2020

Monitoring Environmental Change Using a Participatory Modified Photovoice Approach with Indigenous Knowledge Holders in Kakisa, Northwest Territories

Kaitlin Kok
kokx0240@mylaurier.ca

Monitoring environmental change using a participatory modified photovoice approach with Indigenous knowledge holders in Kakisa, Northwest Territories

by

Kaitlin E. Kok

Bachelor of Arts, Wilfrid Laurier University, 2016

THESIS
Submitted to the Department of Geography and Environmental Studies
Faculty of Arts
in partial fulfillment of the requirements for the
Master of Environmental Studies
Wilfrid Laurier University

Abstract

In response to growing pressures from climate change and the lack of a monitoring strategy for food security at a local and regional level in the Northwest Territories, there is an urgency for residents to record their own images of change in relation to harvester safety. This thesis explores the connection between geographic information systems, sustainable food systems, indigenous knowledge and the importance of place. The objective of this study is two-fold: (a) to develop a monitoring system in conjunction with the community of Kakisa and (b) to increase the resilience of the local food system. The methods used derive from a participatory action research approach to guide the development of a community-based monitoring map supported with interviews and photographs. In the summer of 2017, eight participants were interviewed and a thematic data analysis was carried out following an inductive, descriptive-coding approach. The findings suggest a continued trend that environmental change not only threatens food security and food access to harvesters, but also affects the entire system of a community through relationships and traditional knowledge. The results from this thesis will provide information on the implementation of a monitoring system within Kakisa using a modified photovoice approach.

Acknowledgements

I would like to acknowledge that I wrote my thesis on the traditional territory of the Anishnawbe, Haudenosaunee and Neutral peoples. I would also like to acknowledge my presence on Treaty 11 land which has been, and will continue to be, home to the Dehcho Dene. Thank you for welcoming me, I am grateful to the caretakers and past, present, and future. guardians of the land.

I would first like to thank the community of Kakisa for whom without his research would not be possible. You showed me kindness and compassion and supported the success of the project from the very first step. Thank you to the youth for inviting me to play on those long summer nights and for welcoming me into your life, opening up and sharing some of your stories with me. I am extremely grateful for the time we spent together. Thank you to Greg, Yvonne & your family, for allowing me to stay in your northern home, for your support of the research and encouraging the youth to continue to question and explore outside the classroom. Mahsi Cho.

I also owe many thanks to my supervisor, Dr. Alison Blay-Palmer, and also to Dr. Andrew Spring. I owe a special thank you to Alison for taking me on as a student and to Andrew for trusting me with this project. Thank you to the both of you for your continued patience, support, and guidance, as well as sharing projects with me and allowing me to gain a wide variety of experience.

I would also like to thank my committee member, Dr. Colin Robertson, and reader, Dr. Miguel Sioui, for your helpful comments and guidance. I am also grateful to Dr. Peter Johnson, Dr. Susan Elliott, Dr. Scott Slocombe, Dr. Johanna Wandel and the graduate administrative staff for providing assistance in various ways throughout my graduate degree, as well as to Dr. Bob

Sharpe, Dr. James Hamilton, and Dr. Christopher Lemieux for being excellent instructors to TA with. I had a great TA experience and hope to transition what I've learned through to my next chapter.

Lastly, I am thankful to my friends and family. Thank you to my family for the support you have provided in many various ways and for helping to create a healthy home environment. Thank you to Catharine Brazeau, Stephanie Pike, and Jordyn Atkins as well as the other friendships I formed. I am fortunate to have completed my master's in a department where unique friendships develop and for the laughs we shared while enduring grad school together. Finally, to Phil, for your endless support and unwavering belief in me no matter the distance. This thesis would not have been possible without each and every one of these individuals, so it is to them I dedicate this to.

Table of Contents

List of Figures

List of Acronyms

AAROM	Aboriginal Aquatic Resource and Oceans Management
CBM	Community-Based Monitoring
GIS	Geographic Information Systems
GNT	Government of the Northwest Territories
IPCC	Intergovernmental Panel on Climate Change
IK	Indigenous Knowledge
KTFN	Ka'a'gee Tu First Nation (kah-gee-too)
NT	Northwest Territories
PAR	Participatory Action Research
PPGIS	Public Participatory Geographic Information Systems
TK	Traditional Knowledge
TEK	Traditional Ecological Knowledge
VGI	Volunteered Geographic Information
WWF	World Wildlife Foundation

1. INTRODUCTION

In recent years, multiple bodies of research have emphasized the vulnerability of our planet, the current rate at which we are losing diversity of ecosystems, and the other threats associated with a warming climate. Reports from several organizations have published reports with the same message: we need to take action now to prevent future change impacting at a greater scale (e.g. the Intergovernmental Panel for Climate Change (IPCC); the World Wildlife Foundation (WWF) and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES); the EAT- Lancet Commission on Food, Plant, Health; and Canada's Changing Climate Report (CCCR)).

Communities across the world, and the food systems they depend upon, are under pressure from the increasing global population, environmental degradation and globalization. Climate change poses a significant risk to food systems and future global health. In 2019, the EAT Lancet Commission, a group of over 30 leading planetary, agriculture, and nutrition scientists translated data retrieved from climate reports into measures required to maintain and sustain our food production system. Their report suggests we risk destabilizing the state of the earth if we do not tackle the challenges present within our current food system (EAT 2019). Their research proposes we need to decarbonize the food system within 30 years. The report indicates significant action is required to decarbonize the food system, including preventing further expansion of agriculture into ecosystems, improving the efficiency of water usage, and the cycling of nitrogen phosphorus (EAT 2019). EAT's (2019) proposal to decarbonize the food system aligns with the IPCC's (2018) recommendation that the world attain a fossil free economy by 2050. This report builds on these findings and offers additional recommendations

that can be applied in the creation and maintenance of a sustainable food system, both generally and with reference to the north.

The IPBES and the WWF report suggest 50% of the world's biodiversity will be lost by 2050 (IPBES 2018; WWF 2019). Around 50% of land area on the planet has already been converted into agricultural land, with a 300% increase in food crop production since 1970 (IPBES 2019). For example, 100 million hectares of tropical forest were lost from 1980 to 2000 as Latin America made a transition to cattle ranching and South-East Asia to plantations, 42 million hectares and 7.5 million, respectively (IPBES 2018). While this increase in food production has supported the world's growing population – soil organic carbon and pollinator diversity have decreased and reveal that humanity is facing a crisis not only within the environment, but also human health (IPBES 2019).

The IPCC indicates that we must stay below a global increase in temperature of 1.5°C to have a better chance at limiting the frequency of extreme weather events. However, even if we are to limit to a 1.5°C increase, we are still exposed to many challenges ahead. Risks to health, livelihoods, food security, water supply, human security, and economic growth are projected, and expected to further increase if temperatures rise above 1.5°C (IPCC 2018). The IPCC (2018) also predicts the strongest warming to occur in two regions, with one region being high latitudes in the cold season. The CCCR also states that in northern Canada, the annual average temperature has from 1948-2016 has already increased by 2.3°C and while there are natural variations in the climate, the dominant factor is due to global human influence (Zhang et al. 2019).

Communities in the high latitude regions will feel the effects of climate change through rising costs associated with food and food production, and less nutritiously rich produce.

Northern regions already experiencing accelerated changes of a warming climate will continue to experience increased temperatures, exposure to extreme weather events, reductions in the extent of ice cover, increase in precipitation, the degree and extent of permafrost thaw, declining biodiversity, rising sea levels, glaciers melting, sea ice retreating and diminished snow cover (IPCC 2007; ACIA 2004; Wesche &Armitage 2013; Pearce et al. 2010). Northern regions of Canada, home to many communities with large Indigenous populations, are seeing and experiencing these changes firsthand. The changing environment threatens community livelihoods and the future of place-based Indigenous knowledge (Tripathi & Bhattarya 2004).

Indigenous Peoples have been present and actively involved upon their lands for generations through participating in research, sharing their experiences, observing, monitoring and adapting to changes (Stewart-Harawira 2013). Indigenous Knowledge (IK) systems differ from Western knowledge systems and are founded on the development and sharing of oral histories and experiential, place-based learning (Wesche & Armitage 2013; Parlee & Furgal 2012). IK systems value wildlife, habitat relationships, behavior of nature, body conditions, etc. (Polfus et al. 2013; Kendrick and Manseau 2008; Lyver & Łutsel K'e´ Dene First Nation 2005). However, with a loss of knowledge and an increased rate in environmental change, new challenges are presented to northern Indigenous communities in an effort to adapt (Isogai et al. 2013; Armitage et al. 2011; Ford et al. 2008; Huntington & Fox 2005). With justifiable concern for the future of the planet because of rising threats to food security, there are also strong forces at play to change the food system if we want to change the way our food system works. Indigenous knowledge systems offer some ways forward.

Northern Indigenous communities are identifying ways Indigenous knowledge can be collected and stored so it can be shared with Indigenous youth, future generations, and be

accessible for various land-use planning strategies. To ensure the healthy relationship between community members and the land, the research in this paper looks to investigate the implementation of community-based monitoring technology for recording long-term environmental change and the methods required to incorporate local environmental knowledge to develop a baseline of change. This was accomplished through a community based monitoring approach with the community of Kakisa, Northwest Territories. Technologies are now available to enhance the collection and sharing of this important resource (Isogai 2013). Geographic Information Systems (GIS), for example, can provide a method to document and store Indigenous knowledge (Bennett & Lantz 2014; Gill et al. 2014; Tripathi & Bhattarya 2004; Barlindhaug & Corbett 2014). Examples and previous literature using a GIS approach to monitor places and associated technology will be further explained in chapter 2 of the literature review.

Chapter 3 dives into the methodology and methods this research utilized. Participatory Action Research (PAR) and a modified photovoice method that was used to identify physical landscape changes at a local level impacting local food security with the aid of traditional knowledge and individual relationships with the land. The methods used add to the larger dialogue of how the land is represented as this research placed a map into a community in the Northwest Territories to scale up the resilience of the food system.

Chapters 4 and 5 share the results of the themes uncovered using thematic analysis within interviews and discuss how the results relate to the existing literature as this research seeks to understand place, food and environmental change using an integrated approach. The concern surrounding the risks to northern livelihoods and access to traditional food systems motivates this research's ambition to improve understanding around traditional food systems and to develop a methodological approach to capturing information about the land in a way that

complements traditional local knowledge. The questions which are cornerstones of this research seek to address the development of a baseline of environmental change: to identify what environmental change means for individuals; to examine how environmental change affects the ability to access the land and what it means in terms of relationship to places. Place-based knowledge is also explored through this research by connecting place to meaning and identifying how changes to place will impact cultural and social connections to a place. In this research, place is defined using Tuan's (1974) notion of 'topophilia' defining place attachment as an emotional connection that links a person to the environment.

The conclusion will review a quick summary of the research in addition to final reflections by the author.

1.1. Background to thesis and contributions

The contents included in this thesis are the result of a multi-year partnership between Ka'a'gee Tu (kah-gee-too) First Nation (KTFN), the Government of the Northwest Territories Cumulative Impact Monitoring Program (CIMP) and academic researchers from Wilfrid Laurier University (WLU). This project emerged in response to the concerns the community has surrounding climate change with the aim to identify some of the physical changes local land-users are observing in the surrounding land. This project has identified physical landscape changes due to environmental change which is impacting human activity. These impacts include changes from seasonal temperatures influencing ice melt and buildup and interrupting routine trips on-the-land, to newly developed permafrost thaw slumps presenting new dangers to community members.

In previous research, individuals shared photographs when sharing information about changes they had seen on the land. The research which influenced the sharing of environmental

change photographs can be found in Spring et al. (2018) where community members were sharing their photographs capturing the change they have noticed over previous years. However, the aim of this research was to develop an understanding of how environmental changes are impacting the community and utilize the photographs being shared. This research would not have been possible without the many actors involved who participated and supported the research in various ways.

2. LITERATURE REVIEW

As the community of Kakisa is quite small, little research has been conducted directly with the community and the community's surrounding land. The research that has been conducted is also predominantly natural science based, however it has supported the monitoring of the community's natural food system. For example, the potential impact of a Hydro-Electric Development on Kakisa Lake (Lamoureux 1973), observing trends in permafrost peat plateaus (Coleman et al. 2015), monitoring mercury levels of fish (Reyes et al. 2017), reproductive characteristics of the Walleye fish and Whitefish in Tathlina Lake (Harrison 2017), and measuring the mercury levels of the various fish present within both Kakisa and Tathlina Lakes (M. Laird et al. 2018). In 1988, the Walleye from Tathlina Lake were assessed by Roberge, Low & Read (1988) using information collected from experimental sampling in 1979 and commercial plant sampling between 1975 and 1986 and in 1962, Kennedy published a report on Tathlina and Kakisa Lake. However, the literature on Kakisa is most recently supported by Spring et al. (2018) addressing the northern food system and community capitals.

While there has also been significant research on the impacts of a changing climate in Arctic regions, there is limited research within the sub-Arctic region of Canada recording ongoing

changes (Wesche & Armitage 2013; Pearce et al. 2010). To ensure long-term sustainability of the environment and therefore the food system, the creation of a baseline for change is needed to understand and observe changes which may develop in future years. This can be done through the combined fields of traditional knowledge and environmental monitoring. Multiple studies have suggested the use of community-based monitoring for researchers who wish to study a certain phenomenon within a community should include the community's input and knowledge (Bennett & Lantz 2014; Gill at al. 2014; McGregor et al. 2010; Castleden et al. 2008; Tsuji and Ho 2002; Huntington 2000). This review will examine the benefits of community based monitoring, traditional knowledge and the importance of keeping traditional livelihoods.

2.1. Research Gaps

Multiple searches were conducted mainly in the geography and environmental fields. Searches were conducted in GeoBase, Google Scholar, ProQuest and Scholars Portal using key terms such as community based monitoring, community research, photovoice and traditional/indigenous knowledge. There were no papers returned which featured the exact methods that will be used in this research, however multiple papers were returned which effectively demonstrate how to incorporate community monitoring into a research process and provide examples of different modified photovoice methods. There were also numerous research gaps presented in the literature. Some of these gaps include limited research with the community of Kakisa, limited use of a modified photovoice method and limited information on applying the results of a photovoice method within a natural resource context where Indigenous knowledge can effectively support environmental monitoring means. The search results imply that while the field of Geographic Information Systems (GIS) and IK are a growing field, there are still gaps in the research and untapped opportunities to combining the two. This research aims to link the

emerging fields of GIS, traditional knowledge and food systems, while using a modified photovoice method. Linking these fields together can provide a unique look into how the fields merge together and shed light onto an area of research which is not commonly tied together.

2.2. The Food System

Food systems have seen major changes within previous decades and will continue as climate normals shift, the world population grows, and demands for food supply increase (IPCC 2018; Tilman et al. 2011; Godfray et al. 2010). Some studies suggest that by 2050, the world will need 70 to100 percent more food produced to sustain the global population (Royal Society of London 2009; World Bank 2008). The Food and Agricultural Organization (FAO) has warned that by 2020 agricultural yields will need to almost double, compared to 1990 levels, in order to keep up with demographic trends and the diversification of consumption patterns (FAO 2000). Fortunately, the current consensus seems to be if food waste is reduced, more people eat less meat, and utilize sustainable farming practices, there is a potential to feed a population of 10 billion people (Springmann et al. 2018).

However, these statistics are only relevant if the world's main fertilizer ingredient, phosphate, can be maintained as current reserves are declining (Cordell et al. 2009). Rising carbon dioxide levels are also negatively affecting the levels of micronutrients, vitamins, proteins, etc. present within foods (Zhu et al. 2018). These levels are concern for the future of soil health in terms of having the ability to produce food at a large scale. For example, it is estimated that by 2100, both the southern and Sahel region of Africa will experience increased levels of aridity which may decrease crop yields by up to 20 percent – these regions currently contribute a significant portion to the total maize production in Africa where maize is most

widely produced (Dale et al. 2017; UNFAO 2015). With global forces occurring at such a large-scale, impacts will be felt at local and regional scales (IPCC 2018).

2.1.1. The Northern Food System

With threats of an unpredictable environment in arctic and subarctic regions, the pillars of food security – availability, accessibility, and quality of food – are directly impacted (Wesche et al. 2016). While there are a couple food security definitions which provide different context, all definitions include the idea that nutritional food availability is a right to everyone. The United Nations Food and Agriculture Organization (UNFAO) define food security as existing, "when all people, at all times, have physical, social and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life," (World Food Summit 1996). Hamm and Bellows (2003) defines *community* food security as, "a situation in which all community residents obtain a safe, culturally acceptable, nutritionally adequate diet through a sustainable food system that maximizes community self-reliance, social justice, and democratic decision-making," (p. 37). Food security is a vital concern for individual health and well-being and both are influenced by a household's food security level (Tarasuk et al. 2016).

The Canadian Community Health Survey (2014) identified that the households in NT facing food insecurity is at a level of 24.1% and when compared to southern provinces like Alberta where the rate is almost thirteen points less at 11.4%. These statistics were recently updated from the 2015-2016 year where the rating for NT dropped to 17.6% and Alberta dropped to 11%, however caution should be taken when comparing these years due to a survey redesign in 2015 to better represent the population (CCHS 2016). These statistics show that while NT saw a decrease in between years, Alberta, similar to other provinces are much lower in comparison. The complex system threatening food security in Canada's northern communities is due to

multiple factors including economic factors, change of lifestyle, and land use changes (Council of Canadian Academies 2014; Power 2008). However, environmental changes continue to be a major underlying driving force behind these threats. Varying weather intensifies the dangers associated to traveling on the land through a myriad of reasons. For example, ice can compromise the trails and hunting grounds which directly affects the access to and then availability of fish and wildlife (Ford et al. 2012; Pearce et al. 2010; Berkes and Jolly 2002). These climatic changes coupled with changing socioeconomic conditions affect harvester safety and the local participation rates in traditional hunting practices thereby affecting food production, and cultural practices (Pearce et al. 2015; Pearce et al. 2010).

Many northern Indigenous communities continue to experience a transition away from a traditional way of life and subsistence culture due to the growing western and European influence and changing environmental conditions (Brown-Leonardi 2009). A related growing reliance on imported foods exposes northern communities to a 'nutrition transition' where purchases of imported low-nutritional value foods are increasing (Zotor et al. 2012; Sharma et al. 2009; Receveur et al. 1997).The socio-economic change of culture towards the trend in increased purchases of subsidized imported foods away from land-based, more nutritional diets creates concern for the make-up of the local food system (Sharma et al. 2009; Receveur et al. 1997; Kuhnlein & Receveur 1996). With higher consumption of southern imported foods, there has also been an increase in obesity, diabetes and cardiovascular disease linked to the shift away from country food and a less active lifestyle due to reduced time on-the-land (Van Oostdam et al. 2005).

Paci & Villebrun (2005) found that traditional foods were still more affordable and more nutritious in most of Denendeh (the land of the Dene people) and outside of the few larger

urbanized communities than importing commercial goods. Within the Dehcho region of the Northwest territories, 101 traditional food species can be found in the region (Kuhnlein et al. 2003). Consumed most commonly include: moose, caribou, whitefish, spruce hen and jackfish (Receveur et al. 1996).While harvesting of food from the land, water and sky continue to be a necessary part of the lives and identity of the diverse Indigenous population of Canada (Council of Canadian Academies 2014), environmental changes bring a larger concern to the lack of access to land-based food. Many Indigenous people continue to observe physical and spiritual signs of the land, which then impact their own well-being as the health of the land is important to overall well-being (Parlee et al. 2005). Country food is therefore of high importance to community members not only nutritionally, but also culturally as country food is associated with physical health and well-being (Lambden et al. 2007; Van Oostdam et al. 2005; Receuver et al. 1998). For example, specific country foods are looked at to provide certain functions not found in imported food, e.g. warming the body (Van Oostdam et al. 2005). The nutritional benefits are also substantial in their ability to provide more protein, iron and zinc than from foods available within imported foods as well (Sheehy et al. 2014; Van Oostdam et al. 2005). From these facts it is easy to see how vital access to traditional foods are to northern communities.

2.3. Traditional Knowledge

Traditional Knowledge (TK) is knowledge gathered from spending time on the land and learning from community members. This knowledge comes from learning about wildlife, habitat relationships, behavior of nature, body conditions, etc. (Polfus et al. 2013; Kendrick and Manseau 2008; Lyver & Łutsel K’e´ Dene First Nation 2005). The GNT defines TK as, “knowledge and values, which have been acquired through experience, observation, from the land or from spiritual teachings, and handed down from one generation to another,” (GNT 2005).

However, many scholars cite the use of *Traditional Ecological Knowledge* (TEK). TEK is a subset of Indigenous knowledge that can be understood as, "a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment," (Berkes 1999 p. 8). Residents of Indigenous communities hold valuable local TEK (Adams et al. 2014; Berkes 1999). The combination of multiple ways to transfer and share information through belief and knowledge systems over multiple generations creates a complex and dynamic knowledge system (Berkes 2008; Heiltsuk Tribal Council 2001; Johnson & Ruttan 1993). Those who spend a significant amount of time, including indigenous land users, can detect environmental change at early stages because they can monitor environmental conditions (Kokelj et al. 2012; Gearheard et al. 2011; King et al. 2008; Hinkel et al. 2007; Hinzman et al. 2005; Moller et al. 2004; Davidson-Hunt & Berkes 2003; Krupnik and Jolly 2002). TEK provides a multidimensional approach to local knowledge at large spatial and temporal scales. This knowledge body provides understanding about shifts in climate and the functioning of ecosystems (Adams et al. 2014; Berkes 2008). Local sharing of TEK also promotes communities as leaders of information that can inform both conservation and land management (Gutiérrez et al. 2011; Pretty 2003).

For years, there has been a call to include IK into the research process. Growing bodies of research such as the United Nations and Intergovernmental Panel on Climate Change (IPCC) are increasingly recognizing and recommending place-based knowledge as a key asset for knowledge concerning building resilience with a changing global environment (Fernández-Llamazares et al. 2015; Berkes et al. 2000; CBD 1992). The Government of the Northwest Territories (GNT) adopted a policy that recognized TEK as a valid source of knowledge that

should be incorporated into territorial government decisions where appropriate in 1993 (GNT 1993). The move to recognize TK as valid knowledge and co-management provisions of agreements have shaped the way northern indigenous people are included in environmental governance and research (ACUNS 2018; Berkes et al. 2007; Berkes et al. 2000).

Similar statements are found in Graham and Fortier's publication (2005) *From Opportunity to Action: A Progress Report of Canada's Renewal of Northern Research*, and again found in the *Inuit Knowledge Strategy* (2018) put forward by the Inuit Tapiriit Kanatami, the representation for the Inuit Community, in an attempt to improve the effectiveness and openness of research with Inuit people. Although, there has been controversy (including, but not limited to, the associated mistrust of Western knowledge (Ford et al. 2016)) surrounding the validity and confirmation of using TEK throughout the federal government, there are few effective community-driven plans for the creation of monitoring programs to document observations about the environment within Indigenous communities (Bennett & Lantz 2014). Incorporating TK into a monitoring program can lead to immersed communication, and in the NT, support indigenous environmental governance (Berkes et al. 2000).

2.2. Community-Based Monitoring (CBM)

Community-Based Monitoring (CBM), using EMAN's (2003 p.4) definition as, "a process where concerned citizens, government agencies, industry, academia, community groups and local institutions collaborate to monitor, track, and respond to issues of common community concern." Given ongoing changes to the natural environment in northern latitudes, communities are faced with limitations to record observed changes. A CBM utilizes the knowledge of community members to support monitoring and gathers opinions from multiple individuals.

CBM programs have increased in recent years as the use of geo-web based systems have also

developed in variety and popularity. With updated technology, there is greater opportunity for users to complete simple tasks in a shorter time frame than before, allowing greater time to explore advanced options. Haklay (2013) indicates an increase in citizen science is associated with the reduction in working hours, increased leisure time, and the population of well-educated individuals contribute to the interest in an activity which is not dominant in daily life activities. The author does note the socio-economic driver of this pattern.

While these influences may be prominent in many areas of the world, Kakisa's interest has risen with their increase in observation of changing environmental patterns. With rapid development in mapping software from the year of 2010 and onwards, CBM programs have seen an increase in successful implementation (P. Johnson 2015). The switch to an online web-based system has also promoted the use of web-based maps for everyday activities allowing advanced techniques to be made available to a broader public sphere (Haklay 2013). The mapping world has also seen a direct correlation between online mapping systems and the development of maps through public participation (P. Johnson 2015). User-friendly and online accessible maps promote usability and allows accessibility to a wider audience and contribute growth of the 'GeoWeb'. With Public-Participatory Geographic Information Systems (PPGIS), the uses of the publicly collected data tends to be created and used by members of the general public rather than by a specific user group (Haklay and Tobón 2003). This suggests that there is a large gap for creating a platform which can host the collected information at community levels to display data.

The advancement of Open Source software and web-based activities has contributed to the idea of incorporating complementary web-based mapping systems into community-based projects. The integration of these two fields has been found useful in applications where environmental change is a concern. The development of the Geo-Web has created platforms to

document community input in CBM (See Geolive.ca https://geolive.ca, eNuk https://twitter.com/enuklabrador, Community Knowledge Keeper https://knowledgekeeper.ca). Researchers have found that using GIS in cooperation with social knowledge has great potential. Pavlovskaya (2006) suggests that ‘openings' in GIS have the ability to enable qualitative researchers to use GIS in their own research through reaching out to individuals, something which was not done in this research as the community’s privacy surrounding their data was respected and made priority.

As the field of Participatory Public Geographic Information Systems (PPGIS) continues to grow, there is debate on how the field will develop. The role of the internet and the web as a global organization has created the new model of citizen science, which has been termed ‘citizen cyberscience’ by Francois Grey (2009). The term ‘citizen cyberscience’ implies the combination of PPGIS and Volunteered Geographic Information (VGI) and deems it a category for various publicly collected and shared data. Haklay (2013) states, “citizen science is likely to be the longest running of VGI activities,” (p. 105). The rise of interest for citizen science is complementary to the increase in CBM methods. Using PPGIS to populate a CBM program encourages the development of cohesive CBM and PPGIS initiatives. As communities have grown aware about the importance of recording environmental to aid in developing an environmental management plan, the idea of environmental justice also promotes community science in which scientific measurements are carried out by members of the community (Haklay 2013).

2.3. Traditional Knowledge and CBM

As communities within the northern latitudes of Canada experience pressures from rapid social and environmental change (Downie & Fenge 2003; Krupnik & Jolly 2002), a practical

way to record changes is needed. There is an urgent need to monitor and understand what is changing to ensure future generations can continue to actively pursue traditional livelihoods (Berkes et al. 2007; Berkes et al. 2005). This is an area of concern because, “communication lines with younger generations have been broken,” (McGregor et al. 2010, p. 109). Ensuring that there is a way to monitor what changes are occurring can help prepare future generations by ensuring both older and new knowledge is passed along.

In fact, there are many projects, supported by research institutions and others which merge mapping, traditional knowledge and change (Aporta 2003). N. Johnson et al. (2015) reviewed 81 projects which incorporate CBM and TK. The authors make the observation that many of the CBM programs were initiated based on the need to record observations which could be used later to support decision-making (N. Johnson et al. 2015). Many CBM programs have been focused on monitoring environmental changes hard to identify due to their rapid rate of change. For the most part, Indigenous communities in Canada’s north have played a role or are currently involved in some role of community monitoring, there may just be no recorded information of the monitoring taking place. The idea that CBM programs are used to collect data from the public draws on the definition of what the combination of PPGIS aims to achieve. CBM supports community-based observations (the gathering of knowledge with support from community members) a platform for hosting and regulating observations can be used to inform and support important decision-making procedures (Barnhardt & Kawagley 2005). Using local environmental monitoring recordings which are relevant to the community ensures that the residents’ interests are taken into consideration rather than looking solely to scientific monitoring to make the decision (Barnhardt & Kawagley 2005) which also fosters and empowers community relationships. As locals are familiar with their surrounding environment, the degree

of knowledge these individuals have is incomparable to other forms of data as TK represents a knowledge sector which provides different viewpoints. For example,

> Indigenous Peoples observe multiple indicators, such as wind, ice and snow formation and thickness, and cloud patterns, to help make sense of a dynamic and changeable environment. Their observations of subtle environmental indicators and their familiarity with animal behavior and population dynamics have facilitated successful hunting, fishing, gathering, and overall survival in challenging and changeable conditions, as well as the ability to respond to change (N. Johnson et al. 2016, p.3).

While it is important to understand that modern information technologies cannot replace or capture the knowledge to same extent which is possible when leading a lifestyle based on the land (Barlindhaug & Corbett 2014), the data can be collected in a way which aims to promote knowledge transfer and build local capacity. The idea of using local environmental observations to inform decision-making creates important feedback for further development of the CBM. Nadasdy (1999) argues that this form of monitoring can prove to be extremely important.

With rapid development in CBMs and the results of a changing environment affecting livelihoods, careful consideration is required when recording place-specific information as challenges arise when faced with how to move forward so that TEK is not lost, but captured "…in a way that is respectful of knowledge holders and consistent with the holistic, place-specific nature of TK," (Gill et al. 2014). There is a need to handle the information in a way that is respectful to whomever is sharing the knowledge and retaining the holistic nature of the TEK (Gill et al. 2014; Barlindhaug & Corbett 2014). Using a participatory approach to work with the Gwich'in community resulted in a mapping system which is being used to record traditional and ecological knowledge because it is an appropriate strategy for documenting and disseminating TEK, a form of knowledge that can be difficult to visualize and contextualize (Gill et al. 2014).

2.3.1. Transfer of Knowledge: Why Monitoring is Important

A key reason monitoring systems can be a solution to communities experiencing environmental change is to enhance the transfer of knowledge between individuals. A study conducted with the Indigenous Tsimané community in Bolivia identified that the community was experiencing a change to the natural baseline of environmental changes in every generation (Fernández-Llamazares et al. 2015). The study concluded that the transition of environmental knowledge may be shifting with each new generation due to a difference in the perception of change based on an individual's age and an overall decline in the sharing of knowledge (Fernández-Llamazares et al. 2015). Another great example of building community capacity through mapping is already taking place in a First Nation communities of Nuu-chah-nulth-aht on the West Coast of Vancouver Island. Their project titled 'Uu-a-thluk,' translating to 'taking care of' developed out of the necessity to monitor the land and record changes which could affect their marine harvest. The project introduced GPS devices and other technology skills into the community and is another example of using mapping to build resilience within the food system, as well as general capacity building (Uu-a-thluk 2017).

2.3.2. Indigenous Guardian Programs at Work

On March 22, 2017, the Canadian federal government contributed $25 million over a five-year period to launch a pilot Indigenous Guardians Program aimed to give Indigenous peoples greater say and responsibility in how they manage their traditional lands and waterways (Indigenous and Northern Affairs Canada 2017). The Dehcho First Nations and the community of Lutsel K'e guardian programs have already been running a provisional Guardians project since 2008. In a report put together by Social Ventures Australia to compare similar outcomes that have been achieved with guardian-like programs in Australia, the team concluded an

investment of $4.5 million, generated $11.1 million has in social, economic, cultural, and environmental value (Social Ventures Australia 2016). This was generated through direct employment which decreased social problems such as crime and substance abuse; increased time spent on-the-land which increased access to traditional foods thereby reconnecting cultural and spiritual aspects into the lives of community members again; and, this program also increased self-determination and encouraged community members to be more active in total community development, i.e. having a say in land use plans (Social Ventures Australia 2016).

The Dehcho First Nations have crafted their own set of principles they would like to achieve with the arrival of the Dehcho K'ehodi Guardian program. Dehcho K'éhodi, which translates to 'Taking Care of the Dehcho' in Dehcho Dene Zhatié, will be the regional on-the-land stewardship program for all communities of the Dehcho. Working collaboratively with the already successful Dehcho AAROM initiative to expand the role of community members' connection to the land and encourage working together to monitor the land and water. The principles outlined with the help of community leaders and elders include: Dene language revitalization, youth/elder mentorship, and honouring the Dene laws (Indigenous Guardians Toolkit, n.d.), see Appendix C.

2.4. Chapter Summary

In recent years there has been a large development with incorporating and communicating research to indigenous communities. IK is increasingly being honoured and utilized in research, although gaps continue to exist. There is rising concern among the world's food system, as current patterns will impact the future. The overview of monitoring systems reveals new technologies can be used to monitor changes within the natural food system while honouring IK in an effort to understand environmental patterns.

3. METHODOLOGY AND METHODS

This chapter will explain the methodology and methods approach used in this research. To understand the local perspectives of environmental change and impacts on food security in Kakisa, conventional social science methods were used to collect qualitative data, such as interviews and participant observation. The quantitative data was collected through the process of developing the web-based map, the Atlas. Participatory Action Research (PAR) was used as a methodology to develop an understanding about community goals and needs first. A Food Systems Approach was used to outline the research goals. This data was collected through a modified photovoice method using photo-elicitation interviews with 8 individuals of the community of Kakisa, Northwest Territories and put into a web-map (the Atlas). The data of photographs were placed within the Atlas at the photograph's location during the interview. Photographs and field notes were also recorded by the researcher while in the community.

3.1. Using a Food Systems Approach to Guide Participatory Action Research

Sustainable Food Systems are characterized by three main interconnected features: social justice, environmental integrity and economic equity (Blay-Palmer 2010). Hinrichs suggests in *Imaging Sustainable Food Systems* (2010) that creating sustainability in food systems requires many steps and ventures to succeed and contribute to the possibility that there are multiple ways to establish a sustainable food system. This suggests that sustainable food systems research can contribute to the multiple different ways sustainable food systems work together. Using a food systems approach aims to improve food systems by contributing to the food systems overall sustainability and address, "competing priorities, and the complex relationships that exist

between components of food systems" (Tendall et al. 2015, p. 17). This research aims to use a monitoring system to increase the resilience of Kakisa's sustainable food system.

3.2. Research Objectives & Question

The main objectives of this thesis were developed in congruence with community members. The objectives are as stated:

1. Record traditional knowledge in the form of historical pictures and recorded interviews from community members to establish a baseline of change in the region.
2. Identify places of cultural importance, as well as places of concern.
3. Build capacity for monitoring landscape changes by the community (i.e. evidence of permafrost thaw, species sightings, land use and development, as determined by the community).
4. Establish a database and web-enabled mapping platform, the Ka'a'gee Tu Atlas, that includes monitoring data collected by community members, but also the inclusion of other data, such as GIS layers, and results from other monitoring and scientific studies, to aid in decision-making and direct the course of future studies.
5. Act as a case study for community-based monitoring programs that can be adopted for use by other communities in the NWT.

Building upon these objectives, the research was guided by the overarching question: How can environmental change be measured in a way that can identify changes to the traditional food system? Understanding the changes with TK leads us towards understanding how changes will impact the traditional food system.

3.3. Methodology

To answer this research question, I spent time with the Dene community of Kakisa, NT. This research employed a Participatory Action Research (PAR) case study approach using semi-structured interviews, focus groups and Geographic Information Systems (GIS) to further explore the social-ecological system framework in a community-based setting. Over a period of approximately two months (June-August 2017), 8 participants were interviewed in a formal setting. I also conducted and helped lead formal focus groups, informal group discussions and participant observation with multiple trips made to the community (June-August 2016; March 2017; July-August 2017; February 2018). While multiple trips were made to visit the community in person, continuous relationship building occurred throughout the years by regular interaction via text message and social media. This was important to me because I had felt fortunate to create genuine and embedded connections while I was there and the connection shouldn't stop solely because I wasn't physically there. I enjoyed learning from and spending time with community members in different ways. The small moments were foundational to making this research a success because, while I was present and active for 4 months and collected interviews over two months, it feels like my connection to the community has lasted much longer. I believe the time I spent investing into others and the community allowed me to gain the trust and respect of individuals and likely led to more robust answers in the interviews. Some more detail is provided in section 3.3.5 of Positionality 3.4.6 of Participatory Observation.

3.3.1. Qualitative Mixed Methods

A mix of qualitative and quantitative methods were used. A mixed method approach generates more data, and allows for data to be cross-referenced (Baxter 2010). Using mixed methods can also help with the critical analysis of a problem because using different methods

can help show how perspective influences information by comparing information from different sources (Baxter 2010). A mixed methods approach will prove to be very useful in this thesis as multiple methods allow for more rigorous results. In a study outlining the trend of Arctic Research from the year 2000-2015, authors Petrov et al. (2016) identify a mixed-methods approaches are the most effective approach to tackle complex issues. Some examples can be seen in e.g. Arctic Council 2013a, 2013b; Chapin et al. 2009; Miller et al. 2008. With previous success stories combining the qualitative and quantitative, adding a qualitative component creates a thicker description and assists in the interpretation of the quantitative information.

3.3.2. Participatory Action Research (PAR)

This thesis uses a Participatory Action Research (PAR) approach as the basis for the research conducted. PAR encourages research from a collaborative standpoint to encourage research geared towards changing societal norms of traditional research avenues (Kindon et al. 2007). PAR is a collaborative effort between researchers and participants. Both identify an issue or situation in need of change and then a research plan is developed to contribute to some of the community's key abilities to develop action relevant for community use (Kindon et al. 2007). One of PAR's major strengths is its view on counting experience as knowledge (Baum et al. 2006). The idea that experiential knowledge is viewed as legitimate helps to gather a sense of understanding about the community and counts all responses from individuals who may have less education credentials, but more lived experience. PAR counts experience and "experiential learning as a, "legitimate form of knowledge that influences practice," (Baum et al. 2006, p. 854). Because PAR places knowledge first and IK is knowledge gathered in part from spending time on the land and learning from community members, using a PAR methodology was influential in understanding the role community members play within their environment.

Melrose et al. (2015) suggest that Participatory Action Research (PAR) initiatives should work to better adapt GIS software to incorporate local expertise and knowledge. Establishing the use of PAR within the GIS framework can lead to productive results where public information can be collected and made available to the community (Melrose et al. 2015). Nadasdy (2003) highlights that within recent decades there has been a growth in the provision of co-management strategies. For example, in a study analyzing the increasing volume of Arctic sustainability research (Petrov et al. 2016), authors concluded that the third and most recent trend of research which aims to include IK stated that, "knowledge and research that are community informed are indeed better suited to address complex sustainability challenges," (Petrov et al. 2016, p. 170). Authors likely states this because IK is key in understanding shifts in ecosystems and the climate (Adams et al. 2014; Berkes 2008). Working cohesively leads to increased understanding between all parties involved.

PAR offers a research methodology focused on the participants' role in research. PAR in a community setting places community goals first as it is productive co-operation system with both the community and the researcher. In recent years, there has been strong development behind incorporating local community members into all research projects. The GNWT encourages all research projects to actively incorporate local members into traditional knowledge building and researchers to continue to incorporate more community engagement as a requirement into research objectives.

3.3.3. The Importance of PAR

PAR is extremely important for research within Northern Communities especially in the context of uneasy relationships surrounding research objectives of the past. Using a PAR methodology in a Northern Canadian Indigenous community can establish good research

relationships with the community thereby developing a better understanding for the what the community wants and works to collaboratively achieve community identified needs and goals. In contrast to more static relationships, PAR challenges some of the norms seen in northern research. This is one of the concerns outlined by the Inuit community within the *National Inuit Strategy on Research (NISR).* The NISR, released on March 22, 2018 is a call put forward by the Inuit Tapiriit Kanatami group which is the representation for the Inuit Community. This strategy has emerged after years of communities sharing their knowledge with researchers, but feeling as though researchers are benefitting the most from this sharing. This document outlines the goals to improve the effectiveness and openness of research with Inuit people. The statement below describes some of the dissatisfaction the Inuit community is trying to avoid for future experiences:

> *For far too long, researchers have enjoyed great privilege as they have passed through our communities and homeland, using public or academic funding to answer their own questions about our environment, wildlife and people.*
>
> *Natan Obed, president of Inuit Tapiriit Kanatami (ITK 2018)*

This research strategy also gained support from the Government of Canada signaling the support towards integrated research:

> *The Government of Canada recognizes that Inuit are best placed to determine their own relationship with researchers within their regions and communities. As a result, Canada is supporting this path towards Inuit self-determination by providing $82 million over 10 years, with $6 million per year ongoing, for the*

creation of a permanent Inuit Health Survey, which will build capacity in Inuit communities to develop and collect survey information.

The Honourable Jane Philpott, Minister of Indigenous Services (ITK 2018)

These steps forward are signs that all research should be working with community members to achieve a common goal and ensure community interests are put first and foremost.

3.3.4. PAR in Kakisa

PAR was adopted from the planning stage of the research until the end. The researcher made multiple trips to the community: July-August 2016, March 2017, June-August 2017 & February 2018. The first summer the researcher spent in Kakisa was used to develop relationships with community members and develop a clear idea of community needs and wants to understand what their goals were for their monitoring system. The second visit was used to hold a focus group in the community's band office to identify how community members would like to move forward with the Atlas. This meeting encouraged the research to focus on how the observed environmental changes are impacting safe access to traditional food and on-the-land travel. June-August 2017 was spent conducting interviews, gathering photographs and creating the Atlas. The follow-up February 2018 trip took place to meet with community members, share the progress of the Atlas and develop plans for what the Atlas could become. Communication also took place outside of the time the researcher spent in Kakisa with community members updating each other about one's life or inquiring how the community was doing through text messaging. This is believed to have added to the research outcomes for both parties as the research became more meaningful than understanding environmental change - it became a unique relationship.

This research also supported the employment of a community member to assist in the collection of photographs from other individuals. Due to competing priorities in the community and the small population of Kakisa, the environmental coordinator took on this role and provided guidance and help to the researcher in the form of introductions, assistance in collecting photographs and general comradery. The community researcher has been a community member of Kakisa their entire life and therefore has a full understanding of the culture within the community, as well as confidence from others in their role.

3.3.5. Positionality

This thesis topic explores qualitative research methods. While I should note I received education about both human and physical aspects of the Northern environment within my undergraduate classes at Wilfrid Laurier University, I came to this research with no experience working with indigenous communities, however with a strong interest in exploring how environmental changes are impacting and will impact food systems.

I was born and raised in the Region of Waterloo. I grew up in Cambridge and then moved to Waterloo to complete my undergraduate degree. I was encouraged to obtain an education from a young age as my parents both have post-secondary degrees. I was exposed to new opportunities individuals within many northern communities do not or may not have. While I grew up in Cambridge, I often felt a disconnect to my surroundings. I had a large European influence in my household while growing up as my family had no roots in Cambridge. My father emigrated from the Netherlands to Kitchener with his family when he was young, and my mother grew up in Sault Ste. Marie as a 1st generation Canadian of Finnish descent on her mother's side. Due to these larger connections, I grew up knowing the world was larger than Ontario.

I entered the community of Kakisa as an under-prepared new researcher in an unfamiliar environment both for me, and the community. Upon getting used to my new surroundings, I felt my own personal awareness growing not to overstep my boundaries. As past research has been focused on studying Indigenous populations at large to extract data for sole career advancements, I did not want to be another researcher with these objectives. We (researchers, academics, outsiders) have come from that tradition and I believe we are responsible for deconstructing it. I felt a responsibility to diminish effects of colonization in science and this stigma I brought as a researcher and outsider. However, while I believe in this outlook, my predisposition as a middle-class student from down-south may have continued to impact answers provided to me within interviews and may not represent the total knowledge or connections an individual may have. The participatory action research approach tried to mitigate this as much as I entered as an extension of previous research conducted with Spring et al. (2018). This helped with initial introductions within the community.

With the opportunity to spend a month and a half in Kakisa in 2016, I learned by meeting people and listening to others. I learned by visiting the Band Office every day and being introduced to others with the help of the environmental coordinator/community researcher's important role in the community. Near the end of the first summer, I participated in the youth camp in various ways by helping around camp, helping to watch the youth and mostly spending time with those involved in the camp. While I still felt like I was an outsider from a different world, participating in activities seemed to bring me closer to the youth and the others involved.

Upon returning to Kakisa in March and again in June of 2017, I was greeted back with wide open arms. This acceptance made me feel more at ease with how I perceived myself in the community. This also came with results where photographs and information were shared with

me and a new student and I were invited to collect fish from the nets one evening after spending the day with a community member listening to his experience on the land. I attended both the Dehcho First Nations Assembly and the Dene Assembly and felt part of the community and accepted by other community's presumably because it appeared I was accepted by those who were around me.

Throughout the research, I learned from the community of Kakisa and life in the Canadian North in general. I was fortunate to develop strong relationships and by the end of my second summer I was called 'Little Sister.' I currently feel like I have a second family in Kakisa. I left Kakisa for the last time (for a while) in February of 2018 feeling extremely grateful for the hospitality the community of Kakisa showed me over the duration of my masters.

3.3.6. Modified Photovoice

Used predominantly in the context of health geography, photovoice is a method which can be transferred over to any context of research which aims to identify the opinions individuals have about photographs to gather ideas from a community standpoint, as the aim of photovoice is to work at a community level with community members. The photovoice method is a PAR method first formally created by Wang and Burris in 1997. This method provides a process where people can, "identify, represent, and enhance their community through a specific photographic technique," (p.369), capturing an individual's experience and their perception. The method allows the user to take photos of what they believe to be valuable and share their thoughts afterwards in an interview setting on what they see or why they took the photo. Gathering insight into what community members value can help provide direction for research.

In the beginning of photovoice, labels moved from auto-driving to reflexive photography to photo novella in attempt to try to define what this method entailed (Castleden et al. 2008;

Wang and Burris 1997). Photovoice is the final term which was used to define the method, as the participant being interviewed tries to provide as much information and 'give voice' to the photograph. Using the SHOWeD framework outlined by Wang (1999) aims to uncover what the participant **S**ees, what they believe is **H**appening, how the photo is related to **O**ur lives, **W**hy the situation **e**xists and asking what we can **D**o about it.

However, this research uses a 'modified photovoice' rather than traditional photovoice method as there is a difference in how the photograph is collected as well as some of the questions which were asked. In some of the key articles which influenced this work, the use of the photovoice method involved a modification which strayed from Wang & Burris' (1997) original method. Castleden et al. (2008) focus on collecting the "best" photos of what resonates with community values. Bennett and Lantz (2014) used a combination of participatory photography, photo-elicitation interviews, and web-mapping to document and communicate Inuvialuit knowledge of environmental conditions. This research in Kakisa asked participants to share their photographs they had previously taken and ranged in age dating back to the 1980s to the previous summer. The researcher collected photographs in the summer of 2016 with the help of the community researcher, and as well in the winter of 2017, while the majority of the photographs were collected in the summer of 2017. Due to the sensitivity and that could arise with the collection of photographs, the PAR methodology helped create connections between the researcher and community members. The photos were collected with respect for the community members based on mutual understanding with the researcher.

The photovoice method was used in this research because it incorporates photographs into the research process and focuses on using a photo to share information. It guides the interview to follow along with a photograph and therefore a narrative as well. Photographs are

also a useful tool to depict environmental change. Basing the interview off the photograph allowed the respondent to answer the interview questions in a way which provided great place-based traditional knowledge.

The photos were shared with the researcher in either digital format or as a print. The photos were requested ahead of the interview to identify what form the photos would be shared as. If the photo was a digital copy, the researcher organized a folder for the photos to be used for the interview. If the photos were printed, the researcher scanned the photograph to create a digital format to be able to be uploaded to the Atlas.

Photovoice (Wang & Burris 1997)	**Modified Photovoice (2017)**
Photograph is taken by the participant after agreeing to participate in research	Photo has already been taken
Photograph is taken to get a sense of what resonates with the individual	Photograph provides a historical context
Photograph is a current look at the community and surrounding area	Photograph is used to generate a ‘baseline’ for the historic past

Following the photo collection, photo-elicitation interviews were recorded to gather details from participants about each location. To provide the interview with some structure, participants could view the photograph which they had supplied throughout the duration of the interview on a laptop computer. Participants provided a photo narrative (i.e. a memory of a story associated with the photo and/or details of what the area used to look like) for each photograph. Interviews were recorded with a digital audio recorder (Tascam DR-05 Portable Handheld Recorder) and then transcribed. These interviews were conducted in the Band Office’s meeting room where very few visitors enter, while a trip on the land with one of the community members also took place and written notes were recorded. This trip took place with a community member who

spends quite a bit of time on the land and shared some of the specific changes they have seen with the researcher. The reason why this research requested photographs that have already been taken was to complete the objective of developing of baseline for change to have photographs for comparison for the future.

3.3.7. Case Study: Site, Approach and Rationale

This study was conducted with the Ka'a'gee Tu First Nation, also known as the community of Kakisa, NT. Kakisa is situated to the south-west of Great Slave Lake on Kakisa Lake in southern Northwest Territories (60° 55' N, -117° 29' W). A map of the study area can be found below in Figure 1. The community of Kakisa, Northwest Territories has experienced a great deal of change to their land which has evidently affected their way of life regarding the ability to continue to pursue a traditional way of life. Once a nomadic society, the community moved to the location they are at now due to a large fire in the 1940s which forced them north and ultimately led them to be closer to the Mackenzie Highway. While not geographically defined as remote as the community is accessible by the Mackenzie Highway (Highway 1) year-round by car and does not rely on ferry service anymore with the construction of the Dehcho bridge in 2012, Kakisa is still 70 kilometres away from the nearest service centre (Fort Providence) and 135 kilometres away from the closest grocery store (Hay River). There is no grocery store in the community. The continuous high gas prices therefore have a direct impact on associated costs for the transportation of goods into the community. At the time of this study, the community continues to hunt and fish, although many individuals continue to commute to larger city centres such as Hay River, Yellowknife, and High Level to purchase store bought food to aid their traditional food diet.

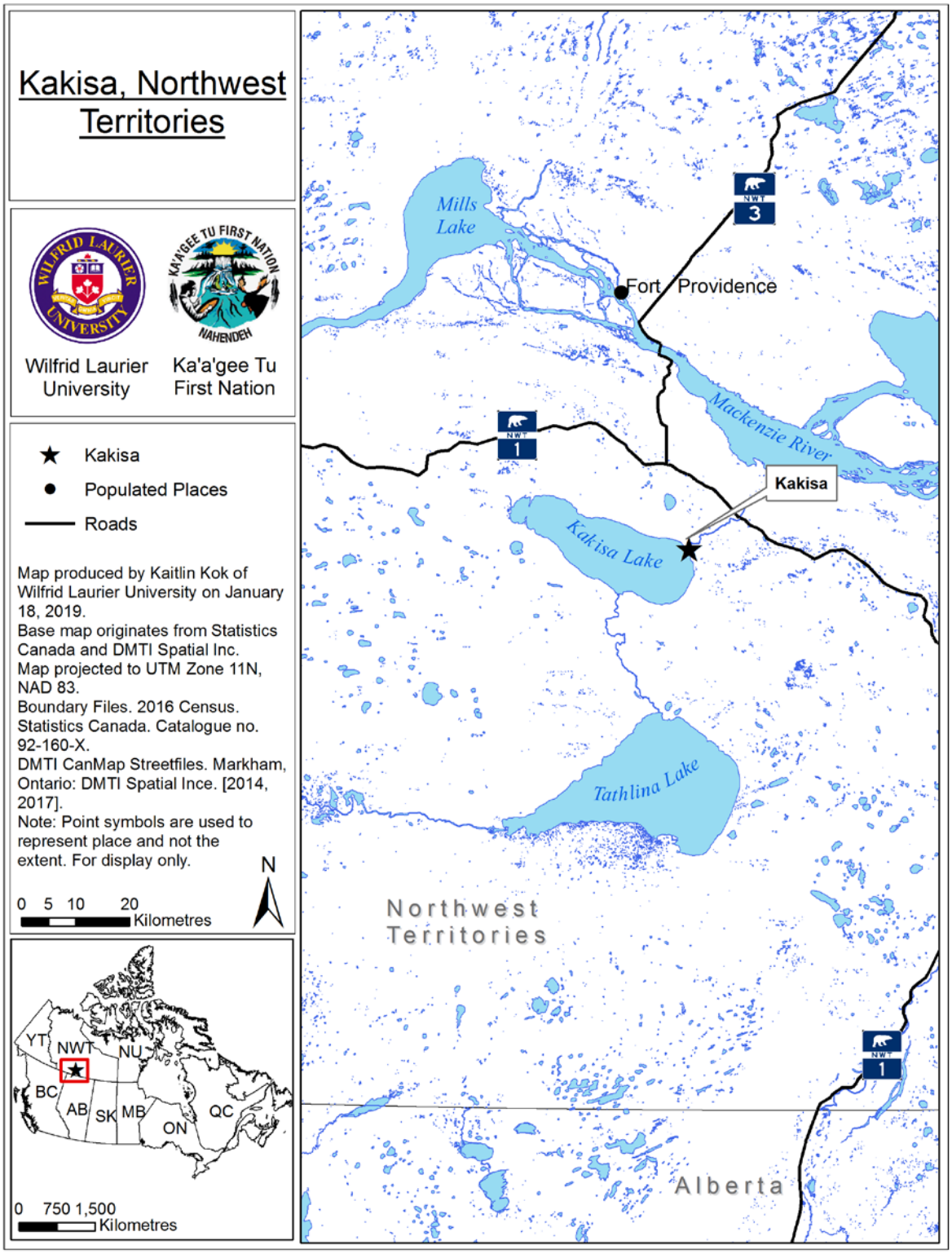

Figure 1 Study site: Kakisa, Northwest Territories.

As described previously, the community is home to less than 50 people but was reported as 36 in the 2016 census (Statistics Canada 2017). In some areas of Northern Canada where school options are limited, declining populations are likely because families move away during the school year and Kakisa Lake School only offers education to a certain grade. As detailed population data is not published for the 2016 census due to the Statistics Canada data control for populations under 40 and therefore open to privacy issues, it does reveal that 55% of the population is male, and 45% female. The 2011 census reveals that much of the population (25 individuals) are within the age range of 25-49 years and 10 individuals are 65 and over (Statistics Canada 2012).

The residents of Kakisa have a close relationship to each other and to the surrounding land. The community values family relationships and closeness to the wilderness while 58% of the population continues to hunt or fish and 45% of the population continues to gather berries (NWT Bureau of Statistics 2014c). These statistics are on the higher side when compared to the neighboring communities like Fort Providence (54% hunt/fish and 34% gather berries) and Hay River Reserve/K'atl'odeeche First Nation (55% hunt/fish and 28% gather berries) (NWT Bureau of Statistics 2014a; NWT Bureau of Statistics 2014b).

Significant warming weather (see Figure 2 Hay River Climate Station mean annual air temperature from 1896 to 2011 (Coleman et al 2015 and different weather patterns have played a major underlying role in the changes seen by community members impacting time spent on the land as a concern for individual safety. For example, the annual fall hunt in 2014 was cancelled due to lower than average lake levels in Tathlina and the plane was unable to land in Tathlina Lake (Spring et al. 2018). Outlined in "A Return to Country Food Workshop" where six Dehcho communities participated in a "Country Food Diet Survey," preliminary results from Kakisa

indicated a high percentage of households continue to harvest country foods on a regular basis meaning that country foods continue to be a constant part of the local diet (Dehcho First Nations 2013). Unfortunately, as the point of this workshop was to motivate communities to continue harvesting from the land, the report suggested concerns surrounding the health impacts of food from the land persist.

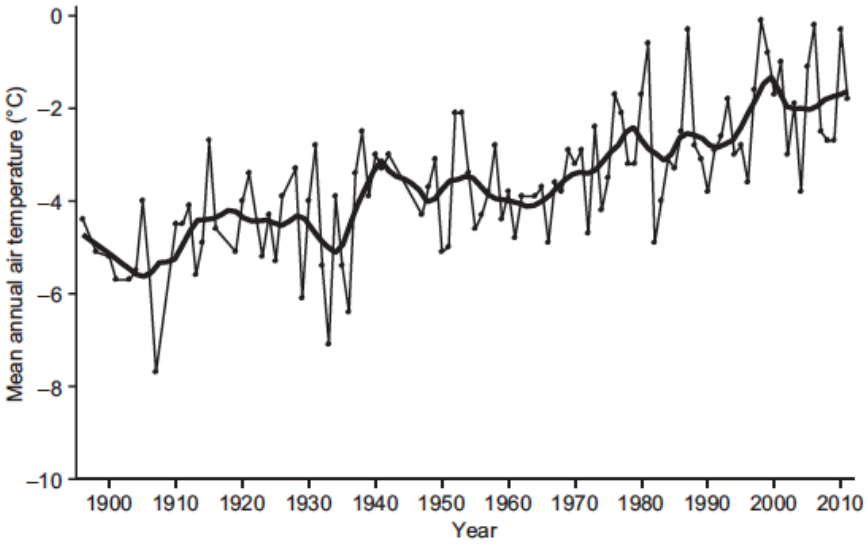

Figure 2 Hay River Climate Station mean annual air temperature from 1896 to 2011 (Coleman et al 2015).

Community fishing has provided important economic benefits and the upkeep of traditions for residents of Kakisa. However, if the surrounding environment is exposed to contaminants, public health could become a concern. Levels of mercury present within fish has grown attention in past decades and impose less desirable consequences on individuals who are most vulnerable to these impacts. Within Tathlina Lake there has been a fickle history with the fishing industry. The lake continues to be both economically and culturally important, however the lake is very shallow measuring to 1 meter in depth on average and therefore more susceptible to environmental changes in temperature, water level, ice thickness, dissolved oxygen levels, etc. (DFO 2010). Commercial fishing on Tathlina Lake began in 1953 with a catch quota of 90 000

kg in the 1950s and decreased to 2000 kg in 2008 in between multiple large-scale declines in population, most notably in 2001 (Stewart et al. 2015; Gallagher et al. 2011). The concern Tathlina Lake shares with lakes in the Dehcho region comes from a notice by the Northwest Territories Department of Health and Social Services (DHSS). The notice stated that while predatory fish in the Dehcho are generally safe to eat occasionally, harvesters should consume smaller fish most often due to the common findings that mercury levels are often higher in predatory fish (DHSS 2016). The predatory fish this notice concerns are the Walleye and Northern Pike. M Laird et al. (2018) shared the same findings as median mercury levels exceed the 0.5 μg/g guideline in Northern Pike and Walleye in Tathlina Lake. Kakisa Lake, however shows median fish mercury levels are similar or lower than reported freshwater lakes within Canada (M. Laird 2018).

The concerns surrounding warming temperatures, healthy fish levels and safe and secure access to traditional food will also have implications for the cultural practices of community members. Some of these concerns have been the major driving factor to implementing a protected area surrounding the community. With oil and gas development nearby since the 1960's, the Ka'a'gee Tu candidate protected area is approximately 9600 km² (GNT ENR, n.d.). The majority of the area considers the Kakisa River watershed which has historic and cultural connections to the ecologically rich area meant to serve the future generations of the community. The proposed protected area can be seen in the map below.

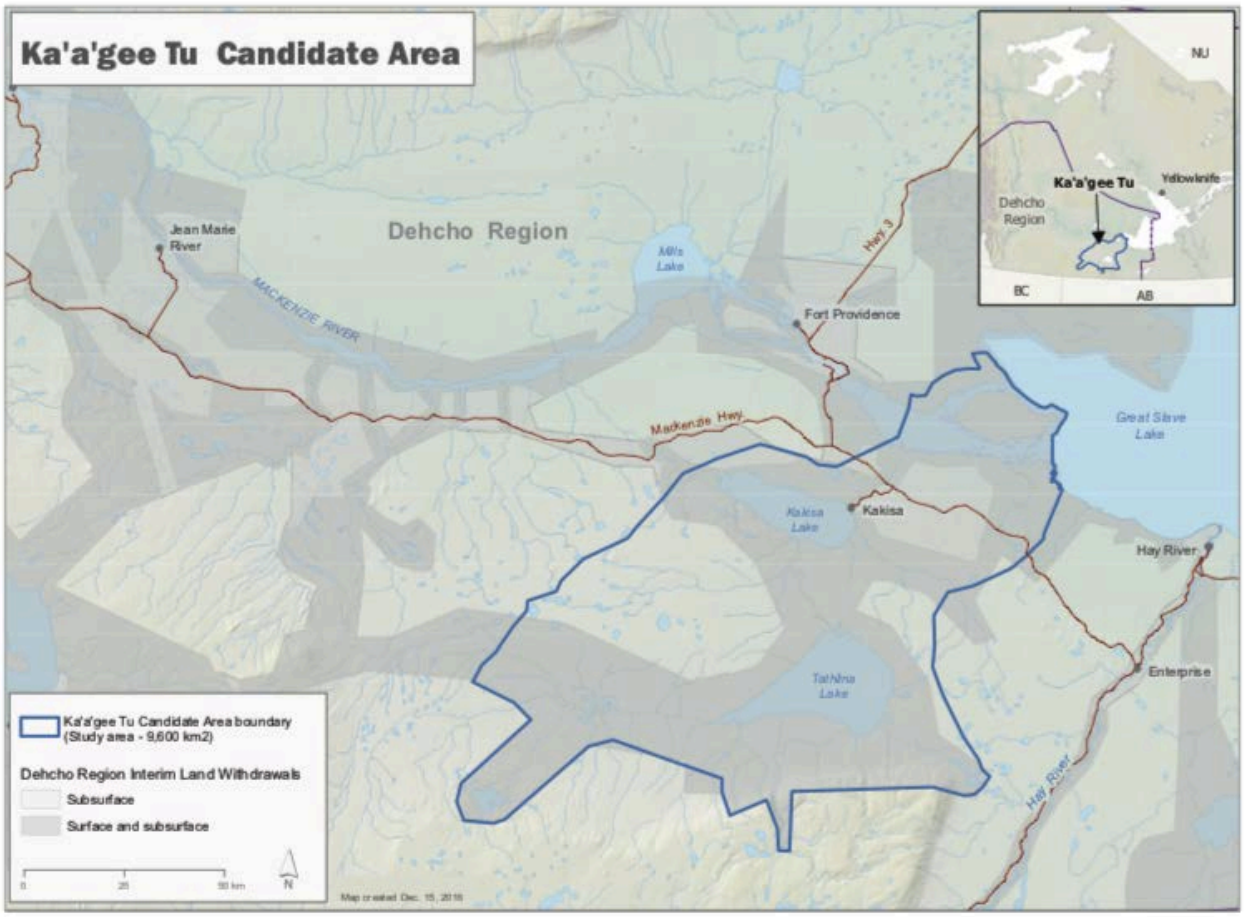

Figure 3 The Ka'a'gee Tu Proposed Protected Area (GNT ENR, n.d.).

Kakisa is a Dene community and continues to practice the Dene laws which are scriptures the Dene live by to live a good life (See Appendix C). Seeking a good life means living a life supported by both land and water. The Dene live a full life where community members pursue traditional living patterns regarding living in harmony with the land. Pursuing a life where animals, fish and plants provide staples to sustainable and traditional practices, with a mindset that, "if the land is not healthy, the people are not healthy, and when the people are not healthy the land will also be unhealthy," (Paci & Villebrun 2005, p. 75). This view supports the research of this thesis aiming to identify areas experiencing environmental change, viewed as a threat to sustaining the community's access to land.

3.4. Methods

This section will describe the methods used in this research. Multiple methods were used which include semi-structured interviews, focus groups and participatory observation. This section goes into detail of how each method was applied.

3.4.1. Questions

As mentioned in the methodology section, this research expanded upon previous research working with the community. Therefore to avoid duplicate and over-research, efforts were made to streamline the research process to focus more on the photograph and its relation to the surrounding environment than directing focus on food changing within the environment. To avoid this over research on specific questions about environmental change and the link to the local food system, these questions follow the SHOWeD framework (Wang 1999). These broader questions attempt to link the connection of place with individuals' relationship with the land to demonstrate the photograph is more than a photograph, but that each place has value and the relationship with a place will inevitably be affected by any change. By understanding what these places mean to the community, one can begin to understand how vital place-based knowledge is, the community's connection to the land, community relationships, and the community's vulnerability to climate change and food security. The questions asked are as follows:

1) Tell me about this photograph. Where was it taken? When was it taken? What does the photograph show?
2) Is there anyone in the photo? Who are they?
3) Does this photo bring back any memories?
4) Does this place have a special meaning to you? Have you been back to this area recently?

Interviews attempted to capture: 1) the attachment and importance of place and how environmental change is impacting the individual and the community and 2) to understand how environmental change would impact the local access to food 3) the potential effectiveness of a community-based web-map in the Dehcho region for enhancing food access, availability, and quality. A fixed list of questions was used; however, the semi-structured interview process did not restrict the interview to remain solely focused on the set script. These questions were subject to being potentially sensitive questions, please see below for more detail concerning the ethics process required.

3.4.2. Ethics

All data collection was completed with and respect for local community members. This work was completed under the supervision of Dr. Alison Blay-Palmer and Dr. Andrew Spring. Due to the nature of this research involved human subjects, the researcher also completed the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans Course on Research Ethics (TCP 2: CORE) certification prior to the first field season in 2016. Further, an application to Wilfrid Laurier University's Research Ethics Board was also required and received approval from the WLU Research Ethics Board in the Summer of 2016 with the number 3935. Participation involvement was granted through signed documents or verbal agreement (see Appendix E, Appendix G, Appendix J)

Working in the Northwest Territories also requires a permit from the Aurora Research Institute. As this research builds upon Dr. Spring's doctoral research, the researcher was added to the project team's scientific research license. This permit number is 16023. All data was collected and analyzed in a manner that respected local culture, customs, confidentiality, and intellectual property.

3.4.3. Interviews

Prior to commencing with the interview, participants were required to sign a consent form to participate. Interviews were recorded using two portable handheld audio recorders in case of error or fault by one of the devices. Seven of the eight interviews were recorded, while notes were recorded for one interview. Notes were written directly onto the map (i.e. if the participant mentioned they had photos in an area they were not sharing at the time of the interview), or in the interviewer's notebook. Audio files were transcribed verbatim and consent was requested for using direct quotations for this research. The participants were offered an honorarium ranging from $100-$200, based on how many hours the individual contributed to the project. This was based on whether the participant provided enough photographs for one interview session versus multiple interview sessions or when the participant invited the researcher out on the land to share changes they have seen and spent more time overall contributing to the research.

The interview used a semi-structured approach photo-elicitation approach. This combined approach allowed for a diverse and meaningful response of opinion and experiences while also providing insight into different perspectives (Hay 2016). A semi-structured interview was used to guide the researcher to focus on the content and issues relevant to the research question while also allowing for open ended questions to produce in-depth responses and allow more freedom compared to closed questions (Hay 2016). The results of the coding are presented in section 4 of results, and all of the codes are in Appendix K.

3.4.4. Mapping the Photographs

During the interview, the location of the photograph was recorded as well. The photographs were processed, scanned if needed, and ready to be shown on a laptop prior to the

interview. The interview proceeded with two laptops. One laptop showed the photograph, and the other laptop showed the Atlas with the ESRI Imagery Basemap on ArcGIS Online. The points were mapped at a scale of 1:5000, or better. In some cases, the basemap was clear enough to see where activity had taken place on the landscape and made finding a location easier for the participant, and improved accuracy for the sites mapped. This method was especially helpful when some photographs shared were from the 1980s and 1990s. The community laptop and the researcher's personal laptop were used to display the photos and the Atlas map. As the researcher and participants went through the photographs together, each photo was assigned a point. For the sake of time and flow of the interview, the researcher entered the file name of the photo into the map as a new point (data entry), and uploaded the photographs afterwards. To create new points on the map the researcher created Hosted Feature Layers (listed as Feature Layer (hosted) on ArcGIS Online). Hosted Feature Layers can be used offline with Survey123 for ArcGIS or Collector for ArcGIS (the application used for the Edukit activity, see Appendix A) and allows for flexibility across the ArcGIS platform for future use as the Atlas can easily be made into an offline map. A new layer was created for each participant to avoid conflict with other participants' data.

After the interviews were completed, the data was backed up onto the researcher's personal laptop and a portable hard drive by exporting the layers from ArcGIS Online as a shapefile, thus retaining location and data entered. Unfortunately, photographs did not export with the layer, but file names of the photographs were kept in the shapefile and photographs can be manually added if the online layers fail in future use. The dataset was checked for consistency before exporting the layer.

3.4.5. Participant Selection

The purposive sampling technique, convenience sampling was used to engage with community members. Convenience sampling, "involves selecting cases or participants on the basis of access," (Hay 2016, p.124) was used because of the small population. However, the purposive sampling was initiated with snowball sampling by the hired community researcher. Snowball sampling works by asking an initial group of survey participants to recommend additional survey participants based on their familiarity with the research topic (Biernacki & Waldorf 1981). In the initial stages of the research, the community researcher's relationships within the community were used to seek out potential people to interview based on their own knowledge of peoples' time spent on the land.

Even though this was a limited sample group, all the interviewees in this research have extensive experience of being on the land. This made for excellent interviews, although it did limit the interviews to a group who had spent time growing up on the land and continue to do so with time ranging from a couple of times per week, to a couple of times per year. The shared information and knowledge is from trusted sources.

3.4.6. Participatory Observation

As this research used a PAR approach, I spent a cumulative time of about 4 and half months in the community and met most community members. During my stay, I observed and participated in community events and land-based activities, such as attending the Dehcho and Dene First National assemblies, taking boat trips on the lake, visiting new areas (for myself) with community members, and joining a trip with one of the local fishermen to collect fish.

I also recorded field notes and photographs as observations and took photographs throughout the time I spent in the community. Most photographs were of the landscape; particularly when

the researcher could go further on the land with the assistance of community members. I also took photographs of environmental change when shared by community members. For example, figure 4 and figure 5 reveal some of these changes which have been noticed in recent years. Figure 4 shows a permafrost thaw slump on Kakisa Lake. Figure 5 shows the increase in the numbers of pelicans on Kakisa Lake, also a recent change. Accompanying residents on their outings and engaging in participant observation, I experienced, documented, and discussed hazards as they were encountered, thus developing an understanding of local practices, attitudes and knowledge that goes beyond what was revealed in interviews.

I also had the opportunity to put together a short 3-minute video about the time I spent in Kakisa following the summer of 2016 with photographs and videos from my personal collection, as well as community partners who took photographs while attending the Ka'a'gee Tu First Nations – Dehcho First Nations Youth camp. The video can be found in on the FLEdGE Website at: https://fledgeresearch.ca/resources-results/digital-storytelling/, (see Appendix B).

Figure 4 Permafrost thaw slump on Kakisa Lake, 2017 (Photo by Kaitlin Kok).

Figure 5 Pelicans on Kakisa Lake, 2017 (Photo by Kaitlin Kok).

3.4.7. Learning and Re-learning: Community Engagement

Throughout the duration of this research and time spent within the community, the researcher was able to play a role in the community, and contribute to community learning with the community researcher and the youth. Some of the major opportunities include contributing to the on-the-land camps in both summers of 2016 and 2017. These on-the-land camps are week long camps put together with the support of Dehcho First Nations, Ka'a'gee Tu First Nation and NWT On-the-Land Collaborative Funding within close proximity to Kakisa. The aim of these camps focused on community mapping and knowledge transfer by Elders to the youth aged 13 and over, as well spending time on-the-land in an effort to connect Elders and youth.

Another project titled 'Edukit' was undertaken in this research as a collaborative effort with the GNT Geomatics office in Yellowknife and WLU resources using ArcGIS Online. The aim of this project was to create the run the pilot test of a proposed school curriculum activity which would introduce students to mapping. This project required students to collect their own data of

trees, plants, animal sightings and historic features while on a 3-day canoe and camping trip outside of the community. As this trip took place outside the community and outside the reach of cell service, a normal online accessible map would be impossible to be use. Using the ArcGIS Collector App allowed for offline data collection and once online, uploads the information which was collected.

Upon returning to the classroom, students were then instructed to create their own narrative of the story using the ArcGIS application 'Storymap'. The students were engaged with the entire exercise because it presented them with the opportunity to see points they personally created allowing for a deeper reflection of the trip. The general review of the app was positive with the youth and some members of the community. The ability to record information and take photos with GPS coordinates attached, all while offline seemed to peek the interests for future use within Kakisa as a practical application. For more information, a research bulletin about this project can be found in Appendix A.

A community researcher was also sought for this research to support the researcher's community's connections as well as support the Community Environmental Coordinator. Unfortunately, there was no interest from external community members. The Environmental Coordinator was hoping to see this project as an addition to existing environmental monitoring initiatives occurring within community, the environmental coordinator agreed to take on this role and thus played a prominent role in the project. The environmental coordinator's knowledge of community relationships and concern for environmental changes was extremely useful within this research.

Throughout this research process, the researcher was also able to attend various events to expand her knowledge of mapping and community research. The researcher was fortunate to

attend the Indigenous Mapping Workshop in 2016 which took place in Vancouver, B.C. with plans for the Environmental Coordinator to join as a participant as well. However, due to unfortunate circumstances the environmental coordinator was not able to attend the workshop.

3.5. Data Analysis

Following the data collection, interviews were transcribed verbatim and when the researcher returned in January-February 2018, the interviews were shared with the participants to verify that the information they shared was correct and the transcription reflected what was said. For the participants the researcher was not able to meet, the community researcher was given the interviews to pass along to the participants. The transcriptions were then coded and analyzed to look for common themes prevalent (Hay 2016). Field notes from observations and transcripts of recorded interviews comprise the data that was analyzed.

Once the transcriptions were reviewed by the community members, the interviews were made into a word cloud to identify the common themes relevant within the interview. Common English words were eliminated and manually modified in the document before submitting the document to be analyzed. While these provided a great catch-all for common themes and words relevant in the interviews to inform the themes, more detail was required. Further themes were then identified and analysis of the themes began with descriptive coding approach. Coding continued until the point of saturation when no new themes emerged. The creation of a codebook was created and the coding was completed manually. Descriptive codes began the coding process.

3.5.1. Wordle

Once the interview was transcribed, the transcription was run through a word cloud software. A word cloud was produced for all eight of the interviews with six interviews being

about one hour long and two interviews passing the two-hour mark, accumulating to just over 11 hours of interviews. The program Wordle was used in this research to create the word clouds. The benefits to word clouds include being useful for preliminary analysis and useful as a validation tool to clear any bias the researcher may have and gather the general theme of the interview. While word clouds are useful in gathering a sense of the data, it is important to note that a word cloud is not wholly representative of the interview. This word cloud only captures the frequency of the word and not its relevance within the interview or how the word was used.

McNaught and Lam (2010) indicate that word clouds are beneficial as a validation tool but not as a stand-alone research tool when compared to traditional content analysis methods. With many word cloud software's available to choose from such as: TagCrowd (Steinbock 2008), ToCloud (ToCloud 2007) or Wordle (Feinberg 2009). Wordle provided unique benefits to this research. An intuitive, user-friendly system offers versatility in its settings and allows for a personal selection of fonts, colours, altering the direction of words, as well as the word count frequency for words produced within the cloud. The main objective the Wordle provided was to clear any bias the researcher may have had when identifying common themes prevalent within the interview.

3.6. Framework

The framework for this thesis uses the Social-Ecology Systems (SES) framework. The SES framework refers to the interdependent relationships among humans mediated through interactions with biophysical and non-human biological units (Anderies et al. 2004). An SES framework represents an ecological system intricately linked with and affected by one or more social systems (Anderies et al. 2004). This mixed methods approach fits into the SES framework

because observing ecological and social systems with both qualitative and quantitative data can contribute to a unique result.

Despite IK, GIS, and food security being different bodies of knowledge having varied epistemologies and ontologies, the idea of linking these three fields together influenced the decision to use the Social Ecological Systems Framework. The major contribution to this framework is mapping the physical landscape, contributing to a modified photovoice method and incorporating the framework throughout the research. The theoretical framework of SES acknowledges that the environment is an open-system, so understanding the best practices to promote the monitoring of the land will add to the development of SES. As Tendall et al. 2015 (p. 18) outlines, "food systems are social–ecological systems, formed of biophysical and social factors linked through feedback mechanisms," depicting that the food system lies within a social-ecological system, and integrating the two systems can further attribute to cyclical system depicted below in figure 6.

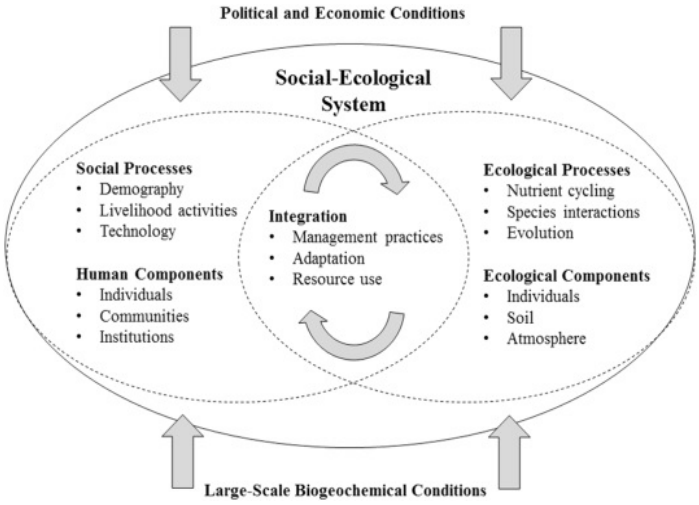

Figure 6 The Social-Ecological System (Virapongse et al. 2016)

3.7. Chapter Summary

The research was designed with a participatory action research approach to interview community members of Kakisa. The design was guided by concepts drawn from the social ecological system framework bridging environment and society through advances in data collection. The methods utilize an approach to modify the photovoice method. Participants were asked a series of questions about their own photo with the aid of a map to capture spatial extent related to place.

4. RESULTS

In total, 460 photographs were collected and added to the map at 96 locations. Photos which were taken in a similar area have repeat locations and thus the difference in number because multiple photos have been taken in areas which most often have a place-based connection. The extent of the photos can be seen in figure 7 showing a map with a buffer of the location of photos collected in section 4.8 Deliverables. The map illustrates the value the interviews and focus groups played in this research. The photos were the tool to capture the spatial aspect, while the interviews revealed the story documented on the map. Using the photovoice approach allowed individuals to tell their story in a way which fought to retain their entire thoughts and perspective.

4.1. Participant Interviews

The researcher conducted eight semi-structured interviews, one focus group and two note taking interviews. These interviews led to the creation of six overarching themes and 177 codes. For a list of all codes see Appendix K, and for additional information on how raw data was

coded see section 3.5 for data analysis. The codes were classified into the following eight overarching categories:

1. Community and Family
2. Knowledge and Youth
3. Land
4. Change
5. Tradition
6. Research, Monitoring and Methods

Within these groupings, it should be noted that there is overlap between these subjects as the categories are not perfectly distinct. For example, when a participant spoke about spending time on the land with family, they likely spoke about social or environmental changes they have noticed. Therefore, the researcher did their best to distinguish the theme based on the context of the respondent's statement. Further discussion of these themes are in the following sections.

4.2. Participant's Perspectives on Community and Family

There are three overarching themes in the topic of community and family: community, family and social. The sub-theme of community is touched upon by many individuals in reference to participating in activities together, important traditions carried out by community members, working together, etc. The family sub-theme includes activities and connections felt within a familial space which are not always present in larger community gatherings. Social was also made a sub-theme because it involves the feelings and emotions the participant has experienced in the community rather than their interactions with or within the community. The following themes are described in more detail below.

- Community

    - Co-operation and Teamwork
    - Strong Relationships
    - Community Bonding
    - Community Fishing
    - Community Gathering
    - Community History
    - Community Knowledge
    - Community Success
    - Food Sharing in Community
    - Elders and their Importance in the Community
    - The Community of Kakisa Itself
- Family
    - Connection with Land
    - Hard work
    - Family goes hand in hand with Traditional Practices
    - Family Connection/Teaching /Sharing Knowledge
- Social
    - Social Camp - the Fall Hunt
    - Community Roles
    - Importance of Community - Feeling of Home

Within the community theme, there were many discussions in relation to placing community needs first and coming together. Many participants felt that community success comes from sharing knowledge and taking part in activities together. Though the topic of the fall hunt is also acknowledged later in the theme of traditions, it is integral at the community level because it brings people together to maintain and build strong relationships. This annual activity strengthens relationships to each other as well as an individual's connection to the land.

> *As soon as the plane lands we make fires in fire pits and cook moose ribs, just fresh. That's how everyone gathers, it's so awesome. Everybody chips in to do things.*
>
> \- Anita

The discussion of elders was also present within the community theme. Elders are important figures within communities as they are key knowledge holders, crucial for the success of the community's future, by educating youth, and much more. They are influential grounding figures. The Dene Law instructs all Dene to, "be respectful of elders and everything around you." Elders try to remain part of on-the-land activities and monitoring projects when they are able to. Their knowledge about the land can inform the community about changes they see and gives them the opportunity to share stories about their life on-the-land. After returning from the fall hunt, meat is often divided to serve the entire community and elders receive servings that are pre-planned as elders have different needs for the type of meat, the texture of the meat, etc.

The community depends on members to do this sorting and delivering and are also important figures within the community. While sharing knowledge and taking on a role often helps with social tasks, some participants felt that due to the social role they had in the community they felt as though they would always be relied on due to the level of community engagement for different tasks. However, other participants felt that because different people had different skills, it was beneficial to everyone to use those skills for the community's advantage. There was also reference to the larger picture of living and working on-the-land and how it is reflected upon within the community. These feelings toward a different lifestyle are reflected in the quote below:

> *When we're out there everyone comes together and we work as a team. Same here but not as much because people have their own houses. Everyday we're doing something. Not divided into weekdays and weekends. Live every day to survive. – Chief Lloyd*

To summarize, the participant's perspectives on community and family reflect the strong relationships between community members which is supported through community activities.

These activities build on previous successes of coming together to work and build on community plans and upkeeps close relationships between the environment, individual people and the larger community where relationship building takes place.

4.3. Participant's Perspectives on Knowledge and Youth

The subject of knowledge and youth merged into one overarching theme as many participants who spoke about the subject of youth also drew a connection to the importance of teaching youth about the community's history. The themes in the knowledge category are also topics wished to be shared with the youth. A sub-theme of history is also placed within this themes because history provides a starting point for sharing knowledge. This will be described in more detail below.

- Knowledge
    - Place-based knowledge
    - Signs and observation on the land
    - Traditional food knowledge
- History
    - Archaeology prospects
    - History of Community
        - Portage
        - History and Places of Meaning
    - History falling apart
- Youth
    - Sharing and Teaching
        - Ideas for future generations
        - Importance of having youth be outside on the land
        - Elders teaching youth
        - Education of place names
- Loss of Knowledge

The idea of knowledge within the community was referenced with the importance of sharing knowledge. Place-based knowledge is one of the key aspects of Indigenous Knowledge

that has been carried down from generation to generation, especially with reference to places on the land. Knowing areas of safe places (i.e. cabins, areas of shelter) is important as changes in weather and travel conditions occur more frequently and are more unpredictable. By gathering this information, it can lead to potentially safer actions when unpredictable conditions arise. While many community members are aware of safe places and places community members are familiar with on-the-land already, there is a knowledge gap with the younger generation this information would benefit. Individuals use this knowledge that they have learned and apply it at the larger scale. For example, one active land-user spoke to some of the detail they have learned over their many years accessing the land.

The names of the trails on that map I know. I've been to all those places. And portages here we go by skidoo where we can't go by the river when there's no ice. Portage all along the bank to Kakisa - Chris

This topic of knowing the land was frequently mentioned relating to improved understanding and learning. Learning about places on the land also relates to the practice of food as well as knowledge about how to prepare traditional food was mentioned by participants in relation to taking care of their food and ensuring proper practice took place as is cited below. Careful steps and preparation ensure safe food practices.

That's the colour when hanging meat so it won't spoil and it will preserve - Community Member

There is high value of youth within this community because they are the future of the community. Reference to the importance of teaching youth the community's history, and knowledge came through in the interviews as something that needs to occur more frequently. This means Elders sharing their knowledge with youth or teaching them about place names and

the safe areas of the land. However, as stated by some individuals, this requires diligence from Elders, adults, and youth. Sharing knowledge and teaching youth about their past and present can help preserve the community's history and hopefully lead youth towards more engaging conversations with community and family members.

> *Teach them the name of the area, where they were so if they ever go that way they'll know where to stop. It's a chance to show the kids just to go out there. Share with them what it means, where they are, where there's gravesites, where there's berries – Chief Lloyd*

There is valiant effort to ensure youth maintain a relationship with the land. While accessing the land does not happen every day, the youth access places their previous generation has grown with and they learn about the land over the course of many years. Many participants shared the importance of being taught and sharing knowledge about the land for multiple reasons. The land teaches culture and history, important places of reference, safety and the dangers present on the land. Most of this knowledge has been learned through time spent on the land, especially because all of the participants are active land-users. For example, this information benefits traveling on the land and an individual's use of the land. It also increases an individual's familiarity with the land.

> *We took our youngest daughter out on the land. The older one used to come with us in the bush. We took our kids out in the bush, that's why they got used to being out on the land. We took our youngest one out when she was 6 months old. We used to travel to Tathlina by skidoo and wrapped her in a sled really warm when we go out there, so she's been with us going out in the bush since she was 16 months old – Anita*

The community's perspectives presented history in terms of the community's history through knowing the previous generations movement and impact on the surrounding land, to being aware historic artifacts and imprints are exposed to the possibility of future damaging changes. Some participant's reported that some of the community's history is falling apart, e.g. old cabins. Information about the community's past also fell into this category such as the way the community had to portage versus land knowledge mentioned in the previous knowledge category.

For the majority of participant's, their history and relationship to the past is an important connection. There were references to important places such as the place the community once lived and due to the community's visible history on the land, there is also hope for archaeological work to take place. All of these associations signify the strong connection linking individual's to the land.

There were also signs that point to the loss of knowledge individuals are experiencing. While this was not as common as other themes, the loss is still occurring. For example, one element of a loss of knowledge is seen below. History has played an active role in the loss of knowledge within many communities.

It's a process, but I don't know how long it takes to tan a hide – Anita

To summarize, many participants shared insights into the knowledge they have about the land and the importance on making sure the next generation learns what is passed on to them. Most participants felt that the incorporation of land-based learning is important to not only maintain their historic and cultural connections, but also important to continue learning different skills other than what is taught through the school curriculum.

4.4. Participant's Perspectives on Land

The topic of land was brought up by many individuals. It is spoken about as if it is a different life on the land as participants referenced physical descriptions of the land, but also underscored the importance of the land and connections within the community. The land theme categorizes social and personal connections individuals have to the land, and hope to share with youth and future generations, and also includes the theme of wildlife as well. The land theme was one of the most relevant themes in relation to social and personal connections, how people continue to use the land, the treatment of the land, and activity that occurs on the land. The following themes are described in more detail below.

- Social and Personal Connection with Land
    - Emotional Connection
    - Enjoying Nature
    - Being with Family
    - Happiness on the Land
    - Connection to Wildlife
    - Social Impact of being on the land
    - Memories
        - Being on the land
        - Fall hunt
    - Appreciation of:
        - Beauty of nature
        - Beauty of snow
        - Community
    - Knowledge from Elders
    - Hard Work
- Clean Land
    - Concern for water
    - Fear of industry contamination
    - Protecting the land
    - Outsiders and development
- Land Knowledge
    - Importance of Knowing the land
    - Teaching about the land

    - Dangers of land
    - Knowledge of Trail system
    - Living off the land
    - Place of Reference
    - Place of Cultural Significance
- Wildlife
    - Migration and Habitat
    - Diversity in Tathlina

Within the theme of land, it is clear that there is a very strong social and personal connection between people and the land. Connections to certain places on the land remind people of good memories, being with family, the happiness they have when on-the-land, the connection to wildlife, admiration for the beauty of nature, and the knowledge they have been taught from their previous generations who lived in the same spaces the community does now.

Within this theme it was also highlighted that a direct link between knowing and feeling comfortable on the land impacts the amount of time an individual will spend on the land. The more an individual feels comfortable on the land, the more time they will spend time on their own on-the-land. Many ‘on-the-land’ camps are being integrated into territorial and band budgets to support initiatives ensuring youth have the chance to be on-the-land and ensure the opportunity for youth to re-connect and learn how their elders lived. It develops understanding within youth for their past and their connection to a wider community. The act of being on the land also promotes a connection that is only developed on the land because one can only create these memories while learning from the land, learning from friends and family and learning about one’s self. Knowing the land and being familiar with the land also makes a difference in how individual’s use the land. For example, one community member~~s~~ spends most of their time working in a larger community but returns to Kakisa on most weekends and feels more comfortable accessing the land in an area they are familiar with.

Yeah, every weekend we come back we try to go, this one we left around 3 and got back after midnight. Like we know where we are and know where to go. In Simpson there we don't know the river on that end, it's different … It's the only time we get to do it, when we get back because we both work in Fort Simpson and so the only time we can do it when we come home because we're on familiar grounds – Diane

This connection is incredibly important at a personal level. People make an effort to make sure they access the land in any way they can. There is general appreciation for nature within the community. This admiration of nature was mentioned in relation to promoting a larger connection an individual has to their community and the association to being on the land and keeping the land clean. This motive comes from a place where community members have seen items and garbage that weren't from local community members, but rather outsiders from other communities and workers from previous decades of land exploration and exploitation. This act disrupted peace and trust and disempowered the individual connection to the land that served the previous generations. These acts are still viewed as disrespectful to the environment. It is clear in this community that individuals are respectful of their surroundings and impact on the environment.

Bring stuff back from town, can't leave that stuff out there. Everything you bring up, you've got to bring back – Lloyd

Due to the nature of past development, the community is more cautious with future development, especially oil and gas development as the nearby Cameron Hills continues to operate. There is concern for the connected waterways because the community is downstream. To ensure the land remains clean and accessible for future generations, Kakisa actively

participates in monitoring programs by partnering with territorial and regional organizations, and academic partners.

> *Cameron Hills is a special place for us too, then again that's where the moose and everything and birds comes from. As we're downstream from Cameron Hills we make sure everything is safe to drink and safe to eat … That's why we do so much to protect our land and water to make sure everything is safe - Melaine*

Many community members spoke to the presence of wildlife within the communities surrounding environment. There was mention to being aware of the different environments and the significance to noticing change. Taking care of the land is seen as a way to ensure wildlife conditions can continue to provide for the community For example, concerns surrounding the possibility of insects contaminating their local wildlife they have seen further down south. The fact is that the community wants to protect the land around them because it protects their way of living as well and the diversity of wildlife play a large role in the success of maintaining future numbers.

> *Has a special meaning because Tathlina has no disturbance over there. Animals every year, beavers flopping round, eagles flying, that's why I love Tathlina, such a beautiful place – Melaine*

Overall, the community plays a large role in the stewardship of the land to keep the land clean and ensure the land can support future generations. The community's efforts are noticed when speaking to members right away as they hope the land can support future generations as it has served them.

4.5. Participant's Perspectives on Change

The theme of change was one of the largest and most prevalent themes throughout the interviews. Almost all participants spoke to their concerns of environmental change as well as the impacts any change has had on social aspects within the community. The concerns most commonly mentioned were worries about the impact future change will have on the cumulative time an individual can spend on the land. For example, some of the changes mentioned were: increased variability in permafrost and thaw slumps creating hazardous conditions for travel to hunting or harvesting areas, loss of land impacting cabins, camps and historical sites (trails, burial sites) and a shift in the range of wildlife and available harvesting areas. The following themes are discussed in more detail below.

- Adaptation
- Social
    - Economic Losses
    - Memories
    - Travel on land
        - Different Travel Time
    - Use of the land
    - What Used to be
    - Ecosystem – Animal and Human Interaction
- Environment
    - (No) Access to Land
    - Growth of Weeds
    - Permafrost
    - Snow and Ice
    - Warmer Weather
    - Water Level
- Food
    - Berry Changes
    - Meat practice
- Travel
    - Boat
    - Plane

    - Snowmobile
- Wildlife
    - Birds
        - Pelicans
    - Fish
        - Fish and Fire
        - Parasites in Fish
        - Fish runs changing
    - Runs
        - Birds
        - Moose
    - Dangers from new species

The surrounding environment is viewed as a provider for the community, and climate change is a threat to the access of a healthy environment. Climate change was cited both directly and indirectly as a cause for many of the reported environmental changes. Observed changes to the physical environment are important to understand as they help community members understand how impacts will affect the social environment. The changing seasonal environmental conditions also cause uncertainty for how impacts will affect the next generation.

Despite the community feeling effects of climate change, people are finding their own ways to adapt to how they do certain things. Sometimes this involves driving to Hay River to fly a plane instead of relying on the float plane to land in Kakisa Lake which is experiencing lower than average water levels. One community member explained that the variability they've experienced in the weather forces them to consider what kind of equipment and gear they bring with them while traveling.

Yes, a little bit of rain. Have to carry gear for all kinds of weather. Even rain in December. – Chris

Other times, adaptation includes changing the way the meat is processed and handled at the fall hunt. Some community members spoke to the changes they adapt with at fall hunt as they

notice it used to be cooler, but now their harvest is more susceptible to rot. As quoted below, small steps are taken to improve this situation to prevent their harvest from spoiling.

> *Just find ways to keep meat from spoiling. Making dry meat and wrap everything else. – Anita*

Warming weather has also created concern about permafrost. There are reports that the texture of the ground is changing and impacting an individual's use of the land due to environmental forces changing the access and use of certain places. The combination of warmer temperatures and severity of wildfires were highlighted as drivers of riverbank erosion linked to thawing permafrost. For example, trees are reported as falling more often due to wildfire damage or sitting in soft ground. Permafrost thaw and changing landscape are also affecting human and wildlife interactions. As the ground changes, it forces the wildlife to change their patterns. Community members have reported that they are seeing an increase of bears in new areas and believes this is due to the bears searching for good ground, just as the community is.

> *It has pretty good ground, but lots of bears. I think that's one of the reasons too. I notice where there's really good ground that's where we're getting more bears. – Lloyd*

As the movement of bears becomes unpredictable, it means people who access the land are more vulnerable. Community members spoke to the wider theme of wildlife and raised concerns with possible changing food sources, the dangers associated with the new patterns of wildlife, and the accessibility to traditional hunting areas on-the-land. Changing wildlife patterns are linked to the changing land and weather patterns. For example, warming weather is also linked to the timing of animal runs changing and increases the difficulty in predicting the effect

this will have on the fall hunt or access to traditional food throughout the year. The changing run times affects food practices.

Its hotter, warmer. It's not like before. Gets hotter faster. The ice goes faster, water heats up faster, the leaves are out faster so the moose start eating leaves earlier, and start running earlier than they used to. – Lloyd

Warming temperatures also affect the fish as the community has noticed the presence of parasites which seems to be a much more common sight than they were 20-30 years ago. The varying weather is also affecting the land as multiple people spoke about a particular place on-the-land which has drastically changed over the past 20 to 30 years. Once a regularly visited camp to hunt and serve as a secure food source, it is no longer accessible or reliable. A place of significance now takes on a new meaning given the impact of climate change.

The tent frames were underwater about 2005. Now we just go travel there and would probably stay over here (somewhere else) for a day trip and go back and forth. It's all swamp back there – it's hard to stay there. If you want to stay you have to go further west or east. – Patrick

It is also reported that because of the inconsistency of cold weather in the winter, animals do not develop the same texture of fur like they once did and this has an economic impact on the community. This is spoken to below.

If we were trapping, we'd have a hard time. Because we don't get there the first week of you can't go out in November, maybe the first week of December. If guys were really making a living trapping, you'd have a harder time. Plus the furs won't be as good. The colder the weather the thicker the under fur, same with beaver, they're coming out earlier and going in later – Lloyd

Another economic loss is the possibility of losing equipment due to the rapid change to environmental conditions. Community members notice a positive feedback in relation to

warming spring weather and increases the susceptibility of an individual's familiarity with the land as travel is a challenging adaptation. Travel occurs frequently by boat, plane, and snowmobile, however later freezing and earlier warming present new dangers for travel. For example, low water levels have interfered with the ability to travel to the annual fall hunt via float plane as previously discussed in section 3.3.7 of the case study site. This impact forces members to access the land at different times than they have previously. The quotation below illustrates the challenge community members face when planning how they will access the land.

> *Once the spring comes everything starts flowing with lots of water. All these creeks and rivers and stuff when it gets hot. That's why those guys got stranded before. Not like before. Once everything gets hot it starts running and you've got lots of water. Can't go anywhere. – Lloyd*

Overall, reports of environmental change are forcing the community of Kakisa to adapt to the way they use and access the land. Being aware of seasonal environmental conditions and the changes associated is ~~a~~ priority for the community not only for safety reasons, but also to understand the changes and their implications moving forward.

4.6. Participant's Perspectives on Tradition

Tradition is a strong theme present throughout this research as it connects two larger themes: community practices and food. These themes were referenced by almost all of the participant's and comments about traditions were commonly mentioned through the presence of practices. The following themes are discussed in more detail below.

- Traditional Food
    - Berries
    - Fish
        - Parasites

        - Mercury
    - Connection with food
    - Hunting/Trapping
        - Fall hunt
- Traditional Practice
    - Arts
    - Being on the land
    - Community gathering
    - Family
    - Sharing knowledge of practices

Similar to the strong connections mentioned above in the knowledge and land themes, Kakisa also has a strong connection to their traditions. Traditional foods are mentioned in relation to food that is acquired from the land and foods that current and previous generations relied on. Traditional foods are part of the community's traditions like hunting or gathering berries, but is also mentioned in the way food is shared in the community. The themes of food and practices are united as traditions. For example, Anita states the significance of the land as it provides fresh and nutritious food.

> *We just eat off the land; fish and ducks and moose meat. All is well for that kind of stuff and it's always fresh too. Nothing in the food, just pure food… That's how we grew up – on straight traditional foods. Like rabbits, chicken, duck, goose, moose, bear, everything that came from the land we ate. – Anita*

Participant's also spoke to traditional practices of spending time with family and the wider community as a traditional practice like the fall hunt. They mentioned the way they use the animals in different ways and ensure a use for most, if not all, parts of the animals. This practice links the relationship between hunting and practices. For example, Lloyd states how hunting and practices benefit the community's interest in crafts and emphasizes how voices are listened to within the community.

When enough people are looking for it [moose hair]we'll shoot the moose, they'll collect the hair when they shoot the moose, cut up the hide and meat. With the fat you're able to make pemmican – Lloyd

Environmental change was mentioned as a threat to the continued access to secure food and sustainable traditional practices. Participants reported negative effects from climate change as impacting the majority of food sources within the community. For example, the availability of berries, the security for accessing hunting and trapping locations, and health of the fish has all been questioned in recent years.

We go for blueberries and cranberries and raspberries, strawberries, but there hasn't been any berries for the longest time until last year – Anita

Concerns surrounding fish relate to the monitoring of mercury levels and the changes they observe in fish as the temperature of the water increases. Participants feel their community practices are now affected by powers out of their control. For example, participant's mentioned the rise of parasite observations in fish liken to the increases in water temperature. The community's adaptation is another example the community takes to make appropriate steps required to continue to rely on local fish.

And right here too you can tell these are parasites. And we're noticing more and more in the fish, they're getting more when we're cutting them open. They just sit in the flesh. And you can eat them as long as you cook it really really really good. Maybe it's from the warmth of the water, because we're noticing more parasites in the fish. – Melaine

To summarize, many community members are concerned with climate change affecting the future of traditional practices and practices associated with acquiring food. Where the land has supported the community since time immemorial, the cause for Kakisa's concern rises out of

their interest to uphold traditional practices both pre- and post- acquiring food and share these practices with the next generation. These two themes are interrelated and encouraged as the practice of being on the land also means taking part in the practices which support the need for being present on the land in the first place.

4.7. Participant's Perspectives on Research, Monitoring and Methods

Participants spoke about the reality of contributing towards research projects through participation and employment. Most spoke to the ongoing monitoring as the most prominent projects within the community. Participants also spoke to the method used in this research within the interviews even though they were not asked about this. The following themes are discussed in more detail below.

- Research and Monitoring
    - Fish sampling/studies
    - Food chain
    - Interest in monitoring
    - Places
    - Routine
    - Soil samples
    - Water sondes
- Method
    - Education
    - Interest in contributing to atlas
    - Updating trail maps
    - Recording change

Research and monitoring are a substantial activity within the community. Community members are acquainted with scientists and researchers from universities, territorial organizations and the government. The participants spoke about skills they have learned and what they do in regards to fish sampling, why sampling is important, and the steps required to ensure a successful monitoring trip. This knowledge and engagement from community members

supports monitoring and fish sampling on a consistent basis. The community members who participate in various studies signal towards building stronger relationships by working together to monitor what both parties are interested in. For example, community members who participated in previous studies state the connections they build are unique because they are sharing their connections to the land with individual's who aren't from the community.

Tathlina will always have special meaning because the science people that go out there, they learn to appreciate nature and why we do what we do; the studies and stuff like that. – Melaine

Some participants used the method in this research as a reflective measure of their life in association to the community, changes they have seen, how they feel about the community, and their opinions on environmental and social change. Individuals indicated they would like to contribute to the Atlas at a later time, so they could gather more photographs and work to update future mapping work. Others were happy they had the opportunity to share their stories and have the opportunity to pass down information to the younger generation. The general consensus from participants in using this method was well-received. Some participants enjoyed this process, as the participant below stated:

This is interesting, I'm glad you're doing this. – Diane

The majority of locations participants referenced are places of meaning and participants saw feasibility of this method in the objective of monitoring environmental changes of the physical landscape which are not actively monitored, i.e. sensitive areas within the ecosystem. For example, at the community focus group a key takeaway was improving the reliability and safety for an individual in unpredictable weather. The variations in the changes from season to

season which occur on an annual basis should be recorded in the Atlas in lieu of surprising circumstance like one community member explained:

Yes, there are changes every year so yeah this past winter too we had a lot of rain, rained quite a bit until morning, big difference – Chris

To summarize, some community members who contributed to this research have previously engaged with other community projects and support the idea that climate change is impacting northern communities. Using this method to combine different knowledge allows input from multiple community actors and forwards the notion of sharing sightings of change and allows community partners to have the opportunity to work more cohesively together.

4.8. Deliverables

This research resulted in several deliverables along the way. The deliverables which were created include the creation of the Atlas itself, as well as maps of community data. The deliverables were identified as a request in the community meeting of March 2017. The maps which were created show the community's data including traditional trails, areas of traditional practices, cultural sites, etc. Other maps created which did not use private community data were created with data collected form organizations like the Office of the Regulator of Oil and Gas Operations (OROGO) and open data resources such as the GNWT and government of Canada. I created particular maps for the community showing patterns between the data like the buffer maps seen below in figure 7. Essentially, any data which was suited for Kakisa or could benefit community members was exported as a map in the format of a picture and shared with the community.

Multiple buffer maps were also created in an effort to demonstrate the community's use of land and spatial relationship with the land like the maps in figure 7 and figure 8. As the community wants to protect the data they have shared in this research, figure 7 shows a buffer around the atlas photos which were collected. Figure 8 shows a buffer where pre-made buffers of traditional place names and the Atlas photo locations intersect. The traditional place names buffer is not shown in this thesis because it is the community's data and does not further support the Atlas' success. The following paragraph will explain the methods used to create the buffers.

Figure 7 was created with the following steps. First, a 5 kilometre buffer surrounding the raw data was created. Next, I used the 'Create Random Points' tool in ArcMap to create new randomized points within the 5 kilometre individual buffers to act as a constraining layer. Within the settings of the tool, I restricted the number of points as a 'long integer number' to 1 so only 1 value (point) would be created within each buffer. Points were also restricted to be a minimum distance of 1 kilometre apart from one another so the shortest distance between two randomly placed points is 1 kilometre. Finally, a new buffer of 5 km was created from the random points using the dissolve export option. This process ensures confidentiality as the raw data is not available to the viewer because the points cannot be delineated like they can be without this process.

Figure 8 was created using the same steps above with an additional step at the end. This was done by creating the same final buffer for the traditional place names layer as was done for the Atlas photo layer. After this step, I used the merge tool to create an intersect buffer to identify where the two buffers overlap. The result of the intersect buffer represents where the buffers of the randomized points overlap to portray the effectiveness of the modified photovoice method. The traditional place names map is not in this thesis, as the intersect buffer in figure 8 reveals

some extent of the area the buffer covered. Due to the shared intersect space shown below, it can be assumed that this method was successful in capturing the community's use of space on the land.

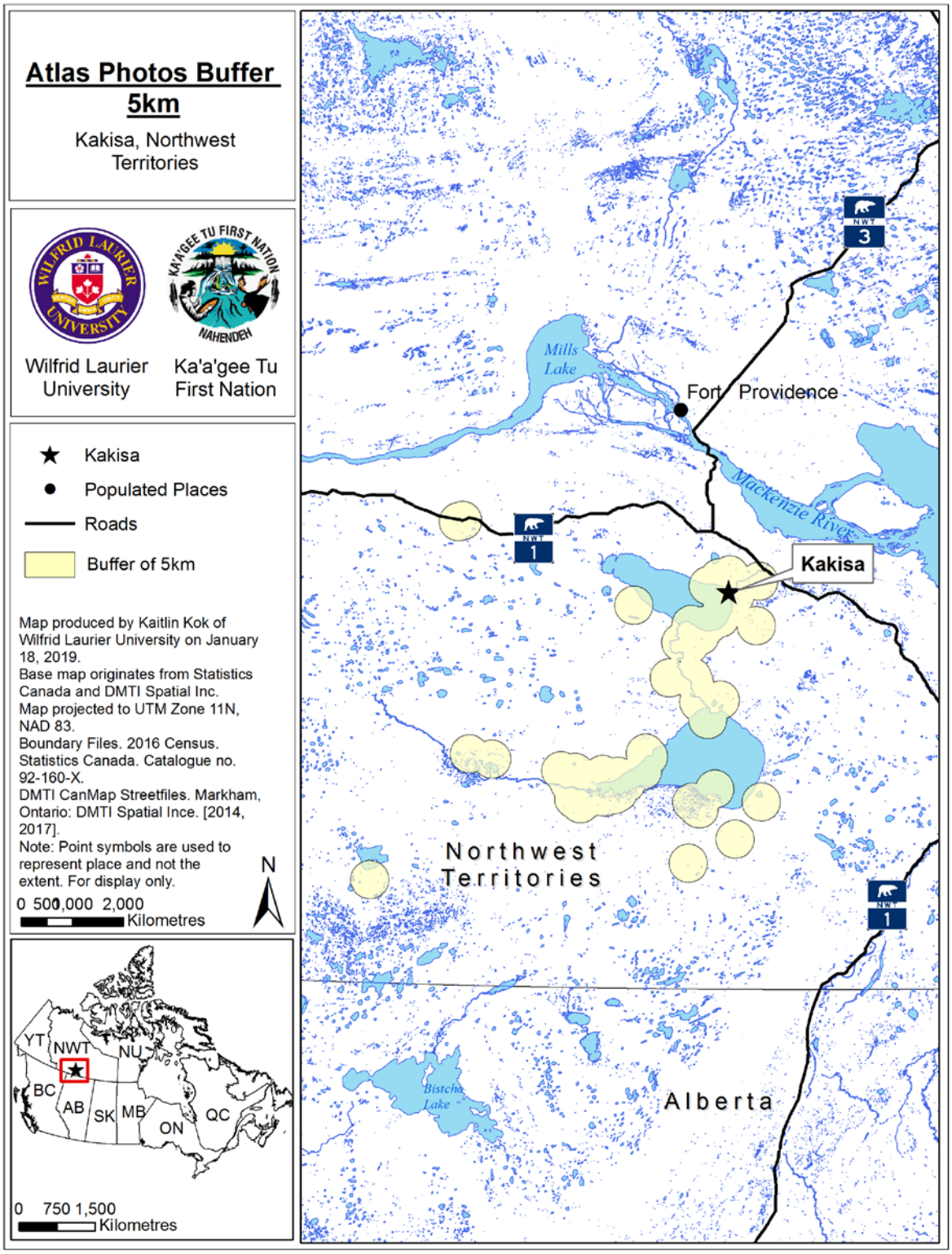

Figure 7 Map showing a 5km buffer around points of collected Atlas photo locations.

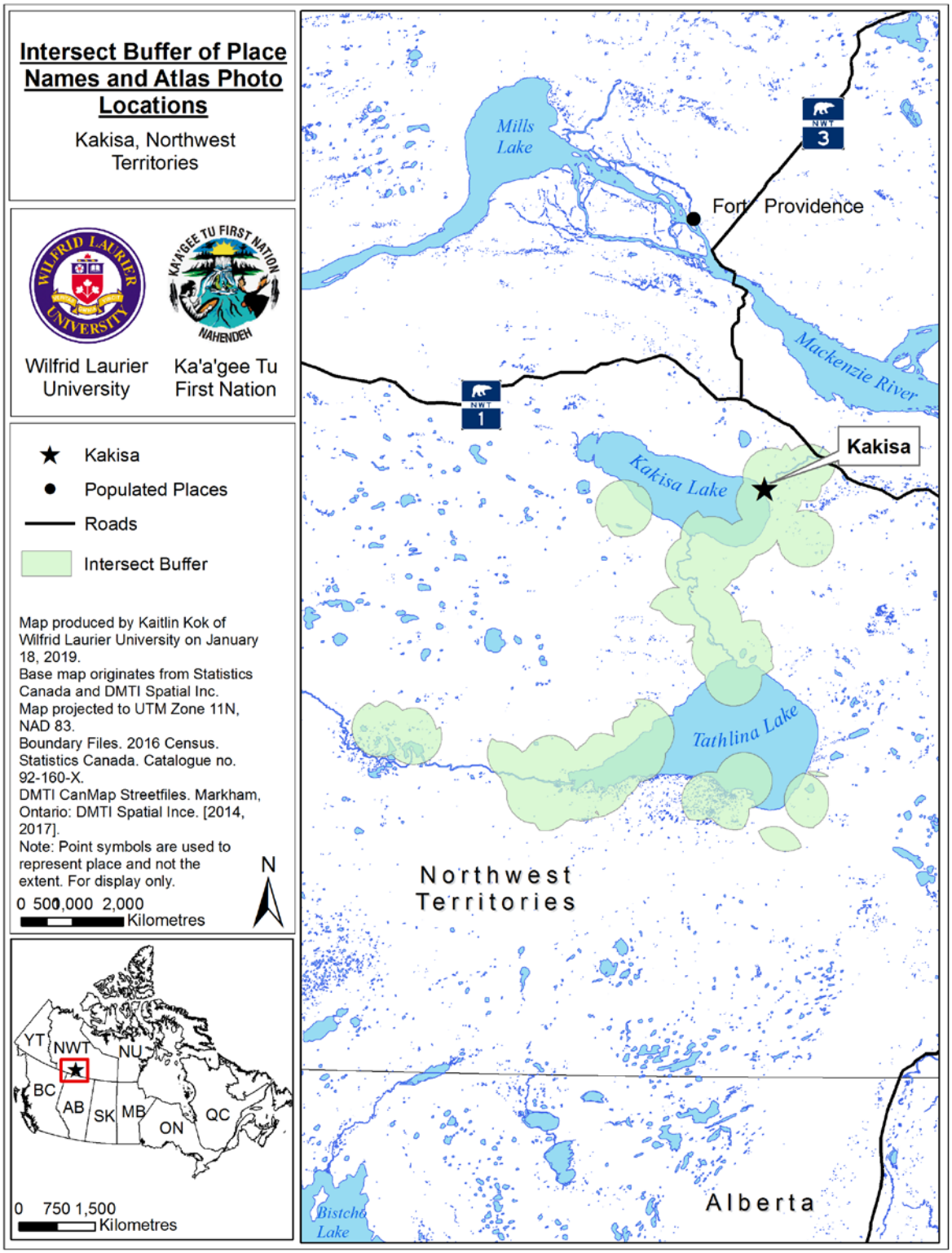

Figure 8 Map showing a 5km intersect buffer where the buffers of the traditional place names and Atlas photo locations intersect.

4.9. Chapter Summary

Participants spoke to a wide variety of concerns in relation to their community and the future in response to climate change, but also spoke to the community's strengths such as teamwork and connection to the land. The interviews were coded and created six overarching themes and 177 codes, 'Community and Family,' 'Knowledge and Youth,' 'Land,' 'Change,' 'Tradition,' 'Research, Monitoring and Methods'. There were also extra maps made which were shared with the community, as well as the maps included in this thesis highlighting the effectiveness of the method.

5. DISCUSSION

The food system has experienced a rapid transformation in many areas of the world. Northern communities are no exception to the changing trends in the way is food is procured, processed, and shared. This research aimed to address some of the concerns and questions surrounding northern food security, such as: how can environmental change be measured in a way that can identify changes to the natural food system? This discussion will explore how the results of this research fits within the larger dialogue of food systems research, climate change, and the modified method utilized. This discussion will further review the results, discuss the method and make recommendations for future research.

Pressures of change are impacting one's access to the land. The last few decades have seen environmental change surrounding the community of Kakisa. The method used in this research was an effective tool to identify patterns present within the community. The interviews illustrated the role further environmental change will have on all elements of physical, mental and emotional health as participants illustrated the effect the environment has on the overall

relationship with the land which helped animate and give the photos context. More generally, the results can be applied at a larger scale and also support findings from the IPCC (2018), IPBES (2018) and EAT (2019) reports drawing concern to the future of a traditional and sustainable food system.

The Atlas also contributes to similar findings seen by Social Ventures Australia (2016) where guardian programs have the potential to increase time spent on the land and thereby access to traditional foods. The increase in monitoring potentially encourages reconnecting to the land with increased security by tracking environmental change.

5.1. Analysis of Results on Perspectives of Land and Environmental Change

During the period of 1896 to 2011, the Hay River Climate Station measured a significant increase in the mean annual air temperature (see figure 2) (Coleman et al 2015). Land-users have also noticed this trend in relation to their ability to access and travel on-the-land due to the changing winter season. The changing travel conditions have further implications as warming weather continues to affect hunting practices and snow melt affecting their ability to travel on land similar to the Inuit and Cree in Hudson Bay (McDonald et al. 1997). Earlier snow melt restricts the ability to travel and procure country food safely which means individuals are more vulnerable to changing ice conditions and a faster spring melt. For example, 2015 was the community's first harvest in three years as widespread drought meant the usual form of traveling by float plane was inaccessible to travel to the annual fall hunt location (Kane 2016). In conclusion, the community's presence on the land changes due to a variety of reasons and confirms the important role of IK i.e. the increase in presence of bears and permafrost thaw slumps making travel more difficult.

Permafrost was mentioned by several participants as one of the major threats to the access of traditional food as well changed land-use by both humans and animals. In Coleman et al. (2015), authors identified an overall decrease in the area of peat plateau and an increase in area of a collapsed fen environment since the 1970s with large increases from 1970-2012. The decrease of secure land is also associated with the lack of security with traveling on-the-land as weather patterns grow increasingly unpredictable. Similar to Kakisa, McDonald et al. (1997) found that preserving the current environment to maintain traditional needs is important to maintaining ways of life and cultural ties. For example, in Cunsolo and Ellis (2018, p.276), the authors explore the mental health and climate change relationship. In their research, one of the respondent's stated:

> *I think that [the changes] will have the impact maybe on mental health, because it's a depressing feeling when you're stuck. I mean for us to go off [on the land] is just a part of life. If you don't have it, then that part of your life is gone, and I think that's very depressing*

In Kakisa, Anita said:

People really like it out there, like you'll see a big change from living here to being out there.

Due to the connection Kakisa has to their surrounding environment it can be presumed individuals in the community feel similar to those who participated in Cunsolo and Ellis' (2018) research. The negative associations with change has the ability to negatively affect an individual's mindset, proving that living with the land is not only better for physical well-being, but social well-being as well.

5.2. Analysis of Results of Community, Traditional Knowledge and Youth

It is clear from this and previous research that traditional knowledge is important to living a meaningful life (Wesche et al. 2016; Parlee et al. 2014; McGregor et al. 2010; Huntington & Fox 2005). In the examples which fell into the knowledge theme, it became clear that if a person has knowledge about the land and their surroundings, they will likely have a deeper connection to the land and the community as a whole. It was also clear that IK was previously learned and shared on a more frequent basis because IK is important for the success of properly preparing food and identifying weather patterns. However, the livelihoods for Indigenous people in Canada's north has changed and IK is not inherently learned by youth in the way it used to be. Local knowledge is key for travelling on the land safely, predicting weather hazards and being able to cope with weather patterns and avoiding problems (Pennesi et al. 2012). With the rise in unpredictable conditions, local knowledge is now more important than ever to identify patterns of environmental change because changing conditions can make travel, hunting and fishing more dangerous. While some participants stated they are familiar with trails and traveling, there is a gap with the youth which this research can serve to fill. Communicating with and involving youth into programming has proven to be successful for youth taking on more prominent roles within the community – such as community leaders and local experts (Emery & Flora 2006).

Kakisa and Indigenous communities alike share the fear of losing elders who are known as, "the knowledge keepers of ceremonies, rites and laws – traditions that form the core of society's culture, history, and identity. Elders remind us who we are and where we need to go," (Talaga, 2018, p. 21). Elders are invaluable individuals to the community who preserve knowledge as well as lessons and wisdom to share with the younger generation. Most of their knowledge about the land, has been learned through their time spent on the land. The Atlas can

communicate the visual place-based connections and reinforces the importance of local knowledge.

5.3. On Traditions, Food and Improving Sustainability

Consistent with previous studies, results from this study agree with similar findings that identifies climate change as a major underlying threat to food security (EAT 2019; IPCC 2018). Northern Indigenous communities are exposed to further changes in livelihoods as foods central to the health and culture of the Indigenous peoples are becoming more difficult to access. Findings in this study are consistent with other literature relating the harvesting of food to building community relationships (Schuster et al. 2011; Lambden et al. 2007). Annual hunts are integral to sharing knowledge and maintaining relationships as the activities associated with a successful hunt brings community members together and proves the idea that food from the land is more than food. Food from the land is also looked to as being more nutritious which continues to raise concerns when considering the future impacts of environmental change similarly found in Schuster et al. (2011), Receuver et al. (2007), VanOostdam (2005).

5.4. Analysis of Results on Mapping, Monitoring and Technology

Participants indicated they understand the value of monitoring and already work with other partners in the territorial, regional and academic setting. This research, similar to Wiseman & Bardsley (2016) found monitoring systems improve coordination between stakeholders and all parties involved are able to record impacts and utilize IK to develop employment opportunities within communities. For example, university partners conducting studies with the community created employment opportunities requiring community members for their knowledge of the

land, but also mentioned improving relationships between the two groups of stakeholders (Wiseman & Bardsley 2016).

5.5. Unexpected findings

An unexpected finding in this research is the gender lens. While this is not a main avenue the research expected to explore, it is worth noting for future research. For example, historically, locations of where a hunt is recorded is most often the male who shot the animal. However, this single-sided approach does not represent those who prepare the meat or the hide, predominantly a role taken on by women. Thus, maps and places do not always capture the total picture as observing women's roles in maps is important to capture the true space of people. Extending this thought, there were also two categories of land-users – the food provider and food user. Most often times the females associated their land-use to gathering plants and providing berries to then preparing food and sharing the food with others, while males spoke more actively about their recollections of travelling to hunt and providing food for others.

5.6. The Method

An objective of this research was to use a new method to understand some of the current changes that were already observed and map areas of change in order to better understand the potential impact to an individual's future access to the land. The method was an effective tool to identify the patterns present within the community. The interviews illustrated the role further climate change will have on all elements of physical, mental and emotional health. Participants illustrated the effect the environment has on the overall relationship with the land. By using the modified photovoice method, it allowed us to explore the larger question in an effort to understand how established and predicted changes in the community will affect future land-use

for community members. Part of the success of the research also lied in the fact that the community was already taking photographs for their own records to reflect upon later.

This method was also effective at highlighting how important place-based areas are to actively pursue traditional activities. This importance reveals how powerful the method has been in gathering past and present data to identify areas of concern. However, while the method provides an important tool to the community, it also revealed the vulnerability of northern communities to climate change. With a general warming in the winter creating serious safety concerns impacting land based activities, changes regarding time spent on the land are impacting secure access to food. This research also complements the community's proposed Protected Area Strategy (PAS) plan they have been trying to complete within the last few years, establishing their own area which is protected, as the community continues to traditionally hunt and fish and care for their land.

The most successful interviews using the photovoice method were interviews which were based off of photos older in date and had more connections with the place photographed. These photos had more meaning than just the literal interpretive description of the physical features and their changes seen within the photo reinforcing that this research also contributes to the deeper understanding and meanings associated with places on the land. In one interview the respondent provided photographs for places they had never been, there was very little information coming from the individual. This shows just how exactly IK is important in providing relevant information about a place. With the decline in travel since the community has moved to where they are now, the lack of connection to places are seen clearly when a lack of association is there.

Further, combining the participatory mapping and photovoice method with a CBM approach increases participation in social and environmental governance in Kakisa and enables

the community to upkeep a sustainable food system. Data collected through the mapping of photographs demonstrated qualities which would differ from data collected through interviews alone. Adding the element of a photograph to an interview presumably increased the level of detail within the interview and allowed for a more detailed recounting of memories. While it is difficult to state if the photograph added more to the interview, the photograph did aid in the key informant's story telling process. The results of these themes reveal the community of Kakisa continues to use the land as a reliant food source in spite of changes affecting safety and the economic return on land-based activities (e.g. trapping).

5.6.1. Improvements for Method

One of the ways this research could see improvement would be through the addition of adding a camera to record the interview with a focus on the map. For example, in some interviews, respondents used the map to talk about their knowledge of a location which was not associated with the photograph. While this method focused on collecting information about the photograph provided, stories by association, i.e. similar situations, another story which happened close to the location where photo was captured, etc. This information was relevant to the research goal in developing a deeper understanding about the relationship with the land and therefore the rational concern for a changing landscape, but was not perceived as a challenge when developing the research plan. While these stories mentioned were not plotted because there was no photograph associated with the story, the information is still useful for the community as it is the community knowledge which can be shared with the younger generation in future knowledge sharing opportunities. However, one of the ways to combat this issue was inserting a map into the transcription to clarify what area they were talking about. Using their edits, places were then added to the map so losing knowledge was combatted.

One thing that hindered the interview experience was using the laptop and internet which required people to sit down and spend time inside during the summer. The summer seems to be the time when people are enjoying time away from work and instead spending more time outside. This limits the time they visit the Band Office in the summer, however the Band Office is still the main meet-up spot for community members to drink tea and coffee and share stories.

This method could have also been improved by having youth present within the interviews or having youth be the individuals do some of the mapping work with me in the summers. While this was not incorporated into this project though future mapping opportunities in the community should as the youth who took part in the Edukit activity excelled in connecting with mapping technology. The youth in the community are also coming to an age where their contribution makes a difference in the community and there are already ideas of trying to incorporate them into small projects with various people.

5.7. The Future of the Atlas

The concern for the loss knowledge within Kakisa is similar to concerns many other indigenous communities are experiencing as well due to their change in livelihood (Power 2008). It is not only a loss of place-based knowledge, but also the loss of species, ecosystems and meaningful landscapes which are attributed to and defined as ecological grief (Cunsolo & Ellis, 2018). Authors Cunsolo and Ellis (2018) state that ecological grief is likely to affect the people who are in close contact with their surrounding environment. This means Kakisa, coupled with the trend of loss of IK and increased changes could leave community members in a vulnerable position.

Fortunately, the aim of the project was to document changes seen by community members in an effort to record change for future generations. Part of this work was to document

stories about the land in an effort to preserve some of the history and knowledge of the community. The value of IK in this research encourages sharing of knowledge amongst community members and records the location of changes and potential dangers on-the-land. The Atlas could also promote safety within a younger generation that do not have a close relationship like their elders who grew up on the land, and can identify changes. The map could be used as a way to share information with the youth and those are from outside the community not familiar with the land as a way to share areas of concern.

Following the original interviews and development of the web-map, follow up trips to the sites will take place if the location of each photograph can be accessed. Photographs taken on follow-up trips will added to the Atlas to have current photographs for future reference. The hope for the Atlas is to continue to provide a space where individuals can contribute environmental change sightings as the Atlas can inform future aquatic monitoring sites, and prioritize areas for protection from development in the area (forest resources in the area, for example). This project also supports KTFN to contribute to regional initiatives, such as the Dehcho K'ehodi stewardship project championed by the Dehcho First Nations. The Atlas serves as an example of community members working together to enhance the stewardship of their lands and can serve as a learning opportunity for other communities. Furthermore, the Atlas can also be used a resource for decision-makers of Kakisa. However, due to the small size of Kakisa and there being no geomatics office within Kakisa, resources could be also be put towards supporting an individuals request to support further education on how to best use this map in the future.

5.8. Future Research

It is important to state that even though the Atlas uses Western Technology, and we developed a map which stands within the community and can be used as a form of resistance and

resurgence, it is not deeply integrated. A new frame of thought surrounding cartographic theory emerged in 2017 by the organization ‘MappingBack,’ explores how maps can challenge the role maps play as a tool of colonialism. MappingBack seeks to reverse this thought by using maps to map *back* what maps focus on. Their successful workshops force participants to engage in outside-the-box thinking and promote alternative forms of mapping. Future research involving maps should always work to incorporate the needs and goals of people. While this research did bring mapping to the community in a way which was desired, we could have improved on making it a more inclusive system and stepping away from colonial mapping methods, similar to what is seen in Lucchesi (2018).

Indigenous forms of mapping are encouraged to promote alternative forms of mapping and are created as a form of resistance. In Lucchesi’s (2018) production of a map of locations of Missing and Murdered Indigenous Women and Girl’s, the map was designed in the shape a ribbon skirt; a cultural garment many indigenous women in the US and Canada wear at events and ceremonies. In turn, women began wearing the ribbon skirt with Lucchesi’s map imposed on the fabric (Lucchesi 2018). Both MappingBack and Lucchesi reveal that the true owners are the people using the maps and maps have the power to mobilize and empower communities to effect social change (Lucchesi, 2018). Therefore, for future research I recommend more input from community members ensuring cultural practices and value are taken into account and can resonate with the audience. I also believe it could promote higher engagement within the community.

6. CONCLUSION

6.1. Summary of Research

When this project began, there was no method to monitoring environmental changes, but in the past year communities of the Dehcho First Nations have worked to build the Indigenous Guardian Stewardship Program partnering with AAROM and community leaders. This work hopes to contribute to Kakisa's regional monitoring initiatives and further supports the motivations by the Dehcho First Nations in initiating the Dehcho K'éhodi Guardian program. This research would not have been possible without local members of the community who are familiar with the land.

Through examining the implementation of a CBM web-based map in Kakisa, conducted interviews and gathered photographs to establish a baseline for change and after identifying common themes present in the interviews and examining the photographs, it can be suggested that environmental change may continue to impact an individual's way of life, both within the community, and on-the-land. These findings are consistent with climate change literature, in the way that use of the land and way of life is changing as food sources are less reliable due to the increasing uncertainty in weather. However, this research links climate and social changes to mapping technology using a modified method where little research exists. There is a gap linking mapping technology to food systems research and this study attempts to capture the spatial extent of a community's food system in relation to environmental change. Future researchers should consider establishing a monitoring project which captures a baseline for change to monitor a longer period of time. Regardless, the results point to the need to monitor environmental change, prevent further environmental change from taking place to ensure the land remains a reliable resource for country food, as well as increase mapping resources within northern communities.

Ultimately, this research is a three pronged approach to examine the effects of climate change on a community in the sub-Arctic. Looking at the emotional, social and physical effects further climate change will play on not solely Kakisa, other communities in northern latitudes may have similar experiences. By creating a CBM system to record changes, the main goal has been accomplished and will support future monitoring. Although no follow-up data has been collected on how successful the implementation of the Atlas is in day to day life, it allows the community to record changes through the comparison of photos at a seasonal and yearly basis. We are hopeful that with the ability to record changes, the Atlas will also increase harvester safety and resilience of the food system.

6.2. Final Reflection

I owe the working knowledge of this thesis to the people who shared with me and allowed me to learn from them. This thesis is intrinsically based on the community's goals, needs and problems which were identified as items of improvement. The knowledge I learned from this thesis has been applied to a larger picture in the hope that this can be used for future work with emphasis on monitoring environmental change within the Dehcho and the larger Northwest Territories.

In a follow-up visit to Kakisa in January 2018, many community members expressed their joy for the project upon seeing the Atlas in use. They were happy to see the community's data on one platform which can be viewed at any time. I am grateful for the opportunity I was given to learn from the community of Kakisa and will forever be grateful for their open-armed hospitality.

7. REFERENCES

AANDC, DFN, Northern Contaminants Program. (2014). “A Return to Country Food” Third Annual Meeting and Workshop. Jean Marie River, NT.

ACIA (ARCTIC CLIMATE IMPACT ASSESSMENT) (2004). Impacts of a Warming Arctic, *Summary report of the Arctic Climate Impact Assessment*, Cambridge, Cambridge University Press.

Adams, M., Carpenter, J., Housty, J., Neasloss, D., Paquet, P., Service, C., Walkus, J., Darimont, C. (2014). Toward increased engagement between academic and indigenous community partners in ecological research. Ecology and Society, 19(3). Retrieved from http://www.jstor.org/stable/26269637

Anderies, J. M., M. A. Janssen, and E. Ostrom. (2004). A framework to analyze the robustness of social-ecological systems from an institutional perspective. Ecology and Society 9(1): 18.

Aporta, C. (2003). New ways of mapping: using GPS mapping software to plot place names and trails in Igloolik (Nunavut). *Arctic*, *56*(4), 321+.

Arctic Council. (2013a). Arctic biodiversity assessment. Akureyri: Conservation of Arctic Flora and Fauna.

Arctic Council. (2013b). Arctic resilience interim report. Stockholm: Author.

Armitage, D., Berkes, F., Dale, A., Kocho-Schellenberg, E., & Patton, E. (2011). Co-management and the co-production of knowledge: Learning to adapt in canada's arctic. Global Environmental Change, 21(3), 995-1004. doi:10.1016/j.gloenvcha.2011.04.006

Association of Canadian Universities for Northern Studies (ACUNS). (2018). Research Excellence in the Northwest Territories: Holistic, Relevant and Ethical Research in the Social Sciences, Humanities and Health Sciences. Ottawa, ON. Retrieved from: http://acuns.ca/wp-content/uploads/2018/07/2018-NWT_English-Web.pdf

Barlindhaug, S., & Corbett, J. (2014). Living a Long Way from Home: Communicating Land-related Knowledge in Dispersed Indigenous Communities, an Alternative Approach. Acta Borealia, 31(1), 1–24.

Barnhardt, R., & Kawagley, A. O. (2005). Indigenous Knowledge Systems and Alaska Native Ways of Knowing. Anthropology and Education Quarterly, 36, 8-23.

Baum, F., MacDougall, C., & Smith, D. (2006). Participatory Action Research. *Journal of Epidemiology and Community Health*, *60*(10), 854–857.

Baxter, J. (2016). Case Studies. In Hay, I. (ed.) Qualitative Research Methods in Human Geography. Oxford University Press. Chapter 5, pages 81-97.

Bennett, T. D., & Lantz, T. C. (2014). Participatory photomapping: a method for documenting, contextualizing, and sharing indigenous observations of environmental conditions. Polar Geography, 37(February 2015), 28–47.

Berkes, F. (1999). Sacred Ecology: Traditional Ecological Knowledge and Resource Management. Routledge.

Berkes, F. (2008). Sacred Ecology. Second Edition. New York, NY. Routledge

Berkes, F., and Jolly, D. (2002). Adapting to climate change: Social-ecological resilience in a Canadian Western Arctic Community. Conservation Ecology 5(2): 18. http://www.consecol.org/vol5/iss2/artl8/

Berkes, F., Berkes, M. K., & Fast, H. (2007). Collaborative integrated management in Canada's north: The role of local and traditional knowledge and community-based monitoring. Coastal Management, 35(1), 143–162.

Berkes, F., Colding, J., & Folke, C. (2000). Rediscovery of Traditional Ecological Knowledge as Adaptive Management. Ecological Applications, 10(5), 1251-1262.

Berkes, F., R. Huebert, H. Fast, M. Manseau, and A. Diduck. (eds). (2005). Breaking ice: Renewable resource and ocean management in the Canadian north. Calgary: University of Calgary Press.

Biernacki, P., & Waldorf, D. (1981). Snowball Sampling: Problems and Techniques of Chain Referral Sampling. Sociological Methods & Research, 10(2), 141–163. https://doi.org/10.1177/004912418101000205

Blay-Palmer, A., Sonnino, R., & Cusot, J. (2016). A food politics of the possible? Growing sustainable food systems through networks of knowledge. *Agriculture and Human Values*, *33*, 27–43.

Brown-Leonardi, C. J. (2009). Notions of property: Traditional land use and boundaries in the Deh Cho region, 249–254.

Canadian Community Health Survey (CCHS). (2016). Statistics Canada.

Castleden, H., Garvin, T., & Huu ay aht First Nation. (2008). Modifying Photovoice for community-based participatory Indigenous research. Social Science and Medicine, 66(6), 1393–1405.

CBD, Convention on Biological Diversity. (1992) Convention on Biological Diversity. United Nations, New York.

Coleman K.A., Palmer M.J., Korosi J.B., Kokelj S.V., Jackson K., Hargan K.E., Courtney Mustaphi C.J., Thienpont J.R., Kimpe L.E., Blais J.M., Pisaric M.F.J. & Smol J.P. (2015) Tracking the impacts of recent warming and thaw of permafrost peatlands on aquatic ecosystems: a multi-proxy approach using remote sensing and lake sediments. Boreal Env. Res. 20: 363–377.

Cordell, D., Drangert, J., & White, S. (2009). The story of phosphorus: Global food security and food for thought. Global Environmental Change, 19(2), 292-305. doi:10.1016/j.gloenvcha.2008.10.009

Council of Canadian Academies. (2014). Aboriginal Food Security in Northern Canada: An Assessment of the State of Knowledge. Ottawa, ON.

Cunsolo, A., & Ellis, N. R. (2018). Ecological grief as a mental health response to climate change-related loss. *Nature Climate Change*, *8*(4), 275–281. https://doi.org/10.1038/s41558-018-0092-2

Dale, A., Fant, C., Strzepek, K., Lickley, M., Solomon, S. (2017). Climate model uncertainty in impact assessments for agriculture: A multi-ensemble case study on maize in sub-Saharan Africa. Earth's Future. 5: 337–353.

Davidson-Hunt, I., and F. Berkes. (2003). Learning as You Journey: Anishinaabe Perception of Social-Ecological Environments and Adaptive Learning. Ecology and Society 8:5. Available at: http://www.ecologyandsoci- ety.org/vol8/iss1/art5/. Accessed on May 7, 2014

Dehcho First Nations, (2013). Ka'a'gee Tu "A Return to Country Food - Kakisa" Meeting and Workshop Report. Kakisa, NT: Author. Retrieved from: https://dehcho.org/docs/DFN_AAROM_Reports_2013_08_27-29.pdf

Department of Fisheries and Oceans Canada (DFO). (2010). Assessment of Walleye (Sander vitreus) from Tathlina Lake, Northwest Territories. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2010/035.

Downie, D., and T. Fenge (eds). (2003). Northern lights against POPs: Combatting toxic threats in the Arctic. Montreal and Kingston: McGill-Queen's University Press

EAT. (2019, January 29). *What is a healthy and sustainable diet? The EAT-Lancet Lecture - Johan Rockström & Walter Willett* [Video File]. Retrieved from: https://www.youtube.com/watch?v=mnlaBhD-124

EMAN (The Ecological Monitoring and Assessment Network). (2003). Improving Local Decision-Making through Community Based Monitoring: Toward a Canadian Community Monitoring Network, En40-883/2.

Emery, M., & Flora, C. (2006). Spiraling-Up : Mapping Community Transformation with Community Capitals Framework, *37*(1), 19–35.

Feinberg, J. (2009). *Wordle.* Retrieved December 18, 2009, from http://www.wordle.net/

Fernández-Llamazares, Á., Díaz-Reviriego, I., Luz, A. C., Cabeza, M., Pyhälä, A., & Reyes-García, V. (2015). Rapid ecosystem change challenges the adaptive capacity of Local Environmental Knowledge Europe PMC Funders Group. Glob Environ Change March, 1(31), 272–284. https://doi.org/10.1016/j.gloenvcha.2015.02.001

Ford, J. D., Macdonald, J. P., Huet, C., Statham, S., & MacRury, A. (2016). Food policy in the Canadian North: Is there a role for country food markets? Social Science and Medicine, 152, 35–40.

Ford, J.D., Bolton, K.C., Shirley, J., Pearce, T, Tremblay, M., Westlake, M. (2012). Research on the human dimensions of climate change research in Nunavut, Nunavik, and Nunatsiavut: A literature review and gap analysis. Arctic 65(3):289-304. http://dx.doi.org.libproxy.wlu.ca/10.14430/arctic4217

Ford, J.D., Smit, B., Wandel, J., Allurut, M., Shappa, K., Ittusarajuats, H., & Qrunnuts, K. (2008). Climate change in the Arctic: Current and future vulnerability in two Inuit communities in Canada.The Geographical Journal, 174 (1), 45–62.

Gallagher CP, Day C, Tallman RF. (2011). Biological characterisitics and population assessment of walleye (Sander vitreus) from Tathlina Lake, Northwest Territories. Canadian Science Advisory Secretariat. Doc. 2010/076. vi + 56 p

Gearheard, S., C. Aporta, G. Aipellee, and K. O'Keefe. (2011). The Igliniit Project: Inuit Hunters Document Life on the Trail to Map and Monitor Arctic Change. Canadian Geographer 55:42–55

Gill, H., Lantz, T., & Gwich'in Social and Cultural Institute. (2014). A Community-Based Approach to Mapping Gwich'in Observations of Environmental Changes in the Lower Peel River Watershed, NT. Journal of Ethnobiology, 34(3), 294–314.

Godfray, H. C. J., Beddington, J.R., Crute, I. R., Haddad, L., Lawrence, D., Muir, J. F., Pretty, J., Robinson, S.,Thomas, S.M., Toulmin, C. (2010). Food Security: The Challenge of Feeding 9 Billion People. *Science*, *327*(February), 812–818.

Government of the Northwest Territories (GNT). (1993). Traditional Knowledge Policy. Yellowknife, NT: Government of the Northwest Territories.

Government of the Northwest Territories (GNT). (2005). Traditional Knowledge Policy 53.03. http://www.gov.nt.ca/publications/policies/ENR/53.03_Traditional_Knowledge.pdf

Government of the Northwest Territories Environment and Natural Resources (GNT ENR). (n.d.) *Ka'a'gee Tu* [PDF File]. Retrieved from www.enr.gov.nt.ca/en/services/conservation-network-planning/kaagee-tu.

Graham, J., Fortier, E. (2005). From opportunity to action: A progress report on Canada's renewal of northern research. Report submitted by the Institute on Governance to the Planning Committee for the Dialogue on Northern Research. Ottawa: Natural Sciences and Engineering Research Council of Canada. 78 p. http://www.nserc-crsng.gc.ca/_doc/Northern-Nordique/NorthRes_06-05_e.pdf

Groulx, M.W., J. Lewis, C.J. Lemieux, and J.P. Dawson. (2014). Place-based climate change adaptation: A critical case study of climate change messaging and collective action in Churchill, Manitoba. Landscape & Urban Planning, 132: 136-147.

Gutiérrez, N. L., R. Hilborn, and O. Defeo. (2011). Leadership, social capital and incentives promote successful fisheries. Nature 470:386-389. http://dx.doi.org/10.1038/nature09689

Haggan, N., N. Turner, J. Carpenter, J. T. Jones, Q. Mackie, and C. Menzies. (2006). 12,000+ years of change: linking traditional and modern ecosystem science in the Pacific Northwest. Fisheries Centre, University of British Columbia, Vancouver, Canada.

Haklay, M. (2013). Crowdsourcing geographic Knowledge: Volunteered geographic information (VGI) in theory and practice. Crowdsourcing Geographic Knowledge: Volunteered Geographic Information (VGI) in Theory and Practice, 1–396.

Haklay, M. and Tobón, C. (2003). Usability evaluation and PPGIS: towards a user-centered design approach. International Journal of Geographical Information Science, 17 (6), 577–592.

Hamm, M. W., & Bellows, A. C. (2003). Community food security and nutrition educators. Journal of Nutrition Education and Behavior, 35(1), 37-43. doi:10.1016/S1499-4046(06)60325-4

Harrison, Grant M. (2017) Reproductive Characterization of Walleye (Sander Vitreus) and Lake Whitefish (Coregonus Clupeaformis) In Tathlina Lake, NT. Theses And Dissertations (Comprehensive). 1904.

Hay, Ian. (2016). Qualitative Research Methods in Human Geography. Oxford University Press.

Healey, G. K., Magner, K. M., Ritter, R., Kamookak, R., Aningmiuq, A., Issaluk, B., & Mackenzie, K. (2011). Community Perspectives on the Impact of Climate Change on Health in Nunavut , Canada, 64(1), 89–97.

Heiltsuk Tribal Council. (2001). Guiding principles for scientific research in Heiltsuk Territory. Heiltsuk Tribal Council, Bella Bella, Canada

Hinkel, K. M., B. M. Jones, W. R. Eisner, C. J. Cuomo, R. A. Beck, and R. Frohn. (2007). Methods to Assess Natural and Anthropo- genic Thaw Lake Drainage on the Western Arctic Coastal Plain of Northern Alaska. Journal of Geophysical Research 112:F02–S16

Hinrichs, Clare. (2010). Conceptualizing and Creating Sustainable Food Systems: How Interdisciplinarity can Help, In Blay-Palmer, Alison. Imagining Sustainable Food Systems (pp. 18-35). Burlington, VT: Ashgate.

Hinzman, L., N. Bettez, W. Bolton, F. Chapin, M. Dyurgerov, C. Fastie, and B. Griffith. (2005). Evidence and Implications of Recent Cli- mate Change in Northern Alaska and Other Arctic Regions. Climatic Change 72:251–298.

Huntington, H. P. (2000). Using Traditional Ecological Knowledge in Science: Methods and Applications, 10(5), 1270–1274.

Huntington, H., & Fox, S. (2005). The changing Arctic: Indigenous perspectives. In Arctic Climate Impact As- sessment: Scientific Report (Chapter 3). Retrieved from http://www.acia.uaf.edu/pages/scientific.htm

Huntington, H., & Fox, S. (2005). The changing Arctic: Indigenous perspectives. In Arctic Climate Impact As- sessment: Scientific Report (Chapter 3). Retrieved from http://www.acia.uaf.edu/pages/scientific.htm

Indigenous Guardians Toolkit. (n.d.). Dehcho First Nations. Retrieved from https://www.indigenousguardianstoolkit.ca/communities/dehcho-first-nations#resource-93-embed)

IPCC (2018) Summary for Policymakers. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. World Meteorological Organization, Geneva, Switzerland, 32 pp.

Isogai, A., Tsuji, L. J. S., McCarthy, D. D., Gardner, H. L., Karagatzides, J. D., Vandenberg, S., Cowan, D. (2013). Examining the potential use of the collaborative-geomatics informatics tool to foster intergenerational transfer of knowledge in a remote first nation community. Australian Journal of Indigenous Education, The, 42(1), 44–57.

ITK (2018). *National Inuit Strategy on Research*. Inuit Tapiriit Kanatami: Ottawa. 44 pp.

Johnson, J. T., Louis, R. P., & Pramono, A. H. (2006). Facing the future: Encouraging critical cartographic literacies in Indigenous communities. *Acme*, *4*(1), 80–98.

Johnson, M., and R. A. Ruttan. (1993). Traditional Dene environmental knowledge: a pilot project conducted in Ft. Good Hope and Colville Lake, N.W.T., 1989–1993. Dene Cultural Institute, Hay River, Canada.

Johnson, N., Alessa, L., Behe, C., Danielsen, F., Gearheard, S., Gofman-Wallingford, V., Kliskey, A., Krümmel, E., Lynch, A., Mustonen, T., Pulsifer, P., Svoboda, M. (2015). The Contributions of Community-Based monitoring and Traditional Knowledge to Arctic Observing Networks: Reflections on the State of the Field. *Arctic*, *68*(5), 1–13. https://doi.org/10.14430/arctic4447

Johnson, P. A., Corbett, J. M., Gore, C., Robinson, P., Allen, P., & Sieber, R. (2015). A Web of Expectations: Evolving Relationships in Community Participatory Geoweb Projects. Acme, 14(3), 827–848.

Ka'a'gee Tu First Nation, Ecology North, Wilfrid Laurier University. (2015). *Ka'a'gee Tu First Nation Exploration of Climate Change, Food Security and Health.* Climate Change and Health Adaptation Program for Northern First Nations and Inuit Communities Funding Application.

Kane, P. (2016). Ka'a'gee Tu, Between the Willows [Video File]. Retrieved from https://vimeo.com/144707039

Kendrick, A., and M. Manseau. 2008. Representing traditional knowledge: resource management and Inuit knowledge of barren-ground caribou. Society and Natural Resources 21:404–418.

Kennedy WW. (1962). A report on Tathlina and Kakisa Lake. 1946. Fisheries Research Board of Canada. 1- 16.

Kindon, S., Pain, R., & Kesby, M. (2007). Participatory Action Research Approaches and Methods. Statewide Agricultural Land Use Baseline 2015 (Vol. 1). https://doi.org/10.1017/CBO9781107415324.004

King, D., A. Skipper, and W. Tawhai. (2008). Māori Environmental Knowledge of Local Weather and Climate Change in Aotearoa— New Zealand. Climatic Change 90:385–409.

Kokelj, S. V., T. C. Lantz, S. Solomon, M. F. J. Pisaric, K. Keith, P. Morse, J. R. Thienpont, J. P. Smol, and D. Esagok. (2012). Using Multiple Sources of Knowledge to Investi- gate Northern Environmental Change: Re- gional Ecological Impacts of a Storm Surge in the Outer Mackenzie Delta, N.W.T. Arctic 65:257–272

Krupnik, I., and D. Jolly. (eds). (2002). The earth is faster now: Indigenous observations of Arctic environmental change., Fairbanks, AK: Arctic Research Consortium of the United States.

Kuhnlein, H. V, & Receveur, O. (1996). Dietary Change and Traditional Food Systems of Indigenous Peoples. Annual Review of Nutrition. 16(1); 417-422.

Laird, M. J., Henao, J. J. A., Reyes, E. S., Stark, K. D., Low, G., Swanson, H. K., & Laird, B. D. (2018). Mercury and omega-3 fatty acid profiles in freshwater fish of the Dehcho region,

northwest territories: Informing risk benefit assessments. *Science of the Total Environment, 637*(Complete), 1508-1517. doi:10.1016/j.scitotenv.2018.04.381

Lambden J, Receveur O, Kuhnlein HV. (2007). Traditional food attributes must be included in studies of food security in the Canadian Arctic. Int J Circumpolar Health, 66(4):308–319.

Lamoureux, R. J. (1973). Environmental Impact of Hydro-electric Development on Kakisa Lake, Northwest Territories (Order No. MK17591). Available from ProQuest Dissertations & Theses A&I; ProQuest Dissertations & Theses Global. (302703830).

Lucchesi, A. (Fall 2018). Mapping for Social Change: Cartography and Community Activism in Mobilizing Against Colonial Gender Violence. Mapping Meaning, the Journal, 2. Retrieved from https://www.yumpu.com/en/document/read/62206699/mapping-meaning-the-journal-issue-no-2 ///

Lyver. P. O., and Łutsel K'e´ Dene First Nation. (2005). Monitoring barren- ground caribou body condition with Dene´soˆa˚ine´ traditional knowledge. Arctic 58:44–54

MappingBack [Webpage]. (n.d). Retrieved July 10, 2019 from http://mappingback.org/home_en/aboutus/

McDonald M, Arragutainaq L, Novalinga Z (1997) Voices from the Bay: Traditional and ecological knowledge of Inuit and Cree in the Hudson Bay Bioregion. Canadian Arctic Resources Committee and the Environmental Committee of Municipality of Sanikiluaq, Ottawa

McGregor, D., Bayha, W., Simmons, D. (2010). "Our Responsibility to Keep the Land Alive": Voices of Northern Indigenous Researchers. Pimatisiwin: A Journal of Aboriginal and Indigenous Community Health, 8(1), 101–124.

McNaught, C., Lam, P. (2010). Using Wordle as a Supplementary Research Tool. The Qualitative Report, 15(3), 630-643.

Melrose, J., Perroy, R., Careas, S. (2015). Participatory Action Research Approaches and Methods. Statewide Agricultural Land Use Baseline 2015 (Vol. 1).

Miller, T. R., Baird, T. D., Littlefield, C. M., Kofinas, G., Chapin III, F. S., & Redman, C. L. (2008). Epistemological pluralism: Reorganizing interdisciplinary research. Ecology and Society, 13(2), 46.

Moller, H., F. Berkes, P. O. B. Lyver, and M. Kislalioglu. (2004). Combining Science and Traditional Ecological Knowledge: Monitoring Populations for Co-management. Ecology and Society 9:2.

Nadasdy, P. (1999). The Politics of TEK: Power and the "Integration" of Knowledge. Arctic Anthropology. 36(1/2), 1-18.

Nadasdy, P. (2003). Reevaluating the Co-Management Success Story, *56*(4), 367–380.

Northwest Territories Department of Health and Social Services (DHSS). (2016). Site specific fish consumption advice http://www.hss.gov.nt.ca/en/services/fish-consumption-guidance/site-specific-fish-consumption-advice (2016). Accessed 12th Aug 2018.

NWT Bureau of Statistics. (2016). Community Data Kakisa. Date Accessed: June 17, 2017.

NWT Bureau of Statistics. (2014a). Community Survey Results Fort Providence. Date Accessed: June 17, 2017.

NWT Bureau of Statistics. (2014b). Community Survey Results Hay River Reserve. Date Accessed: June 17, 2017.

NWT Bureau of Statistics. (2014c). Community Survey Results Kakisa. Date Accessed: June 17, 2017.

Olympus. (2016) http://www.getolympus.com/ca/en/tg-4.html

Paci, C., & Villebrun, N. (2005). Mining Denendeh: A Dene Nation Perspective on Community Health Impacts of Mining. Pimatisiwin: A Journal of Aboriginal and Indigenous Community Health, 3(1).Research 10: 141–163.

Parlee, B. L., Goddard, E., First Nation, Ł. K. D., & Smith, M. (2014). Tracking Change: Traditional Knowledge and Monitoring of Wildlife Health in Northern Canada. Human Dimensions of Wildlife, 19(1), 47–61. https://doi.org/10.1080/10871209.2013.825823

Parlee, B., & Furgal, C. (2012). Well-being and environmental change in the arctic: a synthesis of selected research from Canada's International Polar Year program. Climatic Change, 115(1), 13-34.

Parlee, B., M. Manseau, Lutsel K'e First Nation (2005). Understanding and communicating about ecological change: Denesoline Indicators of ecosystem health In Berkes, F. Huebert, R., Fast, H., Manseau, M., Diduck, A. Breaking Ice: Renewable Resource and Ocean Management in the Canadian North, Vol. 1. Calgary, AB: University of Calgary Press (pp. 165-182).

Pavlovskaya M. (2006). "Theorizing with GIS: a tool for critical geographies?" Environment and Planning A. 38. 2003-2020.

Pearce, T., Ford, J., Willox, A. C., & Smit, B. (2015). Inuit traditional ecological knowledge (TEK), subsistence hunting and adaptation to climate change in the Canadian Arctic. Arctic, 68(2), 233+.

Pearce, T., Smit, B., Duerden, F., Ford, J. D., Goose, A., & Kataoyak, F. (2010). Inuit vulnerability and adaptive capacity to climate change in Ulukhaktok, Northwest Territories, Canada. Polar Record, 46(2), 157–177.

Pearce, T., Smit, B., Duerden, F., Ford, J.D., Goose, A., Kataoyak, F. (2010). Inuit vulnerability and adaptive capacity to climate change in Ulukhaktok, Northwest Territories, Canada. Polar Record 46(2): 157-177. http://dx.doi.org.libproxy.wlu.ca/10.1017/S0032247409008602

Pennesi, K., Arokium, J., & Mcbean, G. (2012). Integrating local and scientific weather knowledge as a strategy for adaptation to climate change in the Arctic, 897–922.

Petrov, A. N., BurnSilver, S., Chapin, F. S., Fondahl, G., Graybill, J., Keil, K., Nilsson, A., Riedlsperger, R., Schweitzer, P. (2016). Arctic sustainability research: toward a new agenda. *Polar Geography*, *39*(3), 165–178. https://doi.org/10.1080/1088937X.2016.1217095

Polfus, J. L., Heinemeyer, K., & Hebblewhite, M. (2014). Comparing traditional ecological knowledge and western science woodland caribou habitat models. Journal of Wildlife Management, 78(1), 112–121. https://doi.org/10.1002/jwmg.643

Power, E. M. (2008). Conceptualizing food security for Aboriginal people in Canada. Canadian Journal of Public Health 99(2):95–7.

Pretty, J. (2003). Social capital and the collective management of resources. Science 302:1912-1914. http://dx.doi.org/10.1126/ science.1090847 10.1126/science.1090847

Receveur O, Kassi N, Chan HM, Berti PR, Kuhnlein HV. (1998). Yukon First Nations' assessment of dietary benefit/ risk. Quebec City: Center for Indigenous Peoples' Nutrition and Environment; 178 p.

Receveur, O., Boulay, M., & Kuhnlein, H. V. (1997). Decreasing traditional food use affects diet quality for adult Dene/Métis in 16 communities of the Canadian Northwest Territories. *The Journal of Nutrition*, *127*(11), 2179–86. http://doi.org/10.1093/jn/127.11.2179

Relph, E. (1976). Place and Placelessness. London, United Kingdom. Pion Limited.

Reyes, E. S., Aristizabal Henao, J. J., Kornobis, K. M., Hanning, R. M., Majowicz, S. E., Liber, K., Stark, K., Low, G., Swanson, K., Laird, B. D. (2017). Associations between omega-3 fatty acids, selenium content, and mercury levels in wild-harvested fish from the Dehcho Region, Northwest Territories, Canada. Journal of Toxicology and Environmental Health, Part A, 80(1), 18-31.

Roberge, M.M, Low, G. and Read, C.J. (1988). An assessment of the commercial fishery and population structure of Walleye in Tathlina Lake, Northwest Territories. Can. Tech. Rep. Fish. Aquat. Sci. 1594. v + 54 p.

Royal Society of London. (2009). Reaping the Benefits: Science and the Sustainable Intensification of Global Agriculture. London, 2009.

Schuster, R., Wein, E., Dickson, C., Chan, H. (2011) Importance of traditional foods for the food security of two First Nations communities in the Yukon, Canada, International Journal of Circumpolar Health, 70:3, 286-300, DOI: 10.3402/ijch.v70i3.17833

Sharma, S., De Roose, E., Cao, X., Pokiak, A., Gittelsohn, J., & Corriveau, A. (2009). Dietary intake in a population undergoing a rapid transition in diet and lifestyle: The inuvialuit in the northwest territories of Arctic Canada. Canadian Journal of Public Health, 100(6), 442-448.

Sheehy, T., Kolahdooz, F., Roache, C., Sharma, S. (2015) Traditional food consumption is associated with better diet quality and adequacy among Inuit adults in Nunavut, Canada, International Journal of Food Sciences and Nutrition, 66:4, 445-451, DOI: 10.3109/09637486.2015.1035232

Social Ventures Australia Consulting. (2016). Analysis of the Current and Future Value of Indigenous Guardian Work in Canada. Unpublished Report.

Social Ventures Australia. (2016). Analysis of the Current and Future Value of Indigenous Guardian Work in Canada's Northwest Territories.

Spring, A., Carter, B., & Blay-Palmer, A. (2018). Climate change, community capitals and food security: Building a more sustainable food system in a northern Canadian boreal community. Canadian Food Studies, 5(2), 111–141. https://doi.org/10.15353/cfs-rcea.v5i2.199

Springmann, M., Clark, M., Mason-D'Croz, D., Wiebe, K., Bodirsky, B. L., Lassaletta, L., de Vries, W., Vermeulen, S.J., Herrero, M., Carlson, K.M., Jonell, M., DeClerck, F., Gordon, L. J., Zurayk, R., Scarborough, P., Rayner, M., Loken, B., Fanzo, J., Godfray, C. J., Tilman, D., Rockström, J., Willett, W. (2018). Options for keeping the food system within environmental limits. *Nature*, *562*(7728), 519–525. https://doi.org/10.1038/s41586-018-0594-0

Statistics Canada, Canadian Community Health Survey (CCHS), (2014).

Statistics Canada. (2017). Kakisa, SET [Census subdivision], Northwest Territories and Region 4, REG [Census division], Northwest Territories (table). Census Profile. 2016 Census. Statistics Canada Catalogue no. 98-316-X2016001. Ottawa. Released February 8, 2017. http://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E (accessed April 10, 2017).

Statistics Canada. Canadian Community Health Survey (CCHS), 2015-2016.

Steinbock, D. (2008). *TagCrowd*. Retrieved December 18, 2009, from http://www.tagcrowd.com

Stewart EM, Coleman KA, Korosi JB, Thienpont JR, Palmer MJ, Blais JM, Smol JP. (2015). Assessing environmental stressors on commercial walleye fishery from a large northern ecosystem (Tathlina Lake) using water chemistry and paleolimnology. Journal of Great Lakes Research. 1-6.

Stewart-Harawira, M. (2013). Challenging knowledge capitalism. Indigenous research in the 21st century. Socialist Studies/Etudes socialistes, 9(1), 39-51.

Talaga, T. (2018) All Our Relations.

Tarasuk, V., Mitchell, A., & Dachner, N. (2016) Household Food insecurity in Canada, 2014. Toronto: Research to identify policy options to reduce food insecurity (PROOF).

Tendall, D. M., Joerin, J., Kopainsky, B., Edwards, P., Shreck, A., Le, Q. B., Kruetli, P., Grant, M..Six, J. (2015). Food system resilience: Defining the concept. Global Food Security, 6, 17–23.

The Northwest Territories Cumulative Impact Monitoring Program. (2016). NWT CIMP Traditional Knowledge Proposal Guide, (October 2016), 1–51.

Tilman, D., Balzer, C., Hill, J., & Befort, B. (2011). Global food demand and the sustainable intensification of agriculture. Proceedings of the National Academy of Sciences of the United States of America, 108(50), 20260-20264. Retrieved from http://www.jstor.org.libproxy.wlu.ca/stable/23060109

ToCloud. (2007). *ToCloud*. Retrieved from http://www.tocloud.com/

Tripathi, N., & Bhattarya, S. (2004). Integrating indigenous knowledge and GIS for participatory natural resource management: state of the practice. The electronic journal of information systems in developing countries, 17.

Tsuji, L. J. S., & Ho, E. (2002). Traditional Environmental Knowledge and Western Science: in Search of Common Ground. The Canadian Journal of Native Studies, 2(2), 327–360.

Tuan, Y. (1974). Topophilia: A study of environmental perception, attitudes and values. New York, New York: Columbia University Press.

UNFAO - Food and Agriculture Organization of the United Nations. (2015). FAOSTAT3 database, Stat. Div., Food and Agric. Org. of the United Nations.

Uu-a-thluk. (2017). Mapping Project Advances Leadership and Stewardship Among Nuu-chah-nulth First Nations. Retrieved from http://uuathluk.ca/wordpress/wp-content/uploads/2017/10/Mapping-Project-Advances-Leadership-1.pdf

Van Oostdam, J., Donaldson, S. G., Feeley, M., Arnold, D., Ayotte, P., Bondy, G., Chan, L., Dewaily, É., Furgal, C. M., Kuhnlein, H., Loring, E., Muckle, G., Myles, E., Receveur, O.,

Tracy, B., Gill, U. Kalhok, S. (2005). Human health implications of environmental contaminants in Arctic Canada: A review. Science of the Total Environment, 351–352, 165–246.

Wang CC. (1999). Photovoice: a participatory action research strategy applied to women's health. Journal of Women's Health, 8(2), 185–192.

Wang, C., & Burris, M. A. (1997). Photovoice: Concept, Methodology, and Use for Participatory Needs Assessment. Health Education & Behavior, 24(3), 369–387.

Wesche, S. D., & Armitage, D. R. (2013). Using qualitative scenarios to understand regional environmental change in the Canadian North. Regional Environmental Change, 1–14.

Wesche, S. D., O' Hare-Gordon, M. A. F., Robidoux, M. A., & Mason, C. (2016). Land-based programs in the Northwest Territories: Building Indigenous food security and well-being from the ground up, 3(2), 23–48.

Wiseman, N. D., & Bardsley, D. K. (2016). Monitoring to learn, learning to monitor: A critical analysis of opportunities for indigenous Community-Based monitoring of environmental change in Australian rangelands. Geographical Research, 54(1), 52-71. doi:10.1111/1745-5871.12150

World Bank. (2008). World Development Report 2008: Agriculture for Development. Washington, DC,

World Food Summit. (1996). Rome Declaration on World Food Security.

Zhang, X., Flato, G., Kirchmeier-Young, M., Vincent, L., Wan, H., Wang, X., Rong, R., Fyfe, J., Li, G., Kharin, V.V. (2019): Changes in Temperature and Precipitation Across Canada; Chapter 4 in Bush, E. and Lemmen, D.S. (Eds.) Canada's Changing Climate Report. Government of Canada, Ottawa, Ontario, pp 112-193.

Zhu, C., Kobayashi, K., Loladze, I., Zhu, J., Jiang, Q., Xu, X., Liu, G., Seneweera, S., Ebi, K. L., Drewnowski, A., Fukagawa, N.K. Ziska, L. H. (2018). Carbon dioxide (CO2) levels this century will alter the protein, micronutrients, and vitamin content of rice grains with potential health consequences for the poorest rice-dependent countries. *Science Advances*, *4*(5).

APPENDIX A Edukit Research Bulletin

Northern Water Futures

Project Bulletin #1

The Ka'a'gee Tu Atlas: Training youth in mapping and monitoring using an innovative EduKit

The Ka'a'gee Tu Atlas is a monitoring project that will enable community members to gain more knowledge of the impacts of environmental change and developments are having on the land and the community. The project was created through the desire to help monitor and protect the land which the community depends on for their food, health and livelihood. One priority of this project is to engage youth in mapping skills and knowledge about the land. In partnership with the NWT Centre for Geomatics an innovative EduKit was piloted with the youth in Kakisa.

What did we do?

Laurier Graduate Student, Kaitlin Kok, and Greg Reardon, the school teacher in Kakisa, took a small group of older students from the community on a three-day canoe trip. Each student was lent an iPad loaded with the mapping application. This application gave the students the ability to record information, take photos with GPS coordinates attached, while in remote locations along their trip. Students were able to stop and explore different sites along their trip, and were asked to fill in information about what they were seeing as part of the application. When the students returned to school, they were able to download their recorded information and create StoryMaps to tell share their experiences with others.

Tarek Chicot records information on the land as part of the EduKit

www.northernwaterfutures.ca

Why is this research important?

Communities throughout the NWT are looking to enhance the monitoring of their lands to ensure the health of the waters, land and animals for future generations. A project like the Ka'a'gee Tu Atlas is an example of a community-led collaboration that focused on developing a monitoring and mapping resource for use by the community. The EduKit serves as an educational project aimed at getting youth interested and involved in research and monitoring using new technologies and tools.

Students build StoryMaps back in the classroom

Students recorded wildlife sightings along the trip

We found that the students really enjoyed working with the technology, and sharing their experiences. Although there were technical challenges with the EduKit, the experience was positive for the students, teacher, and community. The EduKit is far from complete and will require more development and testing. However, it seems like a great opportunity to can build a foundation for mapping and monitoring training in schools.

For more information

This project is a partnership between the Ka'a'gee Tu First Nation and Wilfrid Laurier University. Project funding is from the NWT Cumulative Impacts Monitoring Program and the Laurier Centre for Sustainable Food systems.

For more information contact:

Andrew Spring and Kaitlin Kok
Wilfrid Laurier University
aspring@wlu.ca

Melanie Desjardins
NWT Centre for Geomatics
Melanie_Desjardins@gov.nt.ca

www.northernwaterfutures.ca

APPENDIX B Kakisa Video: Fledge Digital Storytelling

Image of the author's shared video about Kakisa. Video can be found on the FLEdGE Website at: https://fledgeresearch.ca/resources-results/digital-storytelling/.

Kakisa Connections

a story by Kaitlin Kok

APPENDIX C Dene Laws

Figure 9 The Dene Laws are a scripture Dene people live by. Source: Yellowknives Dene First Nation

APPENDIX D Interview Consent Form

Food Security in the Northwest Territories

Principal Investigators: Andrew Spring and Dr. Alison Blay-Palmer, Wilfrid Laurier University

We are seeking your voluntary participation in a research project exploring community observations around the impacts of climate change on health and the availability of country food. Climate change is having a profound impact on the landscape and the communities of the NWT. As communities have a deep connection to the land, changes to the ecosystem are disrupting traditional ways of life, particularly the ability to hunt and gather traditional food sources. This study seeks to understand what changes community members are witnessing on the land and how these changes impact community health and the ability to harvest country foods.

For this phase of the study, we are hoping to conduct in-depth interviews with community members that have extensive knowledge and experience on the land. You have been identified by others in the community as one of these people. Interviews will take place in the Band offices and take approximately one hour. We are asking for you to bring any photographs with you that have been taken on the land over the past 30 years that can show what the land was like at that time, or show any special places or events on the land that are of significance to the community. For participating in this study you will receive $100. Results of this study will be presented at a community meeting in early 2017.

It is possible that as a participant, by answering the questions in the interviews, you could make statements that could be awkward for you when made public (e.g., through academic publications or plain language reports to the community). We consider these risks to be very low, and in line with the risks encountered in the participants' everyday lives; however, we will mitigate these risks by preserving your anonymity in reports, and only use your name after your consent is given, and by meeting with you individually to allow you to review and edit relevant field notes and transcribed interview texts prior to their being made public.

The researchers will keep the collected data in locked facilities or password-protected on computers. The only people that will have access to the files will be the supervisor and researchers. All data collected from this research will be destroyed by December 31, 2021 or when the report is completed, whichever comes first. Your participation is voluntary and you are free to withdraw at any time. If you decide to withdraw from the research at any time, all data collected will be destroyed or returned to you. You are not obliged to answer any questions that you find objectionable or which make you feel uncomfortable.

This project has been reviewed and approved by the Wilfrid Laurier University Research Ethics Board. If you feel you have not been treated according to the descriptions in this form, or your rights as a participant in research have been violated during the course of this project, you may

contact Dr. Alison Blay-Palmer, associate Professor, Department of Geography and Environmental Studies, Wilfrid Laurier University, (519) 884-0710 extension 2604, ablaypalmer@wlu.ca or Dr. Robert Basso, Chair, University Research Ethics Board, Wilfrid Laurier University, (519) 884-0710, extension 4994, rbasso@wlu.ca.

I understand the information described on the previous page and consent to participate in this research:

Name: _____ Date: _____

Signature: _____

INTERVIEW
By initialing the statements below:

_____ I agree to **participate** in this interview.

_____ I grant permission for the researcher to use an **audio recorder**

_____ I grant permission for the researcher to **scan my photographs** with the understanding that they will be shared with the community.

_____ I grant permission for the researcher to use **direct quotations** from our interview and identify me as the source of the information.

_____ I grant permission for the researcher to use **direct quotations** from our interview but **NOT** identify me as their source.

Researcher:

Name: _____ Date: _____

Signature: _____

APPENDIX E Interview Questions

Questionnaire

Using an in-depth interview strategy, the following questions are intended to stimulate discussion and story telling about the photographs that participants share with the researchers on traditional land use and health of the land.

1) Tell me about this photograph. Where was it taken? When was it taken? What does the photograph show?
2) Is there anyone in the photo? Who are they?
3) Does this photo bring back any memories?
4) Does this place have a special meaning to you? Have you been back to this area recently?

APPENDIX F Focus Group Consent Form

Food Security in the Northwest Territories

Principal Investigators: Andrew Spring and Dr. Alison Blay-Palmer, Wilfrid Laurier University
RESEARCHER: KAITLIN KOK

We are seeking your voluntary participation in a research project exploring community observations around the impacts of climate change on health and the availability of country food. Climate change is having a profound impact on the landscape and the communities of the NWT. As communities have a deep connection to the land, changes to the ecosystem are disrupting traditional ways of life, particularly the ability to hunt and gather traditional food sources. This study seeks to understand what changes community members are witnessing on the land and how these changes impact community health and the ability to harvest country foods.

For this phase of the study, we are hoping to conduct a FOCUS GROUP with community members that have extensive knowledge and experience on the land. The FOCUS GROUP will take place in the Band offices and take approximately ONE HOUR. WE ARE ASKING FOR YOUR THOUGHTS AND PRIORITIES FOR MONITORING THE HEALTH OF THE LAND. RESULTS OF THIS FOCUS GROUP WILL BE USED TO FURTHER THE DEVELOPMENT THE COMMUNITY-BASED MONITORING INITIATIVE BEING DEVELOPED WITH THE COMMUNITY.

It is possible that as a participant, by answering the questions in the interviews, you could make statements that could be awkward for you when made public (e.g., through academic publications or plain language reports to the community). We consider these risks to be very low, and in line with the risks encountered in the participants' everyday lives; however, we will mitigate these risks by preserving your anonymity in reports, and only use your name after your consent is given, and by meeting with you individually to allow you to review and edit relevant field notes and transcribed interview texts prior to their being made public.

The researchers will keep the collected data in locked facilities or password-protected on computers. The only people that will have access to the files will be the supervisor and researchers. All data collected from this research will be destroyed by December 31, 2021 or when the report is completed, whichever comes first. Your participation is voluntary and you are free to withdraw at any time. If you decide to withdraw from the research at any time, all data collected will be destroyed or returned to you. You are not obliged to answer any questions that you find objectionable or which make you feel uncomfortable.

This project has been reviewed and approved by the Wilfrid Laurier University Research Ethics

Board. If you feel you have not been treated according to the descriptions in this form, or your rights as a participant in research have been violated during the course of this project, you may contact Dr. Alison Blay-Palmer, associate Professor, Department of Geography and Environmental Studies, Wilfrid Laurier University, (519) 884-0710 extension 2604, ablaypalmer@wlu.ca or Dr. Robert Basso, Chair, University Research Ethics Board, Wilfrid Laurier University, (519) 884-0710, extension 4994, rbasso@wlu.ca.

I understand the information described on the previous page and consent to participate in this research:

Name: _____ Date: _____

Signature: _____

FOCUS GROUP

By initialing the statements below:

_____ I agree to **participate** in this FOCUS GROUP.

_____ I grant permission for the researcher to use **direct quotations** from our FOCUS GROUP and identify me as the source of the information.

_____ I grant permission for the researcher to use **direct quotations** from our FOCUS GROUP but **NOT** identify me as their source.

Researcher:

Name: _____ Date: _____

Signature: _____

APPENDIX G Focus Group Questionnaire

Using a focus group strategy, the following questions are intended to stimulate discussion and story telling about the photographs that participants share with the researchers on traditional land use and health of the land.

Community Mapping	1. Why is monitoring the land important to you? 2. Is there anything you feel can be added to the current project? 3. Are you interested in monitoring anything specific to place on the map? i.e. particular plants and their locations, unmarked trails, etc. 4. Is there one thing you'd like to focus on? i.e. wildlife harvest, harvester safety, etc. 5. Are there places you are concerned about? 6. Are there any locations or places which may not be easily accessible, but members of the community are aware that it is changing?
Participation Assessment	1. Does everyone have a role in monitoring? Do researchers/scientists have a role? 2. Are the values of monitoring widespread throughout the community? 3. How do you want to monitor the land? 4. Do you have access to a smartphone? Do you use your smartphone on the land to take pictures? Do you know how to use GPS? Do you own a camera? 5. What resources, training and equipment are needed for any further steps to monitor the land?
Capacity Building	1. What do you think everyone's role is in protecting the environment? Do you think everyone has the same view? 2. How much information would you like to provide?
Information Gathering and Delivering	1. How would you like to see Kakisa's own community monitoring move forward now that we have discussed different options? 2. How do you want to share the results/ data of the monitoring? Would you prefer to see it on a website? Or a print-out/ newsletter? On social media or Facebook? 3. What information about other research and monitoring would you like access to?

APPENDIX H Hiring Of Community Researcher

Community Researcher

The Ka'a'gee Tu First Nation (KTFN), in partnership with Wilfrid Laurier University (Laurier), is looking to hire a Community Researcher to help develop the Ka'a'gee Tu Atlas project.

The Ka'a'gee Tu Atlas is a community-based monitoring project that will enable community members to gain more knowledge of the impacts of environmental change and developments are having on the land and the community.

As the KTFN enjoy a close relationship to the land, and depend on the land for their well-being, community members have noticed a great deal of change on the land due to the impacts of climate change, but also are concerned with the impacts that other factors, such as forest fire and developments (both present and planned), may have on the long term health of their lands. In response to these impacts, community members identified the need to collect and share information about conditions on the land as well as the health of the plants, water and animals, in order to enhance community stewardship and protection of their traditional territory.

The Community Researcher will be responsible for:

- Acting as a liaison between the research and the community.
- Assisting the Laurier researchers in planning community events and research activities.
- Helping to facilitate and conduct interviews and the collection and scanning of photographs
- Learning mapping tools and research protocols
- Helping identify areas the community is concerned about as well as significant locations throughout the KTFN lands.
- Other responsibilities as determined by the KTFN Environmental Coordinator.

The position will be full-time through July and August 2016, and operate part-time from September through to March 31, 2017

APPENDIX I PHOTOGRAPH, VIDEO AND AUDIO CONSENT FORM

Photograph, Video and Audio Recording Consent Form

During the KTFN Youth-Camp, the youth were given cameras to document what they found to be valuable to them. Part of the camp's goal as part of the "Dehcho K'ehodi—Taking Care of the Dehcho" Stewardship Program was to try and re-connect the youth to learn important land-based skills from community land-users & elders. Following this camp, the Wilfrid Laurier University counterpart had the opportunity to create a video using media captured during this week. This video is intended to be shown to the community as well as wider audiences such as audiences at conferences and on the Food: Locally Embedded, Globally Engaged (FLEdGE) Partnership Website.

I, _____ (recorded person's full name), do hereby consent to the use by _____ (entrant's full name) of my image, voice, or both, in the video recording described above.

In addition, I waive any right to inspect or approve the finished video recording.

I agree that all such pictures, video or audio recordings and any reproduction thereof shall remain the property of the author and that the European Environment Agency may use it as it sees fit.

I understand that this consent is perpetual, that I may not revoke it, and that it is binding.

I understand that these images may appear publicly as part of FLEdGE's website and/or other marketing materials.

I understand the information described and consent to participate in this research:

Name: _____ Date: _____

Signature: _____

By initialing the statements below:

_____ I grant permission for the researcher to **share the photographs and video clips** which I am featured in with the understanding that they will be shared with the

community and a wider audience.

APPENDIX J THEMES

1. Community and Family

- Community
    - Co-operation and Teamwork
    - Strong Relationships
    - Community Bonding
    - Community Fishing
    - Community Gathering
    - Community History
    - Community Knowledge
    - Community Success
    - Food Sharing in Community
    - Elders and their Importance in the Community
    - The Community of Kakisa Itself
- Family
    - Connection with Land
    - Hard work
    - Family goes hand in hand with Traditional Practices
    - Family Connection/Teaching /Sharing Knowledge
- Social
    - Social Camp - the Fall Hunt
    - Community Roles
- Importance of Community - Feeling of Home

2. Knowledge and Youth

- Knowledge
    - Place-based knowledge
    - Signs and observation on the land
    - Traditional food knowledge
- History
    - Archaeology prospects
    - History of Community

        - Portage
        - History and Places of Meaning
    - History falling apart
- Youth
    - Sharing and Teaching
        - Ideas for future generations
        - Importance of having youth be outside on the land
        - Elders teaching youth
        - Education of place names
- Loss of Knowledge

3. Land

- Social and Personal Connection with Land
    - Emotional Connection
    - Enjoying Nature
    - Being with Family
    - Happiness on the Land
    - Connection to Wildlife
    - Social Impact of being on the land
    - Memories
        - Being on the land
        - Fall hunt
    - Appreciation of:
        - Beauty of nature
        - Beauty of snow
        - Community
    - Knowledge from Elders
    - Hard Work
- Clean Land
    - Concern for water
    - Fear of industry contamination
    - Protecting the land
    - Outsiders and development
- Land Knowledge
    - Importance of Knowing the land
    - Teaching about the land
    - Dangers of land
    - Knowledge of Trail system
    - Living off the land

    - Place of Reference
    - Place of Cultural Significance
- Wildlife
    - Migration and Habitat
    - Diversity in Tathlina

4. Change

- Adaptation
- Social
    - Economic Losses
    - Memories (old memories of how it used to look before development)
    - Travel on land
        - Different Travel Time
    - Use of the land (changing where to stay on the land)
    - What Used to be
    - Ecosystem – Animal and Human Interaction
- Environment
    - (No) Access to Land
    - Growth of Weeds
    - Permafrost
    - Snow and Ice
    - Warmer Weather
    - Water Level
- Food
    - Berry Changes
    - Warmer Weather affecting meat practice
- Travel
    - Boat
    - Plane
    - Snowmobile
- Wildlife
    - Birds
        - Pelicans
    - Fish
        - Fish and Fire
        - Parasites in Fish
        - Fish runs changing
    - Runs
        - Birds

        - Moose
    - Dangers from new species

5. Tradition

- Traditional Food
    - Berries
    - Fish
        - Parasites
        - Mercury
    - Connection with food
    - Hunting/Trapping
        - Fall hunt
- Traditional Practice
    - Arts
    - Being on the land
    - Community gathering
    - Family
    - Sharing knowledge of practices

6. Research, Monitoring and Methods

- Research and Monitoring
    - Fish sampling/studies
    - Food chain
    - Interest in monitoring
    - Places
    - Routine
    - Soil samples
    - Water sondes
- Method
    - Education
    - Interest in contributing to atlas
    - Updating trail maps
    - Recording change