

Social-ecological reclamation in the Northwest Territories: A framework for healing human-caribou relations.

by

Micki Baydack

A thesis submitted in partial fulfillment of the requirements for the degree of

Master of Science

in

Risk and Community Resilience

Department of Resource Economics and Environmental Sociology
University of Alberta

ABSTRACT

The impacts of mining activity on human-caribou relationships in the Northwest Territories have been a focus of study in both the natural and social sciences for decades. Guided by Łutsel K'e Dene First Nation elders and harvesters, this study used dendrochronology methods and best practices for Traditional Knowledge research in the community, to explore historical and contemporary patterns of caribou movements near Gahcho Kué, Northwest Territories (63° 48' N, -109° 8' W). Data from trample scars analyzed from this site suggest that the area has been a critical habitat for caribou particularly during the years 1990-2005. Traditional Knowledge from local Indigenous peoples, suggests that reclamation of current mine sites in the range of the Bathurst caribou herd must be done in ways that ensure human-caribou relations and landscapes are healed for future generations.

The results are consistent with trample scar research in Bathurst range and previously documented Traditional Knowledge that asserts caribou have started moving away from the area since the dramatic increase of mining activity in the region with significant social, economic and cultural consequences for Indigenous peoples. The study outcomes may be of interest to policy makers and others involved in reclamation seeking insights about patterns of caribou activity in the region preceding the advent of significant mining activity.

With the aim of contributing to the literature on community-based resource management, this thesis argues that a social-ecological approach based on both science and Traditional Knowledge can improve the reclamation and process for both people and caribou.

PREFACE

The research for this thesis was made possible due to a long-term research collaboration between Łutsel K'e Dene First Nation and Dr. Brenda Parlee at the University of Alberta. Chapters 1, 2 and 3 along with the concluding remarks in Chapter 4 are my original work and build upon the existing literature related to this thesis topic. I was responsible for the compilation of the manuscript, the data collection and data analysis. Numerous additional contributors, advisors, collaborators and participants are responsible for making this research possible. The dendrochronology analysis conducted in Chapter 3 was conducted with the use of software, equipment, lab space and guidance from Dr. Ellen MacDonald in the Department of Renewable Resources at the University of Alberta. Our research assistant Kaitlyn Trepanier carried out the research analysis with the invaluable assistance from Colin Bergeron, who drew upon his vast knowledge of dendrochronology. Chapter 3 will be developed into a journal submission and the results and discussion sections were a joint effort between Colin Bergeron, Dr. Parlee and myself. Community members from Łutsel K'e Dene First Nation: Dacho Poole, Joseph Catholique, Alec Enzoe, Nancy Casaway and Sache Catholique assisted in the collection of tree root samples and site analysis in the field. Dacho Poole assisted with delivery of the semi-structured interviews and participated in numerous workshops both at the University of Alberta and in Łutsel K'e, NWT.

DEDICATION

This work is dedicated to people of Łutsel K'e Dene First Nation who welcomed me with open arms; for that I cannot begin to express my utmost gratitude to each and every one of you. Masi Cho.

“...research is not an innocent or distant academic exercise but an activity that has something at stake and that occurs in a set of political and social conditions.” – Linda Tuhiwai Smith, 1999

ACKNOWLEDGEMENTS

Numerous people have made this thesis possible with their guidance, support and advice in varying capacities; this project would not have been possible without all of you.

Thank you to the community members of Łutsel K'e Dene First Nation who made me feel welcomed time and time again. I would like to express my gratitude the family of Joe Lockhart, his daughter Jeanette and her daughters Lillyan and Mackenzie for opening up their home and family to me while also supporting me. To Sandra, an extension of the Lockhart clan, thank you for welcoming me into your life and inviting me to make a once-in-a-lifetime trip to Fort Reliance- I will return to Łutsel K'e to fish with you. Ray Griffith and Shonto Catholique at the Wildlife, Lands and Environment office in Łutsel K'e, thank you for your support, encouragement and invaluable input during this research process. Alec Enzoe, Joseph Catholique, Nancy Casaway, and Sache Catholique, thank you for accompanying me during the field component of this project and sharing your knowledge with me in the barren lands. I would like to extend additional gratitude to Nancy Casaway, who interpreted interviews with elders throughout this project and without Nancy, many elders voices would have been unheard. Dacho Poole, I cannot begin to thank you enough for your participation, suggestions, input, engagement and eagerness with this project. You are so very inspirational and I know you are destined to do great things for your community and society as a whole. Your positive outlook on life is something that I will carry forward throughout my own life.

To all of the community members who participated in the interviews, without your insights, knowledge and perspectives, this research would have not been possible. Thank you for sharing these insights with me and for having patience as I grew more comfortable with the research process. Dennis Drygeese and Laura Jane Michel, thank you for being so willing to participate in the conference in Quebec, despite not knowing me at that time. Additionally, thank you to you both for taking the time out of your lives to join the workshop at the University of Alberta. Dennis, thank you for your friendship; for sharing your knowledge, support and most importantly laughs with me, it made the research process far more enjoyable for me. Laura Jane, thank you for your friendship and your patience with me as I became more comfortable with the research process. You are extremely talented and I know you will accomplish great things in life,

it has been a pleasure getting to know you and I hope we can remain in contact as we carry on in life. To all other administrative staff in Łutsel K'e, thank you for assisting in the coordination of this project over the last two years.

Thank you to the funders that made this research possible: Toward Environmentally Responsible Resource Extraction Network (TERRE-NET), Northern Scientific Training Program (NSTP), and Resources and Sustainable Development in the Arctic (ReSDA). A special thank you to Kennady Diamonds and Aurora Geosciences for supporting this project in numerous capacities and for coordinating logistics during the site visit.

To all of the students, instructors and professors at the University of Alberta who have assisted me in the development of this project through discussions, or otherwise, thank you. To my supervisor Brenda Parlee, thank you for your time, guidance, patience and direction throughout this research process; I am so fortunate to have been able to learn from you. I would like to thank the members of my committee Dr. Frank Tough, Dr. John Parkins and Dr. Ellen MacDonald for their interest and time invested in this project. Dr. Ellen MacDonald, I would like to extend additional gratitude to you as you have guided me through almost six years at the University. Thank you for taking the time to develop my field skills in my initial years, foster my understanding of ecology, and discuss this project in various capacities over the years. Dr. John Parkins, I would also like to extend my sincerest gratitude to you for your guidance throughout my studies. Colin Bergeron, I cannot thank you enough for your countless hours spent on this project; your desire to share your knowledge is truly inspiring. Thank you for accompanying me on numerous presentations and during the trip to Łutsel K'e; I have learned so very much from you and I look forward to our publication.

Lastly, I would like to acknowledge the support from my friends, family and parents in Edmonton, Vancouver and abroad. Your support, kind words and encouragement is what has kept me travelling along this path and I cannot thank each of you enough. Thank you for encouraging me to pursue this avenue in life; I have learned so very much about myself, others and the world around me.

Table of Contents

ABSTRACT	ii
PREFACE	iii
DEDICATION	iv
ACKNOWLEDGEMENTS	v
CHAPTER 1. INTRODUCTION	1
1.0 Introduction.....	1
2.0 Research Purpose and Objectives.....	1
3.0 Setting.....	2
4.0 Methodological Approach	2
4.1 Methods.....	5
5.0 Theoretical Framework.....	6
5.1 Social-Ecological Systems.....	7
5.2 Engagement of Indigenous Peoples in Natural Resource Management	7
5.3 Traditional Knowledge and Reclamation	9
5.4 Reclamation and Cultural Landscapes.....	12
6.0 Thesis Outline	15
CHAPTER 2. RESULTS PART 1	17
1.0 Introduction.....	17
2.0 Literature Review.....	19
3.0 Methodological Approach.....	22
4.0 Results.....	23
4.1 Social-ecological Uncertainties and Technical Concerns Associated with the Development of Reclamation Planning.....	24
4.1.1 Uncertainties.....	24
4.1.2 A Contaminated Landscape.....	27
4.1.2.1 Contaminated Water Bodies.....	28
4.1.3 Shifting Caribou Movements Patterns.....	29
4.1.4 Human-Caribou Dynamics.....	30
4.1.5 Cumulative Impacts.....	32
4.2 How should reclamation be approached to ensure the land returns to a usable state and the caribou return?	33
4.2.1 Technical Reclamation and Solutions-oriented Approaches.....	33
4.2.1.1 Road Use	33
4.2.1.2 Infrastructure Removal.....	35
4.2.2 Social and Cultural Approaches to Healing the Land.....	36
4.2.2.1 Spiritual Healing of the Land.....	36
4.2.2.2 Retaining Traditional Knowledge.....	37
4.2.2.3 Cultural Stewardship—Involving Indigenous Peoples.....	38
4.3 Pathways for Healing: Responsibility, Accountability and Future Outlooks.....	40
4.3.1 Mistrust of Government and Industry.....	40
4.3.2 Ambiguity of Resource Development.....	41
4.3.3 The Role of Indigenous Peoples.....	42

5.0 Conclusion	44
CHAPTER 3. RESULTS PART 2.....	45
1.0 Introduction.....	45
2.0 Literature Review- An Investigation of the Social-Ecological Systems Approach to Understanding Human-Caribou Relations in Northern Canada.....	46
2.1 Oral Histories About Human-Caribou Relations in Northern Canada.....	47
2.2 Using Trample Scars to Map Caribou Movements around Mining Sites in Northern Canada.....	48
3.0 Methodological Approach.....	50
3.1 Field Research.....	51
3.2 Dendrochronology Sampling.....	52
3.3 Dendrochronology Analysis.....	55
3.4 Data Actualization.....	56
3.5 Łutsel K'e Dendrochronology Workshop.....	57
4.0 Dendrochronology Results.....	57
5.0 Discussion.....	60
5.1 Contemporary and Historic Insights about Caribou Activity Around the Kelvin Lake.....	62
5.2 Oral Histories and Ecological Knowledge of Caribou in and Around Mine Sites.....	64
5.3 Manifestations of Human-Caribou Relations: A Systems Perspective.....	66
6.0 Conclusion.....	70
CHAPTER 5. CONCLUSION.....	71
1.0 Summary.....	71
1.1 Bridging the Gap Between Indigenous and Western Knowledge	72
2.0 Next Steps.....	72
REFERENCES.....	74
Appendix I—Consent Form and Information Sheet	85
Appendix II—Interview Guide.....	90
Appendix III— Research Agreement with Łutsel K'e Dene First Nation.....	92

List of Tables

Table 1. Age of trample scars organized from oldest to youngest scar from samples collected at Kelvin Lake in July 2017.....	60
---	----

List of Figures

Figure 1. Map of the Northwest Territories highlighting Łutsel K'e and Kelvin Lake in relation to Yellowknife.....	2
Figure 2. Locations of diamond mines in the Northwest Territories.....	18
Figure 3. Map of the approximate sampled area at the Kennady North Project.....	51
Figure 4. Site photographs from Kelvin Lake.....	54
Figure 5. CooRecorder sample analysis.....	56
Figure 6. Relative trample scar frequency for samples with a trample scar detected indicating proportional trample scars in relation to tree roots alive in each period.....	59
Figure 7. Panarchy of human-caribou dynamics and the uncertainties associated with mining	69

CHAPTER 1. INTRODUCTION

1.0 Introduction

The Dene of northern Canada have a strong relationship to barren-ground caribou (*Rangifer tarandus groenlandicus*) that is many hundreds, if not thousands of years old (Parlee et al., 2018; Legat 2012; Smith 1971). This relationship has been under stress in recent years due to increasing natural resource development, particularly in the Bathurst caribou range (Boulanger et al., 2011; Gunn et al., 2011; Vors & Boyce, 2009; Vistnes & Nellemann, 2008). As many of the mines of this region reach closure and the period of planning begins for reclamation, questions of how to reclaim the land and health of human-caribou relations grows.

This research uses the lens of social-ecological systems to examine the relationships of northern Indigenous communities to their surrounding landscapes in the traditional territory of Łutsel K'e Dene First Nation in the Northwest Territories. The work is inspired by related research on cultural-landscapes, Traditional Knowledge and natural resource management. The methodological approach is informed by previous collaborative and community-based research in the North including that involving documentation of Traditional Knowledge of caribou. We used dendrochronology methods in combination with semi-structured interviews to understand caribou movements from a community perspective to inform alternative approaches to reclamation. Our approach to this project was directed by community concerns, gaining insights into the extent and magnitude of impacts associated with mines on caribou while also providing a greater breadth of knowledge at a local level to enhance decision-making processes. This approach created opportunities for integration of Indigenous knowledge into the broader framework of natural resource management, fostering locally developed solutions. Through this research, I gained a greater understanding of human-nature interactions and the significance of these changing relationships associated with mineral development in the North.

2.0 Research Purpose and Objectives

- (1) Determine how reclamation of diamond mining activity could be better informed by Traditional Knowledge of Łutsel K'e Dene First Nation (Chapter 2); and
- (2) Determine opportunities for linking Traditional Knowledge and dendrochronology data to understand caribou movements in a cultural landscape impacts by mining activity (Chapter 3);

3.0 Setting

Łutsel K'e Dene First Nation is located on the East arm of Great Slave Lake in the Northwest Territories approximately 200 kilometers east of Yellowknife. Home to the Denésoliné peoples, Łutsel K'e has a population of around 300 people, with the majority being of Chipewyan Dene descent. Located 40 kilometers south of the treeline, hunters have traditionally travelled beyond the treeline into the barren lands to harvest caribou and other game for subsistence purposes. In a modern context, the barren lands within Łutsel K'e Dene First Nation's traditional territory is now becoming increasingly developed for diamond mining, with the most recent exploration project being near Gahcho Kué/Kelvin Lake (63°48' N, -109°08' W) approximately 280 kilometers northeast of Yellowknife in the District of Mackenzie (Figure 1). As economic prospects grow within this region, the pressures associated with industrial development in Łutsel K'e Dene First Nation's traditional Akaitcho territory become increasingly worrisome to many community members.



Figure 1. Map of the Northwest Territories highlighting Łutsel K'e and Kelvin Lake in relation to Yellowknife.

4.0 Methodological Approach

The work was developed in collaboration with Łutsel K'e Dene First Nation with the aim of increasing their capacity inform local and regional process of management both of caribou and the planning, management, monitoring and reclamation of mining activity including those near Kelvin Lake. The work is inspired by variety of participatory and collaborative research

methodologies. Community Based Participatory Research (CBPR) is an approach to research whereby “the decision-making power and ownership are shared between the researcher and the community involved, bi-directional research capacity and co-learning are promoted, and new knowledge is co-created and disseminated in a manner that is mutually beneficial for those involved” (Castleden et al., 2012). CBPR has the immeasurable capacity to honor the traditions of communities, while also providing the opportunity to advance decolonization through research methodologies (Stanton, 2014). Conventional research approaches fail to meaningfully address local concerns and ignore the underlying legacy of oppressive and exploitative research conducted on Indigenous communities, while CBPR uses theoretical and practical connections to address these legacies (Stanton, 2014; Jacobson & Rugeley, 2007).

To grasp the necessity for CBPR, one must understand past Indigenous - non-Indigenous relations. “Research involving Indigenous peoples occurs within a historical context of exploitation and misrepresentation by non-Indigenous scholars, artists, journalists and colonial government agencies” (Ball & Janyst, 2008). Too often research tends to “undermine the experiences and perspectives of Native communities in order to advance the Eurocentric conceptualizations of inquiry, recognition, and success claimed by the academic community” (Stanton, 2014). Given the heightened level of awareness of the unethical treatment of Indigenous people in Canada in both an academic context, and more broadly in the context of human rights, CBPR has emerged as an avenue to collaborate with Indigenous communities and address local concerns from an Indigenous perspective. CBPR exists as a relatively novel approach within academia, with foundations nested in Kurt Lewin’s initial work in the 1940s on group dynamics and further research in the 1970s on social movements as a means for positive social change (Castleden et al., 2012). “Given the growing recognition of unethical research practices involving Indigenous peoples in Canada and in an effort to minimize harm, several national bodies, Indigenous organizations, and funding agencies began producing ethics statements, guidelines, and policies in the early 1980s” (Castleden et al., 2012).

Central to research done with communities is the theoretical notion of power dynamics between researchers, academia and communities. Cattaneo & Chapman (2010) suggest “empowerment is central to the work of improving human lives” as it functionally highlights “social, political, and material resources and inequities in the environment, the strengths of individuals and communities, and the enhancement of well-being through support of the natural

inclination to strive for positive change”. Intended to initiate change at a community level, CBPR redresses the imbalances between knowledge and power (Kwan 2004). In essence, CBPR is more about harnessing autonomy through the deconstruction of the social barriers of disenfranchisement and less about research in a conventional sense. Castleden et al. (2012) emphasizes this notion in that “...unlike conventional research, where analysis takes place in the academy, engaging with community members over interpretation of both language and cultural content may also prevent misrepresentation and misallocation of Indigenous knowledge”.

In applying CBPR methods, opportunities for identifying localized concerns from the community can lead to more robust knowledge dissemination in contrast to conventional methodologies. Co-learning and bi-direction learning embedded in CBPR practices create opportunities for community members to gain knowledge from the social and natural sciences, while researchers are exposed to Indigenous knowledge and culturally-specific protocols (Castleden et al., 2012; Meadows et al., 2003). This was experienced in my own research whereby the community members were gaining insight into the scientific process in both qualitative and quantitative research methods, while I was able to learn from the community by actively engaging a depth of cultural context which served to enhance the quality and meaning of the research. Deploying CBPR methods allows for the depth of research to expand through the interaction between varying knowledge and belief systems (Stanton, 2014).

Drawing from CBPR, this research utilized numerous opportunities to engage community members with the research process to enhance learning at a community level. Notably, this consisted of hiring a community researcher to participate and develop skills throughout the entire research process including areas such as interview methods, qualitative analysis, dendrochronology sampling and dendrochronology analysis. Furthermore, sampling on the land was guided by community hunters and elders to utilize their Traditional Knowledge and actively engage the community in sample collection. Finally, two workshops were held over the duration of this research project, both with the intention of educating and familiarizing community members with research methods. The first workshop occurred in February 2018 at the University of Alberta, where three community members learned about dendrochronology analysis. The second and final workshop occurred in June 2018 and was held in Łutsel K’e to disseminate the information about and results from the project with the Wildlife, Lands and Environment Committee, interested community members, and to children from grades 3-12.

4.1 Methods

The first step of the research involved scoping interviews which were carried out in March-July 2017 to determine the direction of the research. Although initially the focus was more related to community-based monitoring in the region, the scoping interviews revealed a stronger interest in the problem of mining impacts on caribou. A Research Agreement was subsequently developed in May 2017 detailing how research would be carried out including terms for data ownership, control, access and possession. It was refined again in October 2017. A research license for the research was also issued from the Government of the Northwest Territories on July 1, 2017. All work was guided by the Wildlife, Lands and Environment Committee including project scoping, interview design, field activities, verification, analysis and reporting of research results. Community researchers and translators were involved in interviews, fieldwork as well as the analysis of samples in the dendrochronology lab at the University of Alberta. Methods developed by Dokis-Jansen (2015) with Łutsel K'e Dene First Nation in 2013-14 informed the study design.

A four-day field camp was undertaken in July 2017 with five community members around Kelvin Lake on the traditional territory of Łutsel K'e Dene First Nation. This field camp was held to gain community insights into caribou movements in the Kelvin Lake area and link these insights with supporting evidence from tree roots. Elders identified sites where caribou had been active in the region and shared insights about the importance of this area both as caribou habitat and as a cultural landscape. During this field camp, community members guided the collection of *Picea mariana* (black spruce) tree roots along identified caribou trails. These tree roots were sampled and collected to conduct analysis on the presence of caribou around the Kelvin Lake area.

Semi-structured interviews were also conducted to compliment the tree root data collected in the Kelvin Lake area with community perspectives. A total of 26 semi-structured interviews were carried out between 2016-2018 using guiding questions related to issues of mining activity, caribou movements and issues associated with reclamation and remediation. Interviews were conducted with hunters/land users, elders and youth to gain insights into the broader perspective of the community. A total of 14 open-ended questions were directed to participants with additional prompts posed at appropriate times. Each interview was recorded,

transcribed and coded to identify emerging themes. A series of workshops held in early 2017 with elders and caribou hunters resulted in more refined procedures specific to the Kelvin Lake region and for semi-directed interviews in the community. The data was verified in February 2018 and again in March 2018 ensuring consent for all transcript material used as well as photos. The final thesis results were presented to community members, the Wildlife, Lands and Environment Committee and each of grades 3-12 at the Łutsel K'e Dene School June 14-17, 2018.

Due to geographic limitations and time constraints, the sampling design focused on a fine-scale region. This sampling approach initially presented concerns as there was relatively limited information available regarding the fine-scale knowledge on the habitat use of the area immediately surrounding Kelvin Lake. Much of the knowledge from the community pertained to the barren lands as a whole, rather than the specific area of interest in this project. Upon arrival at Kelvin Lake and initial scoping of the land, these concerns subsided due to the observable caribou utilization. This methodology provided an immensely detailed record of the area immediately surrounding Kelvin Lake, however, the results can speak less to landscape-level impacts and tendencies. Although this research allowed for the voices of community members to be shared, this was somewhat limited in that 20 of 26 interviewees were males. This was unintentional, however it may have presented a primarily male dominated perspective across the data, as male and female roles for the Denésoliné have traditionally differed.

5.0 Theoretical Framework

This work was informed by three core areas of literature: social-ecological systems, engagement of Indigenous peoples in natural resource management and cultural landscapes. Building upon the works of Carl Folke and Richard Howitt, we examine social-ecological systems in the context of northern natural resource development to understand the human-caribou relations. Drawing from scholars including Fikret Berkes and Peter Usher, we explore current levels of engagement of Indigenous peoples in natural resource management and opportunities for enhanced levels of participation in decision-making processes. In examining existing literature surrounding the connectivity between cultural landscapes and landscape ecology from an anthropological perspective, we explore the need to understand reclamation from a social-ecological perspective.

5.1 Social-Ecological Systems

Caribou have been integral to the way of life of many northern people across Canada the circumpolar North for thousands of years (Gunn et al., 2011; Sandlos, 2011; Kendrick et al., 2005; Parlee et al., 2005). This dynamic between people and caribou has been described as a “social-ecological system” by numerous previous authors (Berkes 2017; Padilla and Kofinas 2014; Forbes 2007; Kendrick 2003). Scholars have used the idea of the social-ecological system to emphasise the integrated concept of humans in nature and to accommodate the view that the delineation between social systems and ecological systems is artificial and arbitrary (Ostrom, 2009; Folke, 2006; Walker et al., 2004; Folke & Berkes, 1998).

These close interconnections between northern Indigenous people and environments in Canada’s North have led to the generation of significant knowledge about ecological variability (Traditional Knowledge) and the capacity to learn and adapt to those variabilities. (Parlee et al., 2018; Kendrick et al., 2005; Parlee et al., 2005). Like other kinds of complex social-ecological systems human-caribou systems are dynamic; endure a variety perturbations (e.g., habitat quality, predation by wolves) which places stress on human-caribou relations. Among the stresses of greatest concern to Indigenous communities is disturbance from mining activity (Parlee et al. 2018; Festa-Bianchet et al. 2011). Although barren-ground caribou are resilient to some habitat disturbance, the cumulative effects of over twenty years of mining exploration in the Bathurst range has begun to alter the equilibrium of social-ecological system to the point where caribou populations can no longer be sustained. This thesis is guided by this literature on social-ecological systems to help understand the importance and dynamics of change in landscape change in the traditional territory of Łutsel K’e Dene First Nation and the potential to remediate and heal these landscapes in ways that will sustain caribou and people for future generations.

5.2 Engagement of Indigenous Peoples in Natural Resource Management

This thesis emerges in the context of three trends - a decline in the singular dependence on one knowledge system (i.e., western science), increased recognition of traditional knowledge in natural resource management and political pressure to recognize the inherent and Treaty rights of northern Indigenous peoples. Natural resource management institutions based on western science have limitations in effectively mitigating the increasingly complex nature and scale of

environmental impacts of large scale resource development (Uprety et al., 2012; Berkes, 2010; Tsuji & Ho, 2002; Stevenson, 1996). These institutions have become increasingly dependent on the influence of the public and have begun to actively acknowledge the voices of Indigenous peoples.

Since European settlement and colonization, Indigenous peoples in Canada have been excluded from decisions about land and resource development; policies and strategies developed during this period (e.g., criminalization of subsistence hunting) has been described by anthropologists and geographers as the process of “dispossession” (O’Faircheallaigh & Corbett, 2005; Howitt, 2002). Today, land claim settlements and other kinds of institutional arrangements have led to increased recognition of traditional knowledge and Indigenous participation. This is particularly true in areas where comprehensive land claims have been settled and land use planning, land and water boards and other kinds of co-managements have been created. These institutions privilege Indigenous knowledge and mandate the inclusion of Indigenous peoples (land claim beneficiaries) in positions of authority (Parlee, 2012).

However, in unsettled claim areas of the North including the traditional territory of Łutsel K’e Dene First Nation, the Mackenzie Valley Environmental Impact Review Board (MVEIRB) as defined under the *Mackenzie Valley Resource Management Act* creates opportunities for communities to have a say in many aspects of decisions about development, however, opportunities for input into the reclamation phase of a resource development project have remained limited and confusing with numerous bodies and regulations being involved. “These include the *Transportation of Dangerous Goods Act, 1992*; the *Fisheries Act* (especially the Metal Mining Effluent Regulations, which allow for the release of mine tailings in freshwater); the *Canadian Environmental Protection Act, 1999* (particularly in relation to the release of pollutants, which must be reported in the NPRI); the *Explosives Act*; the *Species at Risk Act*; the *Migratory Birds Convention Act, 1994*; and the *Canadian Environmental Assessment Act, 2012*” (Dance 2015:52). The landscape of mine reclamation and remediation in the Northwest Territories is considered especially fragmented with little coherence and integration (Dance 2015: 55).

Consultation, consideration and accommodation vis a vis reclamation may thus emerge as important questions of legal and public concern. Across the Canadian North, tensions between communities, government and industry increase due to a failure to integrate the environmental

knowledge of Aboriginal people in quasi-judicial proceedings (Usher, 2000). In practice, the consultation process is intended to prevent exclusion from decision-making processes, however, industry and communities have voiced frustration with the excessive time frame involved in the consultation process (Bauer, 2017). While well-intentioned, engagement with Indigenous communities consistently lacks either direction and common agreement on what Traditional Knowledge is, what kind of information it provides, and how it can be accessed and integrated within decision-making processes (Ellis, 2005; Paci et al., 2002; Usher 2000).

5.3 Traditional Knowledge and Reclamation

This research explores the role of Traditional Knowledge in the potential remediation and healing of landscapes affected by mining activity. Traditional Knowledge is defined as "...a cumulative body of knowledge and beliefs, handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment" (Berkes 2017). It is legally required in a variety of resource management contexts in the Northwest Territories but has played a limited role in reclamation research and practice to date (Sandlos and Keeling, 2017). In the absence of a well-developed academic literature, this review considers its potential application to this growing field of resource management.

"By employing Traditional Knowledge, it is thought, a greater breadth and depth of environmental information can be brought to bear, along with a more holistic understanding of the relationships amongst living beings and their environments" (Ellis, 2005). This need is not unique to the Canadian North. A global literature argues that successful sustainable development must include Traditional Knowledge in many facets of our understanding and actions towards our planet. In addition to the local knowledge (i.e., observations) that might be useful data, the management practices of Traditional Knowledge systems can provide guidance into many dimensions of resource management including the reclamation and long term monitoring of mining projects (Keeling and Sandlos, 2017). It is argued that decision-making processes often exclude Indigenous perspectives in favor of scientific data, rational analytical thinking, objectivity and reductionism (Couch, 2002). Such privileging of science over Traditional Knowledge can come at the expense of Indigenous peoples and economies (Parlee et al. 2018). The weaving of Traditional Knowledge and science together in decision-making is another

important area of research. Although much lip service is paid to this idea, there are few good examples which are not critiqued as exploitive or lacking meaning and respect of Indigenous knowledge systems (Ellis, 2005; Nadasdy, 1999).

Reclamation defined as “the process of converting abandoned (or soon to be abandoned) mining lands to a usable state, as opposed to allowing them to become derelict”, is an means to mitigate adverse impacts (Keeling & Sandlos, 2015; Bowman & Baker, 1998). However, around the globe it is increasingly apparent that multiple kinds of knowledge systems are needed that are inclusive - not only of different data (or observations) but of the many different beliefs and interpretations of resource management problems (Uprety al., 2012). For example, ‘reclamation’ to many refers to restoration of the resource components of the ecosystem to the pre-mine status of the environment – a process that cannot be achieved and in some cases, would not be desirable. Others believe that revegetation equals reclamation” (Munshower & Clark, 1988). This lack of clarity around the term reclamation can contribute to uncertainty and ambiguity in practices and policies.

Due to the relative proximity of many northern Indigenous communities to mining activity, mining reclamation has led to important questions about who is involved in determining and monitoring if and how sites are reclaimed. For many Indigenous peoples, such as the Yellowknives Dene who are living with the legacies of the Giant mine disaster, the mine Indigenous peoples bear an inequitable burden of the adverse impacts of extraction, long after the mines have ceased operations. “Former mine sites have left in their wake not only a toxic legacy of tailings ponds and waste rock dumps, but also a history of social economic dislocation that continues to disproportionately impact northern Native communities” (Keeling & Sandlos, 2017:4). Lived experiences of the closure of Snap Lake, Giant Mine, Pine Point Mine have left behind varying adverse regional impacts and have amplified growing perceptions of environmental uncertainty. While concerns from Indigenous communities regarding mining has existed for decades in the North, the public has only recently become educated about these concerns and the significance of environmental disasters such as the Faro and Giant mine tailings ponds (Sandlos & Keeling, 2016).

“Although few studies consider the role of Indigenous knowledge in remediating contaminated landscapes in the Arctic, environmental remediation is typically understood

as an engineering and technical problem. Indigenous knowledge and perspectives may also tend to be marginalized because remediation activities are regarded as improvements or rehabilitation of the local environment, and thus above criticism or controversy.” (Sandlos & Keeling, 2016).

There is relatively limited work however, that evidences the use of Traditional Knowledge in the remediation of mine sites in northern Canada. “Traditional Knowledge may be sought as a means to measure potential impacts from remediation activities, or establish baseline ecological conditions prior to and/or during a development project in order to inform restoration goals, but again this serves to confine it to issues of flora and fauna” (Sandlos & Keeling 2016: 280). The marginalization of Traditional Knowledge in this field and area of resource management, is similar to other areas of research. A critical problem that emerged in the context of the Giant Mine remediation process, is that knowledge was too narrowly defined to the technical issues of the mine itself and the only Traditional Knowledge considered relevant was knowledge considered ecological in nature. “The experience of the Yellowknives Dene exemplifies the “containment” of Traditional Knowledge to matters of local ecological knowledge and its exclusion from remediation issues deemed technical or scientific” (Sandlos and Keeling 2016: 285). By framing reclamation of contaminated sites as a purely technical or scientific issue, Indigenous peoples’ knowledge becomes marginalized in the mining discourse and compartmentalized into cultural epistemologies (Sandlos & Keeling, 2016; Nadasdy, 1999).

A more balanced and integrated approach that can address the broader social, political, and moral dimensions is therefore needed (Banuri & Apffel-Marglin, 1993. Keeling and Sandlos 2017; Dance 2015). This is not unique to the North; historic and present day approaches to resource management have viewed as ineffective at dealing with problems like remediation of contaminated sites that are “wicked” in nature or are so complex that no single interpretation, discipline or actor group can address alone (Ludwig, 2001). The integration of Traditional Knowledge would represent a significant departure from the conventional ideology. “The ideologies of our time (economism, scientism, and technocracy) support the progressive view that experts, using scientific methods, can manage the world’s problems” (Ludwig 2001: 758). The inclusion of Traditional Knowledge in reclamation planning and practice provides potential

for enhance resource management and presents opportunities for minimizing impacts associated with resource development.

5.4 Reclamation and Cultural Landscapes

One concept that allows us to take a broader and more integrated view is that of cultural landscapes, which can be defined in various ways; generally referring to landscapes that are the result of both natural ecological and human influences. “By introducing the notion of culture, we are broadening landscape ecology from the strictly physical, biological, and ecological realms of natural sciences to the sociological, anthropological, psychological, philosophical and historical realms” (Naveh, 1995). For many Aboriginal people, envisioning nature as a separate entity is incomprehensible, as humans are agents of change within broader social-ecological system. In our increasingly anthropogenically influenced world, there is consensus that we can ill afford to separate humans from nature, creating sufficient necessity for the understanding of social-ecological systems (Berkes, 2004).

Cultural values are thus important factors in how we define the landscapes in which we live as “...humans not only construct and manage landscapes, they also look at them, and they make decisions based upon what they see (and know, and feel)”, forming the basis for “landscape structure as both an effect of culture and as an artifact that changes culture” (Nassauer, 1995). Social constructionism suggests that landscapes are built environments, created by humans conferring meaning to their environment and the natural world (Greider & Garkovich, 1994). Expanding on these theoretical implications, Greider & Garkovich (1994) explain:

“Our understanding of nature and human relationships with the environment are really cultural expressions used to define who we were, who we are and who we hope to be at this place and in this space. Landscapes are the reflection of these cultural identities which are about us, rather than the natural environment.” (Greider & Garkovich, 1994).

Through the examination of the relations between humans and their environment we can seek to better understand the cultural connotations entrenched in landscapes. Human groups have differentiated themselves from one another across space through the relationships they impose on their natural environments (Anschuetz et al., 2001). The prominent sociologist Emile Durkheim

explored this theory in depth through his perspectives, framing society as “the outcome of collective consciousness shaped by institutional frameworks, human relationships with their natural habitats of indirect concern” (Buttimer, 1971:28). In examining this notion, the relationship between culture and landscape becomes increasingly complex and inseparable. Nassauer (1995) reiterates this in outlining that culture structures landscapes and landscapes include culture, stressing the embodiment of culture and landscape ecology as characteristics of each domain.

Anschuetz et al. (2001) builds upon the human-nature continuum as “landscapes are not synonymous with natural environments. Landscapes are synthetic with cultural systems structuring and organizing peoples’ interactions with their natural environments.” This lends itself to the notion that social experiences that transpire in a cultural landscape create a specific meaning within a social framework. In a northern context, this can be exemplified in that for Aboriginal peoples the word caribou, especially when expressed in their own language “evokes the very essence of life, an existence of living in harmony with other animal-persons embodied in a northern cultural landscape” (Andrews & Buggey, 2008). Alas, it is all too often that the cultural importance of the land base to northern aboriginal peoples fails to be recognized in a non-Indigenous context (Hilson, 2002):

“...land use conflicts occur in mining communities typically because of mine management neglecting the needs of Indigenous people who have cultural attachments to their environment. Mines demand a significant amount of land space and in the process, can prevent rural inhabitants from engaging in subsistence activities.” (Hilson, 2002).

Drawing upon both cultural and ecological knowledge of northern regions as development activities increase can provide a means to gain insight into inner-workings of northern systems. This further amplifies the importance of envisioning natural resource development as a social-ecological process in fostering innovation. “Landscapes are dynamic constructions, with each community and each generation imposing its own cognitive map on an anthropogenic world of interconnected morphology, arrangement, and coherent meaning” (Anschuetz et al., 2001). Emerging perspectives in natural resource management present a shift in applied ecology towards a view of humans as an active component of ecosystems, necessitating participatory management in conservation practices (Berkes, 2004).

A sub-theme and concept of the cultural landscapes literature which has emerged in the field of cultural anthropology and elsewhere is that on Indigenous cultural landscape. In addition to scholarly writing, many institutions including governments (e.g., Parks Canada) now recognize northern landscapes as dynamic expressions of Dene and Inuit cultures and histories. In the Canadian North, the recognition of humans as ecosystem components creates a unique conceptualization of the environment. This is particularly true with the relationship of Indigenous peoples to caribou, in that caribou are integral to the socio-cultural identity of many northern Aboriginal peoples (Brotton & Wall, 1997). For example, the barren lands of northern Canada are the history books of Dene communities; their stories, material culture as well as the resources that underpin their way of life are embedded in those landscape (Legat 2016; Parlee 2005).

Given the significant cultural, spiritual, social and economic value of caribou to northern Indigenous peoples, our understanding of the Indigenous cultural landscapes also requires recognition of these spaces home to caribou as much as they are home to Indigenous peoples. The region of study in this thesis is considered the fall-winter range of the Bathurst and Beverly caribou. Scientists have classified these habitats by many kinds of uses and values including areas for winter forage. The classification of these habitats by Indigenous peoples reflect different methods and insights about their value and use by caribou (Legat, 2001). “Aboriginal peoples, while distinguishing herds is typically less important, maintain a very detailed understanding of caribou movements across the landscape, key trails and locations that are important culturally for travelling, camping and harvesting or watching overall caribou health and well-being” (Government of the Northwest Territories, 2018). Among the areas of the fall and winter range well documented as most valuable to caribou are water crossings such as those at Artillery Lake known as eda cho or “big caribou crossing” to the Denésoliné (Dokis-Jansen 2016; Parlee et al. 2005). However, other areas of the landscape can also be key to both forage as well as movements. Longitudinal data is needed to construct a baseline; in addition to movements being variable over space, populations also increase and decrease over time. The Bathurst herd like other barren-ground caribou herds tend to undergo relatively regular changes in population size over decadal time scales (Zalatan et al., 2006). Presently, populations are at significantly low; the herd population has decreased from 475,000 animals to less than 20,000. As a result of such change, the fall/winter range has contracted significantly such that caribou are

no longer traveling to areas that may have historically been important habitat in years when the population was greater. This thesis work attempted to understand the significance of the Kelvin Lake and established a baseline of caribou use of the region, prior to mining activity in the region.

As this thesis consists of land-based research, it is important to consider the contextual cultural implications of being on the land. The relationships formed between humans and the Earth transcends beyond social, cultural and spiritual realms for many Indigenous groups across Canada. This connectivity to one's surrounding environment is a deeply sacred way of life that is centered around respect and reciprocity. As described by Corntassel (2012), "...being Indigenous today means struggling to reclaim and regenerate one's relational, place-based existence by challenging the ongoing, destructive forces of colonization ... through ceremony or through other ways that Indigenous peoples (re)connect to the natural world". Reinforcing this place-based connectivity, individuals maintain relationships with the land in the form of offerings of tobacco to Mother Earth; preserving traditional practices in modern context (Wilson & Peters, 2005). Tobacco is offered as it is believed to be a pathway to the spiritual world and is "spread on the ground as an offering to the Earth or on the water as acknowledgment to its critical role in life and to ask for safe passage" (Indigenous Corporate Training, 2017).

This innate connectivity to the land is an integral component of an underlying value and belief system across many Indigenous groups. Guided by community members, each member of our research team paid the land with tobacco or coins, as a measure of respect in asking for safe passage in the barren lands. In respectfully asking the land to safely guide us across this largely unknown landscape, we presented a gift to the land to acknowledge its role in this project. Although conceptually distant from personal past experiences on the land, this was a fundamental and enriching step in conducting culturally relevant research in the North.

6.0 Thesis Outline

This thesis is outlined in four chapters. This chapter an introduction to the broader theoretical framework as well as a brief overview of the methodology and implications of the research. Chapter 2 presents a community-based perspective on the cyclical nature of diamond mining in the Northwest Territories and will be developed into a journal submission. Chapter 3 will also be developed into a journal submission and details how historical insights can be

abstracted from dendrochronology analysis to inform management decisions on the land base. Chapter 4 will conclude the thesis with closing remarks about the findings. There are numerous audiences for this thesis including social scientists, natural scientists, government agencies and industry. As many mines in the Northwest Territories approach cessation, there is an ongoing need for a redressed approach to reclamation catering to both technical and non-technical audiences.

CHAPTER 2. RESULTS PART 1

A social-ecological approach to the integration of Traditional Knowledge into reclamation practices

1.0 Introduction

Barren-ground caribou (*Rangifer tarandus groenlandicus*) are fundamental role in the diet, culture and spirituality of northern Indigenous peoples (Parlee et al., 2014; Helm, 2000). Although most Indigenous peoples no longer participate in a nomadic way of life, caribou continue to remain relevant as hunting persists as a means for obtaining nutritious food and preserving cultural identity through actively providing connectivity to the natural world (Brotton & Wall, 1997). Current environmental, economic and social conditions threaten this societal fabric of traditional northern livelihoods, imposing systemic stress on northern human-nature relations. These vast challenges threaten the traditional way of life as recent caribou population decline, shifting heard ranges and other associated factors rapidly alter human-caribou dynamics (Festa-Bianchet et al., 2011). Notably, the introduction of an industrial landscape and the resulting impacts from natural resource development in recent decades poses numerous potential implications and uncertainties (Wolfe et al., 2000). These changes are particularly prevalent in remote northern Canadian communities, including Łutsel K'e Dene First Nation (ŁKDFN), whose traditional territories overlap with mineral-rich economically viable regions. Commencing in the early 1990s the traditional territory of ŁKDFN underwent rapid industrialization and investment in pursuit of diamonds, presenting looming uncertainties associated with the inevitable closure of these mines. Interest in this geographic region led to the opening of four major diamond mines with future mineral development on the horizon (Figure 2).

With many mines approaching the closure and reclamation phases, a greater understanding of effective reclamation processes in northern environments aligning with the values of Indigenous land-users is necessary. To gain greater comprehension regarding these concerns, the objectives of this paper are (1) to explore the social and cultural dimensions of reclamation in relation to mining and northern resource development; and (2) guided by the existing literature on mine reclamation and closure, document community-level uncertainties and areas of concern with current practices.

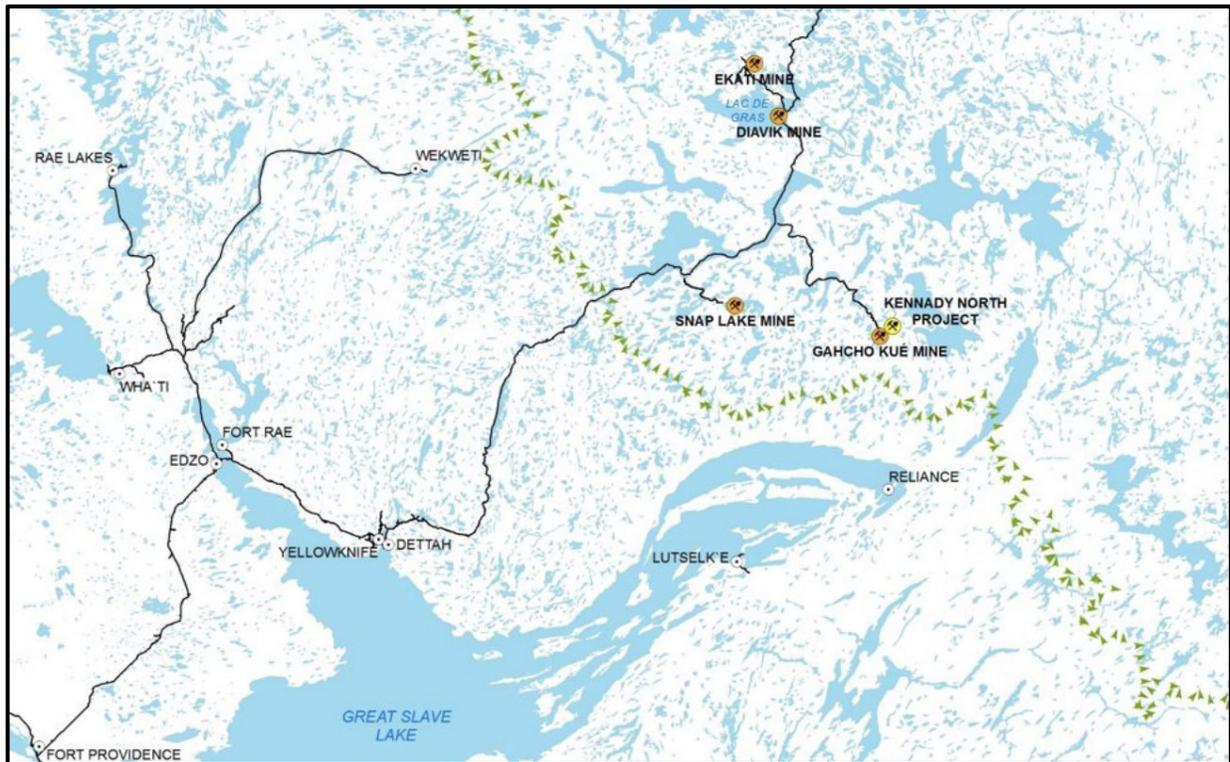


Figure 2. Locations of diamond mines in the Northwest Territories (Kennady Diamonds, 2017)

Commencing in the early 1990s mineral exploration and development boomed in the traditional territory of the First Nation, which exposed barren-ground caribou to unprecedented industrial activity. Over the last two decades, caribou populations have also declined in the region which many First Nations attribute to this mining activity (Boulanger et al., 2012).

Indigenous perspectives and knowledge remain compartmentalized within western scientific applications and are often unable to stand on their own (Nadasdy, 2005; Nadasdy, 1999; Keeling & Sandlos, 2015). This chapter argues that reclamation of these sites with recognition of their importance both to caribou and to First Nations peoples can be enhanced through the inclusion of traditional knowledge. Our findings highlight that reclamation extends beyond purely technical issues at sites and requires the understanding of mining activity as a social-ecological process. There are six themes identified from the Traditional Knowledge shared by Łutsel K'e Dene First Nation. Most significantly are the issues related to political and ecological uncertainty; in addition to concerns that the full extent of impacts are not known, there is also uncertainty about the details of reclamation plans. In addition, concerns surrounding the

extent of dust, water contamination and longitudinal scales were perceived to be misunderstood in current reclamation practices. Although this research focuses on the lived experiences of Łutsel K'e Dene First Nation, key considerations including cultural stewardship spiritual healing of the land and socio-culturally restoring a contaminated landscape are more broadly applicable to northern mining reclamation practices. Examining reclamation from a social and cultural lens allows communities, resource managers, decision makers and industry to garner a robust understanding of the far-reaching implications of reclamation. These findings contribute a renewed perspective to the existing reclamation literature through social and cultural domains, ultimately enhancing the future of reclamation processes.

2.0 Literature Review

We are guided by social-ecological systems theory and previous research on ecological uncertainty surrounding mining reclamation practices. Drawing from longstanding Indigenous natural resource management practices, this study examines an alternative approach to technically-driven reclamation in the wake of growing ecological uncertainty. Situated within the discussion on best management practices, we reiterate the value of local and Traditional Knowledge to inform the sustainable conservation, use and management of natural resources (Uprety et al., 2012; Berkes & Folke, 1998; Holling et al., 1998; Berkes & Folke, 1993). Noting the dominant technically-driven paradigm in natural resource management, we challenge this conventional outlook with a systems approach that includes the interactions of social systems within natural systems (Holling et al., 1998). The limited ability of the existing model to effectively address the increasingly complex magnitude and scope of environmental issues presents the opportunity for the exploration of alternatives (Uprety et al., 2014). Given the inextricable linkage between Indigenous resource users and their land base in northern Canada, this research seeks to inform the disconnect between land users and a post-mining landscape. Deeply rooted cultural and spiritual connection of northern people to caribou has formed the societal fabric based upon these inter-relationships playing a central role in the culture of many Indigenous peoples (Gunn et al., 2011). Connectivity to the surrounding environment has allowed Indigenous peoples in the North to develop a unique knowledge of the climate, lands, waters, plants and animals (Couch, 2002). This relationship is best exemplified through the

immense cultural, spiritual and subsistence value of caribou to northern Indigenous communities (Vors & Boyce, 2009; Kendrick & Manseau, 2005; Brotton & Wall, 1997).

Despite significant longstanding human-caribou dynamics, this relationship is critically threatened as the historic range of the Bathurst caribou herd falls within geographic mosaic of diamond exploration in the Northwest Territories (Vors & Boyce, 2009; Kendrick & Manseau, 2005; Stevenson, 1996). Steady caribou population decline of 70% from a peak in 1986 have become forefront in the discourse surrounding natural resource development in the North (Gunn et al., 2011). Although the population cycle of barren-ground caribou naturally varies over time, research suggests that this substantial decline is associated with the cumulative effects of anthropogenic influences on the landscape (Festa-Biachet et al., 2011; Gunn et al., 2011). Furthermore, these landscape-level changes have increased in the number of people and industrial activities present across the historic caribou ranges with additional exploration and resource development activity to continue intensifying (Gunn et al., 2011). Pressure from geographic overlap between mineral development and the spring, summer and fall migration and rut ranges of the Bathurst herd correlate to negative behavioural responses (Gunn et al., 2011; Gunn et al., 2001). Notably, these negative behavioural responses further amplify the systemic stress on the socio-economic and cultural fabric of northern Indigenous peoples across the Canadian North (Hall, 2013; Vors & Boyce, 2009).

Although the Canadian North has always been a resource frontier; mining is a major economic driver of territorial and federal economy. In the Bathurst range, also known as the Slave Geological Province, the discovery of large deposits of diamonds led to a large-scale staking rush and development boom (Gibson & Klinck, 2005). The speed and scale of this development activity has contributed to the enhanced economic well-being of northern communities; however, it is unclear as to what environmental costs these activities will leave behind. Numerous concerns have surfaced at a community and regional scale regarding the treatment of waste, the effects of dust and other technical uncertainties associated with the contamination of the landscape. Mines and other ecological disturbances can significantly change the relationship of people to their land, water, air and surrounding environment with profound unquantifiable impacts (Paci et al., 2005). These concerns often emerge upon the cessation of mining operatives where local people fear site-specific contamination and the implications of these contaminants on wildlife, vegetation and waterbodies (Gunn et al., 2011).

Contaminants in the North also interact on a larger geographic scale through the atmospheric deposition of industrial contaminants dispersed on vegetation across the landscape, impacting the food chain and altering photosynthesis and metal mobilization rates (Gunn et al., 2011; Naeth & Wilkinson, 2008). Additionally, diamond mining creates large amounts of dust in the kimberlite extraction process, which contains traces of nickel, magnesium, sulphate, calcium, copper, cobalt, aluminum and zinc, and can alter ecosystem processes and dynamics (Naeth & Wilkinson, 2008). To address these technical challenges, reclamation planning can offer insights into the management of wastes, decommissioning of mine sites and treatment of contaminants. However, this process becomes tremendously difficult in the North due to the harsh environmental conditions and a short growing season. Processes such as re-vegetation, the alleviation of physical hazards and stabilizing hazardous waste piles are daunting technical challenges that can take years to mitigate (Dance, 2015). The technical concerns surrounding mineral development are extensive and complex, with many uncertainties remaining largely unaddressed in reclamation planning processes.

By addressing these issues, good mining and reclamation practices can be utilized to target progressive reclamation strategies (Couch, 2002). As the technical practice of reclamation has become a largely unsuccessful pretence for the perpetuation of northern development, individuals recognize the growing need to conceptualize technical solutions to redress reclamation practices. Despite the value of technically-driven reclamation, it is important to consider reclamation as a process with numerous facets including cultural and social dimensions. The failure to acknowledge the cultural and social significance of the landscape within reclamation planning has created issues related to the healing of Indigenous landscapes. There are numerous approaches to address these challenges through reclamation practices emerging from the growing societal desire to restore environmental and ecological systems such as the human-caribou system to a reclaimed state. While previous work has focused on the social and cultural dimensions of reclamation in the forestry industry, to date, there is little literature on these issues in relation to mining. By integrating Indigenous perspectives into an alternative conceptualization of reclamation, we can enhance the existing paradigm of natural resource development through culturally inclusivity to heal from the emotional, spiritual and physical distress of mining (Gibson & Klinck, 2005; Bowman & Baker, 1998)

In this chapter, we will explore these themes from a community perspective to understand what issues are perceived to be of greatest concern to community members. This approach seeks to fill the gap in the literature surrounding social-ecological reclamation practices from a community-based perspective. The existing framework for reclamation in the North is situated around highly technical solutions, failing to address social-ecological interactions and unsuccessfully mitigating adverse impacts. Uncertainties associated with long term implications of changing human-caribou dynamics can address community-level concerns while drawing from Indigenous knowledge to create comprehensive alternative reclamation approaches. By addressing the concerns of community members from a community-based social-ecological approach, reclamation planning and practice can become an increasingly effective means for minimizing long term implications.

3.0 Methodological Approach

The research was undertaken in collaboration with the Łutsel K'e Wildlife, Lands and Environment Committee (WLEC) in 2017. A community researcher was hired and participated in the fieldwork and interviews. In order to understand more about the Traditional Knowledge related to reclamation 26 semi-structured interviews were conducted with (13) hunters/land users, (6) youth, and (7) elders. Initial interviews were identified by the recommendations of the WLEC and community researcher; snowball sampling followed. Honoraria were provided to the participants to compensate the individuals for their time. Efforts were made to stratify the sampled population to have equal representation from each participant group. Interviews included the participant, as well as a youth from the community working as a research assistant, myself, and in several cases a translator was used to translate the questions from English into Dene for several elders. Interviews took place in several places including individual homes, the band office, and Fort Reliance. The research assistant led some of the interviews and guided participants through maps and background information pertaining to the interviews to spatially define a consistent area of concern. In total 14 open-ended questions were directed to participants with additional prompts posed at appropriate times. Interviews varied from approximately 11 minutes in length to 65 minutes, largely dependent on each individual's experience on the land base and knowledge of caribou and land use. The interview guide was central to understanding the concerns of the participants in relations to the decommissioning,

monitoring and reclamation of diamond mines in the region. Prior to the commencement of each interview, a consent form was signed identifying a statement of research intent, along with background information and potential outcomes derived from the project. This consent form ensured participants understood the research project, the interview process and their rights. Each interview was recorded, and was later transcribed using a secure transcription service and later reviewed for accuracy. Following transcription, interviews were coded to identify emerging themes amongst participants and used to inform the knowledge gaps. All interview data including the maps whereby participants illustrated regional caribou activity, the recorded interviews and the electronic transcription documentation are property of Łutsel K'e Dene First Nation and will be returned following the completion of this project to be stored in the Traditional Knowledge archival database.

4.0 Results

Investigating the extent and magnitude of the impacts from mineral development on Indigenous peoples is a growing field of inquiry within Canada (Davidson & Hawe, 2012; Gibson & Klink, 2005). Within the Northwest Territories, the operations of four diamond mines Snap Lake, Ekati, Diavik and Gahcho Kué are all in various stages towards the tail end of operations. This has created a sense of urgency to create comprehensive reclamation planning strategies to mitigate the challenges of post-mine landscapes in a viable and culturally acceptable manner. Social, economic and environmental changes resulting from the introduction of mining to the landscape now require suitable reclamation practices to rehabilitate mining landscape from their reputation of as places of exploitation and degradation (Sandlos & Keeling, 2012). Given that Łutsel K'e Dene First Nation is geographically located in close proximity to the mines, it is only fitting that their perspectives on approaches to reclamation are understood prior to the mobilization of reclamation plans. Not all communities and individuals within a given community view reclamation nor their relationships to the land the same way, making it critical to consider varying opinions on reclamation on both a community and regional scale. For the purposes of this research, we highlight three key elements of reclamation planning mirroring the past, present and future context of reclamation: concerns associated with reclamation; approaches to reclamation; and pathways for healing. These categories are delineated to illustrate the contributions of this body of work to the literature, while also acknowledging that further

research is required to investigate social and cultural dimensions of reclamation. Stemming from each of these overarching themes, we will investigate perceptions of reclamation from a community perspective to gain insights into the social and cultural dimensions of reclamation while also identifying areas key concerns.

4.1 Social-ecological Uncertainties and Technical Concerns Associated with the Development of Reclamation Planning

4.1.1 Uncertainties

High levels of uncertainty are associated with mining activities around Great Slave Lake and the ability or potential inability of the land to return to the pre-mine state. Many community members feel that the land “will never look the same after – after a mine has developed ... and shut down and closed, the land will never be the same as it once was” (Elder 6, 2017) and that “the land will never go back the same, the way it was” (Elder 2, 2017). Youth 4 (2017) builds upon these concerns in that “... the land will probably be destroyed in the process because of things they’re taking out and the chemicals that will be used”. These concerns are deeply rooted in a fear of losing an integral traditional way of life and maintaining an intact relationship with the environment for generations to come. There are many reasons why community members are hesitant to restore their faith in the reclamation policies prescribed by the governing bodies. Elder 3 (2017) suggests reclamation may never be successful:

“...[Reclamation] would be pretty hard. But it’s hard to work with – it’s hard to clean something that’s way deep, deep down, but people can obviously try to take care of the surface, right? And if you try it, we can try it but you can never guarantee an animal not being sick because it takes years and years for plants and lichen to grow back. And so it’s going to take years before anything looks normal again. And again, you got to take what you have brought, take it out and not leave it.” (Elder 3, 2017)

Due to the innate connection to the land, hunters present a unique perspective to a changing landscape through their personal encounters. As a Dene hunter, the observations Adult 5 has made suggest that mines have shifted the population ranges and habitat of several key species. Specifically, he outlines the movement of the muskox into the tree line towards the caribou:

“... according to our grandfathers and grandmothers, the storytelling, they say muskox and caribou meet and it’s not a good sign, you know, they’re not supposed to meet each other, you know, for many years ago, that’s what they were saying – they’re not supposed to see each other.” (Adult 5, 2017).

It is difficult to say what the movement of these species means for the generations to come, however, it can be assumed that the inter-species dynamics in and around Great Slave Lake will drastically change. Future generations face many unknowns as the very fabric of the Dene culture relies on the human-caribou interactions. Community members have expressed deep concern with the manifestations of impacts for future generations:

“I always hope that one day I would tell my kids and then their kids about how things used to be, like my Granny and parents. But it’s probably not going to be that way anymore. I’m probably not going to – I’m probably not going to tell them stories I once heard. I’m going to tell them about how things used to be, right now. How I used to go and try and stop them.” (Youth 4, 2017)

Numerous uncertainties are associated with the social, cultural, political, economic and environmental impacts of diamond mining. As diamond mining emerged as a profitable enterprise in the Akaitcho region in the 1990s, the entirety of the resulting implications has yet to fully be understood and observed. The community’s relationship “...with these diamond mines and [the] different kinds of agreements that we make with them to receive our consent to exploit the land” has allowed Łutsel K’e to learn “about what the impacts really are and what it means to our community” (Adult 1, 2017). Although these impacts are beginning to manifest themselves, it is challenging to develop mitigation strategies as the “... government, the Band and the companies are all independent and they all want different things and have different goals” (Youth 2, 2017). With varying objectives intertwined within these complex governance structures, community members increasingly are acting on the ineffectiveness of the system and demanding enhanced co-management strategies, as exemplified by Adult 7 (2017):

“Well there’s no real template that we can [look at] so basically everything’s new to us. But reclamation is a feasible thing to do after any project that you do so you try to do it

the best way you can including people that are familiar with closing down mines. And then talking with people, getting workshop meetings, sessions, then people know what's happening then the elders would maybe put their sense in there of how maybe they could put it back to normal levels because they were the ones that were living before us and all the young people nowadays are kind of new to it, new to that area because it's kind of closed off. (Adult 7, 2017).

By opening discussions around resource management decisions to all community members, industries and governments there is a greater potential for enhanced decision-making processes to emerge.

Recognition of the economic benefits of natural resource development on the land base are present in the North. "I think the economy should allow businesses to go out and create jobs, do what's necessary" (Youth 2, 2017). Although the economic mindset of development does exist in the community, it is met with immense caution regarding the minimization of significant environmental impacts through the desire to continually assess environmental conditions. One means to address this measure is to "set aside some money for caribou research, more into research and into reclaiming...just to have something to fall back on" (Adult 11, 2017). This is necessitated in that the impacts from resource development face a unique set of circumstances in northern environments. Seeing as "it takes a really long for land to regrow. It could take five years just for shrubs to grow" many community members recognize that "...in my day I don't think I'll see that regrowth, but maybe my grandchildren will" (Elder 6, 2017). To meet reclamation objectives, all stakeholders will have to redefine the regulatory processes, as described by Adult 1 (2017):

"...I'm confident that it can be done but I think that it can't be done through this regulatory process, it can't be done in any of the forms that already exist. It would have to create – we would have to create new ways of – it would – we would have to fight for it. I think the way that they're planning to leave it now is not returning it to its natural state at all, even though I imagine I'm not the only one who wants it to be. (Adult 1, 2017).

Viewing the objectives of reclamation through the lens of the communities directly affected by the development is an initial stride to address the growing uncertainties associated with the cessation of mining activities in the North.

4.1.2 A Contaminated Landscape

It is challenging to maintain a level of trust with the contaminated landscape upon the departure of industry from a region. “I honestly think they just tell people what they want to hear because you're drilling a hole into the ground and you have a bunch of chemicals.” (Youth 3, 2017). Although the routine operatives cease upon industry’s exodus, the impacts from the industrial activity will be experienced for generations to come. The frame of reference for many northerners and their associated mistrust of contaminated landscapes surrounds the significant adverse impacts from Giant Mine in Yellowknife. Throughout many of the interviews, community members alluded to these devastating impacts, although “they’ve been telling people how they’re going to reclaim that land ... to this day, nothing’s been done about it and you can’t even eat berries around there, not for miles.” (Elder 3, 2017). These lingering impacts are changing the land and by extension the people, hindering them from connecting with their land base. “It’s really sad because the water's not the same. Nothing's the same, especially with them putting things into the water” (Youth 3,2017). The uncertainty surrounding the composition of the environment post-mine further amplifies these concerns and necessitates ongoing monitoring.

“...they say everything’s good and that, but there’s a lot of little lakes that are all connected, and there’s a lot of fish there too. Like I say, they [need to] get more monitoring and take more samples of the fish around there, see what’s going on for them to know, if there’s any contaminated fish” (Adult 2, 2017).

As many mines excavate sub-surface materials, they bring to the surface “...the big chemicals in there, and [they go] far away. It’s an imbalance.” (Youth 1, 2017). While in operation, the landscape adjacent to the project site becomes an industrial wasteland. “They make a mess, they leave it behind, this big ninety metres high waste rock is going to be – ninety metres, that’s high, that’s very high, you know, and they're still piling it up there and they're going to leave that there.” (Adult 5, 2017).

Industrial activities in the North have tarnished the connectivity along the human—nature continuum. Many elders have reflected on their knowledge of the land, suggesting that the scars these activities leave on the landscape have lasting impacts within the broader ecosystem. Elder 7 (2017) describes that there are many impacts from the mine, noting that “the caribou does not like the smell of the industry and when they’re drilling or using explosives, the noise is too much for caribou...that is why we don’t have caribou here today.” Through knowledge sharing, these concerns have accumulated, leaving younger generations with sparse hope in regards to the future. “They left their waste behind and the mines said that they would clean it up and it would take years to clean, which they should've cleaned it up when they left... I don't think it's really easy to clean because there's [many] chemicals.” (Youth 3, 2017). Though promises made by mining companies seek to mitigate adverse effects from development, generations of knowledge and observations have mounted, creating an uncanny domain of concern regarding the treatment of wastes. For generations to follow, the Dene will have to live with the direct and indirect impacts derived from mining wastes in their region.

4.1.2.1 Contaminated Water Bodies

The perspectives of community members surrounding the contaminated bodies of water presented paints a grim picture for the future of water on the land. Several community members who work at the mine sites in the region have observed foamy substances in the water surrounding the mines due to “the chemicals that they shoot back into the water” (Adult 10, 2017). Amplifying the impacts from these unknown chemicals is the regional landscape ecology in that there are “so [many] little lakes and water bodies in the North” which contributes to complex hydrology due to the linkage of water bodies across the landscape (Youth 1, 2017). Furthermore, “... [mining companies] don’t a hundred percent what’s going back into that water because there’s a hundred miles of pipe everywhere connecting to each other” (Adult 10, 2017). This means that “we can’t say for sure...[that] it’s safe, because no one is always there to monitor [the water] year-round...so we truly don’t know that it’s safe to drink the water in some places” (Youth 1, 2017). The openness of the landscape provides a means for substances to travel great distances, for example, “...all that stuff from the vehicles ...it goes in a creek and it goes in the caribou, what caribou eat. Caribou drink the water too, because everybody drinks the water” (Elder 1, 2017). Furthermore, pollutants travel great distances and recent environmental studies suggest that “mercury [is] going down [stream] which is not good because . . . it affects

our fish (Youth 3, 2017). As the connectivity of the landscape emerges as a fundamental area of concern regarding the contamination of the region, many community members have entirely lost all confidence with reclamation practices. Adult 6 (2017) highlights this concern in that “...there’s no reclaiming it. There’s going to be no fish there”. Due to the significant reliance on the land for food, water and other subsistence needs, reclamation planning needs to better-address this challenging task. Although several regional reclamation and closure plans have been submitted to the community, there is little hope vested in the success of these measures. As described by Adult 1 (2017):

“...the idea that you can put polluted water in the bottom of a pit and put clean water on top of it and that it will never mix is ridiculous. And I don’t have a lot of faith in science, I know that these are all predictions that they’re making about these sorts of things and it’s very dangerous for us to sort of take it at face value or to not question it because it’s science.” (Adult 1, 2017).

In looking at the perception of water quality as a fundamental cause for concern for the future trajectory of the Dene peoples, reclamation must re-think the treatment of water in mining operations and deliver on more stringent targets for decreasing contamination.

4.1.3 Shifting Caribou Movement Patterns

An increasingly apparent reality for community members is the changing movement patterns of caribou and the associated decreasing accessibility of caribou to hunters. “Since that mine started full time. Before that, I used to work there, I always used to see caribou come through that mine area.” (Adult 6, 2017). The industrial activity on the land is fundamentally changing the landscape through the movement of minerals and waste materials and the associated sounds and smells resulting from these activities. The diamond mines, including the proposed Kennady North Project are geographically located amidst major traditional migration trails for caribou coming in from the northwest and the southeast. “The trails that they’ve travelling for years and years, and all of a sudden, these mines are here, and they completely... scare the caribous” (Youth 7, 2017). Community members such as Youth 4 (2017) fear the

looming uncertainties: “[The caribou] stopped using those migration routes a long time ago. You can tell. And I don't know if it can be any more worse than it is. No caribou at all, probably”.

With the barren-ground caribou no longer using these historical trails, many community members have insights into where these caribou are now migrating. Many community members believe the caribou are moving “...going to continue moving North, Northeast” (Adult 3, 2017) and “every time we go hunting, it's going to be farther and farther out” (Adult 8, 2017). Hunter Adult 5 (2017) builds upon these concerns stating:

“ ... there [are] caribou there, but it's further northeast from here now, and you have to go so far to get them, you have to spend at least two or three nights there to find them. And sometimes in a big white-out or a blizzard, you've got to know where you're at and know what you're doing, because you're pretty much going to get lost out there.” (Adult 5, 2017).

These experiences amplify and already uncertain future, leaving many to question if the caribou will ever come back. Some community members have hope that “...maybe they'll just come back after all the noise is gone, all the machinery, roads closed.” (Youth 5, 2017). Whereas others in the community are less certain “...it probably won't be the same ...nothings ever the same once you move a rock right?” (Adult 7, 2017). As highlighted in this section, it is evident that many community members are aware and concerned about the decrease in use of historical migration routes by caribou and their increasing movement towards the east and northeast, into the barren lands. Amidst the endless uncertainties surrounding the future of the land post-mines, we can be certain the that the integral relationship of the Dene to the caribou will fundamentally change.

4.1.4 Human-Caribou Dynamics

The health of caribou is drastically changing in the North, and by extension the health of the Dene people who rely on caribou for nutrition and subsistence purposes mirrors similar deterioration. Unprecedented changes are rapidly occurring in the North, leaving many local people uncertain with the safety of consumption of caribou. Adult 9 (2017) shared his experience:

“...on the North shore, we went hunting ... and then I shot a caribou; I shot one and then I went to go fix it, I don’t know why, but I went to go fix it. And then I was fixing it and I accidentally cut the guts open and it was just, it’s all green, like just green, like fluorescent green.” (Adult 9, 2017).

Fellow hunters shared similar signs of a decline in the health caribou in that “caribou has been getting like a lot thinner lately to and the meats starting to get tender, it used to be like a little bit tough” (Adult 7, 2017). Adult 7 suggested this tenderization and leanness is occurring and he attributed these changes to a lack of nutrition and potential contamination in the food and the water. Although monitoring has been occurring at mines in the region, it seems as if these changing conditions are unaddressed by government and industry alike. Community-based monitoring projects have collected regional data, including the blood sampling of caribou near Ekati, where community members “don’t know what is it – maybe there’s mercury ... they’re feeding on, it has to go into their blood” (Adult 5, 2017).

As the health of caribou changes, so do their behaviors and interactions on the land base. “The mines stress them out ... and when animals get stressed out they get scared, they don’t eat, they run, so like with more projects [the region will be] pretty concentrated it’s going to be a lot more stressors on the caribou” (Adult 4, 2017). The stress from the mine is likely derived from the notion that “...the caribou are wild. I don’t think they’re used to people at all and their heavy equipment and what they’re using out there” (Adult 11, 2017). These examples highlight numerous ways in which mining activities are changing the wellbeing of caribou and more broadly human-caribou dynamics.

There are mounting reasons to fear the uncertainties ahead, as many elders allude to generational insights surrounding land use. “In the past, our ancestors would say you block a caribou’s trail then it won’t come and it’s like that today with the mining industries, they blocked the major caribou trails now. The caribou don’t come to the big lake here and Great Slave Lake anymore from that.” (Elder 7, 2017). These concerns also transcend to younger generations, fearing the worst that future generations will not be able to hunt (Youth 7, 2017). This generational uncertainty resulting from the decline in health and wellbeing of the caribou and Dene people are increasingly complex calling for action to amend these significant adverse impacts.

4.1.5 Cumulative Impacts

Cumulative effects can be described as “changes to the environment that are caused by an action in combination with other past, present and future human actions” (Government of Canada, 2016). Although numerous technical definitions exist, the fundamental importance in understanding cumulative effects is conceptualizing the notion of accumulating anthropogenic impacts in a given area. In the case of Łutsel K’e Dene First Nation this applies to the surrounding Akaitcho Territory and the impacts of natural resource extraction on the environment. These impacts are described by Adult 10 (2017):

“...a lot of planes [fly] around everywhere ... it’s busy, the whole area right here. It’s not just the roads, it’s also the mines impact and it’s also the people that are searching for fortunes...this area is really very rich with all the minerals and water and wild animals and well, the [major] impact is that people are [in] full force” (Adult 10, 2017).

This highlights the extent and rapidity of mineral development once a region is deemed mineral rich a progression of rapid development ensues. Community members understand that the mining operations continually expand development on the landscape. Elder 2 suggests that “...[the development is] wrecking everything. Like roads, they’ve got a transmission line, 26 miles [long], then [the mines say] they’re going to drill another hole and make more roads... that’s more damage I guess” (Elder 2, 2017). Others suggest the accumulation of “...[contaminants] and equipment ... builds up over time, and, you know, all these little things add up... you never know for sure [what will] happen in the future.” (Youth 1, 2017). This alludes to a growing level of concern regarding the uncertainties associated with cumulative impacts.

It is well documented that the caribou are impacted greatly by the ongoing noise and pollution with the development of the mines because “any development [in the North] is going to impact caribou” (Adult 4, 2017). As mining in the region begins to approach closure, the question of reclaiming these cumulative impacts comes into perspective. Although ecological processes have yet to be fully understood in northern ecosystems, many elders believe the ecosystem has the capacity to overcome these challenges. “For us [Dene] people we live off the land and animals therefore shouldn’t have to have contaminants to grow and reclaim the land.

The land actually can regrow on its own if given the time.” (Elder 6, 2017). In contrast, other community members feel that efforts to reclaim the multi-faceted impacts from the mines are “...all just sort of like best guesses and it’s never been tested, and I always think – it’s like models, they’re modelling and they’re guessing” (Adult 1, 2017). In looking at these varying perspectives, it becomes apparent that much like cumulative impacts, perceptions on reclaiming these mounting impacts vastly differ.

4.2 How should reclamation be approached to ensure the land returns to a usable state and the caribou return?

Community members shared numerous suggestions on potential approaches to reclaim the landscape, ultimately ensuring the return of the caribou. These suggestions are grouped into two core categories: (1) technical and solutions-oriented approaches; and (2) social and cultural approaches to healing. Through delineating these categories, we can better grasp the ongoing challenges with reclamation in northern ecosystems, while also capturing the under-utilized social and cultural dimensions to healing a landscape. Broadly speaking, these approaches speak to ongoing social and environmental harms as a means to understand individual and community level differences in proposed approaches to reclamation.

4.2.1 Technical Reclamation and Solutions-oriented Approaches

4.2.1.1 Road use

As a relatively new addition to the northern landscape, roads present a host of challenges and associated unwanted impacts. The impacts associated with roads have far reaching effects demonstrable by the changes in caribou behavior and by extension changes in caribou migration routes. The accessibility that the roads create changing movements within caribou herds as they face a changing landscape with new barriers such as trucks and powerlines fragmenting the landscape. With an increasing presence of industrialization surrounding caribou herds, hunters are noticing behavioral adaptations such as their comfort with vehicles “...now they don’t really run away, you know, as they used to before.” (Adult 5, 2017). Coupled with the observed negative behavioral changes, many community members fear that the construction of roads will only lead to further development on the land base as described by Adult 1 (2017):

“I know that exploration has already impacted the caribou in that area, so they’ve already had an impact. One of the biggest impacts is the road and the roads that serve the existing diamond mines in our territory, in Akaitcho Territory. These roads are a significant and negative impact, and these impacts we’re already facing today. So more roads, more traffic on those roads, more exploration, more disturbances just going to lead to more negative impacts for the caribou and the Dene, and others living in that area like wolves.” (Adult 1, 2017).

Building on these concerns, community members also suggest that caribou are unable to cross the roads in that “it’s no good for caribou ... the roads are really high and there’s like big jagged boulders” which creates difficult terrain and prevents caribou from crossing. (Elder 7, 2017). Furthermore, the increasingly industrialized region presents additional issues surrounding roads and their associated accessibility:

“...from what I’m hearing – and I’ve been hearing for quite some time now, it’s very disappointing how so many hunters out there don’t even harvest... the animal completely. They leave a bunch of stuff out that you can eat. They’ll just be cutting out certain parts of meat and then they just, you know, leave the rest there. It’s kind of wasteful considering how everyone here, if they got the chance to go hunting, they’d take every single piece.” (Youth 4, 2017).

Although there are many challenges associated with the development of roads and in turn providing access to previously inaccessible areas, many community members shared their perspectives on the mitigation strategies of roads upon cessation of mining operations. Roads were a particularly divisive theme across the participants in that opposing perspectives emerged regarding the reclamation of the roads. Some individuals felt that these roads should be “[left] open for hunters” as a means of accessibility for hunters since local caribou migration and regional populations have significantly declined (Elder 1, 2017). Conversely, others “[propose] that they be taken down” (Youth 4, 2017) because “...a lot of people now go up and get a lot of caribou through that road. It’s ... easy access. So yeah, I think they should have no roads.” (Adult 11, 2017). Decommissioning the road presents an opportunity to reclaim the

landscape "... to get the land to regrow as it once was" (Adult 11, 2017) with new trees growing on the old road (Adult 3, 2017). This requires "...clean up around the roads, [to] make it smoother if caribou comes by...[making it] easier for them to walk" (Elder 4, 2017). Through the restoration of roads to mimic the pre-mine development, restoration of roads may provide opportunities for caribou to return to past migration routes.

4.2.1.2 Infrastructure Removal

Upon cessation of mining operations, the landscape is left with an assortment of infrastructure ranging from machinery and equipment to permanent and semi-permanent buildings. Upon closure, the immediate region becomes "... quiet, but the thing is like you still have all those buildings. [Caribou] will be attracted to those buildings" (Adult 4, 2017). By keeping these structures intact, caribou behaviour will change, likely resulting in an alteration of migration and movement. To address this issue, community members feel that buildings "should not be there" (Youth 3, 2017) and "... it would be great by the time [the mine] closed that the area will look the same as [before]... without all the buildings" (Youth 4, 2017). Focusing on the technical process of infrastructure removal, Youth 2 (2017) builds on these ideas:

"...as for buildings, they should be torn down flat and clean up anything that can contaminate. As for scrap metal, a lot of the stuff up there it's okay. A lot of it can be left, a lot of it can't be. And it's hard to say because there's so many different varieties of materials that those companies use. Some of it is biodegradable but for the majority a lot of it needs to be cleaned up." (Youth 2, 2017).

Reclamation of the landscape requires multiple approaches to mitigate the impacts of development activities and to preserve the land for future generations. Through infrastructure removal, the landscape can begin to regenerate without the foreign objects and contaminants present.

4.2.2 Social and Cultural Approaches to Healing the Land

4.2.2.1 Spiritual Healing of the Land

Connectivity to the land base is something that transcends cultural and empirical boundaries. The connectivity that the Dene people have in relation to the land is a spiritually intact relationship. Threatening culturally transmitted traditional values and activities is the fragmentation derived from natural resource development. Community members speculate many things about the mines, as described by Youth 4 (2017):

“...it’s not going to stop. Ever since I was a kid the mines are there. Until this day, they’re still there. There’s even more now. There was even a tale that one time the elders saw this coming and they told people, but from what I hear, they didn’t listen, I guess. They said that they knew a long time ago when there was lots of elders, the ones that passed on.... so I know that when people say, “It’s not going to probably get better.” I actually – I’m scared for the future. I actually think it’s going to be that way. I have a feeling that one day nothing is going to be the way it used to be in the stories.” (Youth 4, 2017).

Stemming from these concerns of irreversible damage to the land is the ultimate disrespectful treatment of the land “...we see that a lot nowadays, disrespecting. They used [go] off onto the land and leave [offerings] there ... they used to use berries and that instead of tobacco.” (Youth 6, 2017). In a modern context, there is a significant lack of respect being paid to the land, resulting in environmental damage and in turn exploitation. As described by Adult 1 (2017):

“The exploitation of the land leads directly to the exploitation of the women, children in the communities and I don’t think that that’s a message that – although everyone feels it, it’s not always articulated, it’s never studied in the environmental assessments.” (Adult 1, 2017).

This presents a complex outlook to the ongoing discourse on environmental management in relation to the health and well-being of communities. As many mines in the traditional Akaitcho region are reaching the tail end of their operations, we must turn to culturally appropriate means of reclaiming the landscape. “There should be a ceremony ... where we sort of apologize to the land and pray for it to return to its natural state. That should be part of closure and reclamation I think.” (Adult 1, 2017). By incorporating this culturally appropriate method of reclamation as a mandatory component of environmental assessment processes, the land would be returned to its

people, creating meaningful opportunities for traditional activities to re-establish on the land base.

4.2.2.2 Retaining Traditional Knowledge

The generational transmission of Traditional Knowledge is significantly declining for the Dene peoples, largely attributable to the inability to participate in traditional activities. As Traditional Knowledge is deeply rooted in a system of experiential learning through both practice and oral history transmission, a lack of accessibility to traditional activities is directly associated with the corrosion of cultural continuity. "...We don't have that much caribou around to teach. We'd have to go far [and] it's expensive to take a family out. All the food. Skidoo, gas, costs. Before it wasn't like this." (Youth 5, 2017). Traditionally relying on hunting as a subsistence way of life, the movement of caribou away from the community coupled with significant population decline presents unprecedented challenges. These changes place hunters at odds with the ideals of mining and natural resource development as described by Adult 10 (2017):

"Now today if I go hunting it takes me four days so it's impacted myself and a lot of other hunters that goes out ... [the] people that are working in the mine they don't see – they don't really understand the community impacts because they're so busy – they're so busy in their own lifestyle, and they don't see our way of life, they don't understand us." (Adult 10, 2017).

Furthermore, these tensions are transcending into the younger generations, with mounting concerns surrounding the uncertain future of cultural practices:

"Well, the fact that [caribou] no longer come towards this area, it's sad because our parents talk about it and they make it seem so easy to hunt. And for us, we have to go long ways ... and not only that, all the hides we use too, all the crafts we used to make before, and it's all going to be all gone too." (Youth 3, 2017).

This decline in caribou is reshaping the relationship of people to their land and by extension is fragmenting cultural practices. Adult 5 (2017) suggests that this shift in cultural practices will have lasting implications and that "...we have to tell our young generation that, you know, this is what happened before and this is what's happening now." Although many community members

feel that "...you can't cut your own people off on hunting caribou. That's what we're born on and raised on." (Adult 6, 2017), others recognize that the loss in Traditional Knowledge is inevitable given the current status of caribou (Adult 5, 2017):

"... it's not like the olden days now. Before, we used to go out with our families and spend at least a week out there, and make dry meat and really write a lot of stories about it and just being out there, it's a big story-telling [event]. And it's not happening there no more, you know; we don't have as much caribou as we used to before... And for that matter, it's like losing a lot of Traditional Knowledge and skills of not hunting them as we used to before. We take our children, we take our little ones and we do go hunting as far as we can. But now – it's even further now. We have to go further for the caribou ways, and sometimes very little we get them." (Adult 5, 2017).

Amongst the younger generations, fear is emerging around the loss of Traditional Knowledge and practices associated subsistence and cultural land use. Youth 3 (2017) shares these concerns through the lens of the younger generations in the community:

"I honestly think it's kind of sad because . . . I don't travel much... in the land. My dad does. And he doesn't take us. I think mostly because he's worried, but I'm worried for myself and for my future children because they're not going to experience what our ancestors had to experience." (Youth 3, 2017).

Although mining and resource development in the North is likely to continue, the shift towards less time on the land and less cultural continuity through experiential land-based activities address perhaps the greatest concern in the community: the loss of culture.

4.2.2.3 Cultural Stewardship –Involving Indigenous Peoples

There are numerous challenges associated with the cultural disconnect between Indigenous stewardship and natural resource extraction. These tensions are amplified as community members increasingly feel that "right now we're not monitoring it, we're just kind of peeking into what they're doing, we're just peeking into it, we're not monitoring" (Adult 10,

2017). Intertwined within the dimensions of resource management is the underlying ideology surrounding the disrespect of animals and the surrounding environment. Exemplified by Youth 1 (2017), “you really got to pay great respect to the animals, because nature is powerful. You can’t stop the rain. You can’t change the weather.” This highlights the immense power vested in the land, and by extension the uncertainties associated with the disrespect of the land and in turn resource extraction.

To address the tensions surrounding resource development and the adverse impacts associated with resource extraction, community members have suggested approaching future developments in a joint venture partnership. “If we were a part shareholder we would [be] at the mine site ... we would [understand] what they’re doing, [and] make a difference.” (Adult 10, 2017). This would create an opportunity for meaningful job creation to empower community members through education and engagement, such that community members will be able to hold leadership positions, not solely laborer contracts (Adult 10, 2017). Extending beyond partnerships with mining companies, community-based monitoring possesses great potential as “...it’s the only way to protect [the caribou], keep monitoring” (Adult 9, 2017). This is further detailed by Adult 1 (2017):

“...in my mind I imagine that for at least 30 years after closure is completed, that there would have to be an Indigenous sort of monitoring and management program for the area and that should be funded by government and industry. So sort of like our [existing] caribou monitoring – out on the land monitoring programs, this would become a part of it I think.” (Adult 1, 2017).

Implementing a community-based monitoring program creates a means for opening the discourse to Indigenous and non-Indigenous stakeholders. Although this process is likely to be iterative, “the elders and the youth work together to talk about how to reclaim. That would be the best solution, I guess, is just to have more discussions.” (Elder 3, 2017). By creating an open forum for discussions and collaboration, stakeholders can draw from both Indigenous and western knowledge, enhancing the cultural stewardship of the region.

4.3 Pathways for Healing: Responsibility, Accountability and Future Outlooks

Given the cyclical nature of mineral development inevitable closure is never too distant, creating tensions around the cessation of operations and the various responsibilities to be undertaken by government and industry. The delegation of responsibilities following the closure of a mine and commencing reclamation creates a lack of accountability for industry and government, often leaving the community to bear the brunt of the social, cultural and ecological costs. Identified by community member, three core elements need to be addressed in order to maintain a future-oriented approach to reclamation: (1) the mistrust of government and industry bodies; (2) the ambiguity of resource development; and (3) the role of Indigenous people. By highlighting these areas, we address growing areas of frustration and propose measures to enhance the future of reclamation in the North.

4.3.1 Mistrust of Government and Industry

The mistrust of government and industry is an immense barrier to locally-supported and sustainable natural resource development in the North. The tumultuous relationships of industry and government to northern communities is ridden with challenges due to the underlying wariness stemming from the impacts and long term effects of colonization. Furthermore, meaningful relationship building between stakeholders has become diluted due to the skewed distribution of benefits to the communities facing most the impacts upon cessation of resource development. Although strides including impact-benefit agreements have become a commonality to settle the concerns of community members and minimize impacts to the environment, many individuals feel that their voices remain unaddressed throughout this process. Elder 2 (2017) suggests that “it’s hard to say anything, because you can’t stop those guys... even [when] you tell them something they just go ahead with the government, the government will be able to do it. The government gets all the money”. Some community members even feel that their concerns become entirely irrelevant in this process because “...the mines are all about money, money is money. No matter what we say or do, the mine will still want money.” (Elder 7, 2017). Regardless of how the community will be impacted, many worry that this system allows for industry to evade community concerns because the territorial government directly benefits from the development of resources. These regional power dynamics play a pivotal role in solidifying

the mistrust from a community perspective of both government and industry as outlined by Elder 1 (2017):

“Well, you know what, a mining company, all they’re after is money, that’s what they want. They don’t care about us. They don’t care about land, they say they’re going to fix it after they’re done. What are they going to fix? It’s not going to be the same, no. So, if we stop, how are we going to stop it? I mean, what power do I have to stop it with? We work for them too, because they have money. Yeah, as we follow our own soil to wherever they work they make money, where the plant is. Our own soil we haul it, if I’m a truck driver I’m going to haul my own soil to their plant, because they pay me.” (Elder 1, 2017).

This power-imbalance further amplifies mistrust of industry and government, since community members sense “...they don’t tell us everything. They just tell us what we need to know.” (Youth 1, 2017). In failing to delineate the entirety of the resulting implications from resource development, communities are unable to make informed decisions. “There’s some things that many in this community do not understand what’s going to happen in the future because we’re always kept in the dark, you know what I mean, that’s what it is all about” (Adult 3, 2017). The multitude of factors contributing to this biased approach to resource development warrants the mistrust of industry and government, forcing communities to harness their capacity to make responsible choices for the future of their ancestral lands.

4.3.2 Ambiguity of Resource Development

The introduction and conceptualization of resource development in the northern landscape is challenging for the Dene people as they have inhabited the region since time immemorial. In contrast with the generationally transmitted relationship to the land, the capitalist for-profit approach to resource extraction raises many questions around the necessity of mineral development. Adult 5 (2017) illustrates the disconnect between the Dene way of life and capitalist objectives in that, “for us, diamonds are nothing to us, it’s just another rock”. Building upon this, Elder 3 (2017) explains:

“For elders like me, there’s just so much to think about in the way they are destroying land. It’s really hard to comprehend. And for the youth nowadays... there are jobs that are going to be available for them. But for all the elders, it’s a whole different thinking.” (Elder 3, 2017).

Furthermore, the ambiguity of resource development is perpetuated by a lack of consultation and the failure of industry to disclose their development plans. In numerous ways, community members feel that “it’s like they already opened a big hole and pit there, you can’t change it; you can’t change that ... it will never be the same.” (Adult 9, 2017). Whereas others remain intrinsically and culturally devoted to the traditional territory as suggested by Elder 7 (2017): “this is our land, this is where we were raised, we grew up, this is our ancestors land. No matter what happens to it, a development or not, we still call it our home, our land”.

As mining operations come full circle and begin to reach the end of their lifecycles, community members have begun to conceptualize how this dimension plays into the greater discussion on mineral development. Although numerous uncertainties populate the discourse surrounding the reclamation of mining operations, community members share a different perspective filled with immense speculation. “It’s hard for me to think about when a mine will close. I’ve begun to think that the mines will never close, that they’ll just keep finding more resources to exploit and stay open forever” (Adult 1, 2017). With no immediate end in sight for regional resource extraction, community members are projecting a future-oriented outlook. Adult 11 (2017) draws upon her experience on the land, adding hope to the process in that “[Reclamation] might work, yeah. Everything is possible, right? Look at how the forests, for instance, are being cut down and they’re reclaiming it, slowly ... as long as there’s no contaminants, like major, major contaminants probably to destroy.”

4.3.3 The Role of Indigenous Peoples

Although mining and natural resource developments require a specialized set of skills for the daily operation of the facilities, Indigenous peoples are largely excluded from these positions due to the geographically limited ability to attain these skills and the expenses required to participate in training and educational opportunities for these specific skills. Often companies will make promises to fulfill employment opportunities with local candidates, yet a vast disconnect between principle and practice exists. Adult 10 (2017) elaborates on this phenomenon:

“I remember when [the mines] first started here in 1994... they came to this community first talking about the mining and stuff, hiring and everything like that and everything sound so good on the table you know, but once everybody signs the paper and they come up with another paper saying, “oh now if you want to hire your people you’re got to do this, you’ve got to go to do drug testing and you got to go through to security testing.” That was never said before at the first end of the negotiating so I realized that what you say at the meeting here is that there’s always something that they have to impact you in another way and it’s going to always be like that no matter what goes on, what we say could here ... there’s so many regulations and policies and you name it. They’re just blocking them to get hired. You’re going to be lucky if they’re name been picked out like a stick.” (Adult 10, 2017)

From a community perspective, this inability to participate in the regional economy further enhances the disconnect between the land and the Dene way of life. However, community members recognize that this is a particularly concerning matter:

“Not too many people work for the mine. We need more people there, I’ve seen people, amount of people, there’s one guy that told me that there’s not many people here that work from up north. There’s some from Yellowknife and, but there’s lots from out of town like Edmonton, way down to Newfoundland” (Elder 2, 2017).

Although these perspectives shape a grim perspective of the extractive industry, many community members want to see the strengthening of Indigenous partnerships in the sector through the creation of “...a strong partnership, or a strong understanding of each other” (Youth 1, 2017). In approaching the relationship between communities and industries using a capacity building tactic, all stakeholders have the potential to benefit. Furthermore, this approach allows for community members to regain their voices, ultimately contributing to enhancing development practices. Youth 4 (2017) believes “...everyone in this town has a say. Some people just don’t want – just don’t think the same way I do...[but] everyone has a say in this town.” Through building these relationships between stakeholders, Indigenous peoples will develop a greater role in the development of their lands and traditional territories.

5.0 Conclusion

As many mines in the Canadian North approach the monitoring and closure phases, questions around reclamation practices have been raised, particularly by First Nations concerned that mining activity has impacted negatively on barren-ground caribou (Festa-Bianchet et al., 2011; Gunn et al., 2011). Existing approaches to reclamation have been framed as exclusionary of Traditional Knowledge (Sandlos and Keeling 2017). This research identifies some themes related to the reclamation of mines in the region. Unlike some processes which have narrowly defined the terms of reclamation as site specific, technical in nature and exclusive of questions of social-economic, cultural and spiritual significance, this thesis offers a deeper understanding of reclamation as a social-ecological process and the regions impact by mining as a cultural landscape which has been defined and valued by Dene people of the region for centuries. Central to this landscape are barren-ground caribou which have been a valued resource for generations.

The results indicate reclamation must be an integrated healing process in addition to one that addresses specific biophysical problems (e.g., tailings containment and dust deposition). For some community members, this includes their apologizing to the land for the destruction and disturbance. The study illuminates some key themes and issues related to this idea of social-ecological reclamation, however, the work is preliminary. More research is need to more comprehensively understand the potential for Traditional Knowledge to contribute to a social-ecological approach to reclamation.

CHAPTER 3. RESULTS PART 2

Trample scars as an indicator of caribou movements: a methodological approach for understanding the and potential reclamation practices of resource development in northern Canada.

1.0 Introduction

The rapid rate of natural resource development in the Northwest Territories has raised numerous concerns around the status of the Bathurst caribou (*Rangifer tarandus groenlandicus*). In collaboration with community members from Łutsel K'e Dene First Nation, this research involved the documentation of Traditional Knowledge and use of dendrochronology data to enhance understand the history of caribou movements in a region impacted by mining activity. The Denésqliné have lived off these lands since time immemorial. Previous research suggests that mining activity has affected the population and movements of caribou in the region (Parlee et al. 2012; Parlee et al. 2005; Dokis-Jansen, 2015). A lack of longitudinal data about caribou habitat in the region has hampered the understanding of the long-term impacts of mining on caribou. Oral histories which are based on long term or multi-generational empirical provide a valuable understanding of caribou movements over time. Such oral histories, in addition to offering ecological observations (about more or less caribou) provide an understanding the socio-cultural and economic context of change in the region. Dendrochronology data from the study provides a 200 year old record of caribou activity in the region; in addition to suggesting the region has been important to caribou for regions. The absence of trample scars from the samples from the last two decades may indicate that mining activity is influencing caribou movements or is “driving the caribou away” was has been argued by elders from the community since the early 1990s.

These findings have several implications for resource managers, including possible insights into the movements of caribou in a region impacted by mining exploration and development. They also indicate some of the potential synergies between Traditional Knowledge and science for caribou management, management and monitoring of caribou in the context of mining as well as for reclamation of mining activity.

2.0 Literature Review- An Investigation of the Social-Ecological Systems Approach to Understanding Human-Caribou Relations in Northern Canada

Caribou and people live closely together in many parts of northern Canada and the circumpolar North (Parlee & Caine 2018a; Gunn et al., 2011; Sandlos, 2011; Kendrick et al., 2005; Parlee et al., 2005). Despite the intimate relationship between humans and caribou, caribou populations, herd size and geographic location characteristically embody aspects of variability and uncertainty. These human-caribou relationships can be conceptualized as a social-ecological system (SES). A social-ecological system describes the integrated concepts of humans in nature, deeming the boundaries between social and ecological systems as arbitrary and artificial (Ostrom, 2009; Folke, 2006; Walker et al., 2004; Folke & Berkes, 1998). The social-ecological relationships have enabled the Denésq̓liné to adapt to the ecological variability that is characteristic of barren-ground caribou populations (Parlee et al., 2018; Kendrick et al., 2005; Lyver et al., 2005; Parlee et al., 2005). Like other kinds of complex social-ecological systems human-caribou systems are dynamic; a variety perturbations (e.g., habitat quality, predation by wolves) drive population cycles yet the system has remained sustainable over time despite some variability (Holling et al., 1995; Holling, 1973). A critical concern in the present social-ecological systems is that disturbance from mining activity in the fall and winter range is more fundamentally changing human-caribou relations. Although barren-ground caribou are resilient to some habitat disturbance, the cumulative effects of over twenty years of mining exploration in the Bathurst range has the potential to create a new kind of equilibrium of social-ecological system in which caribou populations can no longer be sustained. The Bathurst caribou population which peaked at 475,000 animals in the late 1980s is now reported to be unstable at less than 20,000 animals. Despite calls for caution and limits on further mining activity, more mining projects continue to be developed with grave implications for both caribou and people. (Parlee et al., 2018).

Part of the challenge in understanding and managing stresses on barren-ground caribou is the lack of detailed reliable long-term data that exists about caribou movements prior to the mid 1990s at which time the territorial government began more systematically tracking caribou using satellite collar data. Only place-based oral histories and dendrochronology methods for analyzing trample scars provide long term data about distribution in areas currently under stress from

mining exploration and development (Dokis-Jansen, 2015; Zalatan et al., 2006; Morneau & Payette, 1998).

2.1 Oral Histories About Human-Caribou Relations in Northern Canada

The research is guided by the large body of research related to Traditional Knowledge. Traditional Knowledge is defined as the cumulative body of knowledge, and beliefs, handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment (Berkes, 1993). Previous literature examining Traditional Knowledge about caribou in northern Canada has focused primarily on the cultural significance of caribou, human-caribou relations and local ecosystem management practices rooted in cultural methodologies (Andrews & Buggey, 2008; Kendrick & Manseau, 2008; Parlee et al., 2005; Hilson, 2002; Brotton & Wall 1997). Existing literature supports the integration of Traditional Knowledge into scientific resource management practices, increasing our overall understanding of the environment (Nadasdy, 1999). Building upon this, our research advances our understanding of the value of Traditional Knowledge in managing the impacts of resource development on caribou in northern Canada. More specifically, we explore the assumption and theory in the Traditional Knowledge literature that oral histories are a useful source of insights about long term trends in wildlife and other valued resources.

Traditional Knowledge is invaluable as it has been collected over thousands of years by local people based on their interactions with the environment over time (Berkes, 1993). This form of knowledge is constructed from observations and experiences of Aboriginal people and is orally passed down from generation to generation, creating an intimate knowledge of the land, environment and interactions between these domains (Couch, 2002). Land-based economies have allowed local hunters to have an extensive relationship with the land, allowing them to be to make distinct fine-grain observations (Cruikshank, 2004). Including this knowledge into resource management approaches creates a broader scope of environmental knowledge, practices and values, contributing to greater sustainability (Ellis, 2005). Furthermore, the information stored within Traditional Knowledge remains unparalleled in the scientific record, lending itself as a valuable cultural, social and ecological record (Berkes 1993; Johannes, 1993).

Although the literature extensively discusses the value of Traditional Knowledge, opportunities for the inclusion of this knowledge in decision-making processes characteristically

remains confined to artifacts of Indigenous knowledge systems (Ellis, 2005; Nadasdy, 1999). As a distinct epistemology, a growing consensus suggests Traditional Knowledge can be systematised and incorporated into Western management regimes, however resource managers continue to select exclusionary practices, continuing to marginalize Indigenous perspectives (Cruikshank, 2004). Largely attributable to the scientific processes driving decision-making processes, non-Indigenous stakeholders tend to marginalize Indigenous knowledge in favor of rational thinking, objectivity, reductionism and the westernized ethic of human domination over the natural world (Couch, 2002). Since land claims settlements, some efforts have been made to create co-management opportunities as a means for local peoples to share their perspectives and knowledge around resource development (Cruikshank, 2004; Usher, 2000). Despite these limitations to the integration of Traditional Knowledge into current resource management practices, Traditional Knowledge remains as a fundamental tool in providing insights into the ecological uncertainty of resource extraction (Parlee et al., 2005).

2.2 Using Trample Scars to Map Caribou Movements around Mining Sites in Northern Canada

The methodology known as dendrochronology emerged in the early 1930s to systematically characterize the years in which tree rings are formed, while also dating associated disturbances to tree growth (Fritts & Swetnam, 1989). It has been used to determine many ecological insights related to climate, disease and forest ecology. Scholars of wildlife ecology have also used the method to increase understanding of caribou movements, distribution and population (Dokis-Jansen, 2015; Gunn et al., 2011; Zalatan et al., 2006; Bergerud et al., 2003; Morneau & Payette, 1998). Dendrochronology is a particularly valuable tool to understand past caribou movements across the landscape in the absence of satellite collar data, aerial photographs and other empirical measures. Past studies have selected various approaches to sample tree roots with the most common approaches being random quadrat sampling and relying on the insights of local elders from Traditional Knowledge to select sample locations (Dokis-Jansen, 2015; Zalatan et al., 2006; Morneau & Payette, 1998). Recent studies that use Traditional Knowledge to identify sampling locations highlight the accuracy and value of this knowledge in understanding landscape dynamics (Dokis-Jansen, 2015; Zalatan et al., 2006). Furthermore, sites identified by local peoples have cultural connectivity that remains unaddressed in other research methods.

Morneau and Payette (1998, 2000) employed dendrochronology to understand caribou movement patterns on the landscape in the forest and forest-tundra biomes in northern Quebec. Identifying caribou trails in a 40 m x 40 m quadrat allowed Morneau & Payette (1998) to randomly sample over an area of 1400 m², finding a total of 2377 trample scars. These findings suggest applying dendrochronology as a methodology can provide useful insights to understand movement patterns and changing caribou activity (Morneau & Payette, 1998). Building on Morneau & Payette (1998), Zalatan et al. (2006) employed dendrochronology sampling at 19 sites located along the treeline, identified by Dogrib elders as important caribou migration corridors. Yielding a total of 1991 trampling scars distributed across the Beverly and Bathurst migration corridors, this developed the longest proxy record of barren-ground caribou abundance in the Northwest Territories (Zalatan et al., 2006). The findings found that trends seen in data from the Dogrib Traditional Knowledge matched those depicted in the scar frequency results (Zalatan et al., 2006). As a proxy for caribou abundance Zalatan et al. (2006) provides evidence for the strength and accuracy of scar frequency distribution.

Further expanding upon the pragmatic value of dendrochronology as a methodology to understand past caribou movements, Dokis-Jansen (2015) was guided by Denésgliné knowledge of caribou movements at key water-crossings. The sampling approach differed from previous studies in that it identified Artillery Lake as an area of cultural significance and employed sampling at a site-specific scale. Dokis-Jansen (2015) identified the significance of utilizing oral histories and Traditional Knowledge to direct the study and integrated this into the research design. Using methodologies developed by Morneau & Payette (1998, 2000), Zalatan et al. (2006) and Dokis-Jansen (2015), our research seeks to further enhance the evidence for the value of dendrochronology to assess fine-scale caribou movements.

To understand the gap in the empirical record of barren-ground caribou distribution and to enhance management approaches the research aimed to increase understanding of this social-ecological system by drawing on Denésgliné oral histories and dendrochronology methods (Dokis-Jansen, 2015; Cruikshank, 2001; Folke & Berkes, 1998). This combined social-ecological approach provides the opportunity to conceptualize the web of embedded social and ecological relationships between people and places through a singular frame, enhancing management practices and understanding of the overarching system (Berkes et al., 2008, Davidson-Hunt, 2003).

Given that the empirical data surrounding barren-ground caribou abundance in the Canadian North remains relatively sparse, the braiding of dendrochronology data coupled with oral histories can not only provide insights about the past but can also inform our understanding and capacity to manage human-caribou system in the future including the reclamation of caribou habitat affected by mining exploration and development. Łutsel K'e Dene First Nation as well as other actors aiming to contribute to the sustainability of caribou in the Northwest Territories can use the data to recommend where, how and when landscapes are important.

3.0 Methodological Approach

The research project was developed in collaboration with Łutsel K'e Dene First Nation. Guided by methodological theory on collaborative and community-based research, our research aimed to address capacity building, place-based research, participatory research, validity of local and Traditional Knowledge. Building upon the existing literature, our approach draws from the literature surrounding participatory research, Traditional Knowledge and the integration of Traditional Knowledge of Traditional Knowledge into the western scientific framework an notably was informed by the works of Castleden et al., 2012, Berkes et al., 2000 and Nadasdy, 1999. Working in collaboration with Łutsel K'e Dene First Nation we incorporated the need for research surrounding reclamation and inclusion of Traditional Knowledge as the forefront of this project. By addressing community concerns with research and tools otherwise unavailable to them, we engaged many community members in our research process, building the capacity of the community.

The site was selected to compliment prior studies but focused on the impacts of mining activities on caribou habitat use. On the land, our data collection was informed by hunter's local knowledge of the landscape and indicators of caribou presence (Figure 3). With our findings, we hope to strengthen this method as a tool to enhance the validity of Traditional Knowledge, empowering local place-based understandings of the environment.

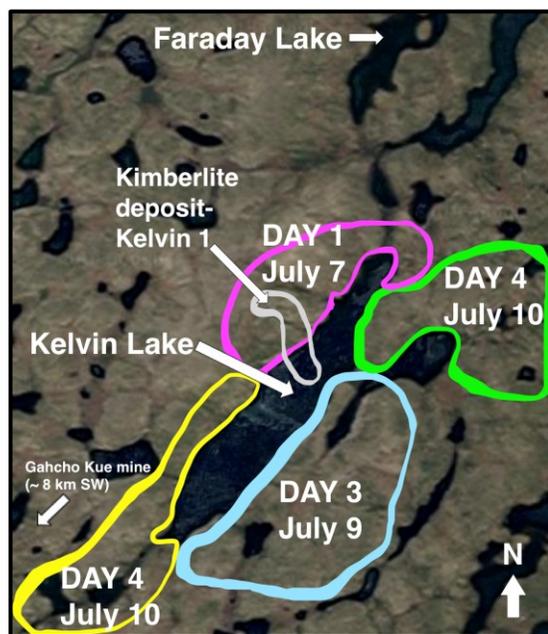


Figure 3. Map of the approximate sampled area at the Kennedy North Project.

3.1 Field Research

Field research was conducted in 2017 near Kelvin Lake (63° 48' N, -109° 8' W). Five community members consisting of hunters, land users and youth took part in the field work component and were instrumental in identifying signs of caribou activity such as areas of velvet rubbing, foraging areas and hunting blinds.

Community researchers and the participating community members identified caribou trails. Qualitative observations were documented about the condition of the trails and small samples of roots were collected. Common signs of the presence of caribou in the area included *Picea mariana* defoliated on the lower branches (Figure 4), caused by caribou rubbing their antler velvet off. The majority of the spruce trees had little to no foliage on the lower portions of the tree, suggesting that this region of the landscape was heavily used by caribou as a migration route, where the young calves would seek comfort to mitigate the irritation from their antler velvet growing in. Trees with minimal vegetation were physically damaged by this process, as indicated by the presence of sap (Figure 4), a natural physiological defense to prevent pests and diseases from entering the tree. Many shed antlers were found along caribou trails, some older than others (as indicated by the vegetation growth), as well as caribou teeth (Figure 4).

3.2 Dendrochronology Sampling

All samples collected are property of ŁKDFN and were removed from their original sites with as little disturbance as possible. Samples of interest were identified by hunters and land users and were collected. The lease holder in 2016 (i.e., Kennady Diamonds) provided access to the site. Although it had been stated and hypothesized that the area was not important to caribou, observations of caribou trails indicated the area had been used by caribou for many decades.

We followed caribou trails and noted any surrounding caribou activity. All six members of the team would walk parallel to the easily distinguished trail to ensure no caribou activity or presence was missed. In many instances, dominant trails with little to no vegetation cover would be in close proximity to several less-utilized trails, or perhaps older, trails (Figure 4). In following the trails, we would carefully search the vegetation to find *Picea mariana* and *Alnus spp.* tree roots growing across or intersecting the pathway. When a tree root was encountered that fit the criteria, the coordinate of the root was taken with a portable GPS. Following this, the sample was carefully cut using a handsaw across the intersection of the trail, with efforts made to minimize the disturbance to the trail and surrounding vegetation. Potential samples were identified and searched for any potential external scarring or exposure of xylem and or resin (Figure 4), as suggested in the works of Zalatan et al., 2006. All the samples collected were located on the ground surface to prevent the need for digging and additional disturbance. This process resulted in samples measuring a length of approximately 8 inches, with some variation in size. Once the root was identified a small sample was removed it was labelled to indicate which side of the root was exposed to the surface, or ‘up’ to orient it and simplify later lab analysis.

Following the individual labelling, the root was then placed into a brown paper bag with an identifying sample number to allow the root to breathe and prevent decay. To ensure all samples were accounted for, notes were taken in a handwritten field notebook outlining the latitude, longitude, trail number, sample number, along with notes of any surrounding caribou activity. In some cases, community members supplemented the sample collection and shared their observations about a specific sample site or notable caribou presence surrounding a specific site, which was further noted in the field notebook. The outcome of sample collection totaled 31 tree root samples, collected along 20 identified trails. At the end of each day, the samples were removed from their paper bags and placed in a dry, covered area to air dry (Figure 4) and later

safely packed back into their respective paper bags and transported to the University of Alberta by air for analysis.



Figure 4. Site photographs from Kelvin Lake- Top left (highly utilized dominant caribou trails, indicated by the depth of soil disturbance and the width of the trails); top center (samples sorted by trail number air drying in a dry, covered area); top right (an older caribou antler along a caribou trail, likely quite old due to the overgrowth of vegetation around the antler); middle left (a caribou tooth along a caribou trail, indicating the presence of caribou); middle center (A patch of lichen that has been foraged by caribou, indicated by the disruption of soil); middle right (visual trample scar identification); bottom left (caribou antlers along a caribou crossing, as identified by members of ŁKDFN); bottom center (sap presence on tree stem- a physiological response, indicating the physical damage of the exterior of the tree, likely from caribou rubbing their antler velvet off); bottom right (*Picea mariana* defoliated on lower branches due to caribou rubbing their antler velvet off)

3.3 Dendrochronology Analysis

Following the collection and safe transportation of the samples from the Northwest Territories to the University of Alberta, the samples were prepared for dendrochronological analysis. Due to the nature of organic materials such as tree roots, it was pertinent to ensure that the samples were dry to prevent molding and decomposition. The sheer volume of samples necessitated the hiring of a part time Research Assistant to assist in the preparation of the samples and to conduct dendrochronological analysis. Upon arrival at the University of Alberta, the samples were unpacked and organized in a dry, dark room, where they air-dried for a period of 30 days. Following this period, the samples were then oven dried for a period of 2 weeks at 60 °C to ensure they were fully dried. Once dried, the samples were organized by sample number and cut at a perpendicular angle into one to two inch cross-sections using a band saw, resulting in a total of 111 subsamples. This was done such that there was a greater chance of locating the tissues damaged by a potential trample scar within each tree root sampled. Once the cross-sections were cut using the band saw, a series of preparations were done to refine the visibility of the samples, and more importantly of the trample scars. Following the methodology of Dokis-Jansen (2015), the cross-sections were polished with incrementally finer grits of sandpaper (220,320, 400, 600 and where necessary, 1000). A belt sander was used to sand the samples using 220, 320 and 400 grits, however, it was necessary to use a hand sander to manually polish the samples with 600 grit to remove the linear striations produced from the belt sander. With trial and error, it became apparent that the *Alnus spp.* samples required further sanding to increase the visibility of the tree rings needed to date the trample scars. After careful consideration, the *Alnus spp.* were determined to be unreliable samples due to the fungus, permafrost damage and an inability to visually identify tree rings clearly and were not used in the analysis. Following the preparation of the *Picea mariana* samples, a high-resolution scanner was used to generate a digital copy between 2400 and 4800 dpi (dots per square inch). These high definition images of the cross-sections were then imported into Photoshop CS5 (Adobe, 2010) where they were manipulated to enhance the color contrast, favoring the emphasis of the tree rings and then digitally rotated, to orient the top of the digital file with the top of the actual tree root. This was a critical step as trample scars would only be found on the top of the tree root, consistent with the impact of a caribou hoof making contact with the top of the root when travelling along a trail. Once digitally prepared, these files were then imported into the software program, CooRecorder

7.6 (Cybis Elektronik & Data 2013) which allowed for the digitized counting of tree rings from the pith to the trample scar and to most recent year of growth (Figure 5). This allowed for the comprehensive dating of the samples and last known presence of caribou along a given trail. Although accurate, this method is not precise since the death of the cambium can extend over two calendar years and the subsequent rings surrounding the scar appear close together or ‘pinched’, making the exact dating of the scars nearly impossible (Morneau & Payette, 2000).



Figure 5. CooRecorder sample analysis (red arrow indicating the trample scar and the black markers showing successive tree ring dating).

3.4 Data Actualization

Visual analysis of trample scars identified areas of discoloration, shape and position of scars along the samples, resulting from the death of the cambium attributable to the physical trampling of the tree roots. It is probable that the caribou were present and their resulting scars happened during the snow-free period (June to October) to the top of the roots along trails (Morneau & Payette, 2000). When following a trail, caribou hooves may come in contact with surface-level tree roots, at which point the root became nicked. In a purely ecological sense,

trample scars form as “a result of debarking cause by caribou activity, which causes cambium death and [a cessation of] radial growth in this section of the root” and tend to be “round, elliptical, or elongated with neat margins” (Zalatan et al., 2006). It was determined that the scars on the samples found in the Kelvin Lake area were undeniably from caribou as the community members drew upon their Traditional Knowledge to determine the presence of caribou and, “no other animal species produces similar damage to [tree roots]” (Morneau & Payette, 2000).

3.5 Łutsel K’e Dendrochronology Workshop

A critical component of this research project was to establish a co-learning relationship with community members to ensure the community was gaining valuable insights from the project. Following the preparation and initial analysis of the samples, four community members (Dennis Drygeese, Laura Jane Michel, Dacho Poole and Alexandria Catholique) from Łutsel K’e were invited to the University of Alberta to participate in a dendrochronology workshop. During this workshop, participants attended several sessions on project-related topics and attended discussions on project-specific progress and initial insights. Additionally, community members manually prepared one sample’s cross sections and were guided as to how to process and interpret the sample results using dendrochronology software. This workshop was concluded with a debriefing of the findings and discussions around the future implications of the findings. From this, one participant highlighted the value of this research, suggesting that “our land and the barren lands are telling us a story from the tree rings” (Dennis Drygeese, 2018)

4.0 Dendrochronology Results

Dendrochronological dating of trample scars provides intuitive insights into the historical presence of caribou in a specified region, given no other species produces analogous damage to conifer roots (Morneau & Payette, 2000). The analysis of samples from Kelvin Lake outlined in this chapter are a preliminary analysis with cross-dating to be conducted for future publications. This preliminary analysis consisted of the examination of the correlation coefficient generated from CDendro (CorrC) as a general indicator of subsamples that were weakly correlated to the other subsamples from the original tree root. When a weaker correlation coefficient was found, the growth curves of subsamples derived from CDendro were then visually compared to each associated subsample’s growth curve from the original tree root. Visually examining the growth

curves of the subsamples from the same sample to one another allowed for the identification of tree rings requiring re-examination. Upon re-examination, a microscope was utilized to look for indicators of trauma cells occurring around uncertain tree rings. If an exact date did not match within scars despite re-examination under a microscope and re-counting of tree rings in CooRecorder 7.6, these scars were treated as two separate scars as they were likely caused by two separate trampling events.

From the samples collected, there was a total of 31 tree roots collected. These samples were then cross-sectioned into 111 subsamples to date and determine the presence and absence of scars. Of these subsamples ($n= 111$), the minimum number of cross sections was 2, representing 6.45% of the total samples, with a maximum of 8 cross sections, representing 3.23% of the samples. The majority (64.53%) of the samples were cross-sectioned into 3 subsamples, with 16.11%, 3.23% and 6.45% of the samples divided into 4, 5 and 7 cross sections, respectively. Using primary analysis of the dendrochronology of the samples in CooRecorder 7.6 (Cybis Elektronik & Data 2013), a total of 88 trample scars were identified on the samples. Of the root samples ($n= 31$), 30 were determined to bear scars, highlighting that this localized region was utilized by caribou at one point in time. There was an average of 1.135 scars per subsample, with a minimum of 0 and a maximum of 6 trample scars in a single subsample.

When dating tree rings, it is important to consider that the exact age of any given scar is ± 1 year due to the potential for the cambium growth to occur over 2 calendar years (Morneau & Payette, 2000). To form a baseline for tree ring growth, each subsample was also dated to identify the age structure of the samples and to contribute to the validity of the tree root growth curves (Table 1). The number of scars formed between 1990 and 2017 is proportionally high, with 56.82% ($n= 50$) scars occurring in this period (Figure 6). Prior to this period, 5.68% ($n= 5$) of scars occurred between 1972- 1978 and 7.95% ($n= 7$) of scars occurred between 1935 and 1941 (Table 1). Relative trample scar frequency determined by calculating the number of scars in a given year relative to the number of samples alive in that year, outlining the minimum age of scar is 2 years, occurring in 2015 and the maximum age of a scar is 170 years, occurring in 1847 (Figure 6). Our findings detail the average age of all tree root samples (scar bearing and non-scar bearing) being 85.7 years old, with the trees germinating in 1932. Further analysis and publications will address growth curves of *Picea mariana* and correlations between samples and subsamples.

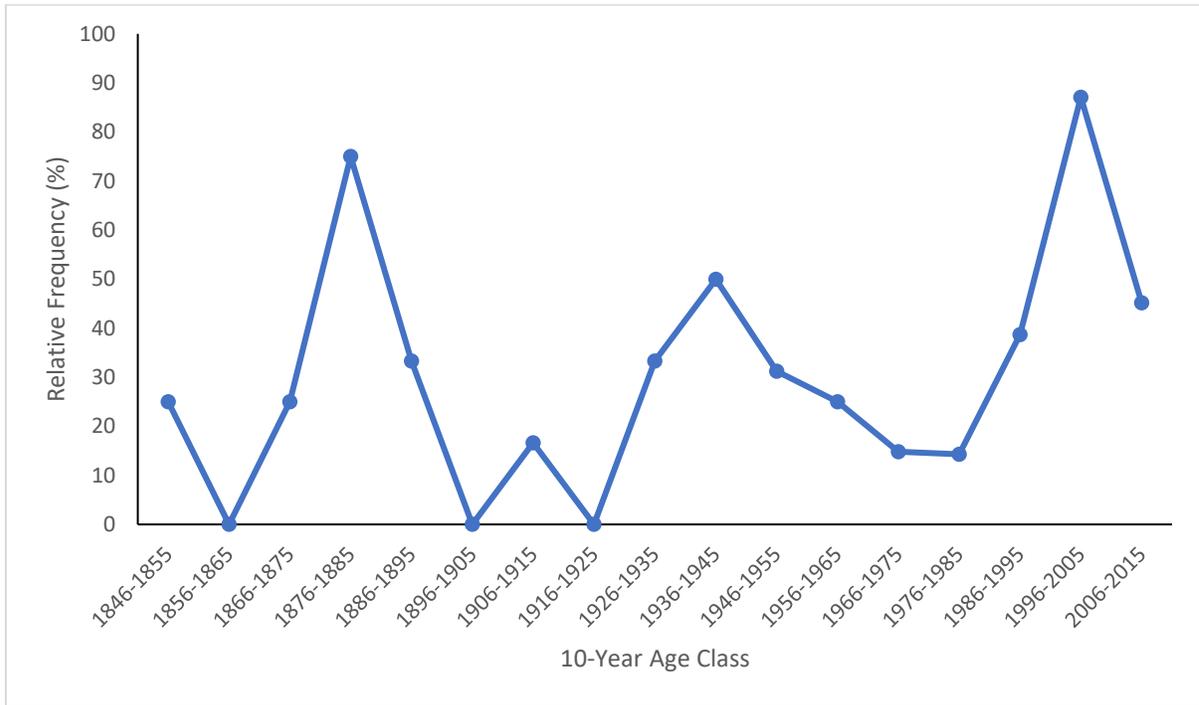


Figure 6. Relative trample scar frequency for samples with a trample scar detected indicating proportional trample scars in relation to tree roots alive in each period.

Table 1. Age of trample scars organized from oldest to youngest scar from samples collected at Kelvin Lake in July 2017.

Sample #	Trample Scar Age (Years)	Year of Scar	Age of Tree Root (Years)	Sample #	Scar Age (Years)	Year of Scar	Age of Tree Root (Years)
5	170	1847	233	9	22	1995	72
2	144	1873	178	10	22	1995	52
2	136	1881	178	17	22	1995	46
2	135	1882	178	17	21	1996	46
2	132	1885	178	22	21	1996	174
2	129	1888	178	26	21	1996	70
2	122	1895	178	16	20	1997	68
2	107	1910	178	21	20	1997	73
13	86	1931	93	36	20	1997	94
22	82	1935	174	29	19	1998	98
25	82	1935	178	7	18	1999	42
22	80	1937	174	8	18	1999	39
22	77	1940	174	14	18	1999	42
15	76	1941	131	17	18	1999	46
22	76	1941	174	19	18	1999	33
25	76	1941	178	21	18	1999	73
29	75	1942	98	31	18	1999	37
22	70	1947	174	34	18	1999	42
5	68	1949	233	38	18	1999	57
5	66	1951	233	6	17	2000	52
5	64	1953	233	10	16	2001	52
22	63	1954	174	13	16	2001	93
22	60	1957	174	26	16	2001	70
13	58	1959	93	6	14	2003	52
29	58	1959	98	14	14	2003	42
5	57	1960	233	19	14	2003	33
22	57	1960	174	22	14	2003	174
5	51	1966	233	40	14	2003	45
29	45	1972	98	2	13	2004	178
22	42	1975	174	7	12	2005	42
25	42	1975	178	32	11	2006	55
5	39	1978	233	12	10	2007	64
22	39	1978	174	18	8	2009	41
25	36	1981	178	32	8	2009	55
14	32	1985	42	26	7	2010	70
12	30	1987	64	2	6	2011	178
15	30	1987	131	28	6	2011	46
22	29	1988	174	13	5	2012	93
22	27	1990	174	21	5	2012	73
2	25	1992	178	22	5	2012	174
15	24	1993	131	30	5	2012	76
19	24	1993	33	39	5	2012	47
19	23	1994	33	16	2	2015	68
29	23	1994	98	28	2	2015	46

5.0 Discussion

This research explores the value of integrating Traditional Knowledge into the broader scientific framework, validating this approach by drawing from the social-ecological literature

and framing the context of human-caribou relations in a broader systems perspective. By addressing the inefficiency in the existing resource management framework we present an alternative approach to collecting insights informing the localized impacts of caribou movements. Furthermore, we draw from community perspectives on relationships to the land to gain holistic information to inform resource management and decision making. The intimate place-based relationship that societies with access to their traditional lands and resources have developed over time allows for deep socio-cultural understanding of the local environment (Kendrick et al., 2005). Central to Dene Way of Life is the fundamental importance of caribou to the social and cultural fabric, persisting over time as a means for food sharing practices to supplement the high costs of store-bought foods, to renew social relations and to reaffirm connectivity to the land (Brotton & Wall, 1997; Stevenson, 1996). The Dene, who have long been hunter-gathers, maintain rich knowledge of the environment and wildlife populations (Kendrick et al., 2005). This nurtured cultural knowledge and associated practices relies on the local environment for both subsistence uses and land-based learning. Although most northern Indigenous communities no longer participate in a nomadic way of life, the cultural practices associated with Bathurst caribou herd remain relevant and central to the Dene Way of Life (Brotton & Wall, 1997). Conflicting with this way of life, is the discovery of vast reserves of minerals, propelling rapid expansion of natural resource development and increasing anthropogenic activity, imposing destructive change on the landscape echoed by sentiments of loss for many local people (Vistines & Nellemann, 2008; Parlee & O'Neil, 2007). These largely economically-driven ventures are at significant odds with traditional ways of living, contributing to the deterioration of the local environment for many northern communities.

Lutsel K'e Dene First Nation is geographically situated approximately 40 kilometers from the tree line, allowing for hunters and trappers to easily access the barren lands for hunting, trapping and traditional uses. Given that caribou traditionally migrate through the barren lands, this geographic proximity connects the community to the barren lands and by extension to caribou. Reflections and memories shared from fellow researchers and community members, prior to my own departure into the barren lands entrenched that the barren lands function both as a special place and a sacred place. This became evident in the interviews with the elders, including Madeline Catholique (2017) as she described that she: "...travelled a lot with [my] parents when [I] was young and then [I] went to residential school...[I] remember [my] youth as

being out travelling on the barren lands”. Through further interviews, it became clear that the elders and hunters identified with the barren lands as a whole, rather than to specific locations across the vast region. The innate association between the barren lands and Bathurst caribou is highly intertwined in the cultural identity of the Chipewyan Dene and outlines that the further decline of this herd might prove devastating in time (Kendrick, 2005; Stevenson, 1996).

As suggested by Stevenson (1996) the Dene people can identify changes in caribou behavior and attribute these changes to natural or anthropogenic impacts on the landscape due to their interaction with the animals. The generational dependency of the Dene people on barren-ground caribou have allowed for the deep understanding of abundance, migration patterns, range shifts and herd movements which are echoed in the historical occupancy patterns of the Denésq̓liné peoples (Kendrick et al., 2005). With the influence of industry on the landscape, these historic migration and movement patterns of the Bathurst herd are significantly changing. This is forcing hunters to travel farther into the barren lands sometimes even requiring airplanes to access the regions where caribou are abundant. This potential loss in accessibility poses an immense risk to the social and cultural fabric of the Denésq̓liné. Caribou and by extension the barren lands are deeply woven into the values, beliefs, and oral histories of the Dene people placing both caribou and the barren lands as a central component of Dene culture and livelihoods (Kendrick et al., 2005). As suggested by numerous community members and the concluding findings of Dokis-Jansen (2015), caribou are using the Kelvin Lake area in a way that the community predicted, with an increase of relative caribou presence on the landscape from 1996-2005. Although relative caribou presence does not necessarily correlate to caribou population, these findings highlight the continued strength of Indigenous ways of understanding human-caribou relations. Throughout the following subsections of the discussion, we will explore value of integrating Traditional Knowledge using a social-ecological systems approach as a means to enhance resource management practices.

5.1 Contemporary and Historic Insights about Caribou Activity Around the Kelvin Lake

Across the Northwest Territories, the Bathurst caribou herd is the most abundant and widely distributed subspecies of barren-ground caribou (Brotton & Wall, 1997). The landscape features of the environment play a key role in the distribution of animals in the herd with many favoring travel along shorelines, eskers and other paths of least resistance (Parlee et al., 2005). Caribou are particularly vulnerable to landscape changes as they have historically adapted to

escape predation using spatial separation from predators and alternative prey (Festa- Bianchet et al., 2011). Lakes and smaller water bodies also play a pivotal role on the landscape acting as a barrier to fall migration at their widest points, while also serving as crossings at their narrow ends, where caribou can easily and rapidly swim across (Parlee et al., 2005). With the increasing presence of industry on the landscape, many uncertainties are associated with the ability for caribou to move across the landscape and the ecological intactness of the land base. Drawing from the literature, it is widely accepted that migratory caribou avoid industrial developments and their associated roads, pipelines, vehicles and buildings (Festa-Bianchet et al., 2011; Vistnes & Nellemann, 2008; Cameron, 2005). As the landscape begins to change due to these industrial-scale developments and environmental stressors, migratory routes will likely shift in response, further disrupting the socio-cultural fabric constructed through connectivity to the land base.

The Denésqiné peoples have constructed this socio-cultural fabric through extensive multi-generational transmission of knowledge and experience on the land, allowing them to identify natural changes in caribou population and migratory movements (Kendrick et al., 2005; Stevenson, 1996). This detailed understanding of caribou movements was explained by Joseph Catholique (2017) in that “a big herd has one mind...they go back to their feeding ground which they found years ago and they go back there again”. Observations such as these suggest that the movements of caribou have remained relatively stable over time, with small fluctuations providing hunters with detailed knowledge. The movements of caribou inform Indigenous hunters of the behavioural responses of the animals to the environment and aid in determining if the animals are under stress (Stevenson, 1996). The imposed changes in the landscape and biophysical environment negatively affect the status of the caribou, ultimately altering the traditional migratory routes (Vors & Boyce, 2009; Kendrick & Manseau, 2008). As the barren lands are vast and the scientific record remains relatively limited, historical movement patterns can be identified through generationally-transmitted Traditional Knowledge and by identifying trample scars on tree roots, later dated to determine caribou movements in time and space (Payette et al., 2004). This approach provides the opportunity for oral histories to explain and strengthen scientifically determined dendrochronological dates extracted from tree roots. Through understanding landscape features and the associated movement patterns of caribou on the land base, we can gain insights into strategies to mitigate significant adverse impacts associated with industrial developments.

There are several probable explanations for the results exhibited in the preliminary analysis of trample scars from Kelvin Lake. As illustrated in Figure 13, 61.48% ($n=75$) scars occur between 1990 and 2017. One possible explanation for this increase in caribou movements between 1986 and 2015 in the Kelvin Lake area is that there may be smaller herd sizes frequenting the Kelvin Lake area. This could be attributable to a large scale population decline, or may be associated with broader impacts associated with natural resource development, however, further research is required to understand these dynamics on a longitudinal scale. In some samples, older scars went undetected as they had healed, despite the resin dots present in the samples indicating the scarring of the sample. As suggested by Morneau & Payette (1998), a loss of scars associated with the death of scar bearing roots is a limitation to understanding the dendrochronological history of a region. The results from Kelvin Lake are site-specific and cannot explain regional landscape dynamics and population fluctuations. However, these results can guide further research to understand the impact of industrial development on the landscape. Given the overlap between regional mineral exploration emerging in the late 1980s/early 1990s, and the high frequency of trample scars emerging at this time, further research could examine this overlap in events on a regional scale.

5.2 Oral Histories and Ecological Knowledge of Caribou in and Around Mine Sites

The literature is heavily populated with concerns around the decline of barren-ground caribou and emphasize that these dwindling numbers exceed “normal” ecological population fluctuations (Festa-Bianchet et al., 2011; Curry, 2009; Vors & Boyce, 2009; Gunn et al., 2004). This significant, rapid and unequivocal decline is attributable to numerous factors including climate change, encroaching industrial development, shifting prey-predator dynamics, and changing spatial dynamics of wildfire (Brook et al., 2009, Curry, 2009; Parlee & O’Neil, 2007; Kendrick et al, 2005). Although these numerous factors could play a role in the caribou decline, this research explores the site-specific historical caribou movements in an increasingly industrial landscape. Due to the looming implications derived from the decline of caribou, there is a growing need to understand and identify ecological indicators of caribou movements. Drawing from the literature on dendrochronology caribou trample scars can extrapolate the number, frequency of trample scars, indicating fine-scale caribou movements in a region (Payette et al., 2004; Morneau & Payette, 2000). Although the dendrochronological record serves to inform the

literature, it excludes the perspective of Indigenous peoples who have utilized ecological indicators for generations to determine caribou movements. To address this, we can draw from dendrochronology records and oral histories comparatively as they share similar longitudinal perspective. Differences in spatial scales between these two bodies of knowledge are synergistic and can provide a more robust perspective into past, present and future environmental changes. Examining the results from Kelvin Lake we can see that caribou movements are changing however, reasons for these changes are not yet understood.

Many local community members attribute this change in caribou movements to the introduction of industrial activity on the landscape. For generations, the Dene have had unparalleled insights into the movements of caribou. Involving local people in the ecological monitoring and co-management of natural resources can facilitate attaining long-term sustainability in visualizing data through the lens of multi-generational knowledge (Brook et al., 2009). This lens provides insights into the relationships between caribou, people and the environment to delineate determinants of caribou movements. These lived experiences of past and current hunters have developed an intimate understanding of caribou body condition, herd health, behaviors, movements and population size (Lyver & Gunn, 2004). Notably, Parlee et al. (2005) suggests that hunters describe the health of caribou to be determined by the body condition of the individuals, with key characteristics such as a well-developed coat, fatter individuals with a wide chest and tail hidden in well-developed hindquarter, and ‘busy’ antlers with many branches indicative of good health. Additional observations from local hunters including the size and composition of groups, the rate and direction of movements contribute to the determination of animal health (Parlee et al., 2005). Expanding on this deep knowledge, several community members have noticed changes to caribou in recent years. This is primarily recognized in that caribou have become thinner and the meat has become more tender, attributable to a “lack of nutrition and what they’re eating” (Adult 7, 2017). Others portray a grim outlook on the health of caribou with many anomalies in caribou health becoming increasingly common, including Adult 5 (2017) noting the presence of mercury in caribou blood. Adult 9 (2017) further details these anomalies during an experience hunting on the North shore of Great Slave Lake:

“...I shot a caribou; I shot one and then I went to go fix it, I don’t know why, but I went to go fix it. And then I was fixing it and I accidentally cut the guts open and it was just, it’s all green, like just green, like fluorescent green” (Adult 9, 2017).

These findings are becoming increasingly alarming, raising questions of ecological integrity across the landscape. As ecological indicators serve to reinforcing Traditional Knowledge they also play a fundamental role in reminding us of the integral role ecological health plays in determining mental, physical, cultural and spiritual health for community members (Parlee et al., 2005; Gunn et al., 2004). Many ecological changes feared for generations are beginning to transpire as predicted by ancestors. “In the past our ancestors would say you block a caribou’s trail then it won’t come ... the mining industries, blocked the major caribou trails now. The caribou don’t come to Great Slave Lake anymore” (Elder 7, 2017).

Despite the depth of knowledge found in these oral histories, recent decision-making processes has led Łutsel K’e Dene First Nation to become increasingly frustrated with the fact that their Traditional Knowledge continues to be portrayed less valuable than western scientific knowledge. Insights such as these embedded in Traditional Knowledge are significant in contributing to the understanding of ecological indicators and delineating the relationships between people, the environment and industry in the North. Identifying and understanding ecological changes identified by local Indigenous peoples and empirical scientific processes can strengthen society’s understanding of ecological indicators of changing caribou movements and inform management practices on the land base. Integrating Traditional Knowledge and dendrochronology into future decision making processes using their parallel temporal scale can validate existing knowledge while creating more robust outcomes.

5.3 Manifestations of Human-Caribou Relations: A Systems Perspective

The theoretical concept resilience emerged from the works of C.S. Holling in the early 1970s to understand relationships of systems to their surrounding environment. In this context, resilience is defined by the ability of a system to overcome perturbations and disturbances to maintain the function of the system through adapting to variation (Adger, 2002; Holling et al., 1995; Holling, 1973). Fundamentally, resilience is a characteristic property of social-ecological systems in determining the capacity of a system to adapt to changing conditions over time

(Berkes et al., 2008; Gunderson, 2000). The term ‘social-ecological system’ stems from Berkes & Folke, (1998) in which they depart from the conventional view of social and ecological systems being conceptualized independent, suggesting social and ecological systems are linked through the integrated concept of humans-in-nature. Adger (2002) suggests that “social resilience is an important component of the circumstances under which individuals and social groups adapt to environmental change. Ecological and social resilience may be linked through the dependence on ecosystems of communities and their economic activities”. Applying this to northern Canada, it becomes apparent that the connection between the environment and culture are intricately woven and largely inseparable. This complex ecological-cultural continuum of northern ecosystems tends to remain relatively stable over time, attributed to the resiliency embedded in the system (Costanza, 2003; Gunderson, 2000). However, this stability is not without fluctuations, variations and oscillations centred around the realism of a highly random world (Holling, 1973). These random events and variations from stable states are highly connected to the self-organized behaviour of ecosystems, which contribute to the structure and processes of system development (Gunderson, 2000). It is challenge to conceptualize resilience without the central component of adaptive capacity which is described as system robustness to changes in resilience (Gunderson, 2000). Adaptive capacity allows for systems to change over time in response to ecosystem dynamics, ensuring the long-term existence of a given social-ecological system by shaping ecosystem dynamics (Davidson-Hunt, 2003; Berkes & Folke, 1998). Utilizing resilience as a frame for understanding social-ecological systems presents a valuable context for sustainable development and more broadly to address policy implications (Folke, 2006). From this systems perspective, the linkages between cause and effect relationships and outcomes of disturbances can be better understood providing a detailed understanding the appropriate approaches to natural resource development (Folke, 2006; Berkes & Folke, 1998).

This nuanced approach to natural resource management undermines millennia of traditional human-nature relationships, creating an opportunity for loss of social-ecological resilience (Gunderson, 2000; Berkes & Folke, 1998). While Indigenous knowledge systems and western knowledge systems remain at odds from a moral and pragmatic perspective, integrating both systems into the framework of natural resource management practices may enhance social-ecological resilience and adaptive capacity of the systems. Applying both Indigenous and western frames of knowledge resilience will persist through the adaptive capacity of the system,

fostering growth of a healthy system through periods of uncertainty (Berkes et al., 2008). Furthermore, this approach requires a shift in conceptualizing systems from a local scale to a regional scale to address areas requiring further understanding such that systems can absorb and accommodate future uncertainties (Holling, 1978).

Exploring the direct relationship between social and ecological resilience provides deeper understanding of how societies function over time and adapt to change (Adger, 2002). Ecological systems and social systems are independently complex, creating additional complexities of interactions when we frame these systems as embedded within each other (Berkes et al., 2008). To understand this concept, we can examine the dendrochronological analysis of trample scars in the barren lands through the lens of social-ecological systems and the underlying contributions of resilience. A fundamental challenge to understand the long-term sustainability of social-ecological systems is the complexities associated with predicting uncertain futures (Walker et al., 2002). Dendrochronological methods aim to fill knowledge gap by drawing from a detailed record of past experiences and perturbations and applying them to the present and future context. Moreover, analyzing the dendrochronological record in a given region provides opportunities for the alignment of knowledge frames, acting as a method of verification and comparison.

From time immemorial, hunters in the North have observed many health-related indicators, including size, composition of groups and most notably rate and direction of movements (Parlee et al., 2005). Traditional Knowledge records have been transmitted for generations, allowing hunters to live in harmony with the ecological distribution of caribou, contributing to the social-ecological relationships of familial groups to the land. Although many northern communities no longer participate in a nomadic way of life, the connectivity of social-ecological systems in the North remains relevant through the continued dependence on natural resources and the historical understanding of perturbations and resilience in these systems (Adger, 2002). In adding dendrochronological analysis to the community's knowledge base, the gap between Indigenous and western forms of knowledge can be bridged. Furthermore, this approach encourages the growth and development of social-ecological systems through periods of uncertainty, enhancing the resilience of the social-ecological systems and by extension of the community.

Given the intimate connection between northern cultures and the natural environment, social-ecological resilience maintains these dynamic webs of relationships between people and places through system-wide adaptive capacity (Davidson-Hunt, 2003). Despite rapid natural

resource development in the North, viewing development through the lens of resilience allows for a greater understanding of social, ecological and economic sustainability (Berkes et al., 2008). Although social-ecological resilience enhances relational connectivity in social-ecological systems, the narrow perceptions of western resource management systems associated with natural resource extraction inadvertently hinder ecosystem resilience by imposing a rigid set of property right regimes and common property institutions (Berkes & Folke, 1998). Our research contributes to the dominant framework of social-ecological systems in the context of human-caribou relations through exploring the driving force of mining activities on the social-ecological system (Figure 7). One key caveat to understanding the cyclical nature of ecological processes is the associated variability of a system resulting from environmental stresses from mining activities. These uncertainties have several possible implications and can potentially shift the existing social-ecological system into a new stable state.

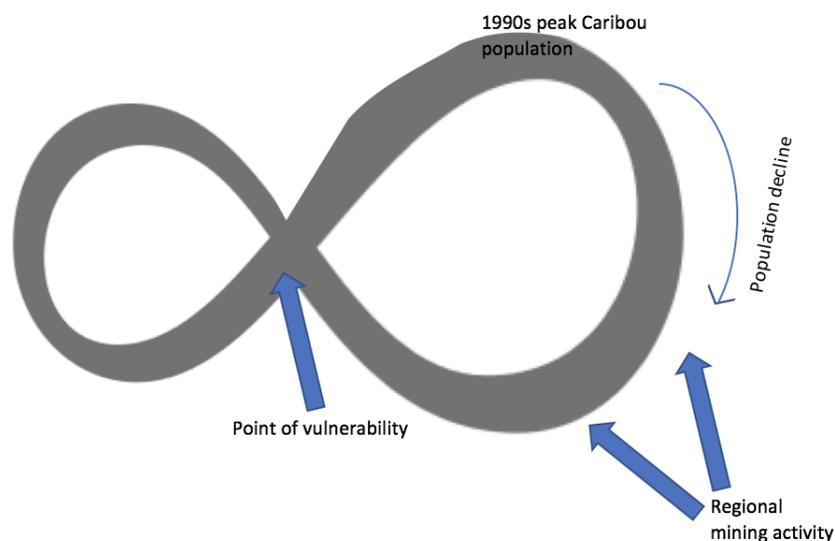


Figure 7. Panarchy of human-caribou dynamics and the uncertainties associated with mining.

Our research contributes to the certainty of the system through the examination of past trends using dendrochronology as an indicator of caribou presence. Findings from the samples collected around Kelvin Lake suggests that caribou are using the area in a way that the community predicted, with trample scars highlighting a peak in caribou presence from 1996-2005, and a decline shortly thereafter, aligning with an increase in regional mining activities. Substantial economic implications and the threat of cultural degradation for hunters and

communities who rely on caribou also surrounds the growing level of uncertainty surrounding stability of caribou population. This growing inaccessibility of local people to their cultural landscape and cultural resources has created conditions for a vulnerable system, as the interaction between mining activities during critically low caribou population size stresses the system. As the system approaches an inevitable point of vulnerability, the question of whether human-caribou relations can persist in the face of mining remains. Given the highly unpredictable and variable nature of social-ecological systems, we can only be certain that the system will reach a point of reorganization. This reorganization may manifest as a new equilibrium or a new stable state as the interactions between humans, caribou find new harmony within the system.

6.0 Conclusion

The aim of this chapter was to document oral histories and dendrochronology data about caribou activity in a region impact by mining. There are three important conclusions.

Five community members who participated in the research qualitative assessed a total of 31 samples of roots from caribou trails suggests significant caribou activity over a 200 year period at this site. The peak periods of activity are during the years 1876-85, 1936-45, 1995-2005. This variability in activity is consistent with documented population cycles for the Bathurst herd however, more comparison with data gathered from Dokis-Jansen (2015) and Zalatan et al. 2006 would increase understanding of both movement patterns and potentially population cycles at a regional scale.

This data is also consistent with previous oral histories of Łutsel K'e Dene First Nation that caribou have not been present in the region since increase in mining exploration activity in the region in the mid 1990s. Although a cause-effect relationship between mining and caribou activity has been drawn in this Traditional Knowledge literature as articulated by elders and land users, no such cause and effect can be determined from this dendrochronology work.

Finally, the work suggests the potential synergies between Traditional Knowledge research and more “scientific” methods of research. By combining the two forms of knowledge, many new insights can be gleaned about the social-ecological systems and the dynamic interrelationships between people, caribou and disturbance associated with mining activity.

CHAPTER 5. CONCLUSION

1.0 Summary

Populations of barren-ground caribou (*Rangifer tarandus groenlandicus*) in northern Canada seem on the verge on ecological tragedy. The Bathurst caribou herd which peaked at 475,000 animals in 1986 is now estimated at less than 20,000 animals; increased mining activity in the range are among those stressors of greatest concerns to biologists and communities (Festa-Bianchet et al., 2011; Gunn et al., 2011). The Denésq̓liné peoples whose livelihoods and cultures have been intertwined with caribou sustainability are among those whose voices matter most in both the management of caribou and in decisions related to mining activity.

This project builds upon previous research with Łutsel K'e Dene First Nation about the impacts of mining on caribou populations including those involving Traditional Knowledge and dendrochronology methods for understanding caribou movements (Dokis-Jansen, 2015; Parlee & Manseau, 2005; Lyver et al., 2005). A central component to this project was the fostering of co-learning relationships with community members so that information being collected would be useful for the community for generations to come. This project was conducted in collaboration with the Łutsel K'e Dene First Nation Wildlife, Lands and Environment Committee over a 2-year period and included both the documentation of Traditional Knowledge and dendrochronology methods. By bringing together these two knowledges there is potential for a deeper level of understanding of social-ecological interactions. (Costanza, 2001; Berkes & Folke, 1998).

As many mines approach the 'closure' phase many associated uncertainties plague northerners as they seek to adapt to the changing conditions of the economy, environment and culture (Parlee et al., 2018). Throughout the project, it became clear that there is a lack of information informing the gap between Indigenous and western forms of knowledge. This knowledge gap has entrenched technically-driven approaches to reclamation as the dominant paradigm, which has in turn alienated Indigenous perspectives and failed to mitigate the decline in barren-ground caribou. To address these concerns, the project evolved with the following core objectives:

- (1) Determine how reclamation of diamond mining activity could be better informed by Traditional Knowledge of Łutsel K'e Dene First Nation (Chapter 2); and

- (2) Determine opportunities for linking Traditional Knowledge and dendrochronology data to understand caribou movements in a cultural landscape impacts by mining activity (Chapter 3);

1.1 Bridging the Gap Between Indigenous and Western Knowledge

The gap between Indigenous and western forms of knowledge has extensively persisted both in practice and in the literature for the last century and it is essential to recognize these conflicts in the context of northern resource development. This gap has seemed to widen with present-day decision-making processes related to mining and mining reclamation. Although Indigenous knowledge and participation in decision-making processes is widely acknowledged in theory, the dismissal of Indigenous perspectives results in minimal participation in environmental management resulting from the initial failure to involve them (Ellis, 2005). As northern resource development becomes increasingly complex, management practices of Indigenous peoples and their traditional ecological knowledge can provide much needed insight into the ecological uncertainty of mining and resource extraction (Parlee et al., 2005). With the intensification of mineral exploration in the northern environments, there is a dire need to inform reclamation practices with the greatest extent of knowledge available irrespective of their cultural or technical domains.

2.0 Next Steps

The research introduced some key concepts and insights about the potential for Traditional Knowledge to contribute to reclamation of mining activity in northern Canada; by taking a social-ecological approach, rather than a narrow and biophysical view, there is the potential to address technical problems associated with mining (e.g., dust deposition) as well as broader social, cultural and spiritual aspects of healing the land.

More research on the potential for weaving dendrochronology methods and those associated with Traditional Knowledge research is needed. The work indicates synergies between these knowledge systems and the complementarity of methods of oral history documentation and the reading of caribou trample scars. More opportunities for weaving are possible however, with additional time and consideration in further studies.

Finally, a significant effort was made toward knowledge translation in this project. In addition to training of a community researcher, involvement of community members in rigorous tree root sampling, dendrochronology analysis (i.e., reading tree root scars) as well as education presentations in the local elementary school, plain language materials from the project are planned. A film that explains the dendrochronology method in the local Dene language is also being created. Finally, more work is needed that builds on the data already collected. Given the digitized transcripts, audio records and dendrochronology samples are owned and held by Łutsel K'e Dene First Nation (i.e., in the *Traditional Knowledge Archive*) more collaborative work is possible related to this method and the themes introduced in the thesis.

REFERENCES

- Abele, F. (1989). Gathering strength: Native employment training in the northwest territories. *Arctic Institute of North America, University of Calgary*,
- Agrawal, A. (1995). Dismantling the divide between Indigenous and scientific knowledge. *Development and Change*, 26(3), 413-439.
- Agrawal, A. & Gibson, C. C. (1999). Enchantment and disenchantment: The role of community in natural resource conservation. *World Development*, 27(4), 629-649.
- Anderson, R. B., & Giberson, R. J. (2003). Aboriginal entrepreneurship and economic development in Canada: Thoughts on current theory and practice. *Ethnic entrepreneurship: Structure and process* (pp. 141-167) Emerald Group Publishing Limited.
- Andrews, T. D., & Buggey, S. (2008). Authenticity in aboriginal cultural landscapes. *APT Bulletin*, 39(2/3), 63-71.
- Armitage, D. (2005). Adaptive capacity and community-based natural resource management. *Environmental Management*, 35(6), 703-715.
- Armitage, D. R. (2005). Collaborative environmental assessment in the northwest territories, Canada. *Environmental Impact Assessment Review*, 25(3), 239-258.
- Ball, J., & Janyst, P. (2008). Enacting research ethics in partnerships with Indigenous communities in Canada: "Do it in a good way". *Journal of Empirical Research on Human Research Ethics*, 3(2), 33-51.
- Banuri, T., & Marglin, F. A. (1993). Who will save the forests? Knowledge, power and environmental destruction.
- Bergerud, A. T., & Luttich, S. N. (2003). Predation risk and optimal foraging trade-off in the demography and spacing of the George River herd, 1958 to 1993. *Rangifer*, 23(5), 169-191.
- Berkes, F. (1993). Traditional ecological knowledge in perspective. *Traditional Ecological Knowledge Concepts and Cases*.
- Berkes, F. (2004). Rethinking community-based conservation. *Conservation Biology*, 18(3), 621-630.
- Berkes, F. (2010). Shifting perspectives on resource management: Resilience and the reconceptualization of 'natural resources' and 'management'. *Mast*, 9(1), 13-40.
- Berkes, F. (2017). *Sacred ecology*. Routledge.

- Berkes, F., Colding, J., & Folke, C. (2000). Rediscovery of traditional ecological knowledge as adaptive management. *Ecological Applications*, 10(5), 1251-1262.
- Berkes, F., Colding, J., & Folke, C. (2008). *Navigating social-ecological systems: Building resilience for complexity and change* Cambridge University Press.
- Berkes, F., & Folke, C. (1998). Linking social and ecological systems for resilience and sustainability. *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience*, 1(4).
- Bhagwati, J. N. (1977). *The new international economic order: The North-South debate*. Cambridge, Mass. MIT Press.
- Bhattacharjee, A. (2012). *Social science research: Principles, methods, and practices*.
- Boudreau, S., Payette, S., Morneau, C., & Couturier, S. (2003). Recent decline of the George River caribou herd as revealed by tree-ring analysis. *Arctic, Antarctic, and Alpine Research*, 35(2), 187-195.
- Boulanger, J., Gunn, A., Adamczewski, J., & Croft, B. (2011). A data-driven demographic model to explore the decline of the bathurst caribou herd. *The Journal of Wildlife Management*, 75(4), 883-896.
- Boulanger, J., Poole, K. G., Gunn, A., & Wierzchowski, J. (2012). Estimating the zone of influence of industrial developments on wildlife: A migratory caribou Rangifer tarandus groenlandicus and diamond mine case study. *Wildlife Biology*, 18(2), 164-179.
- Bowman, B., & Baker, D. (1998). Mine reclamation planning in the canadian north. *Canadian Cataloguing in Publication Data*,
- Brook, R. K., Kutz, S. J., Veitch, A. M., Popko, R. A., Elkin, B. T., & Guthrie, G. (2009). Fostering community-based wildlife health monitoring and research in the canadian north. *Ecohealth*, 6(2), 266-278.
- Brotton, J., & Wall, G. (1997). Climate change and the Bathurst caribou herd in the Northwest Territories, Canada. *Climatic Change*, 35(1), 35-52.
- Cameron, R. D., & Whitten, K. R. (1979). Seasonal movements and sexual segregation of caribou determined by aerial survey. *The Journal of Wildlife Management*. 626-633.
- Castleden, H., Morgan, V. S., & Lamb, C. (2012). "I spent the first year drinking tea": Exploring canadian university researchers' perspectives on community-based participatory research involving Indigenous peoples. *The Canadian Geographer/Le Géographe Canadien*, 56(2), 160-179.

- Cater, T., & Keeling, A. (2013). "That's where our future came from": Mining, landscape, and memory in Rankin Inlet, Nunavut. *Études/inuit/studies*, 37(2), 59-82.
- Cattaneo, L. B., & Chapman, A. R. (2010). The process of empowerment: A model for use in research and practice. *American Psychologist*, 65(7), 646.
- Corntassel, J. (2012). Re-envisioning resurgence: Indigenous pathways to decolonization and sustainable self-determination. *Decolonization: Indigeneity, Education & Society*, 1(1)
- Costanza, R. (2001). Visions, values, valuation, and the need for an ecological economics: All scientific analysis is based on a "preanalytic vision," and the major source of uncertainty about current environmental policies results from differences in visions and world views. *Bioscience*, 51(6), 459-468.
- Costanza, R., Kemp, W. M., & Boynton, W. R. (1993). Predictability, scale, and biodiversity in coastal and estuarine ecosystems: Implications for management. *Ambio*. 88-96.
- Couch, W. J. (2002). Strategic resolution of policy, environmental and socio-economic impacts in Canadian arctic diamond mining: BHP's NWT diamond project. *Impact Assessment and Project Appraisal*, 20(4), 265-278.
- Couch, W. J. (2002). Strategic resolution of policy, environmental and socio-economic impacts in Canadian arctic diamond mining: BHP's NWT diamond project. *Impact Assessment and Project Appraisal*, 20(4), 265-278.
- Cruikshank, J. (2001). Glaciers and climate change: Perspectives from oral tradition. *Arctic*. 377-393.
- Cruikshank, J. (2004). Uses and abuses of Traditional Knowledge': Perspectives from the Yukon Territory. *Cultivating Arctic Landscapes: Knowing and Managing Animal Populations and the Environment in the Circumpolar North*. 17-32.
- Curry, P. (2009). Caribou herds and arctic communities: Exploring a new tool for caribou health monitoring. *Arctic*. 62(4), 495.
- Dance, A. (2015). Northern reclamation in Canada: Contemporary policy and practice for new and legacy mines. *Northern Review*, (41).
- Davidson-Hunt, I. J. (2006). Adaptive learning networks: Developing resource management knowledge through social learning forums. *Human Ecology*, 34(4), 593-614.
- Davidson-Hunt, I., & Berkes, F. (2003). Learning as you journey: Anishinaabe perception of social-ecological environments and adaptive learning. *Conservation Ecology*, 8(1)
- Davison, C. M., & Hawe, P. (2012). All that glitters: Diamond mining and Tâichô youth in Behchokö, Northwest Territories. *Arctic*. 214-228.

- Dokis-Jansen, K. L. (2015). “*These Trees have Stories to Tell*” *Linking Denésqliné Knowledge and Dendroecology in the Monitoring of Barren-Ground Caribou Movements in the Northwest Territories, Canada*.
- Ellis, S. C. (2005). Meaningful consideration? A review of Traditional Knowledge in environmental decision making. *Arctic*. 66-77.
- Ferguson, M. A., & Messier, F. (1997). Collection and analysis of traditional ecological knowledge about a population of arctic tundra caribou. *Arctic*. 17-28.
- Festa-Bianchet, M., Ray, J., Boutin, S., Côté, S., & Gunn, A. (2011). Conservation of caribou (*Rangifer tarandus*) in Canada: An uncertain future. *Canadian Journal of Zoology*, 89(5), 419-434.
- Folke, C. (2006). Resilience: The emergence of a perspective for social–ecological systems analyses. *Global Environmental Change*, 16(3), 253-267.
- Folke, C., & Berkes, F. (1998). Linking social and ecological systems. *Linking Social and Ecological Systems*,
- Forbes, B. C. (2007). Equity, vulnerability and resilience in social–ecological systems: a contemporary example from the Russian Arctic. In *Equity and the Environment* (pp. 203-236). Emerald Group Publishing Limited.
- Ford, J. D., Pearce, T., Duerden, F., Furgal, C., & Smit, B. (2010). Climate change policy responses for Canada’s Inuit population: The importance of and opportunities for adaptation. *Global Environmental Change*, 20(1), 177-191.
- Fritts, H. C., & Swetnam, T. W. (1989). Dendroecology: A tool for evaluating variations in past and present forest environments. *Advances in ecological research* (pp. 111-188) Elsevier.
- Fritts, H. (1976). *Tree rings and climate* Elsevier.
- Gibson, G., & Klinck, J. (2005). Canada’s resilient north: The impact of mining on aboriginal communities. *Pimatisiwin*, 3(1), 116-139.
- Canadian Environmental Assessment Act (CEAA), 52 (2012).
- Government of Canada. (2016). Cumulative effects assessment practitioners' guide. Retrieved from https://www.enr.gov.nt.ca/sites/enr/files/resources/draft_bathurst_caribou_range_plan.pdf.
- Government of the Northwest Territories. (2018). Draft Bathurst Caribou Range Plan. Retrieved from <http://www.ceaa-acee.gc.ca/default.asp?lang=En&n=43952694-1&offset=6>.

- Greider, T., & Garkovich, L. (1994). Landscapes: The social construction of nature and the environment. *Rural Sociology*, 59(1), 1-24.
- Gunderson, L. H. (2000). Ecological resilience—in theory and application. *Annual Review of Ecology and Systematics*, 31(1), 425-439.
- Gunn, A. (2003). Voles, lemmings and caribou-population cycles revisited? *Rangifer*, 23(5), 105-111.
- Gunn, A., Dragon, J., & Boulanger, J. (2001). Seasonal movements of satellite-collared caribou from the Bathurst herd. *Final Report to the West Kitikmeot Slave Study Society, Yellowknife, NWT*. 1504-1510.
- Gunn, A., Johnson, C. J., Nishi, J. S., Daniel, C. J., Russell, D. E., Carlson, M., & Adamczewski, J. Z. (2011). Understanding the cumulative effects of human activities on barren-ground caribou. *Cumulative Effects in Wildlife Management: Impact Mitigation*. CRC Press, Boca Raton, FL, , 113-134.
- Gunn, A., Russell, D., & Eamer, J. (2011). *Northern caribou population trends in Canada* Canadian Councils of Resource Ministers.
- Hall, R. (2013). Diamond mining in Canada's northwest territories: A colonial continuity. *Antipode*, 45(2), 376-393.
- Harmsworth, G. (1999). Indigenous values and GIS: A method and a framework. *Business Alert*, 14(1), 10-15.
- Helm, J. (2000). *The people of denendeh: Ethnohistory of the Indians of Canada's Northwest Territories* McGill-Queen's Press-MQUP.
- Hilson, G. (2002). An overview of land use conflicts in mining communities. *Land use Policy*, 19(1), 65-73.
- Hobbs, R. J., & Harris, J. A. (2001). Restoration ecology: Repairing the earth's ecosystems in the new millennium. *Restoration Ecology*, 9(2), 239-246.
- Holkup, P. A., Tripp-Reimer, T., Salois, E. M., & Weinert, C. (2004). Community-based participatory research: An approach to intervention research with a Native American community. *ANS. Advances in Nursing Science*, 27(3), 162-175.
- Holling, C. S. (1973). Resilience and stability of ecological systems. *Annual Review of Ecology and Systematics*, 4(1), 1-23.
- Holling, C. S. (1978). *Adaptive environmental assessment and management* John Wiley & Sons.

- Holling, C. S. (1986). The resilience of terrestrial ecosystems: Local surprise and global change. *Sustainable Development of the Biosphere*, 14, 292-317.
- Holling, C. S., Berkes, F., & Folke, C. (1998). Science, sustainability and resource management. *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience*, 342, 350-352.
- Holling, C. S., & Meffe, G. K. (1996). Command and control and the pathology of natural resource management. *Conservation Biology*, 10(2), 328-337.
- Holling, C. S. (1997). The Resilience of Terrestrial Ecosystems: Local Surprise and Global Change, in William C. Clark and RE Munn (eds). *International Library of Critical Writing in Economics*. 75. 107-132.
- Huntington, H. P. (2000). Using traditional ecological knowledge in science: Methods and applications. *Ecological Applications*, 10(5), 1270-1274.
- Israel, B. A., Schulz, A., Parker, E. A., Becker, A. B., Allen, A., Guzman, J. R., . . . Wallerstein, N. (2008). Critical issues in developing and following CBPR principles.
- Johannes, R. E. (1993). Integrating traditional ecological knowledge and management with environmental impact assessment. *Traditional Ecological Knowledge: Concepts and Cases*, 1, 33-39.
- Johnson, C. J., Boyce, M. S., Case, R. L., Cluff, H. D., Gau, R. J., Gunn, A., & Mulders, R. (2005). Cumulative effects of human developments on arctic wildlife. *Wildlife Monographs*, , 1-36.
- Johnson, C. J., & Russell, D. E. (2014). Long-term distribution responses of a migratory caribou herd to human disturbance. *Biological Conservation*, 177, 52-63.
- Keeling, A., & Sandlos, J. (2015). *Mining and communities in northern Canada: History, politics, and memory*. University of Calgary Press.
- Kendrick, A., Lyver, P. O., & Łutsël K'é Dene First Nation. (2005). Denésqliné (chipewyan) knowledge of barren-ground caribou (*Rangifer tarandus groenlandicus*) movements. *Arctic*. 175-191.
- Kendrick, A. (2003). Caribou co-management in northern canada: Fostering multiple ways of knowing. *Navigating social–ecological Systems. Building Resilience for Complexity and Change*, 241-267.
- Kendrick, A., & Manseau, M. (2008). Representing Traditional Knowledge: Resource management and Inuit knowledge of barren-ground caribou. *Society and Natural Resources*, 21(5), 404-418.

- Kofinas, G., Osherenko, G., Klein, D., & Forbes, B. (2000). Research planning in the face of change: The human role in reindeer/caribou systems. *Polar Research*, 19(1), 3-21.
- Kuniholm, P. I. (2001). *Dendrochronology and other applications of tree-ring studies in archaeology*. J. Wiley & Sons.
- Kwan, M. (2004). Beyond difference: From canonical geography to hybrid geographies. *Annals of the Association of American Geographers*, 94(4), 756-763.
- Land, L., Olthuis, K., & Townshend, L. (2014). Creating the perfect storm for conflicts over aboriginal rights: Critical new developments in the law of aboriginal consultation. *Toronto, Ontario: The Commons Institute*.
- Legat, A. (2016). Walking stories; leaving footprints. In *Ways of walking* (pp. 47-62). Routledge.
- Legat, Allice, Georgina Chocolate, B. Gon, Sally-Anne Zoe, and Madelaine Chocolate. (2001). Relationship between caribou migration patterns and the state of caribou habitat - Final Report from Dogrib Treaty 11 Council. Yellowknife: West Kitikmeot Slave Study Society.
- Leung, M. W., Yen, I. H., & Minkler, M. (2004). Community based participatory research: A promising approach for increasing epidemiology's relevance in the 21st century. *International Journal of Epidemiology*, 33(3), 499-506.
- Locke, C., Adger, W. N., & Kelly, P. M. (2000). Changing places: Migration's social and environmental consequences. *Environment: Science and Policy for Sustainable Development*, 42(7), 24-35.
- Ludwig, D. (2001). The era of management is over. *Ecosystems*, 4(8), 758-764.
- Lyver, P. O., & Gunn, A. (2004). Calibration of hunters' impressions with female caribou body condition indices to predict probability of pregnancy. *Arctic*. 233-241.
- Martí, J. (2016). Measuring in action research: Four ways of integrating quantitative methods in participatory dynamics. *Action Research*, 14(2), 168-183.
- McGregor, D. (2004). Coming full circle: Indigenous knowledge, environment, and our future. *The American Indian Quarterly*, 28(3), 385-410.
- Meadows, L., Lagendyk, L., Thurston, W., & Eisener, A. (2003). Balancing culture, ethics, and methods in qualitative health research with aboriginal peoples. *International Journal of Qualitative Methods*, 2(4), 1-14.
- Menzies, C. R. (2006). *Traditional ecological knowledge and natural resource management*. U of Nebraska Press.

- Morneau, C., & Payette, S. (1998). A dendroecological method to evaluate past caribou (*Rangifer tarandus* L.) activity. *Ecoscience*, 5(1), 64-76.
- Morneau, C., & Payette, S. (2000). Long-term fluctuations of a caribou population revealed by tree-ring data. *Canadian Journal of Zoology*, 78(10), 1784-1790.
- Nadasdy, P. (1999). The politics of TEK: Power and the "integration" of knowledge. *Arctic Anthropology*. 1-18.
- Nadasdy, P. (2003). Reevaluating the co-management success story. *Arctic*. 367-380.
- Naeth, M., & Wilkinson, S. (2008). Lichens as biomonitors of air quality around a diamond mine, northwest territories, Canada. *Journal of Environmental Quality*, 37(5), 1675-1684.
- Natcher, D. C. (2001). Land use research and the duty to consult: A misrepresentation of the aboriginal landscape. *Land use Policy*, 18(2), 113-122.
- Naveh, Z. (1995). Interactions of landscapes and cultures. *Landscape and Urban Planning*, 32(1), 43-54.
- North, A. (2013). Long-term monitoring and management of federal contaminated sites such as the giant mine in the northwest territories.
- Nuttall, M. (2008). Aboriginal participation, consultation, and Canada's Mackenzie Gas Project. *Energy & Environment*, 19(5), 617-634.
- O'Faircheallaigh, C. (2007). Environmental agreements, EIA follow-up and aboriginal participation in environmental management: The Canadian experience. *Environmental Impact Assessment Review*, 27(4), 319-342.
- O'Faircheallaigh, C. (2010). Public participation and environmental impact assessment: Purposes, implications, and lessons for public policy making. *Environmental Impact Assessment Review*, 30(1), 19-27.
- O'Faircheallaigh, C., & Corbett, T. (2005). Indigenous participation in environmental management of mining projects: The role of negotiated agreements. *Environmental Politics*, 14(5), 629-647.
- Ostrom, E. (2009). A general framework for analyzing sustainability of social-ecological systems. *Science (New York, N.Y.)*, 325(5939), 419-422. doi:10.1126/science.1172133 [doi]
- Paci, C., & Villebrun, N. (2005). Mining denendeh: A dene nation perspective on community health impacts of mining. *Pimatisiwin: A Journal of Aboriginal & Indigenous Community Health*, 3(1)
- Padilla, E., & Kofinas, G. P. (2014). "Letting the leaders pass" barriers to using traditional

- ecological knowledge in comanagement as the basis of formal hunting regulations. *Ecology and Society*, 19(2).
- Parlee, B. L. (2015). Avoiding the resource curse: Indigenous communities and Canada's oil sands. *World Development*, 74, 425-436.
- Parlee, B. (2012). Finding voice in a changing ecological and political landscape—Traditional knowledge and resource management in settled and unsettled claim areas of the northwest territories, Canada. *aboriginal policy studies*, 2(1).
- Parlee, B. L., Goddard, E., First Nation, Łutsël K'édene, & Smith, M. (2014). Tracking change: Traditional Knowledge and monitoring of wildlife health in northern Canada. *Human Dimensions of Wildlife*, 19(1), 47-61.
- Parlee, B. L., Sandlos, J., & Natcher, D. C. (2018). Undermining subsistence: Barren-ground caribou in a “tragedy of open access”. *Science Advances*, 4(2), e1701611.
- Parlee, B., Manseau, M., & Łutsël K'édene First Nation. (2005). Using Traditional Knowledge to adapt to ecological change: Denésqłné monitoring of caribou movements. *Arctic*, 26-37.
- Parlee, B., & O'Neil, J. (2007). “The dene way of life”: Perspectives on health from Canada's north. *Journal of Canadian Studies*, 41(3), 112-133.
- Pearce, T. D., Ford, J. D., Prno, J., Duerden, F., Pittman, J., Beaumier, M., . . . Smit, B. (2011). Climate change and mining in Canada. *Mitigation and Adaptation Strategies for Global Change*, 16(3), 347-368.
- Pickett, S. T., Cadenasso, M. L., Grove, J. M., Nilon, C. H., Pouyat, R. V., Zipperer, W. C., & Costanza, R. (2001). Urban ecological systems: Linking terrestrial ecological, physical, and socioeconomic components of metropolitan areas. *Annual Review of Ecology and Systematics*, 32(1), 127-157.
- Sadler, B. (1993). Mediation provisions and options in Canadian environmental assessment. *Environmental Impact Assessment Review*, 13(6), 375-390.
- Sandlos, J. (2011). *Hunters at the margin: Native people and wildlife conservation in the northwest territories* ubc Press.
- Sandlos, J., & Keeling, A. (2012). Claiming the new North: Development and colonialism at the Pine Point mine, Northwest Territories, Canada. *Environment and History*, 18(1), 5-34.
- Sandlos, J., & Keeling, A. (2016). Aboriginal communities, Traditional Knowledge, and the environmental legacies of extractive development in Canada. *The Extractive Industries and Society*, 3(2), 278-287.

- Schnarch, B. (2004). Ownership, control, access, and possession (OCAP) or self-determination applied to research: A critical analysis of contemporary first nations research and some options for first nations communities. *International Journal of Indigenous Health*, 1(1), 80.
- Sinclair, J., & Diduck, A. (1995). Public education: An undervalued component of the environmental assessment public involvement process. *Environmental Impact Assessment Review*, 15(3), 219-240.
- Smith, J. G. (1978). Economic uncertainty in an "original affluent society": Caribou and caribou eater Chipewyan adaptive strategies. *Arctic Anthropology*. 68-88.
- Smith, J. G., & Burch Jr, E. S. (1979). Chipewyan and Inuit in the central Canadian subarctic, 1613-1977. *Arctic Anthropology*. 76-101.
- Southcott, C., & Walker, V. (2015). A portrait of the social economy in northern Canada. *Northern Communities Working Together: The Social Economy of Canada's North*, 21.
- Stanton, C. R. (2014). Crossing methodological borders: Decolonizing community-based participatory research. *Qualitative Inquiry*, 20(5), 573-583.
- Steger, M. A. E., Pierce, J. C., Steel, B. S., & Lovrich, N. P. (1989). Political culture, postmaterial values, and the new environmental paradigm: A comparative analysis of Canada and the United States. *Political Behavior*, 11(3), 233-254.
- Stevenson, M. G. (1996). Indigenous knowledge in environmental assessment. *Arctic*. 278-291.
- Tsuji, L. J., & Ho, E. (2002). Traditional environmental knowledge and western science: In search of common ground. *Canadian Journal of Native Studies*, 22(2), 327-360.
- Uprety, Y., Asselin, H., Bergeron, Y., Doyon, F., & Boucher, J. (2012). Contribution of Traditional Knowledge to ecological restoration: Practices and applications.
- Uprety, Y., Asselin, H., Bergeron, Y., Doyon, F., & Boucher, J. (2012). Contribution of Traditional Knowledge to ecological restoration: Practices and applications. *Ecoscience*, 19(3), 225-237.
- Usher, P. J. (2000). Traditional ecological knowledge in environmental assessment and management. *Arctic*. 183-193.
- Usher, P. J., Duhaime, G., & Searles, E. (2003). The household as an economic unit in arctic aboriginal communities, and its measurement by means of a comprehensive survey. *Social Indicators Research*, 61(2), 175-202.
- Vistnes, I., & Nellemann, C. (2008). The matter of spatial and temporal scales: A review of reindeer and caribou response to human activity. *Polar Biology*, 31(4), 399-407.

- Vors, L. S., & Boyce, M. S. (2009). Global declines of caribou and reindeer. *Global Change Biology*, 15(11), 2626-2633.
- Walker, B., Carpenter, S., Anderies, J., Abel, N., Cumming, G., Janssen, M., . . . Pritchard, R. (2002). Resilience management in social-ecological systems: A working hypothesis for a participatory approach. *Conservation Ecology*, 6(1)
- Walker, B., Holling, C. S., Carpenter, S., & Kinzig, A. (2004). Resilience, adaptability and transformability in social-ecological systems. *Ecology and Society*, 9(2)
- Wenig, M. M. and O'Reilly, K., *The Mining Reclamation Regime in the Northwest Territories: A Comparison with Selected Canadian and U.S. Jurisdictions* (Yellowknife: CIRL and CARC, 2005), v-vi.
- White, G. (2002). Treaty federalism in northern Canada: Aboriginal-government land claims boards. *Publius: The Journal of Federalism*, 32(3), 89-114.
- Whiteman, G. (2009). All my relations: Understanding perceptions of justice and conflict between companies and Indigenous peoples. *Organization Studies*, 30(1), 101-120.
- Wilmsen, C., Elmendorf, W. F., Fisher, L., Ross, J., Sarathy, B., & Wells, G. (2012). *Partnerships for empowerment: Participatory research for community-based natural resource management* Routledge.
- Wilson, K., & Peters, E. J. (2005). "You can make a place for it": Remapping urban first nations spaces of identity. *Environment and Planning D: Society and Space*, 23(3), 395-413.
- Wolfe, S. A., Griffith, B., & Wolfe, C. A. G. (2000). Response of reindeer and caribou to human activities. *Polar Research*, 19(1), 63-73.
- Zalatan, R., Gunn, A., & Henry, G. (2006). Long-term abundance patterns of barren-ground caribou using trampling scars on roots of *Picea mariana* in the northwest territories, Canada. *Arctic, Antarctic, and Alpine Research*, 38(4), 624-630.

Appendix I – Consent Form and Information Sheet

**CONSENT FORM:
Traditional Knowledge of Caribou Movements**

Researcher: Micki Baydack (Brenda Parlee)

Affiliation: University of Alberta.

Purpose: The purpose of the project is to learn more about caribou movements around the Kennedy Lake site based on the oral histories of elders.

Timeline: Interviews will be carried out between 2017-2020

1. I would like to carry out an interview with you for our project. Have you understood the attached project summary as you have read it or as I have read it to you?

Yes _____

No _____

The interview will last about 1 hour. Information will be recorded in hand-written notes and on audio/video recording equipment.

2. Have all of your questions about the interview or research project been answered?

Yes _____

No _____

3. Consent to Interview: Do you understand and agree to participate in this research project as outlined above. Do you understand that you are not required to participate in this research project. You can choose not to answer questions that are asked and can stop the interviews or withdraw (quit) the project at any time without prejudice or consequence.

Understand and Agree _____

Disagree _____

4. Consent to Use your Name in Public Documents: I would like to use the results of this research in a report and or publications such as journal articles. These will all be public documents. A copy of the final report will be housed at the University of Alberta. Interview data will not be used in any public exhibition without your permission.

I would like to acknowledge you by name in all research documents and materials, or if you prefer the results of your interview can be coded to Person A or 001 etc. so that the public does not know who shared the information. If there is any information that you would not like to share publicly, please let me know.

I DO ___ want my name to be shared in public documents/ presentations.

I DO NOT ___ want my name to be shared in public documents/ presentations.

5. Consent for Storage of your Interview Results

I will share a copy of your interview transcript with you. I will also keep a copy of any audio/video recordings and / or transcriptions for the purposes of reporting and publication. To ensure that your information is valued over the long term, we would also like to store copies at the University of Alberta

I DO ___ want my information stored at the University of Alberta.

I DO NOT ___ want my information stored and would prefer that it be destroyed once the research project is completed.

By signing below I am acknowledging that I have read, understand and agree to the above terms and conditions for this interview.

Interviewee _____ Date: _____

If you require additional information or have any concerns about this project, please contact:

Brenda Parlee
Faculty of Agricultural, Life and Environmental
Sciences 507 General Services Building.
University of Alberta, Edmonton Alberta T6G
2H1 Tel: (780) 492-6825
Fax: (780) 492-0268
brenda.parlee@ualberta.ca

The plan for this study has been reviewed for its adherence to ethical guidelines by a Research Ethics Board at the University of Alberta. For questions regarding participant rights and ethical conduct of research, contact the Research Ethics Office at (780) 492-2615

INFORMATION SHEET

Study Title: Traditional Knowledge of Caribou Movements

Research Investigator:

Micki Baydack
566 GSB
University of Alberta
Edmonton, AB, T6G 2H1
baydack@ualberta.ca

Supervisor:

Brenda Parlee
507 GSB
University of Alberta
Edmonton, AB, T6G 2H1
bparlee@ualberta.ca
Tel: (780) 492-6825

Background

You are being invited to participate in a study being carried out for Lutsel K'e Dene First Nation. We are interested in interviewing you because of your knowledge and experience in caribou harvesting in this region. If you agree to being interviewed, you will be asked to complete a consent form that will detail how the interview will be carried out and what will happen to the results of the interview once completed. The outcomes of this research will contribute to Lutsel K'e Dene First Nation's efforts to monitor and manage the effects of mining activity on caribou in the region. The results will also be the basis of a Master's thesis for Micki Baydack and may be included in community reports or other publications co-authored or reviewed by Lutsel K'e Dene First Nation.

Purpose

The purpose of this study is to gather Traditional Knowledge about the history of caribou activity in areas which may currently be affected by mining activity. By including your interview results in the community's data archive, we will ensure that your knowledge is protected and accessible to future generations as well as those in the community who are currently seeking to influence government and industry monitoring and management of caribou in the region.

Study Procedures

We would like to interview you for less than 2 hours to ask you about your historical experiences in caribou harvesting including observations of caribou movements at key water crossing sites such as Artillery Lake (Eda Cho Kue). This interview will include the following kinds of questions:

- Tell me about the areas where you have most frequently hunted caribou in the last five years, ten years and twenty years?
- How have caribou movements (or the locations where caribou are located in fall and winter months) changed in the last five years, ten years or twenty years?
- Since the mid 1990s, do you recall any specific changes in where and when the caribou are found at sites such as Artillery Lake?
- What are some of the indicators (signs) you notice that tell you that caribou are using the same or different habitats or crossing sites than in the past?

Benefits

You will receive compensation (\$100/per interview) for participating in this research. If you agree, your knowledge will also be included in Lutsel K'e Dene First Nation's data archive which will be accessible to current and future generations of the community.

Risk

We do not anticipate you will be at risk in any way from this study.

Voluntary Participation

You are not required to participate in this study. Your participation is completely voluntary. You are not required to answer any specific questions even if participating in the study. You can decide to stop the interview at any time or contact me within 30 days after the interview is completed in the event you want the results of your interview removed from the research project. If you do decide to withdraw, there will be no penalty to you; you will still receive compensation for your time (as above). If you decide to withdraw, your transcript including any audio/visual records will be returned to you and any copies destroyed. You can also decide to have your knowledge removed from Lutsel K'e Dene First Nations' data archive at any point during or after the research project.

Use of the Interview Results

- The outcomes of this research will contribute to Lutsel K'e Dene First Nation's efforts to monitor and manage the effects of mining activity on caribou in the region. The results will also be the basis of a Master's thesis for Kelsey Jansen and may be included in community reports or other publications co-authored or reviewed by Lutsel K'e Dene First Nation;
- Any other use of the data will require your consent;
- If you would like to be anonymous (not have your name recorded), we will remove it from the transcript and store any records that include your name (e.g. audio / video records, consent forms) in a separate location;
- You will receive a transcript of your interview within 3 months of the interview and store for your future reference;
- The results of the interview including transcripts will also be located in a locked office of Lutsel K'e Dene First Nation and copies located in a locked cabinet in Dr. Brenda Parlee's office (as required by the University of Alberta).

Further Information

If you have any questions about this study, you can contact Lutsel K'e Dene First Nation (Mike Tollis) at (867) 370-3197. You can also contact Micki Baydack/Brenda Parlee at the University of Alberta by phone (780) 492-6825 or by email at bparlee@ualberta.ca

The plan for this study has been reviewed for its adherence to ethical guidelines by a Research Ethics Board at the University of Alberta. For questions regarding participant rights and ethical conduct of research, contact the Research Ethics Office at (780) 492-2615.

Appendix II—Interview Guide

Interview Questions:

Explain the location of the mine (Show on map, have Nancy explain the proximity to Gahcho Kué

1. Do you have any experiences or stories from you, your parents or grandparents about caribou in this area?
 - a. If no, where is the nearest area that you have knowledge about caribou?
2. How do you think the caribou will be impacted by this mine? What are these impacts? How do you think impacts on caribou can be prevented?
3. Do you have any specific concerns about the location of this mine or the operations and how it might impact caribou?
 - a. What do you know that caribou avoid in mining areas?
 - b. Why do caribou avoid these areas?
 - c. What about the impacts to Migration routes?
 - d. What about contaminants in their food?
4. How do you think changes from this mine, combined with the other mines in the region may affect caribou?
5. Many mines have operated in this region. Some are going to close in the next 5 years or 10 years. What would you like the companies and government to do to ensure they caribou are protected after the mines have closed?
 - a. Should the contaminants and infrastructure be left on site (i.e. buried) or removed from the site?
6. What can the mines in the Gahcho Kue/Kelvin Lake area do now to protect caribou for the future?
7. Many mines are required to create reclamation plans when mines approach closure to try and return the land to an equal state prior to the development of the mine. Do you think that reclamation plans are effective at minimizing impacts in general?
 - a. Why/why not?
8. Many mines have operated in this region, given that some of them are approaching closure, how can we better manage the area for caribou in the future?
9. How will the mines affect caribou after they are closed and how long after?
10. What is the best way to leave the mine site once it is closed? How can we restore the caribou habitat once the mines have closed?
 - a. How should the piles be left?
 - b. What about the winter roads?
11. How confident are you that the land on and around the mine can be returned to its original state?
 - a. Why/why not?
12. Do you trust the mining companies with the land?
 - a. What don't you trust with them with specifically?
13. Do you worry that your children, grandchildren or youth in the community will never be able to come back to this region to spend time on the land or hunt?
 - a. Why/why not?
14. Do you feel that you have a say on how the mines use the land?
 - a. Can you explain why?
15. If you could tell the mining companies one thing about the use of the land in the future, what would it be?

Appendix III- Research Agreement with Łutsel K'e Dene First Nation

Research Agreement

“Reclamation of Mining Sites in the NWT and the Integration of Denesoline Traditional Knowledge”

The Research Agreement hereinafter known as “**LKDFN and UA-ReSDA Research Agreement**” made this day of May 1, 2017.

BETWEEN

Lutsel K’e Dene First Nation
Wildlife, Lands and Environment Committee
who are directing the Research, hereinafter referred to as the:

Lutsel K’e Dene First Nation
OF THE FIRST PART

AND

Brenda Parlee
OF THE SECOND PART

hereinafter referred to as the “Researcher.”

1. WHEREAS: The LKDFN and Researcher agree to carry out a Research Project during 2016-2017. Whereas the purpose of this **Research Project**, as discussed and understood by the **LKDFN** and the **Researcher** is to support the development of the Inuvialuit Indicators Project by:
 - o Document oral histories about the Kennady Lake Diamonds site
 - o Support Lutsel K’e Dene First Nation in interpreting caribou activity around the site based on oral histories and tree root samples owned by the community;
 - o Investigate the implications for the reclamation of mine sites in the Bathurst caribou range;

2. WHEREAS: The Researcher has acquired funding and other forms of support for this Research Project from **Resources and Sustainable Development in the Arctic (ReSDA) – Chris Southcott PI and TERRE-NET – David Blowes PI** with inkind contributions from Kennady Lake Diamonds and Lutsel K’e Dene First Nation..

3. WHEREAS: The Research Project is being carried out as part of the requirements of a Master's degree from the University of Alberta. As part of these requirements, and subject to the terms set out in part 1-8, the results will be included in the following public documents:

- a) An MSc Thesis;
- b) Academic publications and presentations.

4. WHEREAS: The LKDFN agrees to:

- a) Participate in and support the project (workshop discussions, feedback on project and information gathered) and;
- b) Review for approval/disapproval any reports and materials intended for public communication and distribution;
- c) Support the Researcher in gathering information as set out in parts 1-6.

The following is agreed upon by the LKDFN and the Researchers:

Access and Use of Existing Data

5. The LKDFN agrees that the Researcher may undertake the research including use of datasets (above) for the purposes of developing the MSc of a graduate student (Micki Baydack). The Researchers agree to use this data only for the purposes of this Research Project.

Reporting and Public Dissemination of the Outcomes of the Research Project

6. The Researcher agree not to use or develop analysis of the data for other reasons other than the Research Project unless written consent is given by the LKDFN;

7. Information collected is to be shared, distributed and stored in the agreed ways:

- a) The Researcher will respect LKDFN ownership, control, access and possession of data provided intellectual property rights;
- b) Any other data identified and analyzed will be made available to the LKDFN;
- c) The Researcher will be available to answer questions regarding the information collected, or to assist the LKDFN should they decide to use the information for purposes beyond the scope of the project;
- d) Activity reports and summaries of results of the Research Project will be presented to the LKDFN twice yearly beginning May 1, 2017 and ending April 30, 2018
- e) A final report will be developed for the LKDFN by August 30, 2018.

8. The Researchers agree to provide the LKDFN with drafts of any intended public outcomes of the Research Project 30 – 90 days prior to their submission for publication or oral presentation. The Researchers agree to make best efforts to address any identified errors, differences of interpretation or other changes to the satisfaction of the LKDFN.

9. The Researcher will fully acknowledge the LKDFN (and the funding agency ReSDA, TERRE-NET) in any public materials generated from the proejct unless otherwise agreed by the LKDFN.

10. In the event that the LKDFN has reason to believe that the terms and conditions of this Agreement are not being met by the Researcher, they should contact the Researcher who will make best efforts to address / resolve any concerns arising.

11. In the event that this Agreement is terminated, the Researcher shall return all originals and copies of raw data, including video, audio and written materials collected or prepared for the purposes of the Research Project to LKDFN.

12. The Researcher undertakes to:

- a) proceed with Research Project according to the terms and conditions set of in this Agreement;
- b) work under the direction of the Lutsel K'e;
- c) act as a resource person with respect to the Research Project and related research as time is allows.

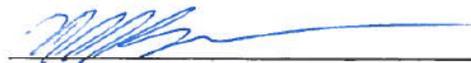
13. The Researcher agrees to stop the Research Project under the following conditions:

- a) By agreement with the LKDFN if concerns arising pursuant to Section 9 cannot be resolved;
- b) If the Researcher is not able to adhere to the terms and conditions of this agreement.


Akius SAO Ra Griffith
Lutsel K'e Dene First Nation
Wildlife, Lands and Environment Committee
Date: Oct. 3/17


Brenda Parlee
Date: May 1, 2017

Date: _____
Micki Baydack


Date: May 1, 2017