of September the leaves are all gone.
4	Climate	Short term changes	Fall	Fall is occuring one month later, this affects moose biology.	That's when the moose loses it's fat. Now it's late, its way late. I think we're 1 month behind…The weather is getting longer. No it gets so and it's warm and in the fall it's really warm, when it's time to freeze, it's still warm.
4	Climate	Short term changes	Fall	Ice formation in the fall is occuring later and taking longer. This affects people's ability to use the land during fall and into winter.	October it's still warm in October and it used to freeze. That's when it started to freeze was in October.Weather, when it started to freeze just before December then its still warm but it freezes it's just because it's warm a guy has got to be careful if he goes out on the ice. Like just about two weeks before Christmas that's when it comes, cool weather. Really cold, drops down to -40° that's when it really freezes and it will keep freezing till Christmas. Till after Christmas and then it will turn warm again.
5	Climate	Short term changes	Fall	Bad weather was predicted by the mood of their dogs and leaves on the trails or roads.	I heard elders say, they knew when the dogs would run around in a playful mood then the weather was going to be bad. And the leaves you see on the trail (road), the weather is going to storm, bad weather day.

Interview #	Subject	Group	Season	Effect	Traditional Knowledge
3	Climate	Short term changes	Winter	Winter's are warmer by 20° in the months of December and January, resulting in increased chance of rain during these months.	...(con'd) Even with the temperatures, the temperature in the month of December you would get -30°C (historically), now you're only getting -10°C, - 5°C. You're going into January and you are still with the -15°C. We used to get a -45°C, -50°C (historically), now you are lucky you might get the -30°C. Into February, you might even get a rain in January and February, and that never used to be when I was young. As I got older it did happen, around the 1960s, there was one time it rained in February or late January around there, but that's the only time. But now it's more prevalent, it happens quite often. That's the changes I have seen, because our cold-weather always went right into March, now it warms up in January and February. As I got older it did happen, around the 1960s, there was one time it rained in February or late January around there, but that's the only time. But now it's more prevalent, it happens quite often...(cont'd)
6	Climate	Short term changes	Winter	Winter storms arepredicted by the willow whistling and shivering.	In the wintertime too…when you start hear whistling on the willows…just like they are shivering, you know there is a big storm coming.
6	Climate	Short term changes	Winter	Warm weather is predicted by snow falling off the branches.	When the weather is going to be warm, the snow starts falling off the branches, and you predict its going to be staying warm for awhile. "warm" is, that you are still wearing a parka to work.
6	Climate	Short term changes	Spring & Summer	Abundant rain is good for the land and the animals.	For us (lots of rain is good)! If it raining on this side of the country then we have cleaning of the land and also new growth and the animals are healthy too!
6	Climate	Short term changes	Summer & Winter	Winter temperature can be determined by the height of a wasp nest in the summer. Warm winter is when the nest is high. Cold winter is when the nest is low. Ground nests predict very little snow.	This is one thing that you look for when you are going by river (looking for wasp nests), when we were travelling with my dad…and Albert Flett (deceased) and this old guys and Joe Morin. If you see those nest way up then they (the Elders) will be happy, not much snow and warm. But if they are down below, then they predict a cold winter...sometime they bury it in the ground....sometimes that means no snow.

Interview #	Subject	Group	Season	Effect	Traditional Knowledge
3	Climate	Short term changes	All seasons	Loss of the muskrat species (Ondatra zebithicus)..	...plus it's warmer too, climate has changed. I noticed that quite a bit, but as far as the environment and my relationship and how I see things, it's a big change. When you used to see 250,000 muskrat pelts in one year being harvested in this delta and there is no more muskrats, around that's a big change.
6	Climate	Short term changes	All seasons	Dog behaviour can forecast rain or snow.	Dogs will bother their ears when its going to rain or snow coming.
6	Climate	Short term changes	All seasons	Rain predictions are based on the phases of the Moon.	The moon…changes how it is looking in the West, when the new moon, to the quarter to the full moon. Even from the new to the 1/4…if the curve is upside down (like an cup upside down), then you know its going to be raining...cree word for this phase of moon is literally "like its spilling". If it is down, like a cup (right-side up), then its stopping everything (no rain).

Interview #	Subject	Group	Season	Effect	Traditional Knowledge
2	Climate	Extreme event	Tornado	Tornado has been observed, which is non-typical	Well, the weather completely it happens all kind of things. Even not quite long ago; it never happened here before a tornado comes through here just a small one at mile 30 that's where it went across the road that's never happened before that way.
6	Climate	Extreme event	Tornado	A tornado was first observed in 1979.	"whirl-wind or dust-devil", those are the little wind storms that used to occur in our areas, you used to see that in the winter time, you would see the snow go up in a little storm… we see that on the mud too…the dust…we would see the dust fly up all of a sudden. But they weren't big. But then in 1979, when Dad died, that's when I first seen a tornado, in Cumberland Lake...it was a tornado it had the funnel cloud.
6	Climate	Extreme event	Tornado	Tornados are becoming more frequent average occurance is every 2.5 years based on the last 10 years.	We are starting to see them more (tornados). That's a big change….the extreme weather we are seeing…I have seen four of them in the last ten years. They hit someplace down South and keep coming North.
4	Climate	Extreme event	Drought	Thunderstorms and heavy rain are less frequent and there is an increase in forest fires. This will affect the growth of subsistence plants.	Yeah, you find it hotter now and these storms that come we never had that before. We had thunders that time I was telling you like a couple of days after we get thunderstorms really hit too! Rain! That's when I was growing up. That's, yeah! And they never had no fires. No fire but really good storms. Now they are gone. ...my mom used to say "we are going to get good berries" (After a good storm)
5	Climate	Extreme event	Drought	Temperature is hotter, there is less rain, less thunderstorms now, then compared to historical.	Today the water is much hotter (warmer). Like the Earth is getting warmer (hotter), for sure it's different now, it used to rain more a long time ago, I remember that when I was in a tent. I didn't like it when thunder and lightning flashed; it's not like that too often anymore.
6	Climate	Extreme event	Drought	Despite drought, bad economy and War, people are still able to survive, through subsistence.	It was a subsistence type of life (when he was born), because of the war... drought and depression. So everyone had to live off subsistence. The Aboriginal people were able to look after themselves.

Interview #	Subject	Group	Season	Effect	Traditional Knowledge
6	Climate	Extreme event	Drought	Low water levels have changed the succession along the river banks and sand bars.	I don't know if that is because there is no food to keep them there (why the geese migrate south so quickly)…willows started growing on the sandbars and also taller grass, so the geese won't be there.
4	Climate	Extreme event	Winter rain	Rain in January followed is followed by 2 weeks of fog. This occured about 10 years ago (2000).	Fog comes when it's starting in January. I noticed that when I was in Sturgeon landing the last winter I fished over there. I noticed in January I was lifting nets, it started to rain. In January it was rainy and after it rained there was fog! That fog comes the next day. For 2 weeks all we had to do was put the spruce boughs on the road. Wherever we go, we only had 1 trail we put spruce boughs. Oh! That last year I was over there? I can't remember the year...10 years...
4	Climate	Extreme event	Winter Rain	Rain in January followed by 2 weeks of fog happened when he was a Youth (mid-1900's). This affected the ability for people to travel on the land.	But quite a while back in there 1 time, I guess that's when it started I guess. Quite awhile back we were still in the trap line. My brother John came from Cumberland House with my mother about Christmas time and it was raining. The dogs could hardly pull the toboggan. Yeah we were going toward Cumberland house for Christmas. Yeah, that's when it started to change, that time. Yeah, and that fog in there stayed for a couple weeks, near Sturgeon Landing.
4	Climate	Extreme event	Winter rain	Fog followed by rain occurred 4 years ago (2006). This results in the extreme ice break-up.	Fog came down and it rained. Fog came down and while we were on this side of, by Hudson Bay point, I had a net going across and we were on McGregor Bay and we were lifting a net towards the evening and all of a sudden just like a big bang, just like somebody a,dynamite like an explosion. I thought it was the mine over there by Hanson Lake. So next day we had to go that way, we went over there next day I could hardly pull my net, it was open on the lake shore. We had to follow the lakeshore, skidooing towards our net. It was wide open about 20 feet wide, that ice opened up straight across. I don't think it was an ice crack, it just opened up. It just opened up, that's that boom we heard... Yeah, that was winter time, that was not too long ago! Yeah, That's unusual that thing....Not that long ago... maybe about 4 yrs.

Interview #	Subject	Group	Season	Effect	Traditional Knowledge
6	Climate	Extreme event	Flood & Drought	Certain areas are changing for the better, when managed properly. Some areas are changing for the worse.	We worked on the trapline, me and my brother. This (interviewee's trapline) used to be the worst trapline, for flooding and drought. It's right on the end of the rivers and starting to go on the lake. That's where all the deposit of sand is. I also worked on a good trapline at Furlease and Barrier (Lake). I have seen the changes on all three. Sometimes I have tears when I go on the Furlease.

Appendix C: Saskatchewan Project Summary

Learning from our Elders
Project
summary

Workshop	Facilitator	Youth	Translators	Co-facilitators & Elders
Training	Naomi Carriere	Gail Clarke	N/A	Bonnie Hamilton-Trottier
Dec-10		Candace Roberts	N/A	Hermaline Fagnon
		Joe Nelson	Clara Nelson	Dan McKay
		Mika Carriere	N/A	
Consultation	Naomi Carriere	Gail Clarke	N/A	Hon. Judge Gerry Morin
Jan-11		Candace Roberts	N/A	Keith Goulet
		Joe Nelson	Clara Nelson	
		Mika Carriere	Clifford Carriere	

Interviews	Total number	Communities	Languages	Men:Women
Gail Clarke	7	Brochet, Manitoba	Cree	2,1
		Southend, SK	Cree	3,1
Candace Roberts	7	Grandmother's Bay, SK	Cree	3,1
		Stanley Mission, SK	Cree	1,1
		Deschambeault Lake, SK	Cree	1,0
Joe Nelson	6	Montreal Lake, SK	Cree/English	4,0
		Weyakwin, SK	Cree/English	2,0
Mika Carriere	10	Cumberland House, SK	Cree/English	8,2

Appendix D: Report of Training of Youth in Vilhelmina Model Forest

SKOGSSTYRELSEN
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VILHELMINA
MODEL FOREST

REPORT 1(7)
Date Dnr 2011/487
21 March, 2011

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Report of Training of youth in Vilhelmina Model Forest.

Background

From 2004 when the Vilhelmina Model Forest (VMF) was inaugurated, there has been an exchange between the VMFM and the Prince Albert Model Forest in various ways. Not least, has the financial aid been very useful for keeping businesses running.

Through the common transdicisplinary project "Learning from our elders: Aboriginal perspectives on climate change and reindeer/caribou habitat in the circumboreal forest" which was granted partial funding from the International Model Forest Network Circumboreal Initiative and Canadian Embassy in Stockholm, such a joint effort entailing cross-regional and cross-country comparisons can now be realized.

As a result of this project VMF has made an inquiry in collaboration with the PAMF to train a number of young people from villages in Vilhelmina in interview techniques and how to deal with RenGIS. Weeks of intense discussion, in workshop and out in the field, have helped to continue the work and have opened a number of avenues for further dialogue and exchange.

The Vilhelmina Model Forest would like to thank the Prince Albert Model Forest for providing the funding for, inter alia, the completed workshop March 7, 2011.

Training and Workshop WMF March 7

Participating youths: Neila Fjellström, Marja-Lisa Thomasson, Kajsa Fjellström, Anna-Maria Fjellström, Ante Baer, Klemets Klemetsson, Sabine Baer, Joseph Baer, Erik Omma Poggats, Olov-Daniel Fjellström, Mattias Fjellström and Amandus Klemetsson

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Contributors: Marita Stinnerbom, Karin Baer, Per Sandström, Camilla Sandström, cast and crew Sebra Film, Anders Berg and Bengt Jonson.

Purpose

The purpose of the training event was to give the young people of the Vilhelmina North Reindeer Herding Community (RHC) guidance and training in documenting the history of the Elders in the RHC through interviews but also to give the young members of the community computer based techniques to manage the pasture land of the reindeers

Goal

To provide young people with skills and experience to document their daily lives by recording interviews with older relatives or others involved in the RHC. To gain insights in the usage of available pasture land, through RenGIS.

Implementation

The narrative has strong roots in the Sami culture and learning about working practices, history and way of life has survived through generations of families through storytelling. To document these stories is seen as essential for the future. On March 7, the RHC in collaboration with VMF conducted a training workshop with young members of the RHC where they got an insight into how to document through interviews. A compendium about interview techniques was handed out. Marita Stinnerbom introduced interview techniques and how to plan an interview. Advantages and disadvantages with open and structured interviews were discussed but Marita also highlighted the need to think through the whole setting such as time and place. After the theoretical introduction the participants were divided into small groups for practical training. The training included the use of tape recorders. After the practical training the whole group identified common subjects that could be of interest: The following areas were identified:

- Large Carnivores,
- Moving trails
- Climate change
- Access to pasture land

Questions linked to these four areas were then developed in groups. The questions were presented to the whole group and successively amended by the group collectively.

Education in RenGIS

The young members were also offered training in using GIS in land planning. Necessary tools to work with the planning documents of the RHC were installed on the computers of the participants. We looked at the pasture land subdivision and explained the concept that the RHC use to define core and key areas and explained how the RHC have developed the land use plan "Renbruksplan". We looked at how to use information from GPS-collared

reindeers and how reindeers use the pasture land during good and bad winter. During the day, a film crew Sebrafilm (www.sebrafilm.se) documented the meeting. The documentation will be part of the documentary "The Green Planet" which will be broadcasted on television.

Reflections from young people

Reflections from the participants is that the training was very useful and that they got an insight into the program RenGIS and how to immerse themselves in reflecting upon the land of the RHC, but also that it is important to document the experience form elders and link that to the current use of land.

Planned activities

The participants have been asked to interview elders in the RHC. The interviews will be based on the questions developed collectively. At the annual meeting of the RHC in June the participants will present the results from their interviews and what they have learnt from Elders and how they can use this information in relation to present land use.

Notes taken by

Marita Stinnerbom

Enclosure
1 Application to PAMF
2 Conformation from PAMF
3 Questions for interviews
4 Interview PowerPoint presentation
5 Interview workshop folder

Copy to
Vilhelmina North Reindeer Herding Community
The Swedish Forest Agency registrator

Some pictures from the workshop and training, March 7, in Bjurholm