First Nation Observations and Perspectives on the Changing Climate in Ontario's Northern Boreal: Forming Bridges across the Disappearing "Blue-Ice" (Kah-Oh-Shah-Whah-Skoh Siig Mii-Koom).

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ABSTRACT

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Forests can have significant potential to mitigate climate change. Conversely, climatic changes have significant potential to alter forest environments. Forest management options may well mitigate climate change. However, management decisions have direct and long-term consequences that will affect forest-based communities. The northern boreal forest in Ontario, Canada, in the sub-Arctic above the 51st parallel, is the territorial homeland of the Cree, Ojibwe, and Ojicree Nations. Nishnawbe Aski Nation (NAN) is the political representative of these Nations that are signatories to treaties 5 (Ontario's portion) and 9. The researcher and NAN collaborated to record observations of changes in the forest environment attributed to climate change and to share and exchange information and perspectives about climate change in 2011. Data were collected from members of ten NAN First Nations whose territorial land stretches across an area of ~110 800 km^2. Forty-three individuals contributed to the data. These individuals represent political leaders, Elders, land users (hunters, trappers, fishers, and gatherers), community land use planning and winter road-making staff, and other community members. The research philosophy "CREE"—C=capacity building, R=respect, E=equity, and E=empowerment—underpinned the methodology, Participatory Action Research (PAR). The benefits and lessons learned in applying PAR from the research partnership are woven into the discussions. Climate change effects are occurring on NAN First Nation territorial land and these effects are explored through the Indigenous lens of "blue-ice". Blue-ice is a term embedded in the Indigenous languages across the fieldwork area. Its presence on the land is linked to transportation in carrying out traditional activities on the land and the delivery of modern goods and services into these First Nation communities. The disappearance of blue-ice is affecting food and energy security. A term often used in the climate change discourse is adaptation. Yet the First Nation perception of "adaptation" is different than the Western concept and we reframed the term to reflect their Indigenous worldview. In the scientific literature much has been written on boreal forests and forest carbon sequestration with respect to climate change. First Nation

perspectives and knowledge about climate change in their territories is limited in the literature. Northern NAN First Nations living in the boreal forest have a unique understanding of climate change effects and need to play a significant role in the development of climate change policy for Ontario's northern boreal forest. Bridging Western and Indigenous knowledge and perspectives about climate change is necessary to formulate the best possible solutions to address climate change.

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memory—the lineage of over 100 years. Seeing time from that vantage point sparks the deeper understanding that caring for seven generations is binding and obtainable. Throughout my studies, you were there repeatedly when I needed you. There are few words, if any, that could describe what is in my heart. A woman could not ask for more in her life than having you as her sons or the privilege of knowing two remarkable human beings.

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"'One picture is worth a thousand words,' said an ancient Chinese; but it may take 10,000 words to validate it. It is as tempting to ecologists as it is to reformers in general to try to persuade others by way of the photographic shortcut. But the essence of an argument cannot be photographed: it must be presented rationally--in words." Garrett Hardin, 1968

Community Members Collaborating in the Study (agreeing to be identified)

Allan Beardy	Muskrat Dam First Nation
Annie Martin	Wunnumin Lake First Nation
Edward Wabasse	Nibinamik First Nation
Eunice Fiddler	Muskrat Dam First Nation
George Sakanee	Neskantaga First Nation
Jimmy Keeper	Pikangikum First Nation
John George Martin	Wunnumin Lake First Nation
Kyle Peters	Pikangikum First Nation
Lawrence Gliddy	Wunnumin Lake First Nation
Lias Yellowhead	Nibinamik First Nation
Lise Marie McKay	Weagamow First Nation
Norman Beaver	Nibinamik First Nation
Robert Roundhead	Nibinamik First Nation
Rose Anne Froggy	Muskrat Dam First Nation
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CHAPTER 1. INTRODUCTION

Climate change is a critical challenge facing the world's populations because this change affects the biological communities and biophysical systems upon which people depend. The magnitude of the world's predicament with climate change, a global wicked problem,[1] has implications for the health of nations (McMichael 2017). Whether or not climate change is occurring from anthropogenic[2] sources is not debated in this dissertation. de Sherbinin (2002) contends it is well documented that humans have negatively affected the planet's natural environment and systems. In particular, there is strong evidence to support the conclusion that human activities[3] are affecting the planet's climate system (Cubasch et al. 2013).

One of the early arguments to investigate climatic changes[4] and impacts to human beings stemmed from global food shortages due to extreme weather

[1] A "wicked problem" is not about the degree of difficulty but about the complexity of solving the problem. Wicked problems have innumerable causes, are tough to describe, and lack a 'right' answer or solution. Environmental degradation and climate change are considered wicked problems; moreover, "not only do conventional processes fail to tackle wicked problems, they may exacerbate situations by generating undesirable consequences" (Camillus 2008).
[2] Anthropogenic means polluting influences on nature caused by human activities (Merriam-Webster 2017 http://www.merriam-webster.com/dictionary/anthropogenic)
[3] Notable human activities include burning fossil fuels for electricity generation and transportation (e.g., diesel, jet-fuel, gasoline) and land use changes (e.g., deforestation for agricultural production (Apps 2003)).
[4] It should be noted that the CO_2 theory that links carbon emissions with global temperatures is not new; the noted British physicist John Tyndall first stated the basic premise in 1861, and in July 1959 Scientific American published the article by Plass, Carbon Dioxide and Climate, subtitled *"A current theory*

events in 1972 (Schneider 1977). The global food crisis in 1972-1973 was rooted in a severe weather shock to the world's grain production in both rice and wheat (FAO 2010). Schneider (1977) argued for interdisciplinary research on climatic changes and the "world's predicament" stating:

> Climatic change is one of the natural environmental factors that constrains the human condition. This is apparent, in the most elementary sense, by the physical tolerance of our bodies to the range of states of elements we define as the weather. However, since the advent of technology, shelter and clothing, for those who possess it, have mitigated our physical vulnerability to the elements. Therefore, the primary impact of climatic variability on people today is through its influence on food supply. Thus, even for the seemingly limited issue of human vulnerability to climatic variations, we are, at the outset, faced with a problem of enormous complexity and one whose dimension is rooted in many disciplines: agronomy, botany, chemistry, engineering, ethics, economics, meteorology, oceanography and sociology- to name but a few. Furthermore, the problem is complicated by the fact that in the near future we may be subject to climatic fluctuations not only of natural origin, but also to those which are a consequence of human activities. (Schneider 1977: p. 21)

Along with severe global crop losses, threats to food security were exacerbated by the Organization of the Petroleum Exporting Countries' (OPEC) embargo of oil exports to the United States of America (US) and Europe (also known as the 1973 Energy Crisis). The embargo further increased staple food prices as the price of fertilizers, a by-product of natural gas, also rose sharply (FAO 2010). This state of global affairs entrenched the recognition of the interrelationships between human populations, the environment, economies and policy. The broader context of ecological concerns and policy development to address

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postulates that carbon dioxide regulates the temperature of the earth. This raises an interesting question: How do Man's activities influence the climate of the future?" (see Plass 1959).

climate change frames the dissertation; the assumption is that we now live in a "carbon-constrained"[5] world.

A crucial factor in our carbon-constrained world is the role and use of forests. Forests cover ~30% of the earth's terrestrial surface (FAO 2001; Bonan 2008) and provide numerous social and economic benefits to human well-being along with significant ecosystem services, such as soil formation and climate regulation (MEA 2003, 2005; CIFOR 2008). The use of forests to mitigate climate change and how to manage forests sustainably in the face of climate change are pressing issues for policy decision makers (Price et al. 2013). Decisions require an understanding of the complexity of forest biomes, forest functions and processes in the climate system, and possible forest responses to climate change. Adding to the complexity are uncertainties in the timing, scale and nature of potential climatic changes over the next century (Ciais et al. 2013).

Future forest conditions, growth, and uses are major uncertainties with climate change, but such information is critical in policy decisions promoting sustainable forest management (SFM; Bhatti et al. 2003; Ogden and Innes 2008). The body of scientific knowledge and information in boreal forest ecology and forest carbon (C) sequestration is substantial (Deluca and Boisvenue 2012) and contributes to sustainable forest management policy decisions. Still, there remain gaps in scientific knowledge and understanding and further research and

[5] The phrase "carbon-constrained" developed from the increasing awareness that mitigating climate change requires limits on carbon emissions (or greenhouse gases (GHGs)) released into the atmosphere from the use of fossil fuels (e.g., coal, oil, gas) as sources of energy (Sioshansi 2009).

information are necessary (Richardson et al. 2012; Kurz et al. 2013; Lemprière et al. 2013; Zha et al. 2013; Way and Yamori 2014).

Also necessary is critical reflection about the institutional and governance structures through which forest policies to address climate change are formulated. These structures too often reflect only the worldviews, perspectives, and agendas of the people within those structures and those with similar views in civil society (Schneider and Sidney 2009). As a result, there is a risk that relevant information will be missed or ignored. Differing worldviews, perspectives, and agendas, such as those of Indigenous peoples, may be neglected in decision making.

The First Nations who collaborated in this research live in Ontario's remote northern boreal forest. First Nation peoples have a strong desire to engage in the formulation of policy to address climate change using their forested lands because changes on the land affect them directly. Increased efforts to mitigate climate change and strategies for adapting to its impacts are needed (McGray et al. 2007) and courses of actions through policy directives have direct and long-term consequences. Complementary options, alternative perspectives and different knowledge systems are vital to developing effective solutions to address climate change using forests (Golden et al. 2011, 2015).

1.1 FORESTS, CLIMATE, AND THE CLIMATE CHANGE DISCOURSE

1.1.1 The Significance of Forests and Climate

Forests are vital to addressing climate change, as forests are a significant component in the planet's climate system. Forest biomes influence earth's climate in physical, chemical, and biological processes that affect "planetary energetics, the hydrologic cycle, and atmospheric composition" (Bonan 2008: pg. 1444). Of particular significance in atmospheric composition and climate[6] is the carbon (C) cycle. The C cycle is a complex and connected cycle in the exchange and fluxes of carbon dioxide (CO_2) from the atmosphere to earth's C reservoirs in both marine and terrestrial environments (Ciais et al. 2013). An important piece in terrestrial C is the forest-carbon cycle or forest C sequestration. The forest-carbon cycle involves the uptake and release of CO_2 from the atmosphere during vegetation growth, decay and disturbances (e.g., fires; Kurz et al. 2013; Lemprière et al. 2013; Yue et al. 2013), and the storage of C in various pools or reservoirs in forest biomass, soils and peatlands (Tarnocai 2009; Luckai et al. 2012). Additions of CO_2 into the atmosphere from human activities are influencing the global C cycle, the forest C cycle and forest environments (Cubasch et al. 2013; Price et al. 2013; NOAA 2015).

[6] Atmospheric CO_2, also known as a greenhouse gas (GHG), is a factor in Earth's heat budget influencing planetary temperatures. Earth's average surface temperature is maintained by two large opposing energy fluxes between the atmosphere and the ground—or the greenhouse effect. Greenhouse gas molecules absorb thermal infrared energy (heat energy from the sun) and radiate this heat in all directions; some of it ultimately comes back into contact with the Earth's surface where it is absorbed (NASA n.d.).

Canada has a particular interest in forested lands and the role of forests and forestry in climate change mitigation. Canada's forests cover nearly 53% of the country's land base (NRCan 2014c) and contain globally significant forest C stocks (NRCan 2009b). Nearly three-quarters of Canada's forest and wooded land[7] are zoned boreal forest representing 30% of the world's total boreal forest (NRCan 2014a). Boreal forests (and temperate and tropical forests) are complex structures of ecological communities with their associated climatic biome fauna and flora ranging from soil bacteria to tree species. Boreal forest distribution, structure, composition, and ecological functions are highly influenced and determined by climate (Bhatti et al. 2003; Hopkins et al. 2012; Price et al. 2013). Changes in temperature, moisture, and atmospheric conditions affect forest biological processes, such as photosynthesis and productivity, as well as forest microorganisms and biotic communities, with subsequent effects in C sequestration.

The sensitivity of Canada's forest ecosystems to a few decades of minor climatic changes has already caused significant ecological responses (Ogden and Innes 2008). The mountain pine beetle (*Dendroctonus ponderosae* Hopkins) infestation in British Columbia is an example. Recent decades of favourable conditions for the insect due to climate change (reduced minimum winter temperatures, increased summer temperatures, reduced summer precipitation) increased the insect's population and extended the range of its

[7] Forests and wooded lands are those with a 5-10% tree canopy growing to 5 metres at maturity; wooded land also includes treed wetlands (swamps) and land with slow-growing and scattered trees (NRCan 2013).

habitat. This resulted in unprecedented devastation to the susceptible host, mature pine (*Pinus*) stands, over an area of 130 000 km^2 (Kurz et al. 2008a). The impact of the mountain pine beetle "converted the forest from a small net carbon sink [reducing CO_2 from the atmosphere] to a large net carbon source [adding CO_2 to the atmosphere] both during and immediately after the outbreak" (Kurz et al. 2008a: p. 987).

In addition to the significance of forests to cycle C in the global climate system, forests provide numerous economic and social benefits that support human well-being. These benefits include timber, non-timber products such as fibre, fuelwood and food, genetic resources and medicines, and cultural, spiritual, and recreational spaces (CIFOR 2008; MEA 2003, 2005; Seppälä et al. 2009; NRCan 2014g). Forests are also the homelands to millions of people (FFP n.d.a). In Canada, more than 2.5 million people live in the country's boreal forest zone (NRCan 2014a). As such, the ability of Canada's boreal forests to provide climate regulation, social benefits, and livelihoods directly affects people. Evidence that shows climate change is affecting Canada's boreal forests "should be major concerns to forest managers and policy-makers at all levels" (Price et al. 2013: p. 330). Decisions to adapt to and mitigate the risks of unwanted ecosystem changes will depend on the ability of policy makers to predict the consequences of their policy decisions with some degree of confidence (Carpenter et al. 2009). Yet, predicting the consequences of policy decisions and ecosystem changes in the future is highly challenging (Dale et al. 2001) given that socio-ecological systems[8] are subject to both gradual and abrupt changes (Folke et al. 2011).

1.1.2 Forests in the Climate Change Debate and Ontario's Approach

Societal approaches to address climate change include mitigation and adaptation measures. Mitigation involves reducing climate change itself through actions that limit greenhouse gas (GHG)[9] emissions into the atmosphere, whereas adaptation deals with efforts to limit human vulnerability to occurring and potential climate change affects (Mann et al. 2014). Although there are a number of approaches to address climate change, such as energy policies,[10] the use of forests or a biological approach is the backdrop within this dissertation.

International measures to offset global GHG emissions through forest C sequestration (CO_2 uptake and C storage) include the Kyoto Protocol (KP) and the United Nations (UN) Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (UN-REDD). Both initiatives flow from the 1992 UN Framework Convention on Climate Change (UNFCCC) and both commoditized C on a global scale—that is, both

[8] A socio-ecological system (SES) consists of 'a bio-geo-physical' unit and its associated social actors and institutions; they are complex and adaptive and delimited by spatial boundaries surrounding a particular ecosystems and their problem context (Glaser et al. 2008).
[9] Greenhouse gases are gases (e.g., carbon dioxide-CO_2) with the ability to trap and retain radiant heat from the sun in the atmosphere warming the planet and attributed to causing climate change (IPCC 2007.)
[10] Ontario's Green Energy Act (2009) was created to expand renewable energy generation (wind, solar, bioenergy) and to encourage energy conservation as a measure to mitigate climate change.

programmes pay for GHG[11] reductions, removals, and prevention in the atmosphere. While each initiative uses forests as a means to mitigate climate change there is a distinction between the two approaches. The KP is a *utilization* approach to reduce GHGs or CO_2 emissions and enhance CO_2 removals in the atmosphere. Under this approach, forest utilization is seen as purposeful enhancement in C sequestration such as the production of forest-based biofuels to displace fossil fuels and intentional forest management activities. The UN-REDD Programme is a *conservation* approach to reduce CO_2 emissions and enhance CO_2 removals in the atmosphere. Forest conservation is a measure intended to maintain forest C sequestration through protection. Reducing deforestation and forest degradation in tropical regions, particularly illegal harvesting and unsustainable forest harvesting practices, is the focus in UN-REDD (UN-REDD 2009). The UN-REDD approach to pay in carbon credits for forest conservation has been suggested as an option in developed countries like Canada with an extensive, globally significant forest cover (Bradshaw et al. 2009). The decades of dialogue in the international arena about the utilization and conservation of forests to mitigate climate change have influenced national and sub-national discourses and policy decisions.

In Canada, the debate around the use of forests to mitigate climate change has fallen into the two major camps—*utilization* versus *conservation*. In the first camp are those who promote managing forests for C through utilization.

[11] There are six identified GHGs within the UNFCCC; to standardize measurements, GHGs are converted to their equivalent in CO_2 warming potential and noted as CO_2 eq (IPCC 2007).

Utilization may include changing the length of time in harvesting rotations, growing trees specifically to store C, producing biofuels, and the storage of C in timber products (Colombo 2008; Galik and Jackson 2009; Chen et al. 2010); these approaches are discussed further in chapter 2. In the second camp are those who argue for conservation as a means to maintain forest C sequestration (Carson et al. 2009). Conservation, particularly setting aside large areas, protects forested areas from any large-scale industrial uses and designates them as parks with limited and restricted uses (Carlson et al. 2009; Tabor et al. 2014).

Globally, the combined area of parks and protected areas constitutes 12.2% of the planet's terrestrial landscape (UNEP 2010); marine protected areas cover 1.6% of global ocean surface areas (Wilkie et al. 2010). Canada's terrestrial protected areas now cover ~10% of the land base or about 1 000 000 km^2 (EC 2010) and ~56 000 km^2 or about 1% of Canada's marine environments (oceans and Great Lakes; FOC 2014). Parks with limited use, such as tourism, are the most common type of protected area in Canada (EC 2014). Forest utilization and/or conservation to address climate change affect forestry management decisions and forest-based communities.

1.1.3 Ontario's Climate Change Approach with the Northern Boreal Forest

In the early 2000's a massive mineral deposit was discovered in northwestern Ontario (500 km north of Thunder Bay, 1 000 km northwest of Toronto) in the centre of the study area. The multi-billion dollar deposit, called the Ring of Fire (ROF), contains a substantial chromite[12] deposit, along with valued metals of copper, zinc, nickel, platinum, vanadium and gold (Hjartarson et al. 2014). Economic estimates in GDP from mining in the ROF are between $6-10 billion in the short-term (10 years) and $14-23 billion in the long-term (32 years); employment projections range between 3 700 and 6 000 annual full-time equivalents (Hjartarson et al. 2014). The ROF is situated in one of the world's largest wetlands, the James Bay Lowlands[13] (Ecological Framework of Canada n.d.), raising concerns about the environmental impacts of mining on water. Other environmental concerns are associated with building transportation and energy infrastructure with potential adverse impacts on wildlife habitat and migration (Hjartarson et al. 2014; Venier et al. 2014), along with potential human disturbances to forest C-stores from development, including human-caused forest fires.[14]

The potential for forests to mitigate climate change was one issue raised in July 2009 when the Ontario Ministry of Natural Resources (OMNR; now called the Ministry of Natural Resources and Forestry (OMNRF)) introduced Bill 191, *With Respect To Land Use Planning and Protection in the Far North.*[15] The Bill passed into legislation as the Far North Act in 2010. The land base designated

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[12] Chromite is the key material in the production of stainless steel and the discovery is the first in North America in commercial quantities—significant enough to sustain mining activity for a century (Hjartarson et al. 2014; OBR 2012).

[13] James Bay Lowlands are an ecozone located in the Hudson Plain Lowlands.

[14] Human activity (e.g., all-terrain vehicles, welding tools can emit sparks) results in hundreds of forest fires annually and opening the north to development increases human-induced fire risk (OMNRF 2014a).

[15] The "Far North" is the legal title that pertains to the land base within the Far North Act (provincially legislated); First Nations in NAN consider the "far north" as part of their territorial lands within Treaty No. 9 (an agreement between First Nations and both federal and provincial Crowns).

within the Act is approximately 450 000 km^2 north of the 50^{th} parallel (the sub-Arctic) stretching across Ontario from Manitoba to Quebec (OMNR 2011). The area is abundant in natural resources with potential development in energy generation (hydropower and biofuels), forestry and mining (OMNR 2010).

The intent of the Far North Act (2010) is to develop the natural resources in a sustainable way while protecting at least 50% of the boreal forest within the Far North boundaries (more than 225 000 km^2) through interconnected forest areas that provides habitat for species (OMNR 2010) and “help maintain the Far North’s unique climate change-fighting properties” (OMNR 2011b). Few would dispute that many natural resources valued by societies or individuals are at risk of being depleted or destroyed by overuse and, if they are to be conserved, then protected areas are necessary (Wilkie et al. 2010). Setting aside 50% of the boreal forest in Far north Ontario in protected areas was driven by an environmental campaign promoting “proactive conservation” in ecological protection[16] (Burlando 2012).

In 2007, the Canadian Boreal Initiative (CBI)[17] and Boreal Songbird Initiative (BSI) sent a petition signed by 1 500 scientists from 50 countries (the majority were from Canada and the US) to Canadian government leaders,

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[16] Concerns about the preservation of biodiversity and ecological integrity resulted in the development of the Convention on Biological Diversity (CBD) considered as an international authority in global conservation goals. The approach for protection uses the World Bank ratio rationale (area protected to total surface area) as an indicator to ensure the overall goal of environmental sustainability in biological diversity (Brechin et al. 2010).

[17] The CBI stems from the Canadian Boreal Forest Framework promoting the establishment of a network of large interconnected protected areas covering about half of the country’s boreal forest. The International Boreal Conservation Campaign (Ottawa) acts as Secretariat for the Boreal Leadership Council (BLC 2017 http://borealcouncil.ca/).

federally and provincially. The letter stated: “There is a globally-significant responsibility to protect Canada's rich Boreal natural and cultural values, a responsibility embodied by the IUCN World Conservation Union's recommendation[18] that Canada and Russia do more to ensure the conservation of Boreal forest regions” (IBCSP 2010). Bradshaw et al. (2009) further argued that Canada has “a moral and global responsibility to create such reserves” (p. 5). Two years later, a report published by the CBI and BSI, *The Carbon the World Forgot* (Carlson et al. 2009), received international attention and moved the climate change discussion beyond tropical forest canopies towards the northern hemisphere and boreal forests. The report called for strong action to protect the boreal forest as a climate change mitigation measure because of its significant C storage in soils and peatlands. Advanced by Noss et al. (2012), who promoted large-scale conservation, the 50% land-based target for conserving biological diversity (and C storage) in the northern boreal took hold (Burlando 2012; Wilhere et al. 2012).

The land base within the Far North Act (2010) is the territorial homeland of Nishnawbe Aski Nation (NAN), the political-territorial organization (PTO) representing the 49 First Nations of the James Bay Treaty No. 9 and Treaty No. 5 (Ontario portion). NAN homelands cover two-thirds of the province of Ontario, spanning approximately 544 000 km^2 (NAN 2014a; see Figure 2, Chapter 3,

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[18] In 2004, the Natural Resources Defense Council, the Wildlife Conservation Society, the National Wildlife Federation, Defenders of Wildlife, the Nature Conservancy (NC-US), Canadian Parks and Wilderness Society (CPAWS), and the World Wildlife Fund Canada (WWF-Canada) sponsored a motion at the 2004 World Conservation Congress of the IUCN on the Conservation of Canada’s Boreal Forest (IUCN 2004, CGR.REC021, IUCN 2005).

Section 3). Thirty-two (32) First Nations within NAN are located in the area designated under the Act, making up 90% of the population (~24 000 people) in very remote communities[19] (NAN 2014a). Six First Nation communities—Eabametoong, Kasabonika, Marten Falls and Webequie, and two communities involved in this research collaboration—Neskantaga and Nibinamik are located near the ROF and also within the area designated under the Far North Act.

NAN First Nations are Cree, Ojibwe, and Oji-Cree people, recognized within Canada as “Aboriginal peoples” having Aboriginal and treaty rights recognized and affirmed by section 35 of Canada’s Constitution Act (1982). Both the Ontario and federal governments signed Treaty No. 9 (Gardner et al. 2012), which covers most of NAN territory and all the land within the Far North Act (2010). As such, governments in Canada (federal, provincial and territorial) have a constitutional obligation to consult with First Nations[20] regarding decisions about the development and use of territorial land that may potentially infringe Aboriginal and treaty rights. Supreme Court decisions[21] spelling out those obligations legally and justifiably put First Nations in a unique place at the centre

[19] There are no permanent roads into these communities. Communities are accessible by air all year round and seasonally on ice/winter roads and a few by river barge during the summer.

[20] Newman (2014, p.1) states that the Crown’s (federal and provincial governments) “duty to consult”, in its modern form, requires governments to take the initiative to consult with Aboriginal communities prior to government decisions that might affect Aboriginal or treaty rights.” The author points out arguments have been made that the “duty” is meaningless because governments have the ultimate authority to go ahead with a policy and approve projects. Governments, however, must take into account the issues identified by Indigenous communities during consultations as the Crown has the legal requirement to act in good faith (Gibson and Zezulka 2015).

[21] A number Supreme Court of Canada cases have upheld and/or defined Aboriginal and treaty rights and clarified the Crown’s duty to consult (Bergner 2010) —Sparrow v. British Columbia (1990), R. v. Marshall (1999), Delgamuukw v. British Columbia (1997), R. v. Powley (2003), Mikisew Cree First Nation v. Canada (Minister of Canadian Heritage) (2005), R. v. Sappier; R. v. Gray (2006), Tsilhqot’in Nation v. British Columbia (2014) and Grassy Narrows First Nation v. Ontario (Ministry of Natural Resources) (2014).

of discussions regarding territorial land, whether it is on resource development, forest management and conservation, or climate change mitigation (Kleer et al. 2011; Newman 2014). Canada also has a moral obligation to consult with First Nations on decisions that affect their territorial land and their communities as a signatory to the UN Declaration on the Rights of Indigenous Peoples (UNDRIP). UNDRIP's approach to consultation also includes the concept of free, prior and informed consent of Indigenous peoples before any resource development occurs in their territories (UNHR 2013; Hanna and Vanclay 2013).

In spite of legal decisions and evolving international law, Indigenous peoples remain vulnerable to political and environmental decision making that historically has excluded them (Davidson et al. 2003; Turner et al. 2008). During 1996-1999 Ontario's Lands for Life land use planning process failed to address numerous concerns raised by Indigenous leaders about the expansion of the protected area system in Ontario. This failure resulted in the Political Confederacy of the Chiefs of Ontario withdrawing from the process, "because the government was ignoring their concerns over 'land stewardship, jurisdiction, treaty and indigenous rights', and treating them as simply one more interest group" (Cartwright 2003: p. 121). The "taking-up" or setting aside of large areas in Indigenous territories to protect biodiversity and ecological services persisted through the 1990's and continues today in policy making.

In 2008, the government of Ontario announced the Far North Land Use Planning Initiative that later provided the legislative foundation to the Far North Act and the Act's requirement for a Far North Land Use Strategy (OMNR 2013).

The Ontario government held discussions on the role of the Strategy between 2008 and 2009 with NAN and Tribal Council representatives through the Oski Machiitawin Land Use Planning Technical Table. NAN participated in those discussions with Ontario regarding land-use planning and mining, including changes to Ontario's Mining Act (NAN 2010b) that, according to the province, "helped inform the drafting of the relevant sections of the Far North Act".(OMNR 2014 p. 4). NAN contends that:

> Despite discussions around land-use planning and other issues related to NAN homelands, Ontario unilaterally announced its intention to permanently protect 225,000 sq. km. of boreal forest in NAN First Nation territory and introduced Bill 191 (the Far North Act) in the Ontario Legislature on June 2, 2009 (NAN 2010b).

The Far North Act is seen by NAN as a unilateral decision made by governments, industry, and environmental groups[22] that continually exclude First Nations in the decisions concerning territorial lands and ignore Aboriginal and treaty rights (NAN 2015b). NAN opposed the Act (and Bill 191 that led to the Act) stating it was contrary to international agreements; NAN called for "adherence to international human rights standards" and UNDRIP regarding free, prior and informed consent (NAN 2015b). Burlando (2012) points out that civil society debates and influences in resource development and conservation may result in First Nations being isolated and excluded from the process:

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[22] NAN (2015) identified the World Wildlife Fund of Canada, CPAWS Wildlands League, Ecojustice, Environmental Defence, Environment North (a local organization), Forest Ethics, Ontario Nature, the Canadian Boreal Initiative, Ducks Unlimited Canada, and the David Suzuki Foundation as supporters of the Far North Act.

> The strategies and tactics used by non-state, transnational networks (i.e., national and international conservation organizations and private foundations) can undermine Indigenous–state relationships by shifting the negotiating positions—and thus the levels of political opportunity and access to resources—of Indigenous People (p. 14).

In the formation of the Far North Act (Bill 191) the engagement and influence of major transnational conservation organizations superseded the engagement of the First Nations[23] whose territorial land the policy affects and their protected rights under constitutional law. The boreal conservation campaign undertaken by civil society organizations including national and international environmental organizations mobilized public and political support (Burlando 2012). Driving the protection of large-scale “intact” forest systems are concerns over certain types of wildlife that require a large landscape like woodland caribou and the preservation of extensive undisturbed C sinks (Carson et al. 2009; OMNR 2011b). Indigenous lands in Ontario’s remote north provide these conditions that appealed to transnational conservation efforts and were set aside through the Far North Act (2010). The create-first-and-negotiate-later approach utilized in the establishment of conservation areas in the Far North Act, while applauded by environmental groups, has done little to dispel the concerns and scepticism of Indigenous peoples regarding the establishment of protected areas in Ontario (McDonald et al. 2012; Smith 2015).

[23] It was determined during Bill 191 Standing Committee hearings in 2009 that a number of groups were not included in the discussions in the run-up to the Bill’s announcement, while others, in particular World Wildlife Fund Canada, were consulted in the preparation of the bill (Legislative Assembly of Ontario 2009, Standing Committee Bill 191 Transcripts).

Along with political vulnerability, Aboriginal communities are vulnerable to the impacts of climate change (Davidson et al. 2003). Aboriginal communities are directly at risk from climatic changes in the forest ecosystems on which they rely for subsistence needs (food, water, fuel), economic generation (harvesting, trapping) and community identity (cultural, spiritual spaces). Northern NAN First Nations are living in a forested region that is expected to experience extensive changes in climate (Fischlin et al. 2007; Bradshaw et al. 2009; Price et al. 2013). The region is already experiencing climate change impacts affecting community safety, food and energy security, and First Nation people's traditional activities on the land (Golden et al. 2015). Engaging with First Nations to understand the effects of climate change, as well as mitigation and adaptation management activities on territorial land, is necessary to build collaborative relationships that ensure all forms of knowledge are considered in policy decisions (Peach-Brown 2009).

Colchester and La Rose (2010) argue that integrated and diverse sources of information are necessary for forest management and adaptation decisions to climate change. Indigenous knowledge (IK)[24] is important to assess climate change effects in forest ecosystems (Seppälä et al. 2009). Understanding the significance of changes in current conditions lies in knowing historical conditions. For Canada's Indigenous peoples, current ecological conditions

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[24] There are many terms and definitions of Indigenous knowledge (IK). I define it as a cumulative body of knowledge and beliefs, evolving by adaptive processes and handed down through generations (Davidson-Hunt and Berkes 2003; FAO 2013) regarding where Indigenous peoples live and their environment that is both generational and firsthand. The terms Indigenous knowledge and traditional ecological knowledge (TEK) and are used interchangeably.

represent significant losses. Historical conditions based on observations stemming from generations of living on the land are the benchmark for measuring these losses (Turner et al. 2008). This benchmark is relevant and necessary to measure ecosystem changes attributed to climate change. Given that NAN First Nations are knowledgeable about the changes on their territorial lands and directly affected by those changes, they need to be included in the policy processes and decision making to address climate change (Golden et al. 2015). The thesis examines mitigating climate change through carbon (C) sequestration and options in forest management to address climate change—namely forest utilization and/or conservation approaches, and First Nation observations of changes in the boreal forest attributed to climate change.

1.2 HYPOTHESIS AND OBJECTIVES

My research hypothesis is that using northern boreal forests in Ontario to address climate change is not achievable without the full engagement of the Indigenous peoples living in Ontario's northern boreal forest. Solutions to climate change using existing Western science[25] and policy approaches without the

[25] There is a general lack of agreement about what Western science actually is. Argued by Jamison "science" bears the imprint of the civilization in which it emerged; in this case, the western world that excludes the eastern world (e.g., China, India) and has several clear dimensions: philosophical, including both cosmological issues (dominant worldviews and attitudes towards nature) and epistemological questions ("objective," methods of discovery and rational); sociological (a particular institutional and organizational form); and technological (the industrial and post-industrial political economy integral to industrialization and globalization (Jamison n.d.). I use the terms western science and science interchangeably as defined above with a caveat—that is, the terms are based in western dimensions, but

Indigenous peoples living in the forest will not be effective. Limiting Indigenous peoples' involvement in policy decisions and/or excluding them from the dialogue perpetuates gaps in knowledge and perspectives in addressing climate change. This research provides a better understanding about climate change in Ontario's northern boreal forest by including First Nation observations of changes on the land attributed to climate change. It also furthers the discussion within Ontario in the climate change dialogue by including Indigenous voices in that dialogue.

The research objectives were developed in collaboration with NAN to benefit both research partners— the PhD student researcher and NAN (see Figure 1, Chapter 3). As such, the research objectives include: i) examination of current literature on the potential of boreal forests to sequester CO_2, and approaches to using boreal forests to address climate change (i.e., intentional management activities and conservation) or a western approach ; ii) to record Indigenous peoples' observations of changes in Ontario's northern boreal forest, thus adding to the body of knowledge on climate change in boreal forest environments; and iii) to examine First Nation perspectives (i.e., worldview) on climate change and climate change policy making in light of Ontario's forest conservation policy development to address climate change.

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recognize western science is also fluid and has evolved, including giving way to the involvement of other groups with first-hand knowledge in policy decisions (Hind 2014); there has also been a departure from its roots through introspection: feminist critique of science and gender bias, the emergence of developing countries and other world powers and their respective science communities (Jamison n.d.), and the recognition scientific "truths" change with time (e.g., the world is not flat).

1.3 SIGNIFICANCE OF THE RESEARCH

In the scientific literature much has been written about the potential for boreal forest C sequestration and forest management to mitigate climate change, including carbon trading (Apps and Marsden 2000; Binkley et al. 2002; Bhatti et al. 2003; Ramankutty et al. 2006; Garcia-Gonzalo 2007; Gibbs et al. 2007; Colombo et al. 2008; Ellerman and Joskow 2008; Galatowitsch 2009; Kurz et al. 2009; Sohngen 2009; van Kooten 2009; Stocks and Ward 2011; Richardson et al. 2012; Kurz et al. 2013; Lemprière et al. 2013; Price et al. 2013; Zha et al. 2013; Way and Yamori 2014). Other studies have focused on the risks, vulnerability, and adaptive capacity of Indigenous peoples, particularly in the Arctic, to climate change (Cruikshank 2001; Huntington et al. 2004; Dowsley 2009; Pearce et al. 2009; Ford et al. 2010; Lemelin et al. 2010a; Galloway et al. 2011; Park et al. 2012; Henry et al. 2013), and the roles of Indigenous peoples in forest management to address climate change, although mostly in tropical forests (Davidson et al. 2003; CIFOR 2008; Macchi et al. 2008; Swiderska et al. 2009; Hayes 2010; Devkota et al. 2011; Azizm et al. 2013; Bushley 2014; Chepngeno 2014). Literature on the engagement of Canada's First Nations in policy development with boreal forest management to mitigate climate change is sparse (Ogden and Innes 2008), as is literature on First Nation observations of changing boreal forest conditions in northern Ontario (General 2012; Tam et al. 2013).

A research study in collaboration with NAN regarding climate change has not previously been conducted, nor have observations of changes in the forest environment attributed to climate change been collectively recorded and reported from ten First Nation communities across the northern boreal region in Ontario. The study also examines First Nation perspectives about climate change and climate change adaptation. The Western concept of these terms are broadly used in climate change dialogues; however, for some Indigenous peoples whose land is being directly altered by climate change these terms are foreign, or not reflective of their worldview and may be culturally offensive. With First Nations collaborating in the research, the study uncovered a missing Indigenous perspective in Ontario's climate change dialogue.

I hope that this work will be utilized to address climate change in Ontario. The study examines changing climatic conditions in the boreal forest contributing to the discourse in using forests to mitigate climate change. The fieldwork adds First Nations' observations of rapidly occurring changes in the boreal forest that are relevant and applicable in understanding current and potential climate change impacts. The engagement and perspectives of NAN First Nations to address climate change are particularly important in light of Ontario's Far North Act (2010). The study examines First Nation perspectives on the terms in the climate change dialogue that are missing in Ontario's climate change discourse.

1.4 THESIS ORGANIZATION

The dissertation follows a manuscript-based format. It includes three journal articles in which the writer of the dissertation is the lead-author; a representative of NAN is a co-author in two of the publications—chapters 3 and 4. Each of the three articles contains a literature review relevant to its discussion that best fits the discussion as published. Therefore, a separate literature review in the dissertation is not included, and there may be some repetition in the chapters. In addition, the conclusions drawn in the journal articles are as published in each chapter.

Chapter 2, the first published paper,[26] examines utilization and conservation approaches in forest C management to mitigate climate change. The discussion includes the commoditization of C through the KP and sustainable development that may influence decisions about the approach to undertake. Since publication of Golden et al. (2011), Canada updated the country's GHG data (Table 1), revised its targets for GHG reductions, and made changes in Canadian policy and activities regarding measures to reduce emissions, including carbon trading. The article has been updated to reflect the current state of affairs. Despite the somewhat tentative future of carbon trading nationally and the falling worldwide price of C since 2010, C still has an economic value internationally (e.g., Doha Gateway Agreement, UN-REDD) and

[26] Golden, D.M., M.A. (Peggy) Smith and S.J. Colombo. 2011. Forest carbon management and carbon trading: A review of Canadian forest options for climate change mitigation. The Forestry Chronicle 87(5):625-635.

in provincial C policies. The Ontario government announced it is pursuing a cap-and-trade carbon trading scheme with Quebec and California (CBC News 2015).

Although Golden et al. (2011) discuss the influence of a C marketplace in managing Canadian forests, in the absence of a C market, the need for forest management decisions that place a value on C as a climate stabilizer remains. There is a planetary need to store and remove CO_2 from the atmosphere and as such, Golden et al.'s discussion on forest management choices to sequester CO_2 and potential trade-offs in other forest management values and objectives is relevant for policy decisions. Climate change affects resource development in the north although it is not a focus of this study. However, building permanent roads for resource access and extraction and as an adaptation strategy for remote First Nation communities has implications for forest C management.

The methodology chapter (chapter 3)[27] discusses Participatory Action Research (PAR) used in this study. PAR has been used in situations where change is needed to help people; PAR fosters new knowledge and increases the knowledge base that empowers the people involved (Boog et al. 2003). PAR engages people in exchanging knowledge, facilitates the examination of previously held knowledge, and opens new ways of looking at a particular situation (Boog et al. 2003). PAR is also a methodology being employed more often in research with Indigenous communities because it is inclusive and respectful (Grenier 1998; Berkes 2004, 2009).

[27] Golden, D.M., C.A. Audet, M.A. (Peggy) Smith and R.H. Lemelin. (2016). Collaborative research with First Nations in northern Ontario: The process and methodology. The Canadian Journal of Native Studies 36(1): 81-105.

Chapter 4 is a publication on the research results[28] based on the observations and perspectives from the ten NAN First Nations collaborating in the research. The publication discusses the direct impacts climate change is having on NAN First Nation communities and First Nation perspectives on “adaptation” and their engagement in Ontario’s decision to set aside land in the Far North in protected areas as a means of mitigating climate change. Observations and perspectives from people who follow an oral tradition have too often been utilized as data in science rather than as a stand-alone knowledge system or theory (Cruikshank 2001). Notwithstanding, the data contribution by NAN First Nations on the changing northern boreal landscape provides the scientific community with additional ground level evidence related to climate change. Furthermore, First Nation perspectives on climate change are relevant to Ontario’s climate change policy making by providing considerations and alternative terms in the dialogue that may improve policy making to address climate change.

The manuscript explores climate change impacts through the lens of “blue-ice” or a First Nation’s focus regarding a familiar condition on the land and a term embedded in the First Nation languages across the fieldwork area. The discussion also reframes climate change adaptation according to the First Nations’ perspectives and worldview. The discussion speaks directly to the research hypothesis that gaps in knowledge and forest conservation policy

[28] Golden, D.M., Audet, C.A. and Smith M.A. (2015). “Blue-ice": Framing climate change and reframing climate change adaptation from the Indigenous peoples' perspective in the northern boreal forest of Ontario, Canada. Climate and Development, 7(5), 401-413.

making in Ontario to mitigate climate change cannot be effectively addressed without the full engagement of First Nations living in the northern boreal forest. Indigenous perspectives on changes in northern boreal landscapes attributed to climate change are missing in the literature and First Nation perspectives on adaptation are missing in policy dialogues. The discussion supports the research hypothesis that gaps in science and policy making have resulted from not fully engaging NAN First Nations.

Chapter 5 provides conclusions, recommendations, contributions to knowledge, limitations, and areas for further research.

CHAPTER 2. FOREST CARBON MANAGEMENT

Golden, D.M., P.A. (Peggy) Smith and S.J. Colombo. 2011. Forest carbon management and carbon trading: A review of Canadian forest options for climate change mitigation. The Forestry Chronicle 87(5): 625-635.

Abstract: Forests have significant potential to mitigate climate change. Canada has 30% of the world's boreal forest. The ratification of the Kyoto Protocol commoditized carbon (C) on an international scale. To achieve Canada's emission reduction targets and mitigate climate change, the potential of forest C offset projects and forest carbon trading is being evaluation. Carbon trading and forest C management have economic and policy implications and potential trade-offs in other forest management objectives. We discuss how forest C management and trading can contribute to global efforts for atmospheric greenhouse gas emissions reduction through either utilization and/or conservation strategies.

2.1 Introduction

Canada's forests, the practice of forestry in them, and the rules for forestry offsets and the accounting for forest carbon (C) under the Kyoto Protocol (KP) can have major consequences for meeting this country's commitment to mitigating climate change. The United Nations Framework Convention on Climate Change (UNFCCC) led to the development of the KP, both international mechanisms through which the global human causes of climate change are addressed. Canada ratified the KP in 2002, which entered into force internationally in 2005, and committed itself to reducing emissions of six greenhouse gases (GHGs) to a combined 6% below its 1990 emissions levels (UNFCCC n.d.a). Canada (and the provinces within it) is a signatory to the Convention on Biological Diversity (CBD) and the UNCED Statement of

Forest Principles, and is a member in the Montreal Process and other environmental and sustainable development policies relevant to forest management.

The intent of the KP is the avoidance of or reduction in atmospheric GHG emissions and the removal of GHGs by C sinks, including forests (UNFCCC n.d.b.). Signatory countries agreed to submit annual GHG inventory reports to the UNFCCC on the six identified greenhouse gases—carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6)—generally derived from national energy statistics on the types and amounts of fuels combusted (Gupta et al. 2003). Emissions and removals due to land use change and optional (at present) emissions and removals due to forestry must also be reported; collectively, these are referred to as Land-Use, Land-Use Change and Forestry (LULUCF).

Canada's GHG National Inventory Report (NIR) by Environment Canada indicates that emissions have risen by ~21% since 1990; 592 000 kt (or 592 megatonnes; Mt) CO_2 eq.[29] in 1990, 734 Mt CO_2 eq in 2008 (EC 2010a), 699 Mt CO_2 eq.[30] in 2013 and 722 Mt CO_2 eq in 2015 (Table 1; EC 2017), excluding LULUCF estimates (EC 2014). In 2015, if LULUCF removals of 34 Mt CO_2 eq,

[29] Different greenhouse gases have different warming potentials, such as the ability to trap and retain radiant heat, in the atmosphere; e.g., methane gas (CH_4) has 25 times more warming potential than carbon dioxide over a 100-year time horizon; therefore, to standardize reporting, GHGs are converted to their equivalent in CO_2 warming potential and noted as CO_2 eq (IPCC 2007).

[30] The decrease in emissions was primarily due to decreases in the electricity and heat generation subsector and manufacturing industries (EC 2014a).

were included in the GHG report the total Canadian GHG emissions would decrease by 4.7% (EC 2017). However, the LULUCF estimates now exclude emissions from significant natural disturbances in managed forests (wildfires and insects; EC 2017).

Table 1. Greenhouse gas emissions; megatonnes carbon dioxide equivalent (CO_2 eq) for Canada's provinces and territories in 1990, 2005, 2013, and 2015 (Environment Canada 2017).

Province or territory	1990 greenhouse gas emissions (megatonnes of CO_2 eq)	2005 greenhouse gas emissions (megatonnes of CO_2 eq)	2013 greenhouse gas emissions (megatonnes of CO_2 eq)	2015 greenhouse gas emissions (megatonnes of CO_2 eq)
Country Totals	592	738	729	722
Newfoundland and Labrador	9.8	10.3	8.6	10.3
Prince Edward Island	2.0	2.1	1.8	1.8
Nova Scotia	20.2	24.0	18.3	16
New Brunswick	16.5	20.6	15.7	14
Quebec	89.8	90.2	82.6	80
Ontario	182.0	211.0	170.8	166
Manitoba	18.7	20.7	21.4	21
Saskatchewan	45.0	69.5	74.8	75
Alberta	174.6	233.8	267.2	274
British Columbia	51.9	64.4	62.8	61
Yukon	0.5	0.5	0.4	0.3
Northwest Territories & Nunavut	1.6	2.0	1.7	2.0

Canada-wide, the forestland component of the LULUCF sector was a net sink of 77.5 Mt in 1990 (forest LULUCF removals greater than forest LULUCF emissions) but a source during 2002 to 2007 (emissions greater than removals). The recent trend of forests in the LULUCF sector being a source is due to natural disturbances, accentuated in recent years by the large-scale mountain pine beetle (Dendroctonus ponderosae Hopkins) outbreak in British Columbia and Alberta (Kurz et al. 2008a), but also attributable to forest fires and wood removed from forests by harvest.

The inclusion of removals by the LULUCF sector recognizes that biological C sinks store C absorbed by plants and that human activity (i.e., forestry and agriculture practices) can affect the size of these sinks. However, while the KP recognises the importance of forests as C sinks (Binkley *et al*. 2002), the potential to claim forests as a climate change mitigation measure, instead of efforts for reductions at emission sources (e.g., coal-fired electricity generation), was so contentious that comprehensive forestry-based mitigation activities were capped and limited in the early stages of KP negotiations (Purdon 2009). In addition, initially KP accounting rules treated C in harvested wood as being completely released into the atmosphere as CO_2 at the time of harvest, even though it is known that the C contained in wood products in use and in landfills is increasing (Chen et al. 2008, Kurz et al. 2008b). The role of forests and forestry in climate mitigation is still a subject of debate in ongoing negotiations. Wood products as a C credit were reconsidered at the COP/21 in Paris, France in December 2015.

Under the KP, measures for reducing GHG emissions and GHG removal by sinks are to be achieved primarily through national actions (UNFCCC n.d.a). However, to assist countries in meeting their commitments, the KP established three international market-based mechanisms: i) emissions trading (ET), also known as the carbon market[31]; ii) the Clean Development Mechanism (CDM), in which an industrialized country invests in a sustainable development project in a developing nation to generate C credits; and iii) Joint Implementation (JI) that allows industrialized and emerging industrialized countries that are signatory nations of the KP to generate C credits from GHG reduction projects (UNFCCC n.d.a.). These three mechanisms established C as a commodity on a global scale.

Carbon trading provides GHG emitting entities, such as countries and industrial sectors unable to meet a GHG reduction target within a set commitment period,[32] the option to buy carbon credits to offset their emissions. Carbon credits are generated through actions and projects, including forestry projects, that avoid, reduce, or remove atmospheric CO_2 (or equivalent GHGs). The initial KP commitment period expired in December 2012 but an agreement to extend the KP was adopted at the UNFCCC Conference of the Parties (or COP) in Doha, Qatar in 2012—the 'Doha Climate Gateway'. The Doha agreement runs for another 8-year period that began January 2013 and maintains the established KP carbon trading mechanisms (UNFCCC 2014g). The net fluxes (gains or losses) of C attributable to forest management may qualify for credits or debits under a post-KP agreement (Houghton et al. 2012) that was negotiated at COP/21 in Paris, France in December 2015.

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[31] Carbon emission reductions, deemed carbon credits, are treated as a commodity that can be bought and sold.

[32] Each trading system defines its rules, GHG reduction requirements, timelines to reach a reduction target, penalties, etc.

While viewed as a step forward in climate change mitigation, these market-based mechanisms have been criticized. Criticisms of the KP and C markets have included: i) concern that market-based mechanisms may perpetuate the continuation of GHG emissions through the purchasing of C credits instead of actual emission reductions (i.e., fossil fuel emissions attributed to economic development will continue to rise; Purdon 2009); ii) uncertainty over whether C trading achieves real, permanent, and measurable emission reductions (Galatowitsch 2009); and iii) the weak role played by forest sinks in climate change mitigation policies (Binkley et al. 2002; Purdon 2009).

What are the considerations in forest C management in relation to other forest management objectives such as timber, biofuel, biodiversity, and recreation? How can C markets and the price of C credits influence forest management decisions? Will utilization and/or conservation approaches in forest management achieve these objectives? Will there be potential trade-offs and what might those trade-offs be? The discussion in this chapter does not provide definitive answers, but presents issues and challenges through a review of the literature on forest C management as a measure to mitigate climate change relevant to Canadian forests and the evolution of forestry in the C marketplace that may affect forest management decision making in Canada. The chapter's literature review was based on governmental, non-governmental and private sector websites, grey literature, as well as a review of the academic, peer-reviewed literature searched through Web of Science.

2.2 Canadian Forests and Carbon Management

The fact that forests sequester C and are an important component in the global C cycle makes them a potentially significant measure for climate change mitigation. Within Canada, a number of forest C initiatives have developed. One forest C sequestration project, established in Saskatchewan in 2002, consists of both planting understocked stands and creating “Forest Carbon Reserves”, where the harvest of otherwise operable stands is prevented, with the expectation that avoiding harvesting creates a larger C stock than harvesting and converting the trees to wood products[33] (Lemprière et al. 2002). In British Columbia, the Haida Gwaii “Climate Forest” project aimed to restore the coastal temperate rainforest to a C-rich old growth climax forest ecosystem.[34] There is a “Fifty Million Tree” southern Ontario afforestation project with the planting goal to be achieved by 2020 (Parker et al. 2009) and under the Far North Act in Ontario, large areas of the boreal are to be set aside from development, in part to protect C stocks from activities that might cause the stocks to be reduced.

The C market is viewed as a significant tool for reducing emissions worldwide (World Bank 2009); it is considered the most cost-effective measure to achieve emission reduction targets (King 2008; Galatowitsch 2009; Purdon 2009). A provincial example of forestry offsets is the launch by the Nature

[33] According to Price et al. (1997) and Ter-Mikaelian et al. (2008), managed Canadian forests can store more carbon than the same forests if unmanaged, depending on the frequency of stand-replacing disturbance.

[34] The pilot project was to create carbon credits through forest management activities by removing alder and replanting conifers along riparian waterways previously disturbed by harvesting (Ramsay 2007).

Conservancy of Canada of a large forest C project selling 700 000 tonnes CO_2 eq in C credits to the Pacific Carbon Trust in British Columbia (NCC 2011), at the time a Crown corporation, demonstrating the use of forest C and C trading for climate change mitigation. The Pacific Carbon Trust was shut down in 2013 due to governmental changes, issues with transparency, and most notable, projects funded for carbon credits did not meet the criteria of “additionally” (Nelson 2014). The following year the BC government resumed buying carbon credits in offset projects, such as forestry and fuel switching, under the Climate Investment Branch in the Ministry of Environment’s Climate Action Secretariat (PCT 2015). The terms in carbon trading, such as additionally are discussed further in the following section.

2.3 The Carbon Marketplace and the Evolution of Forest Carbon Credits

Carbon markets exist either because of governance mechanisms or as a voluntary measure in response to expected GHG emission regulations (Knox-Hayes 2009). The model for C trading is not new. A market-based system of C credits for emissions reduction is similar in concept to the allowances traded for emissions of acid rain-forming gases, which are controlled atmospheric pollutants traded in North American air sheds (EC 2005). Carbon credits, measured in units of metric tonnes of GHGs in CO_2 eq, are generated through either: i) project-based activities, also called offsets, which avoid, emit less, or remove GHGs that would have occurred had the project not been undertaken; or

ii) unused emission allowances[35] credited after an investment to reduce GHG emissions to achieve compliance (e.g., fuel switching or changes in industrial processes; King 2008; Galatowitsch 2009).

Despite the global economic slowdown in 2009, worldwide C transactions were valued at $144B USD (CTW 2010; World Bank 2010) and $120B USD in 2010 (BNEF 2011). Since 2010, C values per tonne significantly fluctuated. However, the volume in number of C credits traded reached record highs in 2012 and 2013, at 10.7 Gt and 10.1 Gt respectively (BNEF 2014). Emission trading schemes, in both regulated and voluntary market systems, which emerged to meet C credit demands in the absence of regulated markets, are developing at national levels. For example, China is running seven pilot projects to test its national program launch in 2016-2017 (Han et al. 2012). There are also trading schemes at the sub-national level, such as California's program in the U.S. and in Canada, Alberta, British Columbia, Ontario, and Quebec have legislated C trading systems (discussed further in section 2.4). All trading schemes define their own rules for trading and regulations for allowable C credits (Purdon 2009). However, standards for measuring, reporting and verification (MRVs) are set by internationally accepted standards, such as the Verified Carbon Standard (VCS n.d.). A detailed review of trading schemes is not possible; therefore only a discussion of forestry C credits is presented. Generating a forest C credit, through either utilization or conservation measures,

[35] Emission allowances are granted by a regulatory body in which subscribing entities must not exceed their allocated (allowed) GHG emissions. Entities reaching reductions below their allocation may retain the carbon credits for future use to meet compliance, or sell in the carbon marketplace.

(and whether regulated or voluntary) are forest management decisions in climate change mitigation.

Forestry has always been the lesser cousin in the C trading market, suffering from an “image problem” (Fehnse 2008) because so many issues hindered the implementation of forest sequestration projects. During early negotiations of the KP it was assumed that forestry C projects would reduce incentives to address the root causes of climate change, especially the development and adoption of low C-energy solutions (Tavoni et al. 2007), with some countries instead claiming large C sinks in their managed forests (Kurz et al. 2008b). The development of forestry C trading was also hurt by indecision on the criteria and rules to manage and account for C in forest projects funded under the CDM and JI (Schmidt 2009). Definitions for afforestation and reforestation, with respect to implementing Article 3.3[36] in the KP under LULUCF, and the subsequent C credits those forestry offsets could generate, varied between countries in terms of i) national definitions of forests and forest cover, and ii) from organization to organization (e.g., IPCC and the Food and Agriculture Organization; IPCC n.d.a). In the absence of agreement on definitions and rules forestry projects were excluded from the European Union Emissions Trading System (EU-ETS), considered the largest and most mature system in the offset marketplace (Purdon 2009), or penalized as “temporary” credits depressing demand for forestry offsets (World Bank 2009).

[36] Article 3.3 refers to carbon fixed in “new” forests established on land not forested in 1990, not existing carbon in forests or other forest C stores (Watson et al. 2000).

For forestry projects to be considered part of C trading, other issues also needed resolution including: i) additionality[37]—would the project not have happened otherwise or is the project different than business as usual? (Binkley et al. 2002; Purdon 2009); ii) permanence[38]—the longevity and stability of the C pool sequestered, as over time forests can switch between being a C source to a C sink (Tavoni et al. 2007; Galik and Jackson 2009); iii) leakage[39]—when emission reductions by an activity occurring in one area, such as bioenergy or conservation, inadvertently result in emissions in another location through increased harvesting or changes in forested land-use (Tavoni et al. 2007; Galatowitsch 2009); and iv) ownership—a difference between the tenure rights to use the land but not land ownership rights, thereby raising uncertainty about who has the right to sell C credits (Binkley et al. 2002; RRI 2010).

Along with these complicating factors, years of C trading has brought to light additional barriers to the development of forestry offset projects, including: i) difficulties in financing offset projects (Purdon 2009; World Bank 2009); ii) complicated and onerous project documentation requirements and registration processes, which add to transaction costs and create lengthy approval times (World Bank 2009); and iii) the need to incorporate the social and community aspects of sustainable development (Binkley et al. 2002; RRI 2010), as well as ecological soundness into projects (Galatowitsch 2009). van Kooten (2009) contends that terrestrial C sink activities, such as forestry offsets, require

[37] A change in existing activities or actions taken that "add" to carbon reductions, removals or avoidance.
[38] Permanence addresses the temporal scale (i.e., the timeframe for carbon to be sequestered).
[39] Leakage addresses the spatial scale (i.e., global changes in land-use and land cover.)

supporting institutions and mechanisms to be in place in advance of their inclusion in C trading systems.

It has been argued that the C marketplace itself hinders forestry projects. For small forest owners, a natural disturbance such as fire or an insect outbreak that reduces C stocks exposes forest owners to a liability for C sold but no longer held (Bigsby 2009; Galatowitsch 2009), thereby discouraging C market participation. In addition, forest offset protocols that calculate a project's GHG removal from the project onset to a standing forest (as long as 100 years), without addressing permanence, ignores the risk of potential C losses caused by disturbances, leading to the possibility of overestimating the project C value (Hurteau et al. 2009), thus reducing C market confidence. More recent forest offset project standards, such as the VCS, require a non-permanence factor (e.g., a set-aside forested area as part of the project) to cover losses from fire or insects (VCS 2011). Bigsby (2009) suggests that an alternative to the current project-based offset system (permanent stores of C on a defined land base with a one-time payment) would be a system of "carbon-banking". This would be similar to capital investment mechanisms, in which those delivering the C sequestered (a deposit) receive annual payments and those using the C offset (a withdrawal) make annual payments.

Despite the challenges, the use of forest sinks for offsets has increased. In 2007, 18% of voluntary C market trades (7.6 million credits) were forestry offsets; in 2008 the volume of forest offset trades increased, with many traders being first-time buyers of forest offsets (Neeff et al. 2009). In 2013, offset buyers in the voluntary markets purchased the majority (89%) of forest C credits (FTEM 2014). Along with growing interest in the voluntary market, forests as offsets are being addressed in regulatory and policy frameworks. This interest is seen in the inclusion of forestry offsets in the EU-ETS, reduced restrictions within the KP for CDM forest projects, and the consideration of wood products C as an allowable offset (UNFCCC n.d.b.). The EU adopted a legal framework in 2013 to work towards a system for monitoring the C balance in land use and defining the mitigation contribution from land post-2020 (European Commission 2014). The increased forest conservation efforts through UN-REDD are currently testing large-scale payments for ecosystem services to 10 beneficiaries (countries and sub-national jurisdictions) according to the amount of anthropogenic forest emissions they have reduced (UN-REDD 2010; European Commission 2014).

2.4 Carbon Trading and Forestry Offsets in Canada

Alberta was the first jurisdiction in North America to impose regulations to reduce GHGs and make use of emissions trading (Carbon Offset Solutions 2014) under the province's Climate Change and Emissions Management Act (2003), which came into effect in 2007. Alberta's scheme allowed forestry offset projects with the restriction that the offset project is within Alberta (C3 2009). Forestry offset protocols were under development with regard to conservation and/or restoration of wetlands and direct emission reductions (e.g., changes in wood processing technology). Avoided deforestation and improved forest management plans were not included (T. Maynes, personal communication.

Climate Change Central, Edmonton, AB, July 9, 2010). However, Alberta's forestry offset protocols have been retracted for review (AESRD 2014).

British Columbia's (B.C.) form of cap-and-trade mandated public sector organizations to reduce GHG emissions internally or purchase offsets from the Pacific Carbon Trust (PCT).[40] Allowable offset activities included afforestation using select seed sources that have faster growth rates and resistance to insects and disease, increased timber volume and C content and forest fertilization; offset projects were to take place in B.C. but now allow international offset projects[41] (BCMFR 2010). B.C.'s more recent carbon forestry offsets are forest management actions, such as the Nanwakolas forest carbon offset project[42] in the Great Bear Rainforest, that protect forested areas previously intended to be harvested (PCT 2015).

The Western Climate Initiative (WCI), a collaboration between four Canadian provinces—British Columbia, Manitoba, Ontario, and Quebec—and seven U.S. states—Arizona, California, Montana, New Mexico, Oregon, Utah and Washington—set a goal to address climate change on a regional scale in 2008 (WCI 2010). All US states withdrew from the WCI in 2011 with the exception of California. In the fall of 2014 the California Air Resources Board

[40] PCT was initially a Crown corporation but now the carbon registry is under the province's environment ministry (PCT 2015).
[41] Offset projects allowed in the trading system includes for example fuel efficient stove-switching in Ghana (PCT 2015).
[42] The Nanwakolas Council (or Nanwakolas Carbon Limited Partnership) includes the Mamalilikulla-Qwe'Qwa'Sot'Em First Nation, Tlowitsis Nation, Da'naxda'xw Awaetlala First Nation, Gwa'sala-'Nakwaxda'xw First Nation, and the K'omoks First Nation. Carbon revenues from the project are for the development of a local "conservation economy" (PCT 2015).

and the Québec Ministry of Sustainable Development, Environment and the Fight against Climate Change, announced their first joint cap-and-trade auction (WCI 2014). In Ontario, an amendment to the Environmental Protection Act (1990), Bill 195 to promote a cap-and-trade GHG trading scheme (Legislative Assembly of Ontario n.d.a), the Environmental Protection Amendment Act (Greenhouse Gas Emissions Trading) was passed into legislation 2009. In April 2015, the Ontario government announced it would be participating in a cap-and-trade system with Québec and California. Although the regulated sectors, rules and allowable offsets for the scheme are still in development (The Canadian Press 2015), offsets protocols are expected to be in line with those identified within the WCI (OMOE 2011).

In July 2010, the Accord, the WCI, and a third initiative, the Regional Greenhouse Gas Initiative (RRGI)—a mandatory capped CO_2 market-based scheme for the power sector in nine (9) states in the northeast and mid-Atlantic of the United States—joined in a cooperative effort to share experiences in the design and implementation of a regional cap-and-trade system. Afforestation, reforestation[43], forest management, forest preservation and/or conservation, and

[43] Definitions of afforestation, reforestation and deforestation (or conversion) vary in trading schemes; Under the KP afforestation is defined as direct human-induced conversion of land that has not been forested for a period of at least 50 years to forested land through planting, seeding and/or the human-induced promotion of natural seed sources; reforestation is defined as direct human-induced conversion of non-forested land to forested land through planting, seeding and/or the human-induced promotion of natural seed sources, on land that was previously forested but converted to non-forested land; and deforestation is defined as the natural or anthropogenic process that converts forest land to non-forest. For the first commitment period of the Kyoto Protocol, reforestation activities will be limited to reforestation occurring on those lands that did not contain forest on 31 December 1989 (IPCC 2000). Under the RGGI reforestation projects involve the restoration of tree cover on land that currently has no, or minimal, tree cover for at least 10 years, and avoided conversion forest projects (i.e., avoiding a land-

wood products are considered within this triumvirate of GHG emissions reduction networks (WCI 2010b). Reforestation, improved forest management, and avoided conversion (or deforestation) are offset projects allowed with the RRGI trading system.

In concert with offset credits as incentives to meet emission reductions, several Canadian provinces have introduced C taxes and fines for non-compliance under regulated emission regimes. Alberta levies a fine of $15 (CND) per tonne of CO_2 on large emitters that fail to reduce their emission intensity by 12%. In 2007, Québec was the first North American jurisdiction to introduce a C tax on fossil fuel distributors within the province. B.C. introduced a provincial C tax structure in 2008 that increased the price of C in increments of 5% per year, and C taxes reached $30 (CND) per tonne CO_2 in 2012 that will not increase until further review (Government of British Columbia n.d.). Manitoba implemented a $10 (CND) per tonne emission tax on GHGs released by coal-generated electricity facilities in 2012 and committed the tax revenues to assist coal-fired energy producers to transition to renewable biomass energy (Wherry 2012). As of January 1, 2017 Alberta has also initiated a carbon tax, or carbon levy[44], on all fuel sales that emit greenhouse gas emissions when combusted at a rate of $20/tonne in 2017 and $30/tonne in 2018 (Government of Alberta n.d.). A survey conducted in 2010 found preference was given to a combined C

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use change or deforestation) are only privately owned forested land that is legally transferred to public ownership for conservation (RGGI 2014).

[44] Alberta's carbon levy on fuels (e.g., gasoline, diesel) also provides rebates to households based on income (Government of Alberta n.d.)

trading and C tax system as a measure to reduced GHG emissions (McAllister Opinion Research 2010). A C tax that allows emitters to purchase offsets in lieu of paying the tax could generate the economic incentive that increases offset project development.

2.5 Factors in Decision Making for Forest Carbon Management and Carbon Trading

Dilemmas can arise when forest management is modified to maximize C sequestration, such as conflicts with other management objectives, ecological functions, and social or economic benefits (McCarney et al. 2008; Galatowitsch 2009). Management efforts to increase forest C may affect biodiversity (Krcmar et al. 2005). Changes in biodiversity, if considered an unacceptable outcome, may lead to tough choices for climate change mitigation. Forest C management may entail compromises between ecological and social values. Sustainable forest management is intended to ensure that an acceptable balance is achieved among these choices. There are examples of forest management achieving both sustainability and increasing C storage, while allowing logging (Garcia-Gonzalo et al. 2007; Neilson et al. 2007; Chen et al. 2010).

Issues in land ownership and cost-allocations-to-benefits faced by forest-based communities can affect implementation of C offset projects (Michaelowa 2007; Pinkerton et al. 2008). Moreover, decisions in offset projects have not always taken into consideration the knowledge of local people, although forest-dwelling people have for centuries managed their forests considering environmental impacts and social and economic benefits (Hawken and Granoff 2010). Local governance, by people who live in and rely on the forest for food, fuel and other benefits such as flood control—in conjunction with national or international authorities—may be more successful in delivering both C storage and co-benefits (RECOFTC 2009; RRI 2010). Recent discussions in Canada are exploring local decisions in making use of climate change modeling and risk assessments for climate change adaptation and sustainable forest management (Klenk et al. 2011).

In addition to fitting into current systems intended to satisfy multiple forest management and stakeholder objectives such as biodiversity and sustainability, the contributions of forests to climate change mitigation must be based on an understanding of the size and mobility of forest C stocks. Forest C is present in live tree biomass, in dead organic matter above and belowground, in forest soils (Kurz et al. 2008b), and, after harvest, in wood products and eventually in landfills (Chen et al. 2010). Significant uncertainty exists about the size of forest C pools, including that in the aboveground boles of live trees. This uncertainty reflects the fact that forestry in Canada has used empirical measurements of forests for more than half a century with the objective of determining the amount of merchantable volume in forest stands before they are harvested. Non-merchantable, aboveground live tree biomass, belowground live tree biomass, understory vegetation, downed deadwood, the forest floor and forest soil, while having been the subject of C research studies, are not routinely assessed in Canada's extensive managed forests. In addition, changes in forest C after disturbance and the ability to increase C sequestration through forest management are not well understood (Binkley et al. 2002; Gupta et al. 2003). This uncertainty has implications in decision making for forest C management.

Uncertainty about forest C sequestration potential is a major difficulty in determining the size of forestry offsets (Nair et. al 2009). Another source of error in C accounting is the default accounting procedure for harvested wood products (HWP) set by the IPCC, which counts wood product emissions as fully emitted at the time of harvest, when in fact oxidation of C in wood products takes years to centuries (Chen et al. 2008). Recently, the IPCC Guidelines have provided flexibility to include C storage in HWP if existing stocks can be shown to be increasing.

> Changes in carbon stocks in wood products could potentially be accounted as part of the activity that is the source of the wood products or as an independent wood products management activity. If management of wood products is treated as an additional activity under Article 3.4, then it may be necessary to exclude wood products from accounting under other Article 3.3 or 3.4 activities to avoid double-counting. Once wood products are in trade, they would be difficult in most instances to trace. The current IPCC default approach assumes that the wood product pool remains constant over time, and therefore does not account for it. However, if this pool is changing significantly over time, a potentially important pool may not be accounted for. (IPCC n.d.b: online).

Trading programs and C accounting standards can also influence management decisions. Galik and Jackson (2009) discuss the use of fertilization to increase forest C sequestration. Fertilization can increase forest biomass, but in allowable offset standards such as the VCS, accounting must include total project emissions, including life-cycle emissions from synthetic fertilizer production and use, which lowers the net GHG benefit (Galik and Jackson 2009), potentially discouraging fertilization as a management strategy to increase C storage. Understanding the complexity of the impacts of forest management decisions is increasingly dependent on methods such as multi-objective optimization models (e.g., Maness and Farrell 2004).

A variety of forest modelling tools will be needed to assist in decision making for forest C management and trading. One reason is the potentially long time frames of forest C projects, which will span what is expected to be a substantial change in climate. The northern boreal forest will probably be the first forest biome to experience large changes in climate (Fischlin et al. 2008; Bradshaw et al. 2009; Price et al. 2013). Boreal forests are expected to shift poleward to the north (Seppälä et al. 2009) and increase in growth through elevated temperatures and longer growing seasons (Thompson et al. 1998; Alam et al. 2008) provided other conditions, such as moisture and nutrients, are not limited (Johnston et al. 2006). Positive or negative changes in forest C sequestration are dependent on the nature of climate change within a specific region (Seppälä et al. 2009). As such, forest specific information on factors influencing emissions or the accumulation of C, such as eco-site climate, soil, tree density, species composition, and management practices, are essential to improve C modelling accuracy (Chen et al. 2000; Nair et al. 2009). Understanding how climate change will alter forest C stocks will be vital for medium and long-term forest management decisions in climate change mitigation.

2.6 Institutional Approaches in Climate Change Mitigation Using Forests: Utilization and Conservation

There is an intense debate between utilization and conservation approaches related to using forests as a mitigation measure. The utilization approach involves intentional activities to increase C uptake and storage to reduce atmospheric CO_2 and emissions. These activities may include the continuous storage of C in harvested trees as a product (e.g., timber) which is replaced as harvested trees regrow, increasing forest growth or C uptake by forest management activities such as planting resilient tree species or providing protection from natural disturbances and displacing conventional energy production through the use of wood biomass in place of more energy-intensive non-wood alternatives. The conservation approach promoting protected areas relies entirely on the accumulation of C from natural forest ecosystem processes to sequester and store C.

Sectors of Canadian society involved in this debate include governments, Canada's Aboriginal people, non-governmental and environmental organizations, and industry sectors and associations. Both utilization and conservation approaches present challenges and benefits as mitigation measures, and forestry activities and management to mitigate global warming hinge on the signals directed by C markets and climate change policy (Binkley et al. 2002). Options for generating C credits and increasing C sequestration outside of monetary incentives have been shown to directly affect forest management decision making.

In the debate about “what counts” as a forest C credit, or how C credits could be generated, it has been argued that a number of management and accounting practices that increase C stocks should be considered. Examples include flexibility in harvest rotations, whether shortened to reduce losses to natural disturbances or increased to extend C storage in forests (Galik and Jackson 2009), C stored in wood and other forest products (Colombo 2008; Chen et al. 2008), and crediting avoided emissions for wood products used in place of materials with greater GHG emissions such as construction materials (Lawson 2008).

Management for timber and C credits, when C prices are high, may lead to decreased timber harvesting (Backéus et al. 2006). When managing a forest for timber is less profitable than managing the same forest for conservation in C credits, “carbon investors will readily give away the potential financial returns from the timber investment to get low-price carbon credits” (Binkley et al. 2002). When timber harvesting and C credits are directly linked, the economics of forest C can change considerably. Colombo et al. (2007) estimate that between 2000–2100, managed Ontario forests could provide wood products storing over 360 Mt of C, equivalent to 15.9 Mt of CO_2 annually, while forest C stocks (or not harvesting) would increase over 100 years by 69 Mt C (2.5 Mt CO_2 eq annually). In this example, crediting C in forests but not in wood products would seem to promote reduced harvesting to store more C in forests at the expense of creating wood products. This point was demonstrated by Backéus et al. (2006), who projected that an increased price for C would decrease harvest levels. Both Backéus et al. (2006) and Colombo et al. (2007) assumed current forest management and climate would prevail over the next century, while it appears inevitable that timber production and forest C will be affected by climate change over this period.

Timber supply modelling using potential climate change scenarios shows that in the next 50 years North American timber production could decline as a result of climate induced dieback in forests (Seppälä et al. 2009), coupled with trends in decreased investment in timber production due to low market prices (Johnston et al. 2006). Decreased North American timber production could shift logging to other forest jurisdictions that may have less stringent controls on forestry practices, perhaps increasing global emissions from deforestation and/or missed opportunities for increased forest C storage in managed forests. While conservation in place of logging also increases C stocks, forest C eventually reaches a maximum in protected areas and is subject to loss by large-scale disturbance, whereas C in wood products is a relatively secure pool that continuously accumulates as forests regrow and are harvested repeatedly (Colombo et al. 2007).

Conservation also poses challenges. Reduced logging in one jurisdiction or removing large areas of forest from management may result in “leakage” (Sohngen 2009). Leakage results from pressures to log forests elsewhere to meet timber or biofuel demands that affect C stocks in another jurisdiction, thereby, having no net effect in global GHG reductions (NRCan 2007; Sohngen 2009). Moreover, if the supply of harvested timber for wood products is reduced, this could displace other wood products such as furniture or increase pressure for other, more energy-intensive building products using concrete and steel (NRCan 2007, 2013; Lawson 2008; Suttie 2008). This could unintentionally increase overall GHG emissions since, as reported for the United Kingdom, substituting one cubic metre of concrete/red brick with timber saves one tonne of CO_2, and maximizing timber materials in a typical house construction can reduce CO_2 emissions from 20 tonnes to 2.4 tonnes (Suttie 2008). Changing building codes, such as the recent Ontario Regulation 191/14, effective January 2015, allowing building heights up to six stories using wood frame construction (previously it was four stories), may displace substantial use of concrete and steel as construction materials.

A carbon-price link also exists between using forests for C storage and forest fuel products (Backéus et al. 2006). The expansion of the biofuels industry, including fuels from wood stocks, is anticipated to have substantial impacts on global C storage (Negra et al. 2008). The success of using forest biomass for energy will depend on: i) the economic viability of the biofuel supply, with secure markets and dependable supply chains; ii) social acceptance through stakeholder engagement in bioenergy development; and iii) demonstrated GHG emissions reductions, which include net reduced CO_2 absorption when changes in forest C are taken into account, the life cycle of emissions through forest operations and biofuel production, and the displacement of fossil fuel emissions (Elghalia et al. 2007; McKechnie et al. 2011).

Other studies have shown a correlation between the price of C and choice of biofuel feedstock. Backéus et al. (2006) showed that in Sweden optimizing the net present value of forest operations discouraged forest harvesting for biofuel at higher C prices. They concluded that the greatest financial benefit came if C was left in the forest rather than by harvesting trees, collecting harvest residues, or thinning to obtain biomass for energy generation in place of oil. However, the conclusions drawn by Backéus et al. (2006) are highly dependent on assumptions concerning decomposition rates, risk of natural disturbance, forest longevity, growth rates if not disturbed, and the type of fossil fuel being replaced. Thus, it is not necessarily straightforward to extrapolate these results from Sweden to Canada, or from one part of Canada to another. It has also been shown that the use of wood for bioenergy from forests that would otherwise not have been harvested, or from residues collected after harvest, increases net GHG emissions compared to coal when forest C impacts are factored into the GHG calculations (Manomet 2010; McKechnie et al. 2011). In addition, different forest biofuel feedstocks have different C emission profiles. Dead wood obtained after natural disturbances due to fire and insects in Canada could provide an increased volume of biofuel feedstock more so than woody residues obtained after clearcutting (Dymond et al. 2010). Although bioenergy generated from wood left after natural disturbances accelerates the release of

GHG compared to on-site decay, the energy is renewable and can act as a substitute for fossil fuels; its mitigation potential should be judged on the combined changes in forest C and the life cycle emissions of each biofuel feedstock type (Dymond et al. 2010).

Another area in the discussion of C and forest management is afforestation—converting land that is not presently forested to forest land. Although this discussion is more prevalent in other countries, research has been conducted in Canada investigating afforestation with hybrid poplar. Dominy et al. (2010) report that, while there are not enough private lands available to fully offset Canada's emissions through C sequestration by tree planting, afforestation, in conjunction with biomass to replace fossil fuels, is an option in the suite of possible mitigation measures for addressing GHG emissions targets. At trading prices under \$15/t CO_2 eq, the rate of return on investment (8% to 12%) is relatively low, but at expected higher future C prices (\$16 to \$32/t CO_2 eq),[45] in addition to benefits from wood fibre and other environmental services, the economics of afforestation could dramatically change (Dominy et al. 2010).

The susceptibility of much of Canada's forests to large-scale disturbance by fire or insect infestations strongly affects C stocks (Thompson et al. 1998; Hunt et al. 2010) and also needs to be considered in either utilization or conservation approaches to climate change mitigation. Greenhouse gas emissions from fires in Canada's managed forests have represented as much as

[45] Carbon prices range between a low forecast at \$15 per ton in 2020, \$25 in 2030 and \$45 in 2050, mid forecast at \$20 per ton in 2020, \$35 in 2030 and \$85 in 2050, and a high forecast price at \$25 per ton in 2020, approximately \$53 in 2030, and \$120 in 2050 (Synapse Energy Economics 2015).

45% of Canada's total emissions in a given period (NRCan 2007).[46] Forest management options for C sequestration in forests prone to stand-replacing disturbances causing potentially high C emissions require a suite of tools to meet the challenges of climate change mitigation. Forest offset policies and protocols that do not provide credit for forest C management, while including emissions due to natural disturbances, or rules that restrict or limit allowable C credits (e.g., C stored in timber), are likely to discourage the use of forest management or interest in developing forest projects to mitigate climate change.

IPCC guidelines for reporting C emissions under the UNFCCC considers natural, undisturbed forests, or unmanaged forests, as neither an anthropogenic C source nor sink, thus excluding these forests from national inventory estimations. However, the IPCC does provide guidance on reporting and estimating anthropogenic sources and sinks of greenhouse gases for managed forests (IPCC n.d.a.). At the 2011, UNFCCC COP/17 in Durban, South Africa, countries agreed on rules for the second commitment period of the KP (2013-2020) in LULUCF accounting. Improved accounting of emissions from HWP are allowed to be included and emissions from natural disturbances that are outside of human control can now be removed in reporting emissions from managed forests (EC 2013). Canada has chosen to remove these emissions in its UNFCCC reports.

[46] Accounting for changes in forest C was optional under the KP and Canada opted not to include forests in the first KP commitment period (2008–2012).

A critical component in implementing any policy or program for forest C management is to understand how economic incentives for C sequestration may affect the practice of SFM (McCarney et al. 2008). Key criteria for SFM in Canada include biological diversity and ecosystem productivity (CCFM 2006, 2008). Literature on managing the combined objectives of forest C management, timber and biodiversity is scarce (McCarney et al. 2008). According to McCarney et al. (2008), land-use specialization for timber and biodiversity, or timber and C, may be more effective in achieving management objectives. However, the price of C credits has an influence—when C prices are low, multiple-use forest management (timber, biodiversity, and C) is the optimal use, but when C prices are high, land-use specialization increases (McCarney et al. 2008).

A land-use approach for both protecting biological diversity and mitigating climate change is the establishment of protected areas, as conservation regions and parks. In Canada, 27.6 million hectares have been set aside as national parks (NRCan 2009a) and there is also a commitment through the Canadian Biodiversity Strategy to extend Canada's network of protected areas (biologically and geographically) to include "natural regions" not yet represented (Johnston et al. 2006). Added to Ontario's protected area efforts is the land now set aside within the Far North Act (2010).

Primary forests[47] are considered more resilient, with larger C stocks than forest plantations or modified natural forests (Thompson et al. 2009). However, primary forests in much of Canada's boreal forests are prone and adapted to fire disturbance (Thompson et al. 2009; Hunt et al. 2010), and climate change is expected to reduce fire intervals and increase fire size (Thompson et al. 1998; Flannigan et al. 2013). Nationally in 2014, fire occurrences were below average; however, the area burned was more than twice the 10-year average (NRCan 2014d). Thus, stand-replacing disturbances could potentially keep substantial forested areas in younger stands with lower C stocks (Hunt et al. 2010). Studies on Canada's forests have shown that in areas prone to high levels of natural disturbance, fire suppression in managed forests may result in higher C stocks than in primary forests (Kurz et al. 1997; Price et al. 1997). Conversely, fire suppression contributes to higher fuel loads and larger emissions when fire does occur (Carpenter et al. 2008; Stocks and Ward 2011). Although boreal forests have a broad genetic variability (i.e., the diversity of genetic traits within populations of species) and are highly adapted to and able to recover from regular disturbance (Thompson et al. 2009), ecosystems may behave unpredictably with changes in climatic conditions (Hannah 2010). The boreal forest of today may not be the forest on the landscape in 100 years.

According to Johnston et al. (2006),

[47] Primary forests as defined by Thompson *et al*. (2009) are forest/other wooded land of native species, where there are no clearly visible indications of human activities and the ecological processes are not significantly disturbed.

> an interpretation of existing policy and planning frameworks in Canada suggests that protected area management plans tend to support continued protection of current ecological communities, while the definition of ecological integrity, in contrast, supports protection of the processes that would facilitate ecosystem adaptation to climate change (p. 33).

Many terrestrial protected areas are in locations threatened by changing climatic conditions (Hannah 2010). Protected areas face multiple stresses and synergies between existing stresses, such as habitat loss, invasive species and moisture changes that have not been factored into ecological modelling for the potential impacts of climate change. Fewer adaptation options exist for protected areas than for actively and extensively managed lands and waters (Johnston et al. 2006). Although forest conservation is perceived as a viable, if not preferred option, to address climate change (and biodiversity protection), it is not a panacea. As explained by McShane et al. (2011):

> it remains rare that the full range of possible trade-offs are acknowledged in communications with funders, policy-makers, and the public, or explicitly discussed as conservation interventions are sought. On the contrary, the pressure to act, and the undesirability—at least from a politician's or donor's point of view—of acknowledging possible downsides and losses can lead conservationists to feel the need to offer optimistic win-win scenarios about the feasibility of addressing multiple agendas. Failing to be open and explicit about trade-offs can thus occur even when conservation practitioners are themselves quite aware of some of the potential downsides of a given scenario or proposal. (p. 967).

The conservation of forests as a climate change mitigation strategy may require reassessment of the set-aside land, redefining "natural regions" (ecological integrity vs. biogeography), and the development of terms for protection in managed and unmanaged forests.[48] To use protected forests for their ability to store C with the changes brought about by climate change may well require management intervention, rather than simply excluding management.

Numerous options exit to manage and maximize forest for C sequestration (Galik and Jackson 2009). Some are designed for immediate or short-term benefit and others are intended for long-term C sequestration potential (Sohngen 2009). Sequestration through forestry does not create permanent stocks, but it can provide time to perhaps delay global warming impacts (Backéus et al. 2006). Uncertainties with climate change will require robust, adaptive forest management strategies at multiple scales with broad management tools in order to be responsive and adaptive to changing conditions, mitigate adverse impacts, or capitalize on opportunities (Baron et al. 2009, Innes et al. 2009).

2.7 Conclusions

Forests are essential both for sequestering C to mitigate global warming and for providing ecological service and human benefits. Climate change could result in significant changes in the ecosystem services provided by forest with impact to both managed and unmanaged forests. International agreements to

[48] As defined in Canada, "unmanaged" forests are those outside the boundaries of what is considered a "managed" forest. Forests are considered a managed forest by the systems of practices in that area. The range of management practices vary from commercial timber production to stewardship for non-commercial purposes (NRCan 2015).

address climate change through market-based mechanisms and the protection of forest ecosystems are complicated by the diverse and complex nature of global forest and C dynamics. A silo perspective, or insufficient integration of decision-making within the forestry sector or across sectors, impedes the inclusion of forestry in climate change mitigation. Climate change is a global concern and national or regions policies affecting forest C that do not take into consideration impacts on global forest C may not achieve the intended results for mitigation of climate change.

Six years of forest C trading have brought to light the inadequacies and inconsistencies in forestry offset protocols and trading system rules. The and potential influence C markets have in forest management decisions has also come to light. Further challenges are hidden in the unintended effects and conflicts with forest management objectives when forestry climate change mitigation projects are implemented.

In our view, both utilization and conservation of Canadian forest can be appropriate climate change mitigation strategies, depending on the regional characteristic of forests, especially the incidence of stand-replacing disturbances. Utilization of forests to increase combined C stocks in forests and wood products cannot be ignored, especially as such utilization provides security against the large and direct GHG emissions caused by forest disturbances. A strategy for forest protection in Canada can also play a part in a national forest strategy for climate change mitigation. However, even with protection of forest, large-scale disturbances are a reality that can turn protected forest from C sinks into C sources for certain periods. Furthermore, long-term protection form all forms of disturbance will affect the biodiversity of disturbance-dependent Canadian forest.

Forest C sequestration and forestry offset activities may contribute to the goal of GHG emissions reduction and the objective of slowing the rate of global warming. However, forest C reductions cannot replace the need to reduce GHG emissions from the burning of fossil fuels. Uncertainties about the timing and extent of climate change will require robust, adaptive forest management strategies, incorporating a suite of options responsive to changing climate. With the threat posed by climate change to the sustainability of Canadian forest, uncertainties need to be removed about the stability of C markets and rules for forest offset projects so that climate change mitigation efforts using forests can be pursued; all the tools in the tool box to mitigate climate change need to be employed.

CHAPTER 3. METHODOLOGY

Golden, D.M., C.A. Audet, M.A. Smith (Peggy) and R. H. Lemelin. 2016. Collaborative research with First Nations in northern Ontario: The process and methodology. The Canadian Journal of Native Studies 36(1): 81-105.

Abstract: The northern sub-Arctic (above the 51st parallel) in Ontario, Canada is the traditional homelands of Cree, Ojibwe, and Oji-Cree First Nations, and members of the political organization Nishnawbe Aski Nation (NAN). The research philosophy "CREE": C–capacity building, R–respect, E–equity, and E–empowerment underpinned the methodology, Participatory Action Research (PAR). Principles of Indigenous methodology (IM) evolved during the research 'bridging' PAR and IM with First Nations as research partners. The benefits and lessons learned are woven into the discussions and aims to present best practices for collaborative research with First Nations in examining climate change.

3.1 Introduction

The importance of engaging with Indigenous peoples[49] in climate change research is evident. Studies have brought attention to the valuable knowledge of Indigenous peoples in climate change adaptation and mitigation (Cruikshank 2001, Macchi et al. 2008), the adaptive capacities of Indigenous peoples to climate change (Devkota et al. 2011, Galloway McLean et al. 2011) and in the 'co-production of knowledge' on climate change (Berkes 2009). Other studies have discovered drawing on Indigenous knowledge produces a better

[49] We use three different terms in our discussion: "Indigenous", which is accepted in the international arena as spelled out in the UN Declaration on the Rights of Indigenous Peoples, 2006 (and adopted by Canada in 2010). "First Nation(s)", which has no legal definition but has come to be the accepted term for "Indian Bands" and "status Indians" under Canada's Indian Act (INAC 2002); "Aboriginal" which is defined in Canada's Constitution Act, 1982 to include "Indians, Métis and Inuit" (we use the term Aboriginal when we mean to be inclusive, following the Constitution Act). We therefore use these terms interchangeably. Outside of state definitions, First Nations in this study consider themselves to be Ojibwe, Cree, and Oji-Cree Nations of people.

understanding than Western knowledge and scientific methods alone, despite the challenges with integrating the two knowledge systems (Cochran et al. 2008; Bohensky and Maru 2011). Increasing there is the recognition that local and Indigenous knowledge fills gaps in scientific knowledge in remote or hard to access environments, particularly in areas of high environmental priority (Brook and McLachlan 2008). Incorporating the depth and breadth of traditional ecological knowledge (IK)[50] provides invaluable insight on the historic and current status of the land (i.e., biophysical, flora and fauna) and across large geographic areas. Argued by Dowsley (2009) this insight not only expands scientific knowledge, but is necessary in forming appropriate policies in rapidly changing environments. The growing literature from Indigenous scholars also places local experiences in a broader context and is therefore relevant as a knowledge paradigm parallel with Western knowledge (Henry at al. 2013) to address climate change.

In recent years, Nishnawbe Aski Nation (NAN), a political territorial organization (PTO) representing 49 First Nations in Ontario, Canada, recognised the importance of addressing climate change and its impacts on their communities. First Nations in NAN are Cree, Ojibwe, and Oji-Cree people and parties to the historic Treaty No. 9 and No. 5 (Ontario portion); their territorial homeland covers 2/3 of the province of Ontario spanning ~544 000 km^2 (NAN

[50] There are many terms and definitions of TEK. We define it as a cumulative body of knowledge and beliefs, evolving by adaptive processes and handed down through generations (Davidson-Hunt and Berkes 2003; FAO 2013) regarding where they live and their environment that is both generational and first-hand; TEK and Indigenous knowledge are used interchangeably in our discussion.

2014). NAN First Nations are predominantly forest-dwelling Aboriginal people and the rapid and unpredictable changes on the landscape related to climate change are influencing their traditional activities, food and energy security (Lemelin et al. 2010a; 2010b; 2010c; Golden et al. 2015). This paper presents the process and methodology of our collaboration and reviews the fieldwork experience with First Nations in northern Ontario to examine climate change on territorial land. The research collaboration applied Participatory Action Research (PAR) and was supported by the methodological philosophy “CREE”: C–capacity building, R–respect, E–equity, and E–empowerment (Lemelin and Lickers 2004). The research experience and lessons learned from the collaboration are woven together in the discussions; some research findings are also included in the discussion. The aims of this paper are to evaluate how the research method worked, or did not work, in practice and present best practices for collaborative research with First Nations affected by climate change.

During a study the researcher and the research participants are interrelated (Creswell 2007) and interactively exchange data during the research process (Charmaz 2006; Bernard and Ryan 2010). The recognition that researchers and participants are interrelated and interactive contributors in research presents the opportunity and basis for research collaborations. Research collaborations provide the space and avenue to exchange, on the one hand, a better understanding in the premise and requirements in academic research, and on the other, guidance in research inquiry that is sensitive and beneficial to everyone involved. Past research with Indigenous peoples (and other vulnerable or marginalized groups in society) has not always been respectful, indifferent, and at times, unethical (Cochran et al. 2008).

Fortunately, there has been a shift in the research community with major strides towards cultural sensitivity and implementing human rights (see TCPS-2). Learning about a culture, their customs and history is as important, if not more so, as studying research methodologies and techniques prior to devising a research project or proposal for research. Awareness in the customs of Indigenous peoples and the use of appropriate tools and language for learning exchanges is essential in cross-cultural research (Golden et al. 2015).

In our experience, the collaboration for research began at the onset with the academic researchers approaching NAN to develop a research relationship to study climate change within their territory. Objectives of the research include: i) documenting observations by community members of changes occurring in the forest related to climate change, ii) examine First Nation engagement and perspectives in current policy approaches to mitigate, or lessen climate change, iii) examine the science literature in the potential for the northern boreal forest to mitigate climate change, and iv) build capacity within NAN communities on the topics in forest and climate change science. Throughout the research, and hereafter in this paper, the university researchers and NAN are referred to as the ‘research team’. Team members are contributors to this paper.

The discussion presents PAR from: i) NAN’s perspective as an umbrella organization to consider and participate in the research as the facilitator and gatekeeper, ii) as a methodology for research with Indigenous peoples and, iii) the effectiveness and practice of PAR in the research collaboration and fieldwork with the First Nation communities in northern Ontario. Also discussed are the principles in Indigenous methodology (IM) that evolved during the research with First Nations as a research partner. PAR allowed for the "bridging" of the Western methodology to meet IM. Although the link was not intentional, nor expected, the openness in the approach to the research project and fieldwork enabled the connection. The research philosophy guiding the studying, "CREE" (Lemelin and Lickers 2004), is also discussed.

3.2 THE SETTING AND APPROACH FOR RESEARCH

3.2.1 Nishnawbe Aski Nation—History, Political Structure and Governance

Nishnawbe Aski Nation (NAN) was formed in response to both colonial federal actions and evolving First Nations political actions that took place in Canada during the early to mid-20th century. The Crown of Canada "made treaty"[51] with Cree and Ojibway people living in northern Ontario (Long 2010): the James Bay Treaty No. 9 in 1905 (with adhesions[52] in 1929 and 1930), and Treaty No. 5 in 1875 (with an adhesion in 1910). In exchange for "sharing" vast tracts of their territory,[53] First Nations were promised remuneration, health care,

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[51] "Made treaty" is a First Nations reference regarding entering into Treaties.
[52] Adhesion is the formal addition of territory land and native peoples under an original Treaty.
[53] The issues around land claims and First Nation perspectives on making treaties are complex and difficult to express without the potential for a debate; "sharing" is a description of intent in making treaties but we do not suggest or imply legal meanings or interpretations.

schools and education, and awarded parcels of land ('reserves') that would be set aside from encroachment by European settlers (Natcher et al. 2009).

Shifts from traditional economic systems[54] to resource exploitation and extraction,[55] health impacts from exposure to foreign diseases, and detrimental social effects from community displacement due to colonization[56] took a huge toll on Indigenous populations in Canada and globally (Morrison 1986; Lee 1992; Sachs 2003). Moreover, First Nations were excluded from the democratic processes afforded to other Canadians in policy development and political decision making with no right to vote until 1954 and 1960, when all adult 'status Indians' in Ontario were formally given the right to vote in provincial and federal elections[57] respectively (Coyle 2005). It was during the late 1960's that NAN First Nations began to undertake political actions to regain control of their rights and governance (NAN 2015).

NAN was formed in 1973 under the name Grand Council Treaty No. 9 and renamed in 1981. NAN's founding members developed and submitted to the Ontario government a "Declaration on Principles and Rights":

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[54] The fur trade is an example of a major economic shift which occurred. First Nations began to travel to British and French trading posts that were not along traditional nomadic routes (e.g., Moose Factory); devoting most of their time hunting for fur and travel to trade, they did not have time to hunt for food, shifting the economy based on "shared" resources (i.e., food for a community), to an economy based on "individual profits" from furs and buying food. Source: Dunn and West. 2011. Effects of the fur trade, *in* Canada: A Country by Consent http://www.canadahistoryproject.ca/1500/1500-13-effects-fur-trade.html.

[55] In 1787, beaver skin exports from Canada to Europe, Russia/Prussia, Asia, and N. Africa totaled 139,509 pelts. Source: McGill University http://digital.library.mcgill.ca/nwc/history/01.htm

[56] Canada was colonized by the British and French; definitions of colonization are "to take control of (an area) and send people to live there" http://www.merriam-webster.com/dictionary/colonization and the physical process of a state putting its government in charge of a foreign place to gain control of its people and resources.

[57] Legislative Act to Amend the Canada Elections Act, S.C. 1960, c.

> In order to regain our freedom, we must establish our own control and return to our traditional Philosophy of Life. We recognize only one ruler over our nation–the Creator, who made us part of nature. We are one with nature, with all that the Creator has made around us. We have lived since time immemorial, at peace with the land, the lakes and rivers, the animals, the fish, the birds and all of nature. We live today as part of yesterday and tomorrow in the great Cycle of Life. ... (NAN 1977)

This statement guides NAN's current objectives which include, but not limited to, political advocacy to improve the quality of life for the people of NAN in the areas of education, lands and resources, health, governance and justice, and improving awareness and sustainability of the strong traditions, culture, and language of the people of NAN through unity and nation building (NAN 2014).

There are 49 First Nations in NAN representing ~45 000 people living on and off reserves (NAN 2014) and each First Nation elects a Chief and Council. The Chief of each community is part of the NAN Chiefs-in-Assembly who are responsible for overall political advocacy and lobbying for NAN territory. NAN Chiefs-in-Assembly operate on a nation-to-state basis with Canada and a government-to-government basis with the Province of Ontario.

3.2.2 The Basis for the Research Participation

NAN Chiefs-in-Assembly (previous, current and future) hold a spiritual connection and interest in their territorial forests and watersheds of five major rivers—the Moose, Albany, Attawapiskat, Winisk and Severn —flowing north into James and Hudson Bays. The Chiefs' involvement in protecting the last great stand of black spruce forest (Picea mariana (Mill.)) in the Reed Tract during the era of the *Commission on the Northern Environment* in 1975 is but one example of NAN's stewardship activities (Suffling and Michalenko 1980).

Of late the Chiefs-in-Assembly (Keewaywin)[58] have discussed the observed impacts of climate change on their land affecting their ability to depend on traditional methods of sustenance, maintain modern winter roads to transport goods and supplies into their remote communities, and implement communication technologies and information services (i.e., cellular towers, internet). NAN communities recognize that although they have contributed the least to climate change, they, like many other Indigenous peoples around the world, could be the most affected as close and direct users of the land (Macchi et al. 2008) and experience a disproportionate burden to the adverse impacts (Ford et al. 2010).

NAN First Nations living in the boreal forest[59] are located in one of the most vulnerable ecosystems to climate change[60] (Fischlin et al. 2007, NRCan 2011). Boreal forest ecosystems are greatly dependent and influenced by fire[61] however, fire-prone conditions are predicted to increase across the country potentially doubling the amount of area burned by the end of this century, and

[58] Keewaywin takes place twice a year, or as needed, over three days. It is a gathering of Chiefs, Elders, the Women and Youth Councils and others to discuss issues relevant to the people of NAN, share ideas, stories, food, cultural practices and time with community members from across NAN territory.
[59] Canada has 30% of the world's boreal forest (NRCan 2009).
[60] "Canada recorded the highest anomaly value in [North and Central America] of +1.3 °C 2001-2010" and was the warmest decade recorded. WMO. 2013. WMO-No. 1103. The Global Climate 2001-2010: A Decade of Climate Extreme, pg. 9. Available at http://library.wmo.int/pmb_ged/wmo_1103_en.pdf
[61] Boreal forests have a broad genetic variability in the diversity of genetic traits within populations of species and highly adapted to and recovers from natural disturbances, such as forest fires Thompson et al., 2009. Secretariat of the Convention on Biological Diversity, Montreal. Technical Series No. 43. 67 p. Available at http://www.cbd.int/doc/publications/cbd-ts-43-en.pdf.

will very likely alter the boreal ecosystem (Flannigan et al. 2008; NRCan 2016). In recent years NAN communities have experienced a number of severe threats from forest fires, and flooding from ice jams, necessitating both repeated and frequent emergency evacuations.[62]

In 2008, the Chiefs-in-Assembly passed a resolution mandating NAN to advocate for the development of programs for their communities to assist in climate change adaptation and impacts, as they felt many government-initiated programs had not been reaching their First Nations at the community level. The Chiefs had also been following international responses to climate change and domestic policy responses by the governments of Canada and Ontario, including Canada's participation in the Kyoto Protocol[63] and Ontario's conservation approach to address climate change within the Far North Act, 2010;[64] all of the land area within the Far North Act is NAN traditional territory. The Act stipulates that along with sustainably developing the natural resources (e.g., forestry, mining), set a goal to put aside ~225 000 km^2 (~50% of the land

[62] Recent fire and floods in NAN First Nation Communities: CBC News, July 21, 2011. Ontario evacuees scattered as fires rage http://www.cbc.ca/news/canada/story/2011/07/21/ontario-forest-fires-evacuation-ottawa.html; Ottawa Citizen, May 11, 2013. Flood evacuations continue at Attawapiskat First Nation http://www.ottawacitizen.com/news/Flood+evacuations+continue+Attawapiskat+First+Nation/8372101/story.html; CTV News, May 27, 2013 Northwestern Ont. First Nation declares state of emergency due to flooding http://toronto.ctvnews.ca/northwestern-ont-first-nation-declares-state-of-emergency-due-to-flooding-1.1298927 ; Chiefs of Ontario, Update on First Nation Fire Evacuees, http://www.chiefs-of-ontario.org/node/200

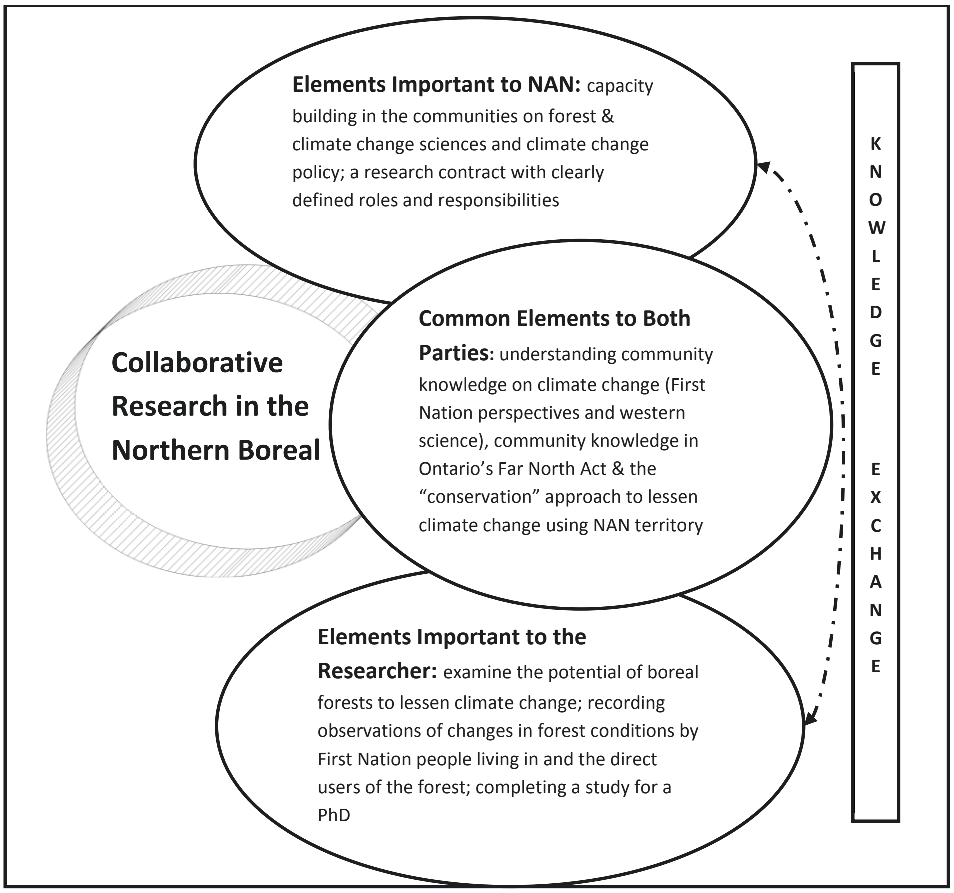
[63] Canada withdrew from the Kyoto Protocol in 2010 and at the moment pursuing a sector-by-sector approach to reduce greenhouse gas emissions (i.e., the Cancun Agreement).

[64] Far North Act, 2010, S.O. 2010, c. 18. See: http://www.mnr.gov.on.ca/stdprodconsume/groups/lr/@mnr/@farnorth/documents/document/stdprod_071241.pdf

base) for conservation of wildlife habitat and as a measure to mitigate climate change.

When NAN was contacted in 2009 by the academic researchers to jointly develop a research project on climate change, NAN recognised the relevance and collaborative approach being presented to conduct the research—both NAN and the researchers could make recommendations on how the study would be developed. It was important to the research team that the research be a two-way information and knowledge exchange between NAN communities, their leadership and community participants, and that the participants “believe in their capacity to conduct research and trust that the information existing within the community is valuable” (LaBoucane-Benson 2004). A suggested checklist by Grenier (1998) for researchers working with Indigenous peoples entails: fully involving community management structures in developing the research project, establishing guidelines on the responsibilities of each party, being clear about the community's role in the review of research reports and stipulating how research findings will be made available to the community, how it will be released to others, co-authorship in research publications, and co-dissemination of the research results at workshops and conferences. Through the collaborative efforts by the research team the study sought and attained all of the above.

After further discussions to identify NAN’s research needs (Figure 1.0), a formal research proposal was submitted to NAN’s senior executive and administrative staff. In formulating a recommendation to the Chiefs-in-Assembly about involvement in the research project, NAN’s staffed weighed the research proposal on a number of factors, notably these two: i) its ability to build capacity at the First Nation community level on climate change topics within the scope of the research, and ii) the recognition of First Nations' Aboriginal and treaty rights[65], and in particular, to obtain free, prior and informed consent (FPIC)[66] throughout the research process, not just at customary research intervals, such as during data collection with interviews.



[65] The research did not specifically address "treaty" rights, but acknowledged their importance. First Nations do not separate those agreements from their view to "share the land, as they did with the animals and other groups" The Justice System and Aboriginal People http://www.ajic.mb.ca/volumel/chapter5.html

[66] Not only is free, prior and informed consent a cornerstone of Canada's national research funding agencies and enshrined in the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS-2, 2010: Chapter 9), but it is also within the UN Declaration on the Rights of Indigenous Peoples (UNDRIP; 2007).

Figure 1.0 Collaborative research diagram. Illustration of research elements sought by Nishnawbe Aski Nation (NAN) and the academic researcher

NAN also examined the research proposal's approach to foster a positive collaboration through the research philosophy "CREE"—C–capacity building, R–respect, E–equity, and E–empowerment. This philosophy guided the study and was set out in the proposal as: i) both parties would exchange knowledge throughout the research, ii) to respect cultural differences and protocols and seek guidance on those, and the awareness in the tools being brought to the table by both parties to conduct research, iii) being mindful of First Nation experiences in past research studies and the accountability to the people involved in the research activities, iv) each party had a commitment and contribution to the study (i.e., financial and/or sweat equity) along with other roles and responsibilities, and v) sharing the research benefits.

Elements within the proposal regarding intellectual property rights, community rights, and respect for IK were deemed positive and very acceptable. The research would observe the interpretation in accordance with article 31(1) of the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP)[67] in protecting First Nations' IK. The proposal also detailed the researcher's accountability and ethics for conducting the research, influenced by UNDRIP

[67] Article 31(1) states: "Indigenous peoples have the right to maintain, control, protect and develop their cultural heritage, traditional knowledge and traditional cultural expressions, as well as the manifestations of their sciences, technologies and cultures, including human and genetic resources, seeds, medicines, knowledge of the properties of fauna and flora, oral traditions, literatures, designs, sports and traditional games and visual and performing arts. They also have the right to maintain, control, protect, and develop their intellectual property over such cultural heritage, traditional knowledge, and traditional cultural expressions" (UNDRIP 2007).

and also according to the Canadian Tri-Council Policy Statement Ethical Conduct for Research Involving Humans: *Chapter 9 Research Involving the First Nations, Inuit and Métis peoples of Canada* (TCPS-2). The proposal included other elements such as: i) obtained data was not intended for any commercial development, but should remuneration arise from the research, proceeds would be shared, ii) NAN's central office along with the University would hold the research data; access to the data provides opportunity for both building knowledge (e.g., a baseline record of changes in the forest) for future studies[68] and empowerment with having the information, and iii) the research would be approved by the university Research Ethics Board (REB) in accordance with the Tri-Council Policy Statement.

The research objective aimed at examining the engagement of First Nations in climate change policy, not just collecting participant observations, was another favourable factor, as was the potential to identify a community's vulnerability to climate change. The application of the information in climate change mitigation approaches, climate change adaptation strategies, and/or climate change policy were important to NAN. Additionally, the review of research results by NAN prior to publication, co-authorship in publications and the joint dissemination of the research in workshops and conference, as well as providing information to community members in a form that could be easily

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[68] Any access and use of the data current or in the future by all parties (or third parties) must follow the TCPS ethical procedures to protect participants' rights and anonymity; notification of the use of the data after the primary research is complete is to be given to the other party; procedures and accommodations for those requirements are included in the research contract.

understood[69] were other favorable considerations. Lastly, the consistency of the researcher's positive and progressive motivation to work with First Nations, and the lack of (or appearance of) a conflict of interest, contributed to NAN's senior management supporting the research proposal.

Individual NAN communities engage in research relationships independently as autonomous First Nations. Since the proposal was to engage more than one community and a precedent in research with NAN as an organization, NAN's Executive Council (Grand Chief and Deputy Grand Chiefs) as a matter of diligence to its collective membership had the proposal reviewed by their legal counsel. The Counsels' recommendation for the research to move forward was based on these key points: i) the proposal was respectful of First Nation Aboriginal and treaty rights, ii) the proposal was thorough in addressing and describing the use of IK as defined in the UNDRIP, and iii) the approach for research, research methodology and outcomes were open to First Nation perspectives and based on collaboration with NAN. Counsel also recommended that the proposal format be used as the standard and template for future research with NAN and/or its First Nations, and that research projects be defined in a legal contract.

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[69] A poster was produced in 2011 after the fieldwork and reviewed by NAN. The poster included images depicting the purpose and relevance of the research to NAN, topics within the research scope (e.g., forest carbon cycles), photographs of community members/events taken during the fieldwork, and preliminary analysis of the data; these were given to the Chiefs of the communities participating in the research to display in their community.

3.2.3 Defining and Shaping the Research

In March 2010, based on the review of the research proposal and Counsel's recommendation to proceed, the academic researcher was invited to make a presentation to the NAN Chiefs-in-Assembly at which Resolution 08/10 in support of the research project was passed. The Resolution included a condition that a research contract be entered into which would capture the principles in the shared research benefits and decision making, the roles and responsibilities for both NAN and the researcher, the key elements contained in the proposal (as previously discussed), along with other matters, such as the means for dispute resolutions. "*The Contract Respecting Collaborative Research*" was signed in October 2010 between NAN (the PTO) and the academic researcher conducting the fieldwork (see Appendix III).

Another exercise that defined and shaped the collaboration was the joint development of the research instrument (the interview questionnaire). This took place over two days in focus group sessions[70] with the research team, NAN staff members, and First Nation community technical advisory staff; NAN sent an invitation to its member communities to participate in the focus group. The sessions assisted in formulating and refining the interview questions on community information being sought by NAN from the research and to ensure the researcher obtained data related to climate change relevant to the research

[70] Focus groups are a small group of individuals (usually six to ten) selected and assembled to discuss and comment on, the topic of research, formulate questions to be used in the research instrument, and other aspects in a research study (Gibbs 1997).

scope. The topics and information for sharing knowledge at the community level were also determined. These included climate change science, the role of forests in global carbon cycles to lessen climate change, and climate change policy. The challenge for the researcher was to deliver the 'scientific' and policy information NAN wanted to build capacity on in the communities; in a manner that could be understood by community members with varying levels of awareness on the topics and the recognition of the language considerations.

The term 'boreal' is not a First Nations term, but rather a Western science term for the ecozone of the research study. Other terms and concepts used in international climate change and science dialogues, such as 'forest carbon'[71] and 'carbon trading',[72] are also not easily translated in First Nation languages. Familiarity on the subject matter and a context related to the concepts are helpful. For example, understanding financial stock exchanges where transfers of money buy a commodity (at the market price) that is not a tangible trade in the same manner as the purchasing of goods and services. Furthermore, why individuals and organizations 1 000's of kilometers away would buy or trade 'carbon' from their forests and create policies to manage and protect it, with or

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[71] Forest carbon refers to the cycle of carbon sequestration (removal of carbon dioxide from the atmosphere) with tree growth, carbon storage (e.g., solid carbon in tree trucks, branches, roots etc. and soil) and the release of carbon dioxide into the atmosphere (from natural disturbance such as fires and insects or decay); the forest carbon cycle is a major influence in global climate.

[72] The Kyoto Protocol established the carbon trading marketplace as an economic measure to reduce, prevent or remove greenhouse gases (ghgs) from the atmosphere; carbon dioxide (CO_2) is one of six identified greenhouse gases attributed to climate change; a carbon credit is measured as 1 tonne in CO_2 or its equivalent – CO_2e (ghgs have different rates and potentials to trap and retain radiant heat in the atmosphere known as warming potentials) and are a commodity bought and sold in carbon markets; UNFCCC United Nations Framework Convention on Climate Change. Kyoto Protocol: The Kyoto Mechanisms Available at: http://unfccc.int/kyoto_protocol/items/2830.php.

without their knowledge and consent, are not easily explained. The concept is a Western concept and just as the term boreal does not exist in their Indigenous languages neither do Western words/phrases that depict climate change and carbon trading.

In order to converse with a First Nation audience it is important to recognize the different “way of knowing” of First Nations. The focus group greatly assisted in preparing for the fieldwork by lending their insights and understanding of First Nations’ culture and, by example, how to exchange knowledge and perspectives. The Ojibway, Cree and Oji-Cree languages are a more *verb-oriented* communication than the use of nouns. Speaking is an active process and words and/or phrases reflect the movement in the flow of life. Discussions and conversations are through a narrative situational context, whether firsthand or from oral knowledge passed down through generations.

Understanding and thinking in this narrative perspective is helpful for conveying the concepts in science, policy and interpreting participant responses. The focus group suggested explaining scientific and policy concepts in a manner that could be understood by participants and from a cultural framework. For example, during Band Council and community presentations “forest carbon” was explained as part of the life cycle in the forest with trees breathing in carbon as they grow (the CO_2 found in the air), storing the carbon in branches and leaves (as solid carbon), and releasing carbon (pictured as the smoke from a fire) as trees decay and die.

During the focus group sessions it was also suggested interviews begin with social courtesies[73]. Beginning an interview in this manner supported a more relaxed setting allowing a participant to become comfortable with the researcher and vice versa. Also suggested was to avoid long questions, and ask "small questions first" such as, how long have they lived in the community and what activities a participant does/did on the land (e.g., hunting, fishing) rather than "what does the phrase climate change mean to you?" Respectfully, questions that are not overwhelming or intimidating opens the dialogue to share what is familiar and known by the participant and relevant to the research—"when trapping have you noticed any changes on the land?" Moreover, words spoken and heard are both reflective and respectful, and respect is giving people time to speak without interruption until they have no more to say on a matter and silent moments between contemplative thought and speaking. This is particularly so with Elders. [74] An interview (before, during and afterwards) became an occasion for personal conversation and knowledge exchanges beyond data collection. The focus group also reiterated that when speaking with Elders, translation would be key. NAN's staff aware of this importance would ensure translators

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[73] Refreshments (tea, coffee, juice, baked goods) were offered at the beginning and during interviews (in hotel settings) and at presentations in community centres; baked goods were brought to a participant's home. When interviews were held with an Elder, small gifts in appreciation of their time were given (e.g., box of tea, warm socks, bag of oranges).

[74] During attendance at the Chiefs-in-Assembly it was observed that Elders wishing to speak were always acknowledged and given the floor. They spoke on topics relating to the discussion at hand, topics previously discussed (at that meeting and/or previous meetings), and topics yet to be discussed. Elders told stories and spoke about their thoughts that had come to mind. No one interrupted or indicated it was time to go back to the meeting agenda; members present sat and listened; when the Elder finished speaking they were thanked for their comments, others commented on their comments, and eventually the meeting proceeded.

were available during interviews and while speaking with community members. The focus group sessions also contributed to the development of appropriate tools to exchange knowledge in a community.[75]

During the focus group sessions (and while working with the NAN research team member) suggestions to build capacity within the communities included: information sessions with Chief and Council, hosting a community presentation, teaching classes in the schools, and along with providing descriptions, the use of pictures and/or diagrams. Images tell a story and convey knowledge.[76] The use of images (and storytelling) was incorporated into all activities to build capacity in each community.[77] The participatory nature of the research also fostered the development of other avenues to build capacity while in the communities not identified during the focus group and described in the section "Applying Participatory Action Research in the Field".

3.2.4 Collaboration to Conduct the Fieldwork

Key to the research project was the collaboration with NAN. Along with facilitating the opportunity to present the research proposal to the Chiefs-in-Assembly (a meeting closed to the general public with the agenda determined by a committee), NAN was instrumental and vital in conducting the fieldwork.

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[75] Tools included images on the various subjects within the scope of the research (e.g., forest carbon cycles, carbon trading, climate change science), posters for display in community buildings and NAN's head office, and slide decks for presentations (within NAN and in discussion with outside organizations and government).

[76] The NAN team member explained the importance of drawings/images in First Nation culture.

[77] Diagrams/images/illustrations were provided on blackboards, whiteboards, flip charts, computer presentations, on paper, and in the snow.

NAN arranged individual First Nation's participation and obtained the communities' free, prior, and informed consent; no community was visited without this prerequisite.[78] Obtaining consent to enter a First Nation community is respecting the community. As explained by a Chief,[79] being on First Nation land (and reserve) is no different than entering someone's home—you must "knock on the door", explain your presence, and wait for permission to enter or if you are denied entrance respect the decision.

The decision about which communities to approach to participate was jointly made by the NAN research team member and the academic researcher. The considerations and criteria included: i) the community had to be located above the 50th parallel—a stipulation by the funding agency contributing to the research[80]; the area within the Far North Act is also above the 50th parallel, ii) representation of at least one community from each of the Tribal Councils within NAN[81] (see Figure 1), iii) include communities located within both Treaty No. 9 and Treaty No. 5 boundaries, iv) representation from small (~250 people) to large communities (~1,000+ people), iv) the inclusion of communities with

[78] Along with being respectful, permission to enter an Aboriginal community to conduct research is in keeping with Article 9.3 Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans.

[79] Notes from a guest lecture given by Adam Fiddler former Chief Sandy Lake First Nation (the Chief during the research), Oct. 2, 2013. Lakehead University, Thunder Bay, ON.

[80] The research was awarded the National Science and Engineering Research Council (NSERC) Northern Internship Research Program grant; the grant required the research to be conducted above the 50th parallel and that $4,000 (minimum) of the grant was to be applied *only* to travel expenses. Travel expenses were ~$10 000 CAD.

[81] There are seven Tribal Councils within NAN. The communities participating in the research are members within these five Councils: Independent First Nations Alliance, Eabametoong First Nations, Mushkegowuk Council, Shibogama First Nations Council, and Windigo First Nations Council. Planned visits to Keewaytinook Okimakanak communities were cancelled due to a tragedy/and community emergency. Others NAN member First Nations are located in non-forested areas; communities within Wabun Tribal Council are located south of the 50th parallel.

different potential climate change impacts, such as forest fires and/or flooding, and v) cover, as much as possible, a range of the boreal forested areas across NAN territory (the fieldwork spanned ~110 800 km^2). To meet the objectives, it was determined visits to ten communities were necessary.[82]

NAN approached each community to host the principal researcher[83] and established FPIC to enter the community. The NAN team member was crucial in building a connection between the communities and the researcher.[84] The community was provided background information on the purpose of the research, the Chiefs-in-Assembly Resolution and the research contract, and questions and concerns were addressed. These varied, but examples included: i) how long was it necessary for the researcher to be in the community, ii) what information was being sought, iii) how would the information be used, iv) who will have access to the information, and v) where will the information be stored. The final decision to participate rested with the community Chief and Council. Once a community agreed, the researcher made the travel plans and contacted the community liaison who prepared for the researchers' arrival and in-community arrangements.

[82] Twelve communities were identified as meeting the criteria.

[83] Requests were made for a community contact person (liaison), driver, translator(s), and accommodations. Every community agreed to the requests which are considered an 'in-kind' equity contribution. These contributions made the research in the communities financially possible, but, more importantly, without this support conducting the research in a community would have been problematic, if not impossible, especially for introductions to Elders and the provision of translators.

[84] Although this is strong statement considering the research was in its early stage, entrance into the communities could not have happened without the efforts of the NAN team member and the Office of the Grand Chief.

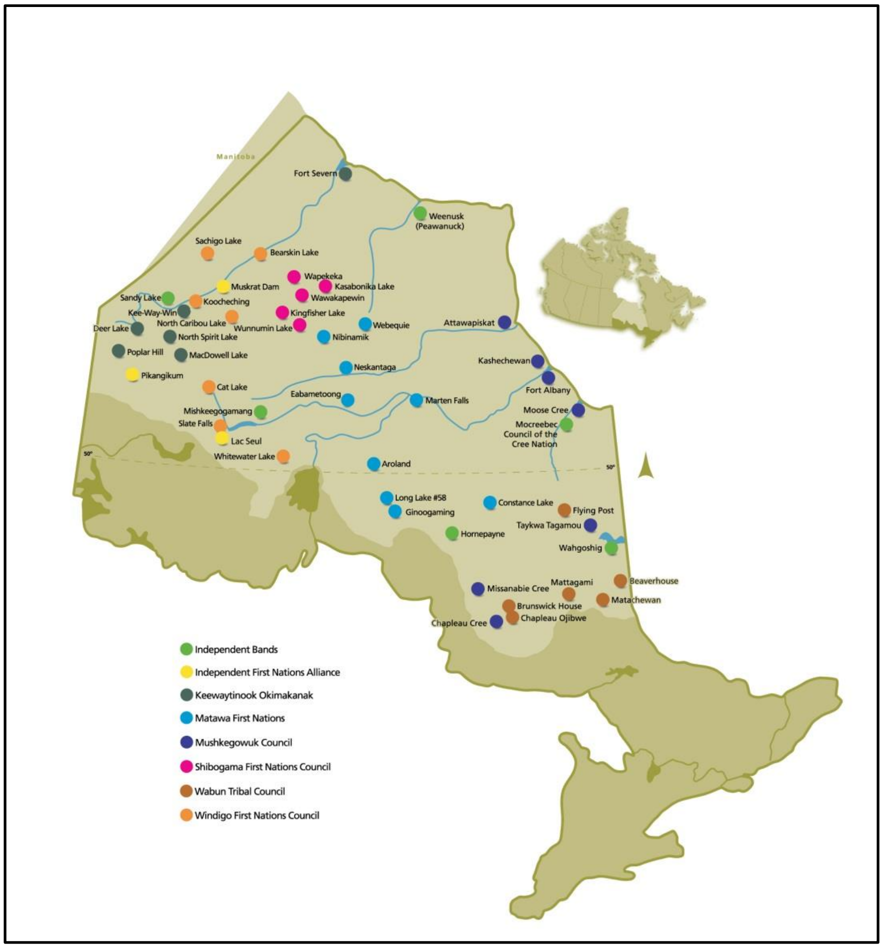

Figure 2.0 NAN territory and community map

The vast geographic expanse of NAN territory and efforts associated with co-ordinating visits and travel to these remote communities presented many challenges. Arranging visits to ten communities over twelve (12) weeks (and initially on a very short deadline[85]) at times was demanding. Besides the role as gatekeeper, making introductions and obtaining FPIC for the researcher to visit a community, the NAN research team member was a senior staff member and

[85] Notification of being awarded the research grant was received 22 December, 2010 (the application was made December 16, 2010) with the strict requirement the fieldwork must begin the 6 January, 2011 and the researcher remain in the field until 31 March, 2011 (12 weeks).

executive level advisor with a full schedule and extensive duties. Protocols needed to be followed, and time allowed for a community to respond. Moreover, a planned community to visit could change within hours,[86] thereby setting in motion arrangements for the researcher to stay in the current community, re-arrangements with the next scheduled community, or arrangements with a different community.

Logistics in the mode and availability of transportation was another challenge. The total travel distance to reach the communities was over 6 300 km. Although some communities were located fairly close to each other (~30 to 100 km) travel was dictated by the available option. Travel modes included winter/ice roads,[87] that many times within days or hours were not open for travel due to safety hazards from unfrozen and thawing conditions (Figure 3), train (only along the James Bay coast), and by airplane—the main mode of transportation to reach these northern communities, with its own logistical constraints.[88] Co-ordinating community visits and managing travel constraints, along with disruptions or changes in plans, requires patience and acceptance. Also required is trust—that the unfolding situations and unplanned circumstances allow for opportunities that otherwise may not have occurred.

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[86] At times, arrangements to visit a community were cancelled or altered due to unforeseen community circumstances, such as, a community state of emergency or sadly a death in a community; when a death occurs all activities halt until a community has mourned.

[87] Winter/ice roads are a combination of roadways made over frozen water bodies (lakes, rivers), boreal forest and muskeg (peat bogs).

[88] Flights in and out of a community do not occur every day, are on different flight routes and/or servicing airlines; so while it may be possible to enter, or leave, a community on one flight segment, connecting flights (or seat availability) to the next community and travel hub may not. Planes are small with limited capacity (i.e., 9-18 persons) and weather is also a factor.

Science is an exploration, exploration is a journey, and making the most of situations along the journey does lead to discoveries and experiences adding to the research and openings for insight that are invaluable to researchers.

The research team recognized that the challenges were offset by the benefits from obtaining observations and perceptions directly from community members. Data includes observed changes occurring on the land from the people living in the study area, as well as generational knowledge. This knowledge offers an understanding of current climate change impacts and provides a baseline (both historic and current) for applications in future studies. Most important to the research team was building capacity in the communities on topics in forest science, climate change science and policy that could not have occurred without being in a community.

Figure 3.0 Snowplough going through the ice. Photo taken January 2011 on the winter road between Muskrat Dam and Sachigo Lake. Source withheld; printed with permission.

The two-way knowledge exchange between community participants and the researcher is considered a strength in the collaboration and underpinned the study and research methodology. Surveys as a method for research are not conducive to research seeking descriptions and perspectives. Face-to-face communication between participants and researchers facilitates interactive, in-depth learning. In every community, presentations, informal workshops, classroom instructions (from kindergarten to senior grades), conversations over coffee, and more took place. While no formal assessment has been conducted on the extent in the dissemination of the research topics and findings, increased awareness on the topics has facilitated discussion in the communities and requests for additional information, including requests by NAN's Executive Council and staff. There is also a strong interest for further research in NAN's northern territory and additional capacity building in the communities on climate change. Most important, the research is being applied in efforts to address climate change risks (e.g., co-ordinated community and government fire evacuation plans).

One anticipated benefit is community relevant information for decision making with climate change adaptation strategies critically important to these northern First Nation communities. Changes occurring on the land are impacting food security, energy security and traditional activities (Golden et al. 2015). Descriptions of past climatic conditions, current conditions and personal accounts of going through the ice when it should be safe out on the land, cannot be understated. The changes are unpredictable, unfamiliar and disconcerting to community members who remember the cold and a frozen landscape requiring protective clothing from the elements October to May. Experiencing first-hand rain showers the first week of March in a sub-Arctic community emphasized the noted changes reported by the participants.

Participant observations of changes on the land attributed to climate change, such as “the sound of the cold is different”, were also better understood after walking in the forest on a very cold, still winter night and hearing a “snapping” sound coming from the forest canopy.[89] A number of study participants commented that this winter sound is not heard as often as in the past, nor is it always possible to use the cold winter air to transmit sounds and voice messages over long distances.[90] The research approach and being accepted into the NAN First Nation communities helped the researcher to understand the cultural narrative. The storytelling during interviews and while being in the community contributed to the richness of the data[91] and being taken out on the land described in the data provided insights while in the field and during the data analysis.

[89] While out for a walk one evening reflecting on the day, the researcher heard the crackle of a snapping branch that resonated with the words from an interview the previous day.
[90] A participant described how in the past he was able to speak to a family member living around a bend and across the lake during the cold winter nights; the cold air was the telephone.
[91] Often noted changes on the land were told as a story in recollecting the activities done in the past with the people involved (e.g., grandparents, parents, cousins) and the places where they took place (e.g., hunting grounds, islands, summer camps on rivers).

3.3 CONTEXT AND SITUATIONAL PLACEMENT

Hesitation on the part of First Nations to participate in research is rooted in past experiences. Many First Nations associate research with colonization (Smith 1999; Porsanger 2004; Castleden et al. 2008), including practices as being research subjects or the topic of research (Blodgett et al. 2011), being subjected to unethical practices[92] including deception with research studies (Cochran et al. 2008),[93] and portrayed in an unfavourable way. First Nations have been excluded from the research processes (Blodgett et al. 2011), and research with First Nations has been conducted from a Western European worldview (Getty 2010). Even when recognized, First Nations and IK are often subsumed under the Western scientific approach. The Western European approach to university-based science and research often takes an 'objective' view disconnected from cultural backgrounds (Brook and McLachlan 2008) and adopts a one-size-fits-all approach (Blodgett et al. 2011). The methods are based on prescribed scientific measurements and language to frame, conduct, and develop research outcomes (BCAAF 2010). Moreover, Western research is characterised by Porsanger (2004) as solving an "indigenous problem" (p. 107) or investigating Indigenous peoples and void of Indigenous perspectives and knowledge.

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[92] First Nations leaders demand apology for nutritional experiments, CBC News, 18 Jul 2013, http://news.ca.msn.com/top-stories/first-nations-leaders-demand-apology-for-nutritional-experiments.

[93] Cochran et al. (2008) discuss the studies of the Havasupai people in Arizona and the Nuu-chah-nulth people in Canada. Blood samples taken for research were explained for use in one purpose but used for another, and used in subsequent studies without consent.

Traditional knowledge, "usually described by Aboriginal peoples as holistic, involving body, mind, feelings, and spirit" (TCPS-2 2010: Sect. A) has in the past been neither accommodated nor considered scientific. There is a mindset that Western science is superior to IK (Pretty 2011) and local knowledge,[94] "feelings and spirit" and anecdotal information cannot be measured or quantified and are therefore not scientific. However, in recent decades there has been a shift among researchers to ethically conduct research using methods that are culturally sensitive and/or locally situated (Blodgett et al. 2011), and to appropriately document and apply traditional and local knowledge (Huntington 2000).

The study incorporated the main characteristics of PAR: i) educative (for both parties), ii) dealing with individuals as members of a social group, iii) problem-focused with the intent of taking action, iv) treating all participants as inherently part of the process, and v) a collaboration where each party contributes and each party benefits from the interaction (Hart and Bond 1995; Winter and Munn-Gidding 2001).

3.3.1 Participatory Action Research, Research with Indigenous Peoples and Indigenous Research

Minkler (2004) discusses PAR as being distinguished not so much as a method, but more for revealing the methodological context and the importance in the attitude of the researchers. Boog et al. (2003) describes action research

[94] Traditional and local knowledge is considered "situational" knowledge to a specific place over an extended period of time.

as “a scientific approach in the interdisciplinary and multidisciplinary sense of the word, which means that action researchers must be willing and able to cross traditional disciplinary boundaries and combine theories and techniques from the varying ‘disciplines’ of social science. Those working as action researchers must have the competence (capacities and capabilities) to use several methods and techniques of social research, learning, and communication, depending on what the specific research situation demands” (p. 423).

PAR’s cyclical process of learning, reflection and the development of critical consciousness (Gaventa and Cornwall 2001; Kidd and Kral 2005; Lemelin et al. 2010b) promotes informing and engaging organizations and communities from not only the project’s design stage, but throughout the research process, including on-site and post-site visits and in analyzing and providing research results. In doing so, PAR reduces the separation between researchers and participants (Boston et al. 1997). In all cases, PAR is a method for inquiry in human situations, and therefore each PAR experience is unique to the research context (Dickson and Green 2001).

Of late, researchers have encouraged multi-sectoral approaches to problem solving that has facilitated the use of PAR in diverse fields across natural and social science disciplines. The seriousness of planetary issues has raised awareness that finding solutions requires expertise beyond a single discipline, working outside discipline silos, and utilizing innovative approaches in research. Human impacts on ecosystems and their integrated ecosystem services (see MEA 2003, 2005) prompted the recognition in the advantages of conducting interdisciplinary research (Doll and Francis 1992; Rees 2003; Weaver and Lawton 2007; Sunderlin et al. 2008; Pretty 2011). PAR has been used as the methodology in multidisciplinary research, such as ecology and forestry researchers working with health and policy researchers (Parkins and MacKendrick 2007; Reed 2008; Campbell et al. 2007; Bohensky and Maru 2011). PAR is also used in research with Indigenous communities as it provides a vehicle for incorporating IK in knowledge creation and sharing (Grenier 1998; 2004, 2009).

Cross-cultural research is challenging previous Western scientific assumptions (Natcher et al. 2007), along with Western approaches and perspectives to research. Kreitzer and Lafrance (2010) discuss how PAR moves research away from a hierarchical top-down approach (a predominant concept in Western culture) into a dialogue for knowledge creation. Varcoe et al. (2011) discuss knowledge building as a two-way street, despite challenges with integrating different knowledge systems (Cochran et al. 2008; Bohensky and Maru 2011). Lester-Smith and Price (2010) point out that First Nation Elders recognize that learning Western ways along with Indigenous ways makes them stronger in both.

A predominant message from Indigenous peoples is for trust to be at the centre of research (Aspin 2004; Kreitzer and Lafrance 2010), and trust develops from informed and inclusive engagement. Getty (2010) argues Indigenous research incorporates cultural protocols and values into its methodology and promotes the inclusion of research questions from the community involved.

Even more inclusive is having members of a community actively involved in the research process and sharing in research benefits. Shifting previous research approaches that placed power with the researcher breaks down the marginalization of Indigenous peoples (Stevenson 2011). The attention to ethical approaches in conducting research and the importance of de-colonizing research is viewed as particularly important with research involving Indigenous people (Smith 1999; Stevenson 2011; Varcoe et al. 2011).

Research with Aboriginal peoples has also brought to light other research dilemmas. Western research methods and frameworks, like PAR, may hinder or obstruct well-intentioned inquiry and be inappropriate or disrespectful (Natcher et al. 2007; Lester-Smith and Price 2010). Inserting individualistic ethical frameworks applied in Western research, including confidentiality and securing individual informed consent, may be inappropriate in research across diverse cultures where individual rights may not carry the same weight as communal rights (Maiter et al. 2008).

While it has been established that IK belongs to Indigenous peoples (UNDRIP 2007), at a local level is ownership held by the individual sharing the knowledge or the community in which the knowledge is situated? Does one community have ownership of the knowledge or does ownership lie with a number of culturally related communities? Indigenous researchers promoting IM, which is a distinct research method embedded within an Indigenous cultural viewpoint (Evans et al. 2009), may provide the answers. McGregor et al. (2010) argue that researchers who are non-Indigenous are ill equipped to bridge scientific and Indigenous knowing, and that “Indigenous peoples require their own researchers with extensive training and recognition within their discipline to assist them in the search for new knowledge to address new and ongoing problems and questions” (p. 119).

Indigenous knowledge is interconnected to the individual as part of all living things, the earth and stars (Chinn 2007; Botha 2011), and described as ‘different ways of knowing’ (Botha 2011; Pretty 2011). Knowledge also includes connections to the spirit world (Natcher et al. 2007). As explained by Indigenous researchers Lester-Smith and Price (2010) “differing in knowing” is not to imply polarization, but acknowledges the presence and guidance of ancestors in research inquiry. Botha (2011) further argues that “conventional qualitative research has tried to access, understand and represent these indigenous ways of knowing through a variety of creative, participatory and reflexive methods ...; [however], what passes for indigenous research tends to be methods of data collection and analysis conducted and represented by Westernised researchers according to modified, but ultimately hegemonic[95] modern Western knowledge traditions” (p. 315).

Since Maori scholar Smith’s seminal work (1999), there is now a significant body of work exploring various aspects of Indigenous research methods (Natcher et al. 2007; Getty 2010) and Indigenous researchers are themselves bringing forward methodologies and approaches to research based on Indigenous worldviews (Lester-Smith and Price 2010; McGregor et al.

[95] Hegemonic meaning Western controlled or influenced.

Simmons 2010). Strengthening opportunities for Indigenous researchers by breaking down Western academic barriers, so that Indigenous researchers can raise the relevance of IM, is and will be important for exchanging knowledge (Stevenson 2011). Whether non-Indigenous researchers can conduct IM is not a discussion within this paper. However, aspects of IM can develop in research inquiry with First Nations as research partners (Golden et al. 2015).

With the shift in academic research from exclusionary to inclusionary, it can be argued that the opening for, and recognition of, IM has in part been created by this shift. Research that calls for respectful (not indifferent) and ethical research with Indigenous peoples, de-colonizing research, repositioning the balance of power with those who hold the knowledge, mixing methods of conventional qualitative inquiry that is appropriate in the research circumstance, and addressing identified challenges and gaps in research methods with different knowledge paradigms and worldviews, have created the space for different and unique research methodologies long overdue in knowledge building. Moreover, the magnitude in planetary challenges requires innovative knowledge to find solutions.

3.4 THE FIELDWORK

January 6-March 31, 2011 ten First Nations participated in the research (in order of visits): Muskrat Dam, Weagamow, Pikangikum, Sandy Lake, Neskantaga, Nibinamik, Attawapiskat, Fort Albany, Kingfisher Lake, and

Wunnumin Lake (Figure 4.0). Although many similarities exist in these remote First Nations each community is distinct. Their uniqueness is related to cultural backgrounds (Cree, Ojibwe, and Oji-Cree), ties to traditional cultural practices and activities on the land, geographic location (inland lake/river, salt water coast) and local flora and fauna, such as moose (*Alces alces*) and polar bear (*Ursus maritimus*), European influences (French/English trading posts, the presence of Anglican and/or Catholic churches), and the community's population and infrastructure such as a high school or hospital.[96]

NAN, as an umbrella organization and gatekeeper into the communities initiated community participation to conduct research. The attention to FPIC in the request for participation and introduction of the researcher by NAN's research team member fostered trust. More than accepting the researcher into the community to conduct fieldwork, communities agreeing to participate made a commitment and investment in the research. Chief and Council's provided a community contact person (a guide and/or driver), translators to conduct interviews with Elders, and accommodations for the researcher. [97] Without this in-kind support, being in the field, along with the travel expenses, would have been cost prohibitive. More importantly, the communities actively participated and engaged in the research.

[96] Larger communities (+1,000 people) have high schools thus youth in the community do not leave to southern centres to continue with studies. Two communities had a hospital but no doctor on-site (doctors visit over the course of a year); hospitals provide medical services not delivered/or equipped beyond what is available at nursing stations which are in communities without a hospital.

[97] First Nations participating in the study covered expenses in-kind by providing hotel stays (over the 90 days; hotels in the communities are on average ~$100/night) and translators at no charge or fees.

Figure 4.0 Fieldwork map. The map shows the ten NAN First Nations (above the 50th N parallel) who collaborated with the fieldwork. Flights into the north originate in the travel hubs of Sioux Lookout (in the west) and Timmins (in the east) and serviced by different airlines; communities though close in distance are not necessarily on the same flight routes. Travel in east-west directions across the province to reach the north travel hubs requires stops in Thunder Bay, Sault Ste. Marie and Sudbury. Rail transportation is possible between Moosonee and Timmins. Travelling by road is only possible during winter months on ice-roads, which at times were not frozen and closed. Total travelled distance to the reach the communities was nearly 6 300 km.

Community participation made possible a contact person offering guidance, community organized band Council and community meetings, classroom visits, and introductions to key community members. Huntington (2000) argues having a community identify key persons to a researcher is the desired approach to reach individuals having the knowledge and information relevant to the research. The majority of the individuals contributing to the data were identified by community leaders and the contact person.[98] One objective of the research was to record observations of changes in the forest. Community members living traditional lifestyles, active in traditional activities, and through their employment in the community are key informants and vitally invaluable to the research.

Forty-three (43) individuals contributed to the data. They represented Council members, Elders, land users (hunters, trappers, fishers, and gatherers), community land use planning and winter road-making staff, and other community members.[99] The research instrument was semi-structured interviews, including both open-ended and closed questions, and the sessions were audio-recorded. This type of interview structure gave participants some measure of control during the interview, but also allowed for comparisons across interviews as all participants were asked more or less the same questions (Huntington et

[98] Only two participants are considered "random" participants that the research meet while walking in the community and attending a community trappers meeting.

[99] Additional information on the participants is found in Section 5.2 "Blue-ice". No youth community members (under 18) were participants in the study.

al. 2004; Bernard and Ryan 2010). Semi-structured interviews also allows for flexibility in research inquiries (Huntington 2000).

During interviews, listening is fundamental, and probing for further explanation is anticipated. Probing a participant's response adds clarity and confirmation in responses to questions, but foremost, acknowledges that their voice and knowledge are a valuable contribution to the research. In research, "details" matter. First Nations living in the northern boreal are acutely aware of changes on the land related to climate change and shared that information in voluminous detail.

3.5 DISCUSSION

3.5.1 Applying Participatory Action Research in the Field

PAR is active engagement and interactive involvement with the research participants which includes researchers—researchers are participants. The participatory nature of the research encourages exchanges of knowledge and information between the participants before, during, and after interviews. Engagement with the community outside of conducting interviews[100] teaches researchers. Not only does a researcher begin to learn and understand the daily lives of the people engaged in the research, but also comes to a better

[100] Accepting invitations (birthday parties, dinners) and attending a community event or celebration (bingos, community elections) and attending the funeral of a community member, as well as shopping and while walking in the community are activities in which the researcher and community "get to know" each other and builds trust.

understanding of the cultural implications in how "our research partners frame the local effects of global climate change" (Crate 2008, p. 527).

Reflection is a critical component in PAR (Boog et al. 2003). Reflection or reflexivity is both personal and epistemological. "Personal reflexivity focuses on personal assumptions, values, experiences, etc. that shape the research; epistemological reflexivity requires the researcher to recognize the limits of the research that are determined by the basic research decisions such as a research question, methodology, method of analysis, etc." (Borg et al. 2012, online). An essential tool to researchers in both the reflective process in conducting research and analysing the data is memoing. Birks et al. 2008 describes memoing as:

> Memoing enables the researcher to engage with the data to a depth that would otherwise be difficult to achieve. Through the use of memos, the researcher is able to immerse themselves in the data, explore the meanings that this data holds, maintain continuity and sustain momentum in the conduct of research. As a chronicle of the research journey, memos remain as an indelible, yet flexible, record for personal retention or dissemination to others. (p. 68).

Memos were written throughout the research study, but memos during and after interviews and daily personal journal entries were invaluable during the fieldwork.

PAR encourages the discovery of unforeseen information (Huntington 2000). Decisions in the field to adjust the research inquiry as points of interest or discoveries come to light are necessary and fundamental to research. Research discoveries may include those arising from an intuitive sense—recognizing an important piece of information that presents itself during research inquiry that may lead to a significant discovery.[101] At the beginning of the fieldwork, a response to a question uncovered a pertinent First Nations' observation to an explicit familiarity about the land that shaped a point of inquiry in subsequent interviews. The response "the ice is different" in an early interview, led to seeking more information (probing) to explain the difference. Differences in ice are very complex and well known in northern First Nation communities. Modifying probing questions on ice beyond clarity in changes in ice thickness and timing in freeze ups/thawing to include questions on ice properties and formation contributed to an in-depth understanding of a major environmental condition relevant to northern First Nations. The presence (or absence) of the "*right kind of ice*", a term embedded in their language "*that comes from the land*", is a critical factor in transportation. Transportation is fundamental to traditional activities carried out on the land (i.e., hunting, trapping) and in the delivery of necessary community goods and supplies via winter/ice roads to last until the next winter season.[102] Changes in the climatic conditions that form the "right kind of ice" are impacting these activities and threatening food and energy security (Golden et al. 2015). Modifying the points or questions for inquiry in conjunction with probing questions contributes to an in-depth understanding in matters important to our research partners. Moreover, a researcher may bring a

[101] Upon hearing from an Elder the term "blue-ice" at the onset of the fieldwork there was an immediate and discerned "ah ha" moment (i.e., hairs stood up and there was a "knowing this was important") that further shaped the research inquiry.

[102] Travel on winter/ice roads is vital to these remote First Nations; access provides the only economical transport of goods into the communities (store bought food, for some communities potable water, fuel (gas and diesel for electricity generation, housing, equipment etc.).

fresh perspective and attention to something that is noteworthy but considered as common knowledge to the participants or a cultural frame of reference. The effects from climate change may be familiar amongst a group of Indigenous peoples but unknown outside of the community.

Participants could also seek clarification to a question or phase during an interview. In response to a question regarding climate change adaptation, one participant expressed "Adapting to change: … maybe I misunderstand that because adapting to change is changing my thought, my view on life". The response revealed a First Nation perspective to 'adaptation'—adaptation is associated with colonization. The response also presented an opportunity for the researcher to explain 'adaptation' in Western science concepts and the meaning in the international dialogue on global actions to address climate change. Along with verbal communication (and hand signals), participants and the researcher drew pictures to provide further understanding to a research question, response, or topic.

A noted departure from a Western concept was time. Time does not necessarily follow a 'clock' in First Nation culture;[103] rather time aligns with a place and cycle on the land. Elders and land users describe interacting with and being on the land during sunlight, the position of the stars, elements of the seasons, and over generations. There is also no separation between the people, land and sky (the horizon is where they touch not delineate), the presence of

[103] This is not to say clocks are not used, they are just as in western cultures, but not to the extent and not as prescriptive.

ancestors, and the 'Creator'. This perspective was interwoven into descriptions of observed changes occurring on the land. Changes in timing of snowfalls and the "*right*" kind of snow, and the disappearance of the "*strong ice*", along with differences in flora and fauna (i.e., bird migrations, unknown animals, and the position of the tree line) were told as stories, present and past—"*my Great Grandmothers before"*, and as gifts from and the presence of the Creator or "*Old Spirit".* At times, the stories and 'knowing' were shared and shown out on the land. Storytelling, listening and being on the land are considered Indigenous research methods (McGregor, Bayha and Simmons 2010).

Time is also being in the present moment shaped by the unique and ever changing community circumstances. Scholars collaborating with First Nations in research must be prepared for and accept community dynamics, with each community being different. Flexibility and patience are essential, as is a willingness to recognize and accept that knowledge comes in many forms during research inquiry and outside the designed research processes.[104] Interviews are not always kept to the scheduled time and place and may not even occur as unplanned activities and unexpected community events take priority. In northern First Nation communities numerous occurrences can change interview schedules, for example, the re-opening of the winter road,[105] an unplanned

[104] A cancellation in the research schedule provides an opening for other knowledge exchanges and personal interactions with community members that may not have occurred otherwise, such as the extraordinary experiences of being taken out on the land to a sacred site.

[105] Along with access for transport trucks to deliver major community supplies, winter roads provide the travel route to southern centres to purchase personal goods and enable visiting with friends and relatives in neighboring communities.

event,[106] participants taking part in hunting and fishing trips because conditions were now “right”, and sadly, a death in the community are occurrences that change interview schedules.

Non-aboriginal persons stand out in a community and the presence of a visitor quickly spreads among community members. Most important in a community getting to know a researcher is a researcher’s openness to share personal stories and journey to conduct research,[107] along with the research purpose and approach; in this case investigating climate change and PAR. Conversation draws people, first with listening, then in asking questions (directed at the researcher and from the researcher to a community member), to expressing an interest and willingness to participate. Conversations with community members, even in attending to an innocuous task[108], can initiate openings for shared learning.

The first focus group session was planned prior to going into the field. The focus group session that took place in a community[109] was spontaneous and held in a semi-public area.[110] Once introductions and the academic

[106] The arrival of a Dash 8 aircraft, a new addition to the servicing airline fleet with larger passenger capacity and an on-board washroom is rare and most welcomed, if not needed, especially for those travelling with young children, pregnant women and the elderly travelling for medical purposes to centers in the south. Although its arrival was on a regular scheduled flight into the community, viewing its arrival and an on-board tour was a community event.
[107] First Nations understand the concept of a journey whether as one taken on the land, in life and over generations; research is a journey - in the decision to embark on being a graduate student/researcher, developing a research project and conducting research.
[108] For example, going to a community building to send a fax, or grocery shopping – generally, any activity in being around people in the community.
[109] A second focus group was planned with a group of Elders; very sadly, the night before it took place an Elder passed away and the session was cancelled.
[110] A lunch room in a community building.

formalities for research were completed,[111] the participants shared their observations, experiences and perspectives, as well as the experiences of others not present but known throughout the community. As participants discussed a topic, information was reaffirmed sparking others' recollections that added to the dialogue. Although the session adds data and insight, it also presents research challenges.

Using Western research formats and ethical protocols can hinder PAR with First Nations in what it attempts to achieve—dynamic interactions. Prescribed methods or protocol requirements run counter to those that participatory inquiry seeks to employ. First Nation gatherings by nature are not rigid, but active and fluid. As such, in a group interview or focus group the challenges for researchers include: i) background noise (also captured in audio recordings) and activities causing disruption; ii) participants leave to attend to other matters and then return so the same participants are not present for all questions, and iii) new participants join in without going through the research ethic protocols. Signed consent forms are already cumbersome in one-on-one interviews, especially when speaking with Elders where translation is necessary. During impromptu gatherings, which are certainly in keeping with participatory

[111] Research protocols for consent include a thorough presentation of: the research project, the format for collecting the data (e.g., interviews, audio recordings), security information on data storage and access, clarity on their rights to not answer questions and stop an interview, request access to the analysis, review their transcripts etc.; each topic must be conveyed and understood by the participant (the most effective way is to ask a participant throughout the explanation if they have questions on the point just presented), and should they then agree to participant sign a consent form (and if they are willing to have their name released in the analysis/results a third party signature is also required); the information discussed is provided in hardcopy and contact info for the researcher is included should they have any questions, or other matters to discuss, as is the University ethics board contacts if they have any concerns. This process takes time (20-30 minutes, or longer when translation is required).

research, obtaining signed consent forms adds an element of formality that can dampen the conversation.[112]

When a participant does not sign a consent form because it will disrupt an ongoing discussion, that person can certainly contribute to the dialogue, but their comments cannot be included as data. This also adds the task of sorting out their voice in audio recordings from those who have signed consent forms. Abdicating consent and non-adherence to ethical conduct is strongly discouraged and changing protocols during fieldwork would make research ethics review boards uneasy,[113] but obtaining consent in some situations poses hindrances for researchers in the field, particularly for researchers working alone.[114] Solutions to this dilemma might include: i) during the ethical protocol(s) explanation to the group, express that newcomers will also need the same consideration and thank the group for their patience, ii) request before an individual speaks to please state their name (also helpful in identifying a voice in audio recordings)[115] and whether or not they have signed the consent form (the first time they speak), iii) for individuals arriving later, ask if they would like to be formally included in the research, and if so, either be informed about the protocols and sign a consent form at that time or at the end of the session (all

[112] Group participants must also be explained the details of the research, consent protocols, and sign a consent form with the understanding that anonymity cannot be ensured as with one-on-one interviews.
[113] A comment from an anonymous reviewer of the manuscript.
[114] The presence of another researcher(s) would assist through dividing the tasks between conducting the session and obtaining consent (or not) once the session has begun.
[115] This request is a lesson learned, in that, although a person was initially acknowledged, each time they contributed to the dialogue their name was not repeated, and acknowledgement of a new member to the group was not consistent, particularly as the discussion proceeded over a period of hours. The practise of acknowledging a speaker by name, each time they speak, takes place at Chiefs-in-Assembly meetings.

participants signing a consent form may without prejudice, at any time for any reason withdraw their consent), and iv) before the session begins, review the intent of the ethical protocols and the above options (and/or others) and let the group decide the best way to proceed, along with recording the group's decision for future reference. Conceding the ethical protocol decisions to the participants in the focus group (and a community as a whole) is not only participatory, but doing so demonstrates respect and acknowledges the community's autonomy to determine appropriate mechanisms for conducting research.[116]

Despite the consent challenges, the group exercise had other benefits. Participants learned not to be apprehensive about the research process, thereby generating a willingness to share their knowledge and building trust. First Nation communities in the north are very connected and interrelated to each other. The sharing of a research experience with other community members, and family and friends in neighbouring communities, is essential for researchers to understand and value. Comments such as "so you're the [researcher] I heard about" in another community, or days later being approached by a participant with more details remembered, or the names of people to contact within the community and in the next community made this perfectly clear. Being known among community members[117] and knowing community members builds reciprocal trust that is crucial to participatory research; trust facilitates the

[116] As a novel approach from a western research perspective, this type of process would most likely require inclusion in the application for research ethics board approval.
[117] A researcher's conduct/reputation will be passed along to others in a community and to other communities.

cooperative sharing of knowledge and information to attain the research objectives and data being sought by the research partners.

PAR also provides opportunities for knowledge exchanges led by community members. Collaboration with NAN prior to the fieldwork resulted in suggestions about avenues to deliver information sessions in the communities, and those took place in every community. However, a knowledge exchange tool unforeseen prior to the fieldwork was community radio stations, established by the Wawatay Native Communications Society beginning in 1974 (Budka et al. 2009). Every community has a radio station;[118] it is an essential and shared means for communication. Cellular service is sporadic and virtually non-existent, especially out on the land.[119] Community news bulletins and personal messages to community members are sent over the radio,[120] even during on-air programs, and Elders in the community listen to, call into, and host radio shows.

A radio broadcast to exchange and disseminate knowledge by a call-in talk show is not only an appropriate community communication tool, but it was community driven and required community support. Going on air needed: i) advertisement of the event, ii) a radio operator, and iii) a translator for on-air discussions. Along with radio talk shows it was suggested by a community member to hold a climate change contest (over the radio). The community also

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[118] Radio stations are community operated, and every community sets its own on-air programming schedule outside/in addition to broadcasts streamed from Wawatay Radio.
[119] During the fieldwork, cellular service was limited to travel hub airports and communities on the James Bay Coast.
[120] "Roy, your Dad needs the truck".

provided support by hosting the contest and donating prizes.[121] PAR, as the research method, fostered the development of these community relevant knowledge exchanges during the early weeks in the field and continued in successive communities.[122]

Academic researchers are perhaps more prepared prior to fieldwork (e.g., cultural awareness and historic background, study methodologies, instrument development, etc.) than afterwards. PAR requires researchers to be engaged with participants (responsive) and within themselves (reflective) before, during and after conducting research. Researchers conducting PAR with a different culture and removed from their environment for an extended period of time need to be prepared for potential post-fieldwork adjustments. A challenge not anticipated was experiencing 'culture shock' *after* returning from the fieldwork.

Living in northern First Nation communities to collaborate in research was an energizing and rewarding experience. First Nations people, despite serious social and economic dilemmas, have a great sense of humor and are very welcoming and communal people, warmly inviting guests into their homes and extending invitations to participate in family and community events. The remote geographic locations of these northern communities contribute to a quiet and

[121] The contests were a joint endeavor. The researcher prepared an information sheet with potential questions and answers, distributed them around the community (e.g., band offices, nursing stations, local stores), and reviewed the question in school classrooms. Advertisements were made by the community radio operator providing the locations to pick up the potential questions and answers. Prizes were donated by Chief, Council, community organizations, and the local store; prizes were inclusive of all members in the community (e.g., bags of oranges, flour, oats for Elders, pizza for the youth, prepared/takeout meals for families).
[122] Wunnumin Lake First Nation, the last community visited, hosted a talk show and contest.

slow rhythm. Life revolves around the cycles on the land—the long dark winters and anticipated spring goose hunts. Returning to the noises, lights and tempo of a city can be overwhelming,[123] along with processing the fieldwork experience that includes personal stories shared by community members. Yet, acclimatising to a metropolitan lifestyle provided a poignant realization of the adjustment Aboriginal people experience when visiting and/or transitioning to live in a Western cultural setting[124] with its enormous sensory stimuli and influences. Returning to the city also provided an insight into the Indigenous perspective; the identity and connection to the land that are constant. In the words of an anonymous Aboriginal poet:[125]

> I'm a warrior with a lot of respect.
> When I'm in the bush I know who I am and know what to do.
> When I am in the bush I can see where I'm going.
> When I'm in the bush, I feel so happy and my heart feels so peaceful.
> When I'm in the bush I seek for answers; I always find them.
> When I'm in the bush I respect the land, my people,
> the Creator and everything around me.
> When I'm in the bush, I find myself, love and forgiveness to my parents.
> This is my path.
> It may be hard,
> but living off the land is what makes me strong and powerful.
> It is beautiful.

[123] Sirens interrupting sleep, light pollution, traffic, freeways, billboards, and crowds of people.
[124] First Nation youth leave their remote communities to attend high schools in the south.
[125] A copy of the poem was given to me during the fieldwork. After efforts to learn the author's name, the poet's name remains unknown; the author may be from the James Bay coast area.

3.6 CONCLUSION

In collaborative research projects with Indigenous peoples, the researcher and research participants are interrelated (Creswell 2007, 395) and the interaction between all the parties is to discover and include local priorities and objectives (Berkes 2007). Wyatt et al. (2010) warns that models of collaboration, forest management planning for example, where narrow roles are adhered to and specific outcomes are built into the design, are not appropriate and counterproductive in working with First Nations. Berkes (2004) argues that scientific and traditional knowledge can generate complementary outcomes when research projects are collaborative from the onset. The research collaboration began at the design stage with joint decision making throughout the research process, during on-site visits, in co-authorship publications, and in providing research results to NAN, First Nation communities and individual participants.

The CREE philosophy to build capacity, collectively conduct research with respect, seek the investment of equity by each party, and empower those involved through knowledge creation supported the methodology. The research needed a methodology that would balance Western academic requirements, including administrative and academic constraints, with First Nations' worldview and cultural dynamics. Key to finding this balance was the parties having awareness of their individual and combined valuable contributions, perspectives, and requirements. The researchers were aware of the academic tools being brought to the table in conducting research, mindful of First Nation experiences in past research studies, and respectful of First Nation knowledge, culture, social and organizational networks. It was acknowledged that communities have their own insights and capacity, apart from academic involvement, to conduct research and contribute to research relevant to them (Blodgett et al. 2011). There was also recognition by NAN and community participants that the researcher brought knowledge to share with the group, a valuable viewpoint, and potential linkages at regional and national levels (Kidd and Kral 2005). PAR was selected on its merits for: i) knowledge building and exchanges, ii) the space for collaboration in keeping with the developed relationship between the researcher and NAN, and iii) consistent with the research philosophy.

During a research collaboration developing trust is not forced, but stems from the regard and acceptance (from both parties) and builds while being actively attentive and engaged in the collaborative processes, particularly in fieldwork. Respecting Indigenous traditional knowledge, culture and social protocols, and explicitly seeking free, prior, and informed consent, fosters trust. Trust allows the willingness of the participants, both First Nation and academic, to contribute their knowledge as individuals and the knowledge communities collectively hold to share in research benefits, and extend knowledge to a larger audience.

PAR created the pathway for the two-way knowledge exchange identified at the onset as a substantial element and strength of the research. It was important to NAN to build capacity on climate change and boreal forest science in their communities. Additionally, the research would assist NAN in identifying strengths and gaps on knowledge and issues around climate change relevant to their communities. For the researcher, it was important to gather information to add to the body of knowledge on climate change impacts occurring in the northern boreal forest and First Nations perspectives on approaches to climate change mitigation, adaption and policy.

The study is both a top-down and ground-up instance of PAR: an umbrella organization facilitated and undertook activities to engage in research, and communities and individuals actively participated in the research fieldwork. PAR allows for flexibility and adapting research inquiry to community dynamics and the people involved. The emergence and development of community relevant tools for knowledge exchanges and avenues to engage the community in capacity building are attributed to the participatory nature of the research.

Using Western research formats and ethical protocols poses challenges for researchers in the field and can hinder research with First Nations. These can also be inappropriate within Indigenous cultural viewpoints and community frameworks. Research with First Nations as research partners opens the exploration and opportunity to develop methods for community preferred and derived protocols as well as meet ethical review boards' criteria. In addition, research partnerships close the gap in acknowledging and including IK in the research findings, and in a manner that is not exploitive or unknowingly misappropriated.

Connecting Western methods and research practices with Indigenous approaches and worldviews is considered a strength in Indigenous research methodologies (BCAAFC 2010). Moreover, Indigenous methodology at times has been shown to intersect PAR (Evans et al. 2009). A collaborative research relationship with First Nations allows for creating the space for IM to emerge during the research process. Indigenous research methods such as being on the land, is considered a cornerstone in Indigenous research methodologies (McGregor, Bayha and Simmons 2010). Indigenous peoples have a strong oral culture, and First Nation words or phrases are better understood when out on the land. Expressions that define a specific place with inherent environmental conditions in relation to carrying out traditional activities clearly reveal themselves when being on the land.

A Cree phrase, known by a community over many generations, depicting “the open area… near the bay… where the geese land [during migration]”[126] has within a generation rapidly shrunk by the advancing shrub specie—alder (*Alnus*), and geese populations no longer land in this particular place during migrations as in the past. Being taken to this place emphasized the significance of climate change impacts. The advancing treeline, attributed to climate change, is shifting the hunting grounds of traditional foods to areas further away and impacting a cultural frame of reference.

[126] The authors wish to acknowledge and show respect for First Nations’ languages; an attempt to write the phrase phonetically is potentially problematic if written incorrectly; it could be misleading, or possibly offensive to another First Nation as there are many dialects and nuisances.

PAR, which is action oriented, helps to identify community action for a particular issue or problem (Kidd and Kral 2005). While still in its infancy, actions on the research findings are underway. Some of the preliminary findings and benefits include: i) a baseline on conditions related to climate changes in NAN First Nations territory for future use, ii) NAN community awareness on climate change for use in adaptation strategies, iii) NAN perspectives on 'adaptation' and the need for space to be created for First Nation perspectives at the beginning of and throughout climate change policy decisions to address climate change, and iv) more effective climate change policies through combined and recognized equality in scientific and Indigenous knowledge. Considering the potential magnitude of climate change affects to people and planetary ecosystems on which we depend upon, all knowledge is relevant and necessary.

The significance for building knowledge through the inclusion of Indigenous knowledge and 'ways of knowing' to address climate change has begun to emerge. The research based on collaboration and inclusion, respect and trust, cultivated a research experience bridging Western academic and Indigenous research methods. With First Nations as a research partner, PAR and IM intertwined. The research evolved to resemble and reflect IM— respect, sharing power, creating knowledge that was first-hand and generational, and culturally framed in being on the land. More important and in keeping with IM, the research findings will benefit First Nations on issues relevant to them in addressing climate change on their territorial lands. A 'bridged methodology' benefited everyone involved in the research experience—in the process of sharing and gaining knowledge, and identifying gateways for applying the research findings. Adapting to and finding solutions to climate change will require an inclusive depth and breathe of knowledge.

CHAPTER 4. RESEARCH RESULTS

4.1 "BLUE-ICE"

Golden, D.M., Audet, C.A. and Smith M.A. (2015). "Blue-ice": Framing climate change and reframing climate change adaptation from the Indigenous peoples' perspective in the northern boreal forest of Ontario, Canada. Climate and Development, 7(5), 401-413.

Abstract: The northern boreal forest in Ontario, Canada, in the sub-Arctic above the 51st parallel, is the territorial homeland of the Cree, Ojibwe, and Ojicree Nations. These Nations are represented by the political organization Nishnawbe Aski Nation (NAN). January 6–March 31, 2011 the researchers and NAN collaborated in a study to record observations of changes in the forest environment attributed to climate change and share and exchange information and perspectives about climate change. Data were collected from ten First Nation communities across a geographic area of ~110,800 km^2 (43,000 mi^2). We explore climate change impacts through the lens of "blue-ice"; a First Nation's focus regarding a familiar condition on the land and a term embedded in their languages across the fieldwork area, and reframe adaptation in the First Nations' perspective and worldview. Changes in blue-ice on the landscape is affecting transportation in traditional activities such as hunting and fishing, as well as the delivery of essential community supplies. The word 'adaptation' linked to climate change does not exist in their languages and the term is associated with European colonization. We propose the term 'continuity' to reflect the First Nation worldview. Our recommendation is giving First Nations' perspectives and knowledge of their territorial landscape a foundational role in the development of climate change policy for Ontario's northern boreal forest.

4.1.1 Introduction

The Indigenous peoples[127] of the boreal forest north of the 51st parallel in Ontario, Canada are Cree, Ojibwe, and Ojicree people who reside in 32 First

[127] We use three different terms to cover Indigenous peoples: "Indigenous", as spelled out in the UN Declaration on the Rights of Indigenous Peoples, 2007 (and adopted by Canada in 2010), "Aboriginal", which is defined in Canada's Constitution Act, 1982 to include "Indians, Métis and Inuit"; and "First Nations", which has no legal definition but has become the accepted term for "Indian Bands" under the

Nation communities. First Nations are recognized within Canada as "Aboriginal peoples" having Aboriginal and treaty rights, affirmed by section 35 of Canada's Constitution Act, 1982. These 32 northern communities, as well as an additional 17 others, are represented by Nishnawbe Aski Nation (NAN), a Provincial-Territorial Organization (PTO). Their homeland covers two-thirds of the province of Ontario, spanning approximately 544,000 km^2 (~210,000 mi^2; NAN 2011).

In 2010, Ontario passed the Far North Act. The Act enables land use planning for resource development (e.g., mining, hydroelectricity) and includes the goal of 50% protection of the land base to support biological diversity and maintain ecological processes and functions, "including the storage and sequestration of carbon from the atmosphere" (OMNR 2011). The land area covered by the Act (~450,000 km^2 or ~174,000 mi^2) is land within the traditional territory of NAN member First Nations. While First Nation involvement and approval of land use plans is enabled by the Act,[128] NAN raised strong objections to the legislation,[129] stating that as worded the Act gives the Minister (in the Ministry of Natural Resources and Forestry overseeing the Act) the final decision-making authority, and as such impedes their rights to decide how,

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Indian Act (INAC, 2002); the communities that were part of the study are all "First Nations" and consider themselves to be Ojibwe, Cree, and Ojicree Nations. We therefore use the term First Nations and Indigenous interchangeably.

[128] The Act "supports the environmental, social and economic objectives for land use planning for the peoples of Ontario that are set out in section 5" (Far North Act 2010, s.1(b)). Section 5 also outlines "a significant role for First Nations" in planning and the protection of cultural values through "community based land use plans", with the goal of at least 225,000 km2 in "an interconnected network of protected areas".

[129] NAN Launches Anti-Bill 191 Campaign News Release, Tuesday, August 13, 2010, Thunder Bay, ON http://www.nan.on.ca/upload/documents/com-2010-08-13-nans-position-on-bill-191.pdf

where, and when their lands and natural resources would be developed or conserved.

Policy decisions to address climate that affect NAN First Nations and are made without their full engagement and input will fail to fully consider their rights, perspectives, or values. First Nations within NAN have direct ties to the land and recognize the importance of addressing climate change impacts in their territories. The rapidly occurring changes related to climate change are influencing how they interact with, and respond to, a changing environment. Threats from floods and forest fires, and changes on the land are affecting community safety, food and energy security.

In 2010, NAN and the researchers (hereafter referred to as the research team) developed a research proposal and entered into a research contract defining each party's roles and responsibilities. The objectives of the research included: i) documenting community members' observations of climate-related changes occurring in the forest, ii) examining First Nation perspectives and engagement in policy development on climate change, and iii) examining the potential for northern boreal forest to mitigate climate change. This paper presents the first objective with discussion of First Nation observations in changes to the forest environment, and the second objective on their perspectives on adaptation related to their worldview and relevance in climate change policy.

We begin our discussion with the concepts of adaptation, resilience, adaptive capacity and the growing literature on joint scientific and Indigenous knowledge research in climate change. Presented in the discussion is an overview of the research method—Participatory Action Research (PAR) and combining scientific and Indigenous peoples' worldviews. We continue with a brief description of the geography of the study area and the homeland of the First Nations collaborating in the research. Next, we present fieldwork observations from the First Nation participants on the rapidly occurring and unpredictable changing conditions on their land through the lens of "blue-ice".

Blue-ice is more than 'ice'. "Blue-ice" is a term embedded in their Indigenous languages. It refers to a specific environmental condition in its formation that is both a familiar frame of reference in seasonal cycles and in activities carried out on the land, and constant in its importance as an element of life. Our analysis on the disappearance of blue-ice observed by First Nations is an indicator of warming temperatures on the planet (Mueller and Warwick 2003; NASA n.d.), and is significant to these people affected by its disappearance. Changes in blue-ice are a climate change impact on transportation, which affects food security, energy security, and traditional activities. Discussion includes participants' responses to the term 'adaptation' based on their worldview and historical context. We propose the word 'continuity' to reflect the First Nation view of adapting to the landscape—a process that has been perpetual over millennia (not restricted only to more recent anthropogenic climatic changes). We recommend giving First Nations perspectives and ecological knowledge of their changing landscape a foundational role in the development of climate change policy for Ontario's northern boreal forest.

4.1.2 Adaptation, Climate Change and Indigenous Peoples

Impacts from climate change will not be distributed equally around the world (Fischlin et al. 2007) and attention is now shifting from climate change mitigation to climate change adaptation[130] (Folke et al. 2007; Huntjens et al. 2012). Mitigation efforts towards climate change intend to reduce the severity of impacts, while adaptation assumes there will be significant changes and therefore adjustments will be required in activities, thinking and decision-making (Kwiatkowski 2011). Adaptation in relation to climate change has several definitions and related concepts found in the academic and grey literature (Levina and Tirpak 2006). Different interpretations and definitions of the term have been adopted by different fields, such as anthropology, biology and business management, and the more recent social development and justice arenas, to align with their particular disciplinary foci (Walker et al. 2004; Engle 2011b).

The shift in focus to address climate change from mitigation to adaptation is reflected in, and connects, two schools of thought—socio-economic development and social-ecological interactions. The sustainability and socio-economic development literature discusses vulnerability and risk (Walker et al., 2004), with a focus on changing human activities to prevent or mitigate climate change (Engle 2011b). In the social-ecological system (SES) literature, adaption

[130] Climate change mitigation are actions to reduce, prevent, and remove greenhouse gases from the atmosphere, whereas adaptation is planning and preparing for climate change impacts to lessen the impact or capitalize on the opportunities.

discussions centre on the attributes of a system's resilience, adaptability, and transformation (Walker et al., 2004). Since Holling's (1973) seminal paper on the concept of resilience, refinements of the concept have emerged (Walker et al. 2004). Holling's concept explored the capacity of ecosystems to persist in the original state subject to 'perturbations' (Folke et al., 2010), or simply put, to understand ecosystem responses to change (Adger et al. 2011). Since then concepts from the resilience and vulnerability literature have been applied with sustainable development concepts (Park et. al 2012) to understand the complex systems of human responses to environmental change, particularly adaptation to climate change (Abel et al. 2006; Huntjens et al. 2012; Park et al. 2012). O'Brien et al. (2009) argue that resilience research into the interaction of social and ecological subsystems provides insight into complex systems as a whole. Untangling the complexities to develop effective policies is viewed as essential to sustainability for ecological and socio-economic systems (Lui et al. 2007).

Folke et al. (2007) suggest ecological and human dimensions "are not just linked but truly integrated ... and the interplay takes place across temporal and spatial scales and institutional and organizational levels in systems that are increasingly being interpreted as complex adaptive systems". Complex adaptive systems (CASs) theory builds upon and differs from traditional systems theory in that it incorporates the role of adaptation in the dynamics and responses of complex systems. Complex adaptive systems are characterized as self-organizing, a complex whole interacting at a localized scale in non-linear dynamics, and across temporal and spatial scales (Hartvigsen et al. 1998). The key element is the influence of adaptation. There are three fundamental characteristics in the ability to adapt that contribute to the overall resilience of a system: 1) a system's susceptibility to change while still retaining its structure and function, 2) the degree a system is capable of self-organizing, and 3) adaptive capacity to learn and adapt (Carpenter et al. 2001; Abel et al. 2006) .

Vulnerability is the degree to which a system is likely to experience harm, as in the extent and occurrence of a disturbance from internal and external variables, which can be from global, regional, and local forces (Liu et al. 2007). Defined by Walker et al. (2004), resilience is the ease or difficulty of changing a system—that is, how resistant it is to change due to a disturbance, and its ability to retain essentially the same function, structure, identity, and feedbacks during change. The concept of adaptive capacity has emerged from the sustainability (focused on vulnerability) and social-ecological (focused on resilience) literature. A key element of adaptive capacity is its creation from the production and communication of information and knowledge (Lemos et al. 2007).

Indigenous knowledge I, often referred to as Traditional Ecological Knowledge (IK) has led to the development of elaborate coping strategies and valuable knowledge that plays a role in adaptation to and mitigation of climate change (Macchi et al. 2008). Indigenous knowledge is a cumulative body of knowledge and beliefs, evolving by adaptive processes and handed down through generations (Davidson-Hunt and Berkes 2003). Studies on the knowledge of Indigenous peoples in adapting to and mitigating climate change (Devkota et al. 2011; Macchi et al. 2008), the adaptive capacities of Indigenous peoples to climate change (Galloway McLean et al. 2011) and the co-production of knowledge on climate change (Berkes 2009), have brought Indigenous perspectives on adaptation and the application of Indigenous knowledge to modern climate change problems (Berkes et al. 2000; Galloway McLean et al. 2011). As direct users of the natural environment Indigenous peoples have valuable and experiential knowledge at a regional level on ecosystems and the services they provide (Davidson et al. 2014). Adger et al. (2011) argue many sources of resilience in the collections of social and institutional memories (i.e., past experiences and successful adaptions to change) are likely to be challenged by climate change and are insufficient in managing resilience unless put to use—at different scales in scope, time horizons, and governance (including regionalizing influence and authority) to frame problems and recombine experiences in order to build adaptive capacity.

In Canada, research with Indigenous peoples on climate change has largely focused on the Arctic (Nakashima, 1993; Cruikshank, 2001; Huntington et al. 2004; Cobb et al. 2005; Dowsley 2009; Pearce et al. 2009, Henry et al. 2013). Our discussion of adaptation reflects a conversation that brings to light perspectives from Indigenous peoples in ten communities living across the sub-Arctic in the boreal forest.

4.2. STUDY OVERVIEW

4.2.1 Research Method and Data Collection

The study is a collaboration between NAN (as an umbrella organization and participating communities), the academic researchers, and individual participants, using Participatory Action Research (PAR). Traditional knowledge is “usually described by Aboriginal peoples as holistic, involving body, mind, feelings, and spirit” (TCPS-2 Sect. A., 2010). In Western science there still exists a mindset that it is superior to IK (Pretty 2011) in that knowledge that includes ‘feelings and spirit’ or ‘anecdotal’ information cannot be measured or quantified, and is therefore not scientific. Moreover, perspectives from oral traditions have too often been utilized as data in science rather than stand-alone knowledge or theory (Cruikshank 2001). However, there is an increasing recognition that local and Indigenous knowledge, particularly in areas of high environmental priority such as climate change, may provide insight and fill in data gaps on remote or hard-to-access environments (Brook and McLachlan 2008). Incorporating the depth and breadth of IK on the historic and current status of the land (e.g., biophysical conditions, flora and fauna) across large geographic areas of traditional territory is invaluable to fill gaps in scientific knowledge and in forming appropriate policies in rapidly changing environments (Dowsley 2009). Studies have discovered that drawing on Indigenous knowledge produces a better understanding than Western knowledge and scientific methods alone, despite the challenges with integrating the two knowledge systems (Cochran et al. 2008; Bohensky and Maru 2011). Moreover, growing literature from Indigenous scholars places local experiences in a broader context and is therefore relevant as a knowledge paradigm parallel with Western knowledge (Henry at al., 2013).

This study incorporated the main characteristics of PAR: i) educative (for both parties), ii) dealing with individuals as members of a social group, iii) problem-focused with the intent of taking action, iv) treating all participants as inherently part of the process, and v) a collaboration where each party contributes and each party benefits from the interaction (Winter and Munn-Gidding, 2001). PAR created the pathway for two-way knowledge exchanges: building capacity on climate change at the community level (i.e., forest science, climate change science, and political dialogue) identified at the onset to be a part of and a strength of the research, and recording observations from community members living in the sub-Arctic boreal forest environment related to climate change.

Our discussion is a collection of responses conducted with careful, systematic audio-recordings during semi-structured interviews with individuals and focus groups, along with field notes and memoing. Forty-three (43) individuals from the visited communities contributed to the research data.[131] The vast majority of the contributors were key informants or knowledgeable people within a community. Huntington (2000) argues that having a community identify and introduce key persons to a researcher is the desired approach to reach individuals having the knowledge and information relevant or useful to the research. A few participants the principal researcher met while walking or

[131] Respectfully acknowledged, unavoidable community circumstances took precedence over the research; many times the winter road opened creating an exodus of community members to obtain much needed supplies, or sadly a death occurred and all community activities halted, including interviews, except those to mourn.

shopping in a community ('random' participants). The participants represent Council members, Elders, Land Users (hunters, trappers, fishers, and gatherers), community Land Use Planning Members, Winter Road Staff, and other community members. For the purpose of this discussion, descriptions for the role of a community member are found in Table 2. The information provided by these individuals was coded for themes and organized using QSR NVivo 9/10 software.

Table 2. Community Roles of Interviewees

Community Role	**Description**
Council Member	An elected individual by the First Nation community to be the Chief, Deputy Chief or a Band Council Member
Elder	An individual recognized in the community for their generational and/or traditional knowledge; not necessarily someone who has lived a long time, though usually (i.e., a grandparent or retired person); a community advisor and/or traditional teacher; lives or once lived a traditional lifestyle
Traditional Lifestyle Land User	Community member who lives off the land by traditional activities—hunting, fishing, trapping, gathering fuel and plants (edible, medicinal); makes tools and equipment (e.g., snowshoes, nets)
Seasonal Land User	Someone who engages in traditional activities on the land either on weekends (e.g., fishing), when hunting seasons occurs for various species of animals/birds (e.g., moose, goose) or gathering edible and medicinal plants when in season (e.g., blueberries); Seasonal Land Users are usually employed within the community (e.g., schools, nursing stations, band offices, airports), employed in an industry near the community (e.g., mining), volunteer or have other roles in the community
Community Land Use Planning Team Member	Member of the community employed to create a land use plan around a community's reserve land identifying potential development areas (e.g., forestry, mining), traditional and sacred places (e.g., trap lines, burial sites) and ecologically important sites (e.g., wetlands, spawning waterways)
Winter Road Staff	An individual employed by the community to build and maintain the road(s) during winter seasons

Elders represent the largest community group interviewed (30%), Winter Road Staff made up 16% of the participants, Land Use Planning Members represented 12%, and Land Users 8% of the participants. It should be noted Winter Road Staff, Land Use Planning Members and other community members are usually also ‘Land Users’, but their specific role in the community related to their employment is very relevant in the discussion of “blue-ice” and therefore noted accordingly.

4.2.2 Research Area

From January 6 to March 31, 2011 ten First Nation communities located in northern Ontario, Canada at latitudes between 51°and 54°N, from near the Manitoba border in the west to the James Bay coast in the east, a geographic area of approximately 110,800 km^2 (43,000 mi^2), participated in the research (Figure 5). The communities contributing to the data, in order of visits were: Muskrat Dam, Weagamow, Pikangikum, Sandy Lake, Neskantaga, Nibinamik, Attawapiskat, Fort Albany, Kingfisher Lake, and Wunnumin Lake. These communities are in very remote locations only accessible by aircraft with the exception of travel during winter months on winter/ice roads, and for the two communities along the James Bay coast (Attawapiskat and Fort Albany) short-time river barge transportation in the summer. These First Nations are intrinsically connected to the climate, landscape, flora, and fauna. Hunting, fishing, and trapping (e.g., moose (*Alces alces*), *walleye (Sander vitreus*), and marten (*Martes americana*)) are part of their culture in traditional activities and family gatherings (e.g., seasonal hunts of snow goose (*Chen caerulescens*)), as is gathering firewood and wild fruits such as the blueberry (*Vaccinium myrtillus*).

The study area contains two ecozones: the Boreal Shield, Canada's largest ecozone, and the Hudson Plain (or Lowlands).[132] Advancing and retreating glaciers etched the depressions and shaped the regional landforms creating the thousands of lakes, numerous rivers and streams, vast wetlands and peatbogs (muskeg). Land elevations (within the study area) vary from 360 m in the west to sea level in the east.[133] The area, as classified by Köppen,[134] has a continental sub-Arctic or boreal climate. The sub-Arctic region experiences the most extreme seasonal temperature variations found on the planet, ranging from -40 ^{o}C (-40 ^{o}F) in winter up to +30 ^{o}C (86 ^{o}F) in the summer. Historically, summers are short lasting no more than 3 months and winters are severe lasting 5-7 months with snowstorms, strong winds, and bitter cold due to continental polar and Arctic air masses. Precipitation occurs throughout the year in the forms of rain and snow and there is no dry season (Pidwirny 2011).

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[132] Sub-Arctic geography retrieved from Natural Resources Canada, The Atlas of Canada Climatic Regions http://atlas.nrcan.gc.ca/site/english/maps/archives/3rdedition/environment/climate/030

[133] Land elevations were taken from topographical maps The Atlas of Canada, Natural Resources Canada; Retrieved from http://atlas.nrcan.gc.ca/site/english/maps/topo/map

[134] The Köppen Climate Classification information as developed by German geographer Wladimir Köppen (1846-1940) continues to be the authoritative map of the world climates in use today; Retrieved from http://www.elmhurst.edu/~richs/EC/101/KoppenClimateClassification.pdf.

Figure 5. Fieldwork Map: Indicated are the northern communities visited and travel hub centres from which travel to the communities was possible. Flights north originate below the 50th parallel in Sioux Lookout (in the west) and Timmins (in the east); travel in east-west directions to access the northward hubs requires stops in Thunder Bay, Sault Ste. Marie, and Sudbury, ON. Total travel distance to reach the communities was nearly 6,300 km (3,900 mi). In our discussion we divide the study area into three regions N of the 51st: the west, at longitudes between 91° and 94° W, central, at longitudes between 87° and 90° W, and the east, at longitudes between 81° and 83° W.

4.3 RESULTS AND DISCUSSION

4.3.1 "Blue-Ice": A Lens into Climate Change

Evidence for climate change and its effects on the lives of millions of Indigenous peoples[135] is accumulating in the literature (Downing and Cuerrier, 2011; Galloway McLean et al., 2011). The changes demonstrate a deviation from familiar conditions outside a culture's traditional knowledge (Sakakibara, 2011). During the course of the fieldwork, similar findings arose in the repeated descriptions of changes in seasonal temperatures and precipitation, vegetation and wildlife, along with comments on the rapid rate and extent of changes observed and experienced, the uncertainty as to why these events were occurring, and the unpredictability of environmental conditions on the landscape. Crate (2008: 527) points out that "in the field, we need to understand how our research partners frame the local effects of global climate change in order to tease out cultural implications."

The reference to kah-oh-shah-whah-skoh-siig mii-koom as pronounced in Ojicree, and written in Ojicree syllabics as ᑲᐅᔕᐧᐊᐢᑯᓯᒡᒥᑯᒼ , or "blue-ice", was a phrase consistently used by First Nations to describe a specific and familiar environmental condition that is rapidly changing, with significant implications and relevance to community members across the study area. The importance of "blue-ice" formation on lakes and rivers (and in general frozen waterbodies and

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[135]The UN Secretariat of the Permanent Forum on Indigenous Peoples (2009) reports 370 million Indigenous peoples live within 90 countries around the world.

the muskeg) cannot be overstated with respect to First Nation recollections and memories, its cultural significance in traditional activities, and the current and future well-being of these communities. The formation and presence of ice influences these First Nation communities throughout the year. Tremblay et al. (2006) had similar findings in their study using traditional knowledge and local observations as well as scientific knowledge to characterize ice conditions relevant to the Aboriginal communities involved. “Blue-ice”, though noting a color (and is blue-greenish where fresh water meets marine water in the mouth of the rivers at James Bay[136]), is a cultural and community frame of reference to the conditions and attributes of the land, and the activities connected to them. It is fixed in the past, present and future and climate change observed by these First Nations is discussed through that lens.

Blue-ice in the scientific literature has specific properties and particular meteorological circumstances in its formation (see Yu et al., 2012 on blue ice in the Antarctic). In the northern boreal, “blue-ice” forms out of water exposed to very cold sub-zero temperatures over an extended period of several weeks.[137] Explained by Gudra and Najwer (2011) “supercooled water and low air temperature are ideal conditions for the formation of *frazil ice*, small crystals of free-floating ice” (p. 625). Though this may seem to be straightforward, the timing of two environmental conditions must be met in the forming of “blue-ice”—

[136] Eight of the ten communities are located inland and situated next to lakes or rivers; two communities are located on the James Bay Coast at the mouth of major rivers- the Albany and Attawapiskat.
[137] Comments and recollections from community members included ice strong enough to walk across within days after temperatures became very cold—the blue-ice trusted for its strength, lasting for many months.

frigid temperatures and the absence of snow. As explained by an Elder, the arrival of snow on open water is beneficial, to quickly chill the water, but not beneficial after the initial ice forms:

> When I was a kid … from September to October it used to be cold, really cold … when the lake started to freeze and we used to have blue-ice and this blue-ice lasted like a long time before the snow comes ... and when the snow came we didn't have a snow that was coming down like a slush, because it was so cold. But now every winter, the snow usually comes first. We have snow on the ground first and then we would have slush on the lakes and then ... it freezes up. (Elder, central region)

When snow arrives too soon after the initial layer of ice forms, water underneath the ice is insulated from the cold northern air impeding "blue-ice" formation. Snow also has other influences on ice formation. As explained by a community member, during ice formation water naturally floods across the ice surface from open areas or at ice edges, and when water meets snow the formation of slush occurs (a slurry mixture of snow crystals and liquid water). Snow on the ice surface can also cause melting of the existing ice creating a contact zone of water and snow that results in slush. Slush when it freezes is a white-coloured ice, and referred to as "slush" by First Nations even in frozen form (due to its mixture of snow and water and not solely water). Differences in the types of snow are also a factor in ice formation and falling snow is mostly affected by temperature (Table 3). In the scientific literature:

> there are various types of ice, differentiated depending on the way it is formed. *Snow ice* forms when snow falls on water surfaces at a temperature of about 0^0 C [32^o F] —ice does not melt. Sudden

temperature drop causes snow ice to change into *white ice* (Gudra and Najwer, 2011: 625).

Table 3**.** Air temperature and snow crystal formation. Adapted from Gudra and Najwer (2011) and participant snow descriptions.

Air Temperature	**Snow Crystal Type**	**Snow Crystal Characteristics**
Below -10 ^{0}C (14 ^{0}F)	Powder snow	Fluffy, light weight, small in size like dust particles; non-sticking separate crystals; easily moved by the wind; dissolves quickly in open water
Between -10 ^{0}C and -3 ^{0}C (14 ^{0}F and 27 ^{0}F)	Packed snow	Heavier than powder snow; crystals will eventually stick together, forming a dense layer or compacted snow layer on the land; packed snow can be walked on leaving no footprints;
Above -3 ^{0}C (27 ^{0}F)	Wet snow	Heavy snow due to its water content; crystals easily merge together forming a group of flakes or clumps; crystals stick well together creating a water-snow mixture; can be the consistency of sloppy "mashed potatoes" and difficult to travel across

The major difference in blue-ice and slush is strength. Recorded from interviews in the study area, "blue-ice is the strong ice that freezes right" (Elder, west region) when "the cold was strong" (Elder, central region). Ice is diverse by nature and blue-ice is dense (in comparison to slush) and considered twice as strong; therefore "there needs to be twice as much slush ice to equal the strength of blue-ice"(Winter Road staff member, west region). In the scientific literature, there are no established methods for measuring ice parameters; the most common examination of ice is measuring layer thickness in a water body (Gudra and Najwer 2011). The depth of blue-ice described repeatedly across the study area was nearly half the depth as in the past.

Along with changes in the formation and depth of blue-ice is the duration of ice on the land from its arrival to breakup. In the past, ice began to form in the fall (September/October) and remained until May (or even into June); its presence on the land lasting six to eight months. In recent years, blue-ice (slush and ice in general) is forming later and disappearing earlier, by nearly two months and even more. Community members remember those conditions in these translations:

> On the river systems … on the shores of the rivers ... we were still dragging our boats. A long time ago … the lakes and the river system around June 10 would be the time that they would open up. (Elder, central region)
>
> Now the ice is gone when it is maybe March. (Traditional Lifestyle Land User, central region)
>
> For breaking, for the ice to break, sometimes it happens in April but usually that is in May ... the beginning of May … it happens in the past they say in June ... the ice broke. (Winter Road Maker, east region)

First Nation knowledge on ice formation, strength, thickness, timing, and duration is widespread across the northern boreal because the presence of ice is a critical factor in the activities carried out on the land. First Nations are witnessing changes in both snow (the timing and type) and warmer temperatures in the months in which blue-ice historically formed and stayed on the land.

4.3.2 Impacts from Changes in Blue-ice

For these First Nations, the significance of disappearing blue-ice is the transportation link to food and energy security, and continuity with traditional activities. Winter road access is a vital lifeline in these remote communities as it is the only time in which the economical transportation of goods and supplies occurs. Each community is responsible for building a section of the winter road system to create transportation corridors from the north to access permanent highways and urban centres south of the 50th parallel. Transported goods include groceries, and in some cases potable water, fuel (gasoline and diesel), modular houses and building supplies, household items (furniture, appliances, computers), equipment and tools (school, medical, electricity generators), and vehicles (cars, trucks, snowmobiles). At many times during the fieldwork winter roads were not open. Instances of road making equipment falling through the ice (Figure 6) or rivers beginning to flow signalled the temporary halt of transport trucks or the end of the winter road season. At times, even access for cars and light trucks was questionable.

Community members in charge of winter road making have had to adjust the type and weight of equipment to the strength-bearing capacity of the ice. In the 1980's, heavy snowploughs in excess of 18 tonnes were standard equipment, which changed to 10 tonne equipment 10-12 years ago, to the current use of lighter and smaller ¾ and 1 tonne trucks fitted with ploughing equipment (personal communication, Vernon Morris).[138] This adjustment reflects a compounding dilemma with the disappearance of blue-ice. Smaller road-making equipment increases the time needed to complete and maintain the winter road, and the timeline for reliable winter road conditions is becoming

[138] Notes taken during a discussion Muskrat Dam, ON, January 19, 2011

shorter. The following observations emphasize the changes in winter roads across all regions in the study area:

> Last winter ... there was hardly any winter. I noticed that. It didn't freeze up. … and then the spring, it comes too fast. The reason why I noticed that ... was the winter road. We couldn't use it after that. It was a really short winter. (Seasonal Land User, west region)

> The winter road didn't last that long ... I think they finished it in January [2011] and they are still good … so probably this is the last week [last week of March] to use it. (Seasonal Land User, central region)

> Last year we were like a month behind schedule because of all the mild days we had … couldn't do it [make the road]. (Winter Road Maker, east region)

Figure 6. Snowplough fallen through the ice. Photo taken January 2011 between Sachigo Lake and Muskrat Dam, Ontario (west region). The reduction in the strength of the ice for winter road transportation is attributed to the absence and/or decreased depth of "blue-ice" formation. Source withheld; printed with permission.

Diminishing winter road access significantly increases the prices of goods and decreases availability. Without winter roads, goods (though not large heavy items) arrive by costly air cargo. During the fieldwork it was not uncommon to pay ~CAD 5.00 for a dozen eggs. Gasoline was priced at CAD 2.45/litre (~US $9.80/gallon)[139] or more during times of scarcity, and at times shelves in the stores (particularly perishable foods) and fuel tanks at the gas pumps were exceedingly low or empty. Moreover, the further people travel out on the land to obtain traditional foods due to changes in animal and bird habitat and migration, the more expensive it becomes to carryout traditional activities for food. A community member explained the situation: "It is not worthwhile to go moose hunting as it is expensive. … the ride is very expensive… it comes out about the same as to buy food from the store than to go hunting."

With fuel trucks increasingly unable to access communities, not only will cost be an important factor, but also the supply of fuel will be in jeopardy. Less fuel for vehicles may not be as critical as less fuel for electricity.[140] Northern NAN communities rely on diesel-generated electricity with the exception of the few NAN communities along the James Bay coast connected to the province's electrical grid. Electricity not only powers appliances, but also heating and cooling systems in homes, buildings (schools, nursing stations, band offices)

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[139] Canadian retail gasoline prices in 2011 averaged $1.24/litre; Fuel Focus, 2011 Annual Review, Natural Resources Canada. Retrieved from http://www.nrcan.gc.ca/energy/fuel-prices/gasoline-reports/4733.
[140] The Globe and Mail Canadian Press. Sunday, Dec. 02, 2012 Neighbouring reserve to Attawapiskat narrowly avoids fuel, housing crisis. Retrieved from http://www.theglobeandmail.com/news/national/neighbouring-reserve-to-attawapiskat-narrowly-avoids-fuel-housing-crisis/article5899087/ .

and the community water treatment plant. While many homes are wood heated, many are not. No heat in the winter at sub-zero temperatures is potentially life threatening. In addition, access to potable water is an issue in every community. It is a minor issue when an electrical generator temporarily fails shutting down the treatment plant and pumping station, but in some communities, access to potable water can be a major issue when the water quality is so poor that it has to be delivered whether by transport trucks or air cargo.

Some community members and Elders (still physically capable) live off the land in a traditional lifestyle using skills that have been passed down to the next generation mostly through teaching by doing, but there are changes occurring:

> In the ‘70s I had the opportunity to work the land with Elders, people who taught me how to trap, hunt and fish and I appreciate what is out there on the land. We learned the language again, and the customs, the way of thought and how to care for the land and for the animals and stuff. … All that is changing really fast. (Council Member, west region)

Many community members, though employed within the community (e.g., schools, band council offices, winter road making) and not living off the land, are still ‘land users’ travelling across lakes and rivers to reach traditional hunting, trapping and fishing areas on weekends and during seasonal activities (e.g., goose hunts). Land users are acutely aware of changes in ice conditions affecting traditional activities particularly in terms of personal safety. Changes in ice conditions, sometimes very unpredictable on a day-to-day basis, present potentially life-threatening situations:

> There was this one area ... it thawed … really fast ... and it was this area where I fell through the ice. ... It was just white ice too; there was no blue-ice. It was just like a snow that had frozen there, no ice. But I was all by myself and when I first fell into the ice I got scared wondering how I'm going to get out. (Winter Road Maker, west region)

> We trap, and we hunt out this way, like out towards [the] east … there is a river that goes all the way to James Bay … we used to go across by dog team or our skidoos [snowmobiles]. Now we can't even go across them in some places. (Traditional Lifestyle Land User, central region)

Regardless of the changing conditions, First Nations' continuity with the land remains, although how traditional activities are conducted or the timing of when some activities occur is changing. One participant described the changes in the goose-hunt as:

> Like I said, the middle-end of April we [the family] would go set up and then do hunting through till the third of week of May. ... It's like earlier and earlier that we have to go set up because we have to carry a lot of stuff over. ... I don't want to take it all by canoe ... when the ice is already all gone; so what we do is we go there prior, set it all up ... leave it there until we go geese hunting. But this year it was not even five days after we set up that we were already back out there hunting geese because they were already there. (Traditional Lifestyle Land User, west region)

In every community, "blue-ice", along with ice, slush, the unfrozen and melting landscape was a notable recurrent topic of discussion in regards to observations of changes and activities carried out on the land.

4.3.3 Adaptation and Reframing the Language

Archaeological evidence suggests that Indigenous populations have previously adapted to climate change (Applied History Research Group 2000, 2001). Recently recognized are ‘culturally appropriate adaptations’[141] devised through community participation, which are necessary for Indigenous communities to adapt to climatic changes (Downing and Cuerrier 2011). For researchers to understand the impacts and adaptations to climate change of Indigenous peoples requires a different lens. To do so, it is necessary for researchers to reframe their viewpoint through dialogue and engagement with Indigenous communities (Pearce et al. 2009). The collaborative nature of this study between NAN, its communities, individual participants, and the research team created the space to explore the language and context of climate change adaptation from a First Nation’s worldview.

NAN representatives and participants in the study reacted to the term ‘adaptation’. In the Cree, Ojibwe, and Ojicree languages spoken in NAN territory, the word ‘adaptation’ does not exist. First Nations in this area, prior to European contact, lived a nomadic lifestyle for thousands of years, moving with seasonal resources in traditional activities or into more favorable locations with changing circumstances on the land and have long understood the need to act in accordance with the changing landscape because their lives and livelihoods depend on it. Adaption was inherent, not a term.

In modern times, ‘adaptation’ must be understood in the political context between First Nations and the Canadian state. It is a term coloured by colonization. Canadian state policy with First Nations has had an assimilation

[141] One culturally appropriate response would be how First Nations address changes in hunting areas because of wildlife habitat changes.

goal exercised more clearly at some historical periods than others (Tobias, 1976). Legislation passed in 1857, the Gradual Civilization Act,[142] captured this intent, as did a proposed amendment to the Indian Act (1867) in 1920, giving the federal government the power to eliminate (enfranchise) First Nations' legal status as 'Indians' (Salem-Wiseman, 1996). For First Nations, adaptation has meant struggling against assimilation policies to maintain their identity as peoples. While the state consolidated its power, First Nations were forced to adapt by losing theirs. One interviewee captured this sense of loss of control:

> Adapting to change … maybe I misunderstand that because adapting to change is changing my thought, my view on life … to something that is imposed on me. And I really have no power to assist in that process. (Seasonal Land User, west region)

Adger et al. (2005) point out that assessing the success of adaptation will involve new and challenging institutional processes that should be judged on the criteria of effectiveness, efficiency, equity, and legitimacy. The last two criteria are particularly relevant to First Nation communities. Consideration needs to be made for the social and human rights implications of climate change (OHCHR, 2009) including the rights to life (food, water), along with free, prior and informed consent (FPIC in the use of their territories to address climate change and in decisions to manage and adapt to the impacts. Dowsley (2009) argues reducing policy barriers that constrain community level decision-making in turn increases

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[142] The Gradual Civilization Act sought to assimilate Aboriginal people ("Indians") into Canadian settler society by encouraging "enfranchisement", a legal process for terminating a person's Indian status; Retrieved from http://indigenousfoundations.arts.ubc.ca/?id=1053.

community options and adaptive capacity that can help to cope with rapidly changing environments.

Adaptation needs to be understood not only in the political context, but also more importantly, in terms of First Nation values and beliefs about their relationship to the land. The First Nation worldview is rooted in ties to the land with responsibility given to them by the Creator to look after that land (NAN, 1977). That responsibility still defines how First Nations see themselves, in spite of changes forced upon them, whether it is state policy or climate change. Indigenous knowledge is interconnected to the individual as part of all living things, the earth, stars, and planets (Botha, 2011; Chinn, 2007) and described as holistic and 'different ways of knowing' (Pretty, 2011; Botha, 2011). It could be argued that the interconnected Indigenous perspective across temporal and spatial scales (see Davidson-Hunt and Berkes, 2003) reflects the concepts of CASs theory, and perhaps this perspective has a greater scope in understanding a complex issue like climate change. This wealth of knowledge has only begun to be understood, accepted, and applied outside Indigenous communities.

While adaptation necessitates change, 'adjustments' to climate change should be limited to ecological, social, and economic aspects (Smit and Pilifosova 2001). First Nations in the study recognize the need to develop anticipatory reactions to rapid climate change and to evolve activities, but remain the same as a people. Continuity in activities on the land occurs as noted from this interview:

> I pack the snow and then I have to make sure that I drive across that one certain place the entire winter. That is the only way. Because if I drive or cross it over [the river] in a different area, it's not as safe. (Seasonal Land User, west region)

The magnitude of changes and the hazards these changes have created (and will continue to create) affecting First Nations' subsistence way of life has also provided the impetus to plan appropriately for a changing environment. First Nations engagement and perspectives are critical in the planning and policy processes to address climate change on territorial land.

4.4 CONCLUSION

First Nations observations about changes occurring on the land and water were strongly similar across the study area and many discussions and descriptions focused on "blue-ice". The term is embedded in their languages and is as elementary to life as water (only in a solid state) and is a measuring stick for people's activities on the land. Blue-ice ties transportation to food and energy security, whether to access modern goods and services or carry out traditional activities. Blue-ice (and ice in general) historically formed in the fall and remained until spring or over a period of six to eight months. Today, blue-ice forms later, disappears earlier, and its depth is less (almost by half as in the past), reducing both the timeline in frozen lakes and rivers, and its strength-bearing capacity. Travel conditions on frozen waterways and winter roads can be extremely hazardous even during months typically considered the middle of winter (e.g., January).

The concept of ‘adaptation’ found in the climate change literature is foreign to First Nations in the northern boreal forest of Ontario. Indigenous peoples (and/or local communities) have for centuries managed and aligned the benefits from the environment with human interests (Hawken and Granoff, 2010). Adaptation is not a word or concept in their culture, yet it is inherent and necessary to living on the land for these remote First Nations. The term adaptation also carries a negative connotation associated with the history and influences from colonization to these Indigenous peoples.

The research team was challenged to use terms in keeping with the First Nation worldview framed by their connection to the land. Comments from Elders on interpreting “the sound of the cold” made this relationship remarkably clear. We transformed the term ‘adaptation’ to ‘continuity’ to reflect the Indigenous connection to the land. Consistent with theories in complex adaptive systems, First Nations understanding of, and interaction with, the landscape takes place across temporal and spatial scales, in generational and first-hand knowledge over a large geographic area and at a local level concerning blue-ice.

First Nations in the study recognized the need to develop anticipatory reactions to rapid climate change and to evolve activities in continuity with the land, *while still staying the same as a people* and retaining their cultural identity. Changes in blue-ice are requiring adjustments, but the Indigenous worldview remains intact. The important distinction we make is that only activities in response to climate change are applicable to the term adaptation (not First Nation people), and that in spite of adaptive changes to climate change, the First Nation worldview has remained perpetual and resilient. Most important to the Indigenous peoples in this study is recognition of their right to a homeland from which they cannot be displaced and which is central to their identity.

Policy and decision-making in response to climate change, to mitigate the extent of change and required adaptation actions, is arduous and fraught with uncertainty. A major contributing factor to the difficulties with the decision-making is the integral complexity of ecological and social systems. The value of Indigenous knowledge handed-down through generations in adapting to climate change, the application of traditional knowledge to modern climate change problems, and Indigenous perspectives on adaptation have been discussed. However, climate change policy in Ontario is being developed without meaningful consultation with First Nations and does not address the issues highlighted in this paper. This study illustrates the relevance and uniqueness of First Nations knowledge about climate change within their territory in relation to both their perspective of continuity and to the rapidly changing conditions on the land. The importance of First Nations involvement in climate change policies that will affect their territories and communities cannot be overstated, both as a constitutional requirement to protect Aboriginal and treaty rights, and in their knowledge on in changes occurring in the sub-Arctic.

The absence of Indigenous knowledge in the climate change discourse and policy decisions may have a perverse outcome. Excluding meaningful and broad participation by Indigenous peoples perpetuates the dominant Western approach to climate change adaptation and may limit the knowledge and information needed to identify key indicators in the complications, challenges, or solutions to the impacts. Rather than non-Indigenous people building adaptation strategies from a Western framework, or using traditional knowledge where policy makers deem it appropriate, space needs to be provided throughout the entire policy-making processes for First Nations perspectives. The new challenge for Indigenous communities and Western policy makers is inclusion in the dialogue.

Fundamental to the dialogue is reframing the language, which in this case is from ‘adaptation’ to ‘continuity’. Reframing the language would create a basis for discussions more meaningful to and respectful of First Nations, and facilitate the opportunity for greater understanding amongst policy makers of the changes occurring in the northern boreal forest. It will require formulating strategies and protocols in which First Nations are actively involved in the policy process from the onset, and not just the recipients of policy decisions made by others. Policy makers need to give Western and Indigenous knowledge mutual respect and substantial consideration. First Nations continuity with the land is relevant to addressing climate change, potentially leading to more effective climate change policies in Ontario, Canada and the rest of the world. It is time to build bridges across the disappearance of “blue-ice”—kah-oh-shah-whah-skoh-siig mii-koom.

CHAPTER 5. CONCLUSIONS

The conclusions drawn from the research are my own, and not those of the research partner, Nishnawbe Aski Nation (NAN). NAN does have the research data and may use it to draw their own conclusions, and/or use the data in future climate change research to meet the needs of its community members. Perhaps most importantly, NAN holds the voice recordings of Elders and community members contributing to the data, speaking in their languages about descriptions of their lands, past and present.

The chapter begins with framing the climate change predicament facing the world's social and ecological systems and the significant role of forests in regulating climate. The international debate in approaches to use forests as a means to address climate change and how the Indigenous peoples in Northern Ontario were inadvertently drawn into that debate are also discussed. The conclusions in the published papers are then brought into the discussion to assess the knowledge and policy gaps in Ontario's decision to address climate change with the Far North Act (2010). The chapter continues with a discussion on the research collaboration that is considered a strength in the study and how the outcomes from the collaboration are assisting NAN with efforts to engage its communities in the climate change dialogue within Ontario. The chapter concludes with the limitations or constraints in conducting the study and offers recommendations in areas of future research.

5.1 THE DILEMMA AND THE DEBATE

The complexities in the planet's climate system and the significant role of forests in regulating climate are well documented (Bonan 2008; Tarnocai 2009; Luckai et al. 2012; Ciais et al. 2013; Kurz et al. 2013; Lemprière et al. 2013; Yue et al. 2013). Also recognized are the negative influences on the planet's climate system from human activities (Schneider 1997; Cubasch et al. 2013; NOAA 2015). Finding solutions to lessen the effects on the climate system from human activities is a daunting challenge. Fossil fuel production and use are a major source of energy across the globe and the GHGs emitted during combustion is the pollution affecting changes in earth's climate (Cubasch et al. 2013). Climate change threatens to destabilize global ecosystems and functions in planetary systems with long-term ramifications affecting human systems (CIFOR 2008; Seppälä et al. 2009; IPCC 2014; NRCan 2014c; McMichael 2017). Major concerns with changes in climate are the effect on forest environments and the forest C cycle (Ciais et al. 2013).

Climate change is expected to affect all forest environments (Fischlin et al. 2008), and the boreal forest is considered one of the most vulnerable forest ecosystems to climate change (Bradshaw et al. 2009; Seppälä et al. 2009; Price et al. 2013). Changes in boreal forest ecology (productivity, soil/peatlands and disturbances) have huge implications in the planetary climate system because of their interdependent and reciprocal feedback mechanisms (Flannigan et al. 2008; Tarnocai 2009; Ciais et al. 2013; Lemprière et al. 2013; Myhre et al. 2013;

Holmquist and MacDonald 2014). Alarmingly, the boreal forests of today will not be the forests 100 years from now given current rates of impacts (Johnston et al. 2006; Kurz et al. 2008b) and projected future forest conditions due to climate change effects (Colombo 2008; Boulanger et al. 2014). These changes also have implications for the use of boreal forests to address climate change (Colombo 2008; Golden et al. 2011; Price et al. 2013).

The use of Canada's extensive boreal forest is appropriate in the development of climate change mitigation strategies. Sound policies require knowledge of forests at stand and landscape scales and forest ecological processes that are bound to the global climate system (Kurz et al. 2013; Price et al. 2013). Managing forests sustainably in the face of climate change is a pressing issue along with inherent challenges in policy making (Price et al. 2013). Adding to the challenges are uncertainties about potential climatic changes over the next century (Bhatti et al. 2003; Ogden and Innes 2008; Ciais et al. 2013). Resource policies based on historical environmental conditions are not conducive to managing resources under the changing and unpredictable conditions expected with climate change (Johnson and Hesseln 2012). Furthermore, predicting the consequences of policy decisions and ecosystem changes in the future is difficult given that socio-ecological systems are subject to both gradual and abrupt changes (Folke et al. 2011).

One of the difficulties in developing policies, particularly in today's carbon constrained world, is moving policy making away from the adherence to existing processes and policies. Alternative policy processes and developing policies have limited benchmarks to gauge their success (Johnson and Hesseln 2012) and "[P]olicy is generally based on what has worked in the past rather than anticipating what is likely to happen in the future" (Johnston and Hesseln 2012: p. 31). Forest management activities to sequester C may contribute to the goal of reducing GHGs in the atmosphere and the objective of slowing the rate of global warming. Likewise, setting aside boreal forests to protect forest C sequestration is also a necessary component to address climate change. However, the potential for increased natural disturbances in the boreal and to use forests for their ability to uptake CO_2 and store C to address climate change may well require extensive and adaptive management intervention, rather than simply excluding certain uses and management options (Golden et al. 2011).

The global imperative to find solutions to mitigate climate change is fundamentally the debate between forest utilization and forest conservation. Both approaches have economic, social and ecological considerations and consequences. In the international arena the KP, or utilization approach, now includes more forestry management options to generate C credits to mitigate climate change. Forest conservation in C credit payments to mitigate climate change is the purpose of the UN-REDD programme and an approach that has been suggested for Canada with its vast forest cover. Protecting forests as a measure to address climate change is merited in that conservation reduces the risk from human overuse or depleting forest resources and ecological functions (Wilkie et al. 2010) such as C sequestration. While protection is warranted, large landscape conservation efforts seen during the 19th century (e.g., the creation of Banff National Park) through to the more recent promotion of protecting remote, intact landscapes have not, as a rule, engaged or included adequate consultation with the Indigenous peoples living in those landscapes (Burlando 2012).

When the international focus on forest conservation to slow down climate change shifted from tropical forests (e.g., UN-REDD) to boreal forests (e.g., Carlson et al. 2009), NAN First Nations were inadvertently drawn into the international climate change discourse. Setting aside protected areas in Far north Ontario was driven by a transnational environmental campaign promoting large-scale conservation. The boreal conservation campaign undertaken by civil society organizations, including national and international environmental organizations, mobilized public and political support (Burlando 2012; Wilhere et al. 2012). This support led to the commitment of protection of 50% of the land base for biological diversity and C storage (Noss et al. 2012; Carlson et al. 2009) within the Far North Act (2010) Burlando 2012; Wilhere et al. 2012).

NAN objected to Bill 191 and eventually the Far North Act (2010) because it designated half their territory as protected areas without adequate consultation as prescribed by the Supreme Court of Canada and without their free, prior and informed consent as directed by the UN Declaration on the Rights of Indigenous Peoples. . Although under the Far North Act (2010) First Nations are integral to the community-based land use planning processes and have continued use of territorial lands for traditional activities (hunting, fishing, trapping, gathering) regardless of the protected area classification,[143] the Minister overseeing the Act has final approval of the land use plans. Additionally, in spite of the provincial governments' requirement to consult and accommodate First Nations, consultations occurred with groups that have neither a constitutional right nor any legal standing in determining activities on Aboriginal land. First Nations were excluded from the processes and discussions forming Bill 191 that led to the creation of the Far North Act (Burlando 2012). Furthermore, First Nation concerns were not adequately addressed during the legislative processes leading to the passing of the Act. As a result, Indigenous perspectives and knowledge about the land were not included in the province's climate change strategy to use Far North forested land.

Many involved in more recent conservation efforts are challenging Indigenous peoples' exclusion (e.g., IUCN categories[144]; Anaya and Williams 2001; Brosius 2004), as well as the existing historical approach to ecological protection of land cover (e.g., World Bank ratio) as a reliable or even relevant benchmark for protecting biodiversity and mitigating climate change (Johnston et al. 2006; Cole and Yung 2010). Addison et al. (2013) assert that conservation decision making employing scientific modelling and engaging local people in a

[143] It is now clear, although not explicitly addressed in Bill 191, that traditional uses of the land, such as hunting, fishing and trapping, will continue in all protected areas within the land base of the Far North Act (2010).

[144] IUCN Category IV Protected areas that conserve ecosystems and habitats, together with associated cultural values and traditional natural resource management systems. One objective of this category is "To contribute to sustainable development at national, regional and local level (in the last case mainly to local communities and/or indigenous peoples depending on the protected natural resources" (IUCN 2016).

participatory process leads to improved modelling and better land management and conservation decisions. The exclusion of Indigenous peoples and local community access and management within protected areas are not viewed as best practices for protection (Brechin et al. 2010; Diaw and Tiani 2010). As such, should conservation prove to be the preferred approach in addressing climate change, the inclusion of Indigenous peoples in the decision making cannot be overlooked.

5.1 ASSESSING THE GAPS

The sheer magnitude and challenges of climate change make it one of the most complex issues humans have ever encountered (World Bank 2009) and addressing climate change includes forests. While our understanding of forest ecology and the climate system have vastly improved in the last few decades, there are also disconcerting incomplete and missing data sets in scientific knowledge necessary to quantify forest C and forecast future C sequestration in the boreal forest (Bernier et al. 2010; Letang and de Groot 2010; Bona et al. 2013; Wang et al. 2013; Bontemps and Bouriaud 2014). These gaps are even more acute in unmanaged forests than managed ones. NAN First Nations live in Ontario’s remote northern boreal forest considered by the Crown as unmanaged, although as argued by Hawken and Granoff (2010: p.125) “all of the earth’s ecosystems have long been managed, influenced, and manipulated by humans”.

The applications of interconnected Indigenous perspectives across temporal and spatial scales may expand the pool of possible measures to mitigate climate change. Including the people who live on the land may generate openings for innovation outside of the Western science perspective needed to address climate change. Moreover, forest data for Western research is missing in remote northern boreal forests including Ontario's northern boreal (Pan et al. 2011). Engaging Indigenous communities in these northern remote forest areas may diminish the gaps and missing data in science, improving the understanding of the northern forest environment's current and potential future conditions. To date, very few studies have considered how a changing climate could affect the mitigation potential of forests. There are also few published studies that examine the synergies, conflicts (i.e., potential trade-offs in forest values) and linkages that may exist between mitigation and adaptation (Nabuurs et al. 2007; D'Amato et al. 2011), and none in the context of the forests of Canada's boreal zone (Lemprière et al. 2013). Indigenous knowledge and integrating IK and Western science have increasingly become recognized as important, if not vital, to address pressing global environmental concerns. Combining knowledge systems contributes to creating new knowledge by considering each system's independently valuable knowledge and information about sustainable forest management and adaptation to climate change.

Yet, there is often an integration gap between the highly generalized understanding produced by formal Western science and Indigenous knowledge that can be framed as a lack of cross-level interaction in these knowledge systems (Cash et al. 2006). The lack of interaction in the knowledge systems is in part due to the exclusion of Indigenous peoples in policy formulation. This gap is an impediment to strengthening social-ecological systems' resilience to climate change. Moreover, the gaps in knowledge about how protected areas are designed and managed to meet ecological, cultural, social, and economic objectives may be bridged and strengthened by the engagement of Indigenous peoples; their continued exclusion harms them and conservation policies.

NAN First Nations are already experiencing the impacts from climate change over a large land base that subsequently has influenced how they are able to carry out traditional activities. In the climate change dialogue this is known as "adaptation". To First Nations "adaptation" is their perpetual connection or "continuity" with the land that remains even though that land is changing. However, ancient generational knowledge of First Nations was disrupted in Canada by state assimilation policies (Tobias 1976; Salem-Wiseman 1996) and because of that disruption, potential Indigenous knowledge to address climate change may have been lost. In addition, resource development and Western land management practices (e.g., forestry, parks management) have also changed the land they once knew and managed—managing their territorial land under climate change is now an even greater challenge. Conversely, the wealth of knowledge First Nations in Far north Ontario do possess from living on the land for generations is relevant to addressing climate change.

Research has brought attention to the significance of Indigenous adaptive learning that strongly suggests its relevance as a model for global adaptation strategies to climate change. Also recognized is the value of Indigenous peoples in the co-production of knowledge about climate change (Berkes 2009). Fundamental to forest C management is having the pertinent data. The Indigenous observations recorded in this study of environmental changes in recent decades are very applicable to finding solutions to climate change. There is an opportunity to develop an extensive knowledge base in key forest attributes to improve forest knowledge (including data sets) across the Far North by engaging with and collaborating in research with First Nations. The need for interdisciplinary collaboration to address climatic changes that threatens human security (e.g., food and energy) has been noticed for decades (Schneider 1997). However, the inclusion and integration of NAN First Nations' knowledge and forest observations to address climate change were not included in formulating Bill 191 and subsequent Far North Act (2010). This is a knowledge gap in Ontario's approach to mitigate climate change.

A policy issue, particularly problematic with climate change, is the reluctance to consider innovative ideas if the proposed alternative lies far outside accepted practices. Generally, policy is not anticipatory in what is likely to happen in the future, but rather relies on what has worked (or not worked) in the past. The Crown failed to engage with First Nations in the development of policy using territorial land to address climate change in a meaningful way. Opportunities for First Nation participation were limited, at best, during the Bill

191 processes that preceded passing the Far North Act (2010) into legislation. Additionally, the 50% conservation target within the Far North Act (2010) was determined and influenced by outside actors and transnational environmental organizations. The inclusion of these groups on the one hand and the failure to include Indigenous groups on the other is a policy gap in Ontario's processes to mitigate climate change.

The recognition of Indigenous knowledge and creating the space to apply it to develop solutions to address climate change have yet to be realized in Ontario. What is needed is a new relationship between the Ontario government and First Nations built on cooperation and respect—from both sides:

> throughout my life I have heard these things that people have talked about, the governments have talked about … preserving the land and stuff like that … but I haven't seen people working together trying to, you know, to make it better, to make it work. I haven't seen that. Maybe it is time that they seriously look at it and how we can work out to protect whatever is left of it [Earth]. (Elder, central region)

There is a strong need, if not an imperative, for integrating Western knowledge and Indigenous knowledge in ecosystem management to develop innovative approaches to address climate change. The potential and opening to do so in Ontario may be through the existing community based land use planning process enabled by the Far North Act or revamping what is in place for a different process led by First Nations.

5.2 THE RESEARCH COLLABORATION AND OBJECTIVES

Often researchers have not respected Indigenous peoples or shared the research benefits with them. This research project has reported back to the individuals who were interviewed (including transcript reviews) and the communities through formal reports, distributing the co-authored publications and a community poster, and community presentations. In addition, NAN will also store and control[145] the data collected during the study. This study sought from the beginning a research collaboration to investigate climate change impacts in NAN territory. The research methodology, PAR, was supported by the methodological philosophy “CREE”: C–capacity building, R–respect, E–equity, and E–empowerment. PAR was conducive to NAN’s role as the facilitator and gatekeeper for conducting the research and obtaining individual First Nation communities’ free, prior and informed consent that led communities to inviting the researcher to conduct the study, acceptance in the First Nation communities, and community engagement and investment in the research.

Climate change will add to the challenges faced by First Nations in these remote communities. The research documented the observed changes that are occurring in the treaties #5 and #9 territory of the northern Ontario boreal by the Indigenous peoples whose forests are their homeland. The research findings have been/are being utilized and applied in actions to address climate change in

[145] NAN will be able to use this data for future reference and research; the research ethics (and protocols for the use of the data) undertaken during the study will be maintained by NAN and which were established in the collaborative research contract signed at the beginning of the study.

NAN territory. The research findings were presented at NAN's Winter Road Forum in 2014 and are being considered in a regional adaptation strategy to address the disappearance of winter roads.[146] The discovery of the Ring of Fire mineral deposit generated interest in building all-weather or permanent transportation corridors into the Far North. However, even in the absence of resource development, unstable winter roads due to climate change are directly affecting First Nation communities.

The research documented the extent and magnitude of impacts to transportation for First Nations living in the north due to climate change and the disappearing 'blue-ice'. Building a surface transportation system, such as all-weather roads, is an adaptation option for these communities. Former NAN Grand Chief Harvey Yesno also presented the research findings and implications for NAN First Nations in deriving adaptation strategies at the Climate Summit of the Americas, July 9, 2015 in Toronto, Ontario. The research also assisted with the development of the current work at NAN to engage its communities in the climate change dialogue by building capacity through information sharing and hiring community members to be part of a NAN climate change network (personal communication, L. Big George, NAN, April 11, 2017).

[146] The NAN 2014 Winter Road Forum Report identifies six potential all-weather road corridors to connect the 32 remote communities to each other and to urban centres south of the 50th parallel.

5.3 RESEARCH LIMITATIONS AND RECOMMENDATIONS FROM THE RESEARCH

The data is only a partial representation of climatic impacts and changes occurring in NAN territory. Missing in the data are observations from the other 23 First Nation communities in the northern boreal. The research was limited by the time spent in each community, especially when cultural protocols took precedent over any other activities (e.g., the death of a community member), and the costs associated with research in remote areas. The data also does not include details and information needed in other forest research applications to address climate change. Additional research in the northern boreal is necessary to mitigate and adapt to climate change, as well as advance our knowledge on future forest responses to climate change.

NAN First Nation observations of changes that are occurring in their territorial homelands and theories and perspectives on climate change have been missing in Ontario's climate change policy making. Collaborations in the co-production of knowledge between the forestry sector, forest researchers (government and industry), and First Nations are strongly recommended. Developing "knowledge relationships" provides the space for exchanging knowledge and reduces the information gaps in either or both Western science and Indigenous knowledge. Moreover, training and employing First Nation community members in Western science, including tools and methods to monitor, measure and record forest attributes (e.g., soil and peatland profiles, maintaining micro-meteorological tower sites, forest disturbances), would fill in the missing scientific data needed to improve and broaden forest C modelling capabilities and results. It would also allow community members to remain in their communities for work and retain a traditional lifestyle. Much-needed prospects in northern First Nations, particularly for the youth, are educational pursuits and employment opportunities. The remoteness of these communities limits both, and seeking either usually requires leaving the community.

Elders in the north are keenly interested in sharing and teaching the youth traditional activities and their forest knowledge—to protect the forest and the people is one in the same. Moreover, Western knowledge on expected climate change impacts and information to better prepare for climate change is lacking in NAN First Nation communities. Bridging this gap through knowledge exchanges has the potential to lead to innovative approaches to address climate change and develop adaptation strategies in Ontario, as well as build Indigenous community capacity.

In addition to the impetus for a transportation corridor to enable resource and economic development in the Far North, building surface transportation systems such as all-weather roads is also an adaptation strategy in response to climate change. Discussions on building an all-season surface transportation system are necessary independent of the discussions about economic development. Reliance on winter roads for the delivery of goods and services makes remote First Nations in northern Ontario vulnerable in food and energy security, a situation that will be exacerbated by changes to winter roads due to climate change (Mihalus 2016). My recommendation is to build upon the NAN

Winter Road Forum Report 2014 and engage First Nations in the discussions in the design of an all-weather surface transportation system in Far north Ontario. In addition, beyond environmental assessments in watersheds and migratory pathways, and the consideration of potential cumulative impacts from development, a comprehensive Environmental Assessment (EA) would need to include the forest C-stores and potential impacts to forest C by human disturbances. In short, a Strategic Environmental Assessment (SEA)[147] is recommended. Chetkiewicz and Lintner (2014) also recommended this conclusion in *Getting it Right in Ontario's Far North: The Need for Strategic Environmental Assessment in the Ring of Fire.*

First Nations' input is also necessary in designing studies to investigate the impacts to their communities from transportation development. Respectfully, not all northern First Nations are in favour of road development or seeking permanent transportation corridors to their communities (personal communication, L. Big George, NAN, April 2, 2015). The decision to forgo all season road development is the right of a community. However, the decision should not preclude a community from receiving financial and human resources to develop a community-based climate change adaptation strategy.

In light of the dependency of these northern First Nations on diesel-generated electricity and fuel delivery by winter roads, I also recommend the

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[147] "Strategic environmental assessment (SEA) is the systematic and comprehensive process of evaluating the environmental effects of a policy, plan, or program and its alternatives. The emphasis is on examining environmental effects, but most SEAs may also identify significant economic and social effects. In short, its purpose is to promote integrated decision-making" (Government of Canada 2016).

continued examination of alternative energy sources on a community-by-community basis (Seymour 2016).[148] Doing so would improve a community's energy security in light of diminishing winter roads to transport fuel. Some communities may be located in areas best suited for wind power, run-of-the-river hydro, solar power, biomass power, or potential combinations of these energy alternatives. The delivery of power over transmission lines connected to the provincial power grid is a solution. However, anticipated extensive forest fires, along with an extended fire season due to climate change, may cause disruptions in aboveground power lines. Concerns about power disruptions may be limited to the fire season (summer and fall) and therefore not as critical in winter months for heat, but days or weeks (potentially longer) without power will affect community water treatment and pumping stations, as well as lighting and other electrical appliances in homes and buildings such as nursing stations. Developing alternative energy supplies also aligns with displacing fossil fuels to reduce GHGs in the atmosphere.

Since identifying areas of important C stores is being considered within community-based land use plans, payments for the conservation of such sites and protection to mitigate climate change deserve consideration in a program similar to UN-REDD as suggested by Bradshaw et al. (2009). First Nations in NAN are excluded from accessing global funds to address climate change as

[148] Some First Nations in the north have begun this process, and other studies between NAN and Lakehead University, Faculty of Natural Resources Management are underway or have been completed. One of the recommendations from NAN's legal counsels' review of the proposal was the researcher's involvement in a NAN Research Committee; I have undertaken that task during this past year.

they reside in a developed nation or Annex I country, yet they lack the resources to adapt to and mitigate climate change. Their requirements and constraints to address climate change are as significant as those found in developing nations and Indigenous peoples communities around the globe that may receive international funds and support (e.g., UN-REDD).

The fieldwork data adds First Nations' observations of rapidly occurring changes on the boreal landscape and perspectives to understand current and potential climate change impacts regarding their communities, homelands, and traditional activities. Further research collaborations between Western science and Indigenous knowledge holders to co-produce knowledge have the potential to inform and design policy decisions that are key to boreal forest sustainability and mitigating climate change. Mitigating and adapting to global climate change requires the breadth and depth of human knowledge. The involvement of First Nation peoples living in the remote north, across an extensive area of the boreal forest, will lend strength to our human capacity to address climate change. Time is of the essence and including First Nation observations and perspectives on the changing climate in Ontario's northern boreal, by forming science and policy bridges across the two knowledge paradigms, is necessary: the "Blue-Ice" (Kah-Oh-Shah-Whah-Skoh Siig Mii-Koom) is disappearing.

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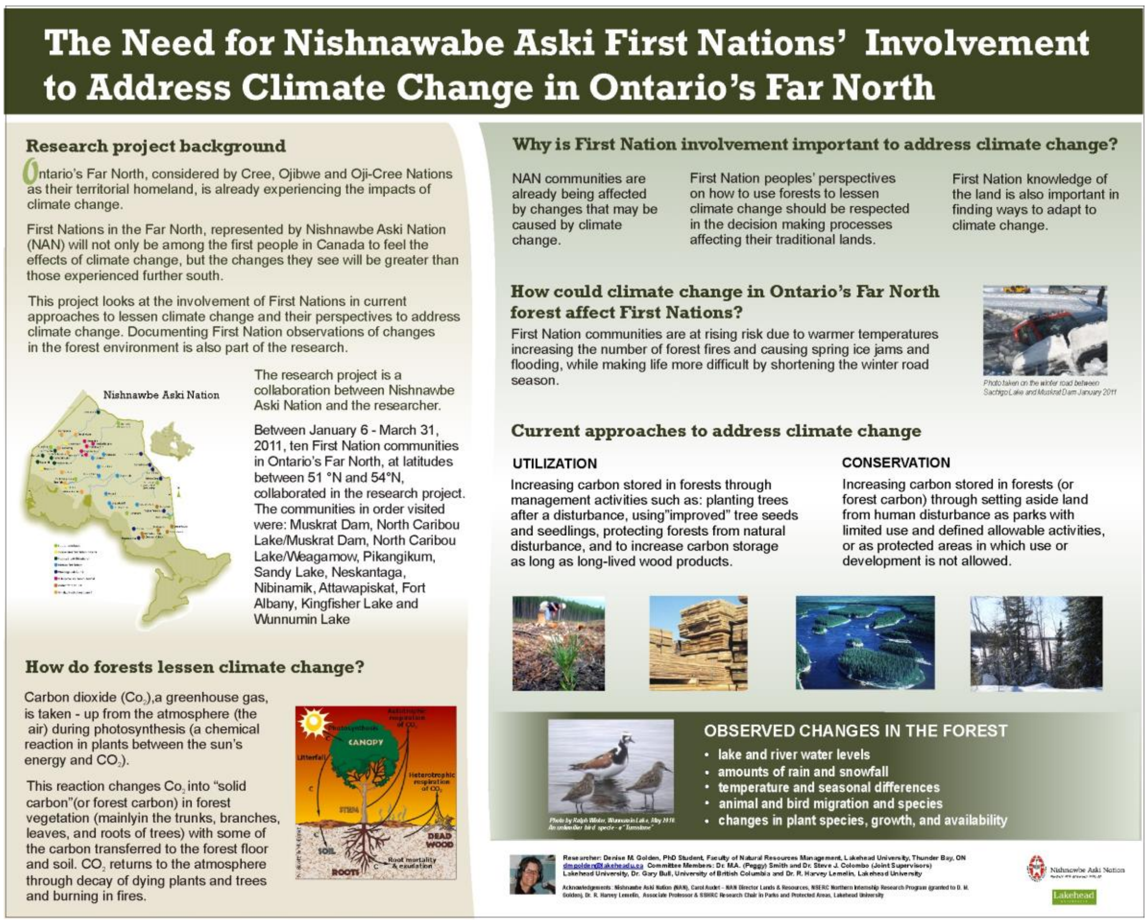
APPENDICES

APPENDIX I

SAMPLE OF NAN COMMUNITY INFORMATION MATERIALS



Note: typo – *Co*$_2$ should be CO_2

Note: The poster was produced as a contribution to the research from Dr. Steve J. Colombo, Ontario Forest Research Institute (OFRI) and committee member Joint Supervisor to the candidate. The content was prepared by Denise M. Golden, Ph.D. Candidate Lakehead University. She is entirely responsible for the content. The poster was delivered in person to the Chiefs of the ten First Nations involved with the research at a NAN Special Chiefs-in-Assembly, November 2012 in Thunder Bay, ON.

APPENDIX II

OVERVIEW OF THE AREA CONTAINED IN THE FAR NORTH ACT (2010)

Component/Attributes	Description	Details
Biophysical	Size	~452 000 km^2
	Provincial Landmass	42%
	Delineation	north of the 50^{th} parallel
	Characteristics	boreal, tundra; sub-Arctic climate
Socio-Cultural	Infrastructure	on reserves only; diesel electric generation; airports located near/next to communities; remote, fly-in or winter road access; Note: a few communities have access to summer barge transportation and provincial power grid (located along the James Bay coast)
	Non-Aboriginal Communities	2 (Pickle Lake and Moosonee)
	First Nations	33 (one community is not a member within NAN)
	Population	~24,000 – 90% Aboriginal
Protected Areas	Number (current)	71
	Type	69 provincial parks and national wildlife areas; 2 DPAs are under CBLUPs
	Projected (new)	specific land assignment unknown, and type of protection is undetermined; total area of land to be assigned protection status ~225 000 km^2
Economic	Tourism	ecotourism, outfitting (and other types of accommodations; limited restaurants)
	Extraction (expected)	forestry, additional mining projects, aggregates
	Energy (expected)	hydro-electricity, biofuels
	Traditional	trapping/animal skins; limited commercial fishing; some traditional clothing, beadwork;
Consultation		limited with Indigenous organisations; provides for community based land-use planning by individual First Nations

Note: the Table is adapted from (Lemelin et al. 2012); printed with permission.

APPENDIX III

RESEARCH CONTRACT (SELECTED PAGES)

CONTRACT RESPECTING COLLABORATIVE RESEARCH

This CONTRACT made as of the 8th day of October, 2010.

BETWEEN:

NISHNAWBE ASKI NATION
("NAN")

and

DENISE M. GOLDEN
("GOLDEN")

IN CONSIDERATION of the mutual promises contained herein, and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, NAN and GOLDEN have agreed to enter into this Contract for their mutual benefit, and they therefore agree as follows:

<u>Interpretation</u>

1 This Contract shall be interpreted and implemented in accordance with article 31(1) of the United Nations Declaration on the Rights of Indigenous Peoples, adopted by the United Nations General Assembly by Resolution 61/295 on September 13, 2007. Article 31(1) provides as follows:

Indigenous peoples have the right to maintain, control, protect and develop their cultural heritage, traditional knowledge and traditional cultural expressions, as well as the manifestations of their sciences, technologies and cultures, including human and genetic resources, seeds, medicines, knowledge of the properties of fauna and flora, oral traditions, literatures, designs, sports and traditional games and visual *and performing arts. They also have the right to maintain, control, protect and develop their intellectual property over such cultural heritage, traditional knowledge, and traditional cultural expressions.*

Definitions

(a) "NAN" means the collective community or a person who is a member of the NAN community representing as its officers, employees, directors, agents;

(b) "Participant(s)" refers to a person or group of persons in the NAN community as set out in Schedule "A" (Chiefs and Council, Staff, Land User, or Youth) participating in the Project;

(c) "GOLDEN" means the project researcher, admitted to University as a graduate student according to the policies and procedures of the University;

(d) "Project" means those activities, rights, responsibilities and terms, outlined in the attached Schedule "A";

(e) "Intellectual Property" includes, but is not limited to, technical information, reports, photographs, plans, models, designs, or know-how, whether patentable or not;

(f) "Publish" means disclose or otherwise distribute any Intellectual Property to the public or others not under a duty to keep such Intellectual Property confidential;

(g) "Publishing Date" means the date upon which material is to be sent with the intent to Publish;

(h) "Thesis" means a thesis or graduate student project relating to the Project.

The Collaborative Research Project

2 The title of the Project developed by GOLDEN in collaboration with NAN is the "Boreal Forest Management in a Carbon Constrained World: Ontario's Institutional Approaches to Address Climate Change and First Nation Engagement". The Project has been approved by Lakehead University as part of GOLDEN's academic requirements for the graduate degree Doctorate of Philosophy in Forest Sciences

("PhD"). A copy of the Research Proposal is attached as Schedule "A" to this Contract.

3 The Project has been approved by the NAN Chiefs in Assembly by Resolution 10/08, a copy of which is attached as Schedule "B" to this Contract.

4 In general terms, the purpose of the Project is for GOLDEN to examine, with NAN, the potential for northern NAN forests to mitigate climate change, and First Nation roles and capacity in decision-making with evolving Ontario government policies and proposed legislation to address climate change. Objectives of the Project come under two focus areas: (1) climate change mitigation potential, and (2) community climate change awareness. A more detailed description of the Project is contained in Schedule "A".

5 The method of the Project shall be collaborative. There shall be a two-way information and knowledge exchange between NAN Participants and GOLDEN, as described in Schedule "A".

Specific Responsibilities of GOLDEN

6 GOLDEN shall fully inform NAN in the Project about the purpose, design and methods to be used in the Project.

7 GOLDEN shall seek the free, prior, and informed consent of Participants and their representative organizations in the Project.

8 GOLDEN shall maintain the confidentiality of responses made by Participants in the Project.

9 GOLDEN shall acknowledge the involvement of NAN in the Project.

Specific Responsibilities of NAN

15 NAN shall provide the necessary endorsements for GOLDEN to gain access to NAN member communities. Actual access is subject to the consent of the member communities.

16 NAN shall assist in the arrangement of lodging, meals, and other logistical matters to deliver the community climate change presentations and/or to conduct interviews and focus group session(s) in communities and/or gatherings and facilities. The assumption and allocation of cost for such arrangements shall be determined on a case-by-case basis and in advance. NAN shall not be liable for any such costs unless it agrees in writing and in advance.

17 NAN shall share data and research publications with GOLDEN as deemed appropriate by NAN. NAN specifically reserves the right and discretion to withhold any material NAN deems in its sole discretion to be privileged.

18 NAN shall provide expertise, particularly with regard to cultural appropriateness in community contacts, and comments to GOLDEN on research design, methods, interview questions, and preliminary results during the course of the Project.

19 NAN and some its Participant members may act as co-authors of any future publications related to the Project, if and when appropriate, in accordance with the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans policy on publication and Paragraph 31 contained in this Contract.

APPENDIX IV

RESEARCH ETHICS BOARD APPROVAL[149]

[149] Note: from the initial consideration for a title of the dissertation and its completion, the results from the analysis determined a different title was needed to reflect the research adequately.

Lakehead
UNIVERSITY

Office of Research

Tel (807) 343-8283
Fax (807) 346-7749

August 4, 2010

Principal Investigator: Dr. M. A. (Peggy) Smith
Student Investigator: Ms Denise M. Golden
Faculty of Natural Resources Management
Lakehead University
955 Oliver Road
Thunder Bay ON P7B 5E1

Dear Dr. Smith and Ms Golden:

Re: REB Project #: 123 09-10/ROMEO #1461006
Granting Agency name: N/A
Granting Agency Project #: N/A

On behalf of the Research Ethics Board, I am pleased to grant ethical approval to your research project entitled, "Boreal Forest Management in a Carbon Constrained World: Ontario's Institution Approaches to Address Climate Change and First Nation Engagement".

Ethics approval is valid until **August 4, 2011**. Please submit a Request for Renewal form to the Office of Research by July 4, 2011 if your research involving human subjects will continue for longer than one year. **A Final Report must be submitted promptly upon completion of the project**. Request for Renewal and Final Report forms are available at:

http://research.lakeheadu.ca/ethics_resources.html

During the course of the study, any modifications to the protocol or forms must not be initiated without prior written approval from the REB. You must promptly notify the REB of any adverse events that may occur.

Completed reports and correspondence may be directed to:

Research Ethics Board
c/o Office of Research
Lakehead University
955 Oliver Road
Thunder Bay, ON P7B 5E1
Fax: (807) 346-7749

Best wishes for a successful research project.

Sincerely,

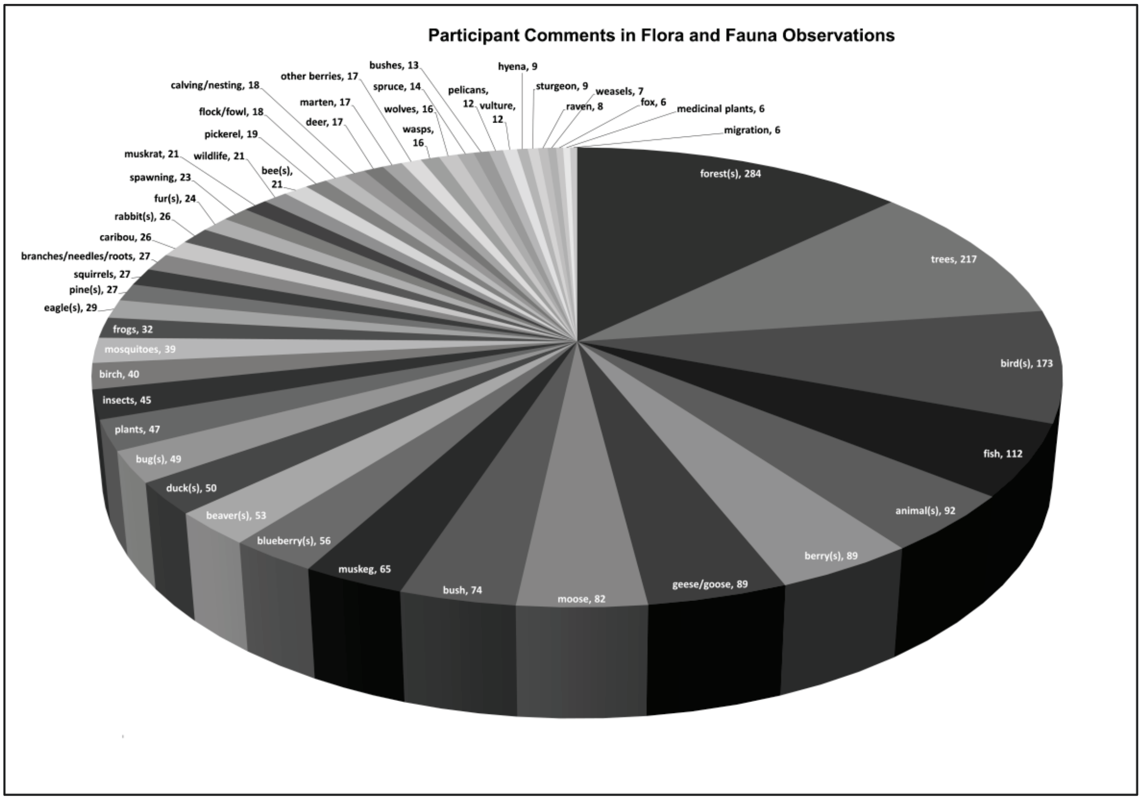
Dr. Richard Maundrell
Chair, Research Ethics Board

/sw

cc: Office of Research
[redacted]

APPENDIX V

PARTICIPANT OBSERVATIONS OF FLORA AND FAUNA



Participant interviews included questions on any noticed any changes in the forest trees and plants (berries), lakes and rivers, animals, birds and insects (bugs). The chart is a sample of responses in flora and fauna. Responses cited specific animals (e.g., moose, beaver), birds (e.g., goose, vultures), fish (pickerel, sturgeon) etc., as well as generic terms (bushes, fish).