

CLIMATE CHANGE AND INDIGENOUS PEOPLES' HEALTH IN CANADA



National Collaborating Centre
for Indigenous Health



Centre de collaboration nationale
de la santé autochtone

HEALTHY LAND, HEALTHY PEOPLE

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SUMMARY

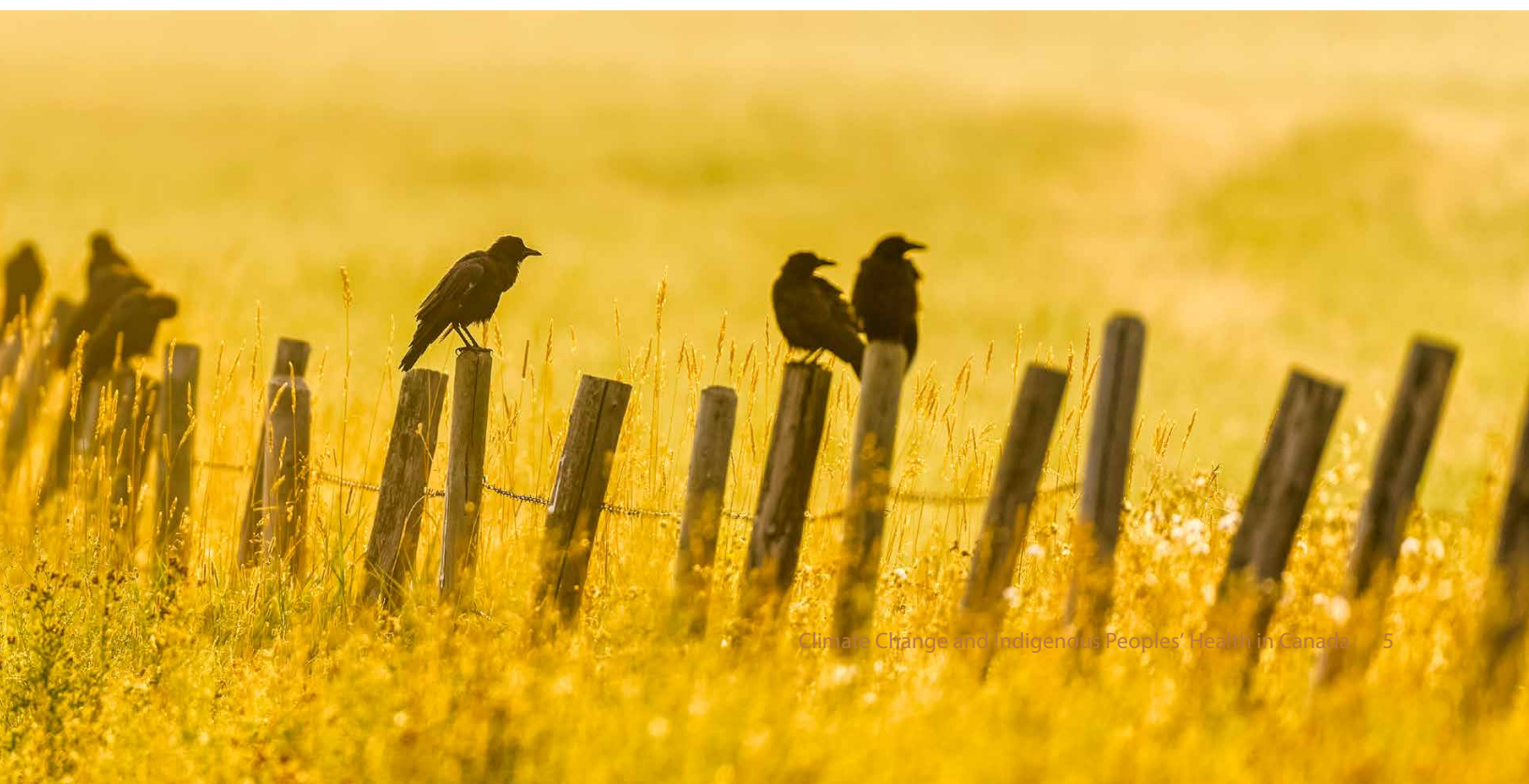


First Nations, Inuit, and Métis peoples in Canada are uniquely sensitive to the impacts of climate change because they tend to live in geographic regions experiencing rapid climate change and because they have a close relationship to and depend on the environment and its natural resources. The direct and indirect impacts of climate change on the health and well-being of First Nations, Inuit, and Métis are interconnected and far-reaching.

The changing climate will exacerbate the health and socio-economic inequities already experienced by First Nations, Inuit, and Métis

peoples, including respiratory, cardiovascular, water- and foodborne, chronic and infectious diseases, as well as financial hardship and food insecurity. Natural hazards, coupled with unpredictable and extreme weather events, can result in temporary or long-term evacuations from traditional territories, in addition to greater risk of injury and death from accidents while out on the land. Infrastructure damage or instability due to climate change, particularly in northern and remote locations, may restrict access to health systems and supplies. Climate change threatens First Nations,

Inuit, and Métis peoples' ways of life, resilience, cultural cohesion, and opportunities for the transmission of Indigenous knowledges and land skills, particularly among youth. Cross-cutting climate impacts will disrupt the livelihoods of First Nations, Inuit, and Métis peoples, affecting their sense of identity and cultural continuity and compounding existing mental health issues. Indigenous knowledge systems and practices are key to First Nations, Inuit, and Métis peoples' ability to observe, respond, and adapt to climate and environmental changes.



KEY MESSAGES

- First Nations, Inuit, and Métis peoples in Canada are uniquely sensitive to the impacts of climate change, given their close relationships to land, waters, animals, plants, and natural resources; tendency to live in geographic areas undergoing rapid climate change, especially Northern Canada; and greater existing burden of health inequities and related determinants of health.
- The health impacts of climate change on First Nations, Inuit, and Métis peoples are interconnected and far-reaching. They result from direct and indirect impacts of climate change that exacerbate existing inequities, and affect food and water security, air quality, infrastructure, personal safety, mental well-being, livelihoods, and identity, as well as increase exposure to organisms causing disease.
- Health impacts are experienced differently within and between First Nations, Inuit, and Métis men, women, boys, girls, and gender-diverse people. Thus, research and adaptations must respect cultures, geography, local contexts, and the unique needs of these communities.
- First Nations, Inuit, and Métis peoples have been actively observing and adapting to changing environments in a diversity of ways since time immemorial. Indigenous knowledge systems and practices are equal to scientific knowledge and have been, and continue to be, critical to Indigenous Peoples' survival and resilience.
- Indigenous knowledge systems are increasingly recognized, both nationally and internationally, as important in adapting to climate change, monitoring impacts at the local and regional level, and informing climate change policy and research.
- First Nations, Inuit, and Métis peoples are rights holders. Preparing for the health impacts of climate change requires that Indigenous Peoples' rights and responsibilities over their lands, natural resources, and ways of life are respected, protected, and advanced through distinctions-based, Indigenous-led, climate change adaptation, policy, and research.

Overview of Climate Change Impacts on the Health and Well-Being of First Nations, Inuit, and Métis Peoples in Canada

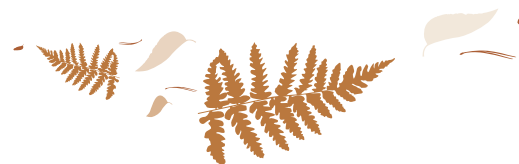
| Health Impact or Hazard Category | Climate-related Causes | Possible Health Effects |
|---|---|--|
| <p>Impacts on First Nations, Inuit, and Métis peoples and communities</p> | <ul style="list-style-type: none"> • Increased wildfire, drought, and flooding events • Instability and melting of permafrost and changes to ground snow cover, sea ice extent and thickness • Changes to sea levels and weather patterns • Higher exposure to climate risks in relation to natural and built environments (such as poor housing, water, sanitation, and environmental contaminants) • Decreased availability, quality, quantity, and safety of traditional food sources • Melting and damage to ice roads • Effects of warming and changes to precipitation patterns that affect survival and transmission of disease-causing organisms | <ul style="list-style-type: none"> • Air quality health impacts (e.g., respiratory and cardiovascular diseases) • Increased water and foodborne diseases • Mental health impacts (e.g., stress, anxiety and post-traumatic stress disorder) • Increased injuries and deaths from accidents (e.g., natural hazards and extreme weather events) • Increased direct and indirect health impacts from permafrost-related infrastructure damage • Exacerbation of health and socio-economic inequities • Exacerbation of chronic and infectious diseases • Food and water insecurity due to decreased access to, and quality of land, waters, plants, animals, and natural resources • Decreased opportunities for transmission of Indigenous knowledges and land skills, particularly among youth, affecting sense of identity, mental well-being, and cultures • Temporary or long-term evacuation or displacement of populations from traditional territories, disrupting lives, creating financial hardship, and affecting mental well-being • Impacts on health and infrastructure (e.g., restricted or delayed travel for health and emergency services, access to medical supplies, and patient safety) |





INTRODUCTION

*“Sister of ocean and sand,
Can you see our glaciers groan with the weight of the world’s heat?
I wait for you, here,
on the land of my ancestors,
heart heavy with a thirst for solutions
as I watch this land change while the world remains silent”¹*



Indigenous² Peoples, in Canada and globally, are recognized as uniquely sensitive to the impacts of climate change because they often live in geographic regions already experiencing rapid change and because of their close relationships with and dependence on land, waters, animals, plants, and natural resources for their sustenance, livelihoods, cultures, identities, health, and well-being (Ford, 2012; ILO, 2017; Jones, 2019). Non-climate determinants of health exacerbate these sensitivities, including a greater existing burden of health inequities compared to non-

Indigenous populations and the historic and ongoing effects of colonization and socio-economic and political marginalization (Ford et al., 2010a; Ford, 2012; ILO, 2017; Jones, 2019).

The health impacts of climate change on First Nations, Inuit, and Métis peoples are interconnected and far-reaching. Changing temperature and precipitation regimes will increase the frequency and intensity of extreme weather events (e.g., floods, storms, heat events, droughts), wildfires, sea level rise, and coastal erosion, with direct and indirect impacts on food

and water security, air quality, infrastructure, personal safety, mental health and well-being, livelihoods, and identity (Ford et al., 2010a; Ford, 2012; Yusa et al., 2015). These impacts will be experienced differently within and among First Nations, Inuit, and Métis men, women, boys, girls, and gender-diverse people in communities from coast to coast to coast.

Although often portrayed as passive victims or harbingers of climate change impacts in international reporting (Ford et al., 2016b; Belfer et al., 2017), Indigenous Peoples in Canada and around the world have been

¹ Excerpt from *Rise* (Jetñil-Kijiner & Niviána, n.d.).

² The term Indigenous is used in this report to refer collectively to the original inhabitants of Canada and their descendants, including First Nations, Inuit, and Métis peoples, as defined under Section 35 of the *Constitution Act, 1982*. Wherever possible, clear distinctions are made between these three distinct, constitutionally recognized groups. Indigenous Peoples outside of Canada are also referenced in some instances – particularly with respect to international climate policy, processes, and rights – and are identified as such.



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actively observing and adapting to changing environments in a diversity of ways for millennia (Ford et al., 2020). Indigenous knowledge systems and practices have been critical to their survival and resilience and are increasingly recognized as valuable to understanding and responding to climate change (Ford et al., 2016b; Expert Panel on Climate Change Adaptation and Resilience, 2018; ILO, 2019). Mobilizing Indigenous knowledges and experiences in climate change adaptation, policy, and research in a consistent, collaborative, decolonial, and rights-based way, however, remains a significant challenge (IPCC, 2014; Ford et al., 2016b; Belfer et al., 2019; Huntington et al., 2019; Latulippe & Klenk, 2020).

This report provides an overview of climate change risks to Indigenous Peoples' health in Canada. It begins with a description of Indigenous health inequities, followed by climate change risks to health specific to natural hazards; mental health and well-being; air quality; food safety and security; water quality, quantity, and security; infectious diseases; and health systems. The role of Indigenous knowledges in climate change adaptation, monitoring, policy, and research is then discussed within the context of Indigenous Peoples' rights as well as national and international obligations. Existing knowledge gaps specific to First Nations, Inuit, and Métis peoples important for efforts to protect health are provided, along with considerations for moving forward.

First Nations, Inuit, and Métis Populations in Canada

First Nations, Inuit, and Métis peoples in Canada are a youthful and fast-growing population. In 2016, the Indigenous population reached 1,673,785 (4.9% of the total Canadian population), which represents an increase of 42.5% from the 2006 Census (Statistics Canada, 2017). From 2006 to 2016, the First Nations population grew by 39.3% to reach 977,230; the Inuit population grew by 29.1% to reach 65,025; while the Métis population grew by 51.2% to reach 587,545. The average age of the Indigenous population in 2016 was 32.1 years, which is almost a decade younger than the non-Indigenous population.

Approximately 29.2% of First Nations, 33% of Inuit, and 22.3% of Métis people were 14 years of age or younger in 2016, compared to 16.4% of the non-Indigenous population (Statistics Canada, 2017). The proportion of Indigenous people over 65 years of age is also on the rise and accounted for 7.3% of First Nations, Inuit, and Métis populations in 2016 (Statistics Canada, 2017).

There are more than 600 First Nations communities in Canada, representing more than 60 Indigenous languages (Statistics Canada, 2017). The largest proportion of First Nations people live in Ontario (24.2%), followed by the western provinces of British Columbia (17.7%), Alberta (14.0%), Manitoba (13.4%), and Saskatchewan (11.7%) (Statistics Canada, 2017). In 2016, the majority of Inuit (72.8%) lived in the 53 communities of Inuit Nunangat (the traditional homelands of Inuit), with the largest proportion living in Nunavut (63.7%), followed by

Nunavik (24.9%), Inuvialuit (6.6%), and Nunatsiavut (4.8%) (Statistics Canada, 2017). Inuktitut is the term used for all Inuit languages; it includes 12 main dialects and nine different writing systems³ (The Royal Canadian Geographical Society, 2018). The majority of the Métis population (80.3%) live in communities and settlements⁴ in Ontario and the western provinces. Alberta has the largest Métis population (19.5%), followed by Manitoba (15.2%), British Columbia (15.2%), Quebec (11.8%), Saskatchewan (9.9%), and the Atlantic provinces (7.2%). Métis have their own unique language called Michif, a combination of French and Cree languages that also borrows from English and other Indigenous languages.

Recent Statistics Canada data suggest Indigenous Peoples are increasingly urbanized. Among First Nations with registered or treaty Indian status, 44.2% lived on reserve in 2016, while the remainder lived off reserve. Growth was noted for both on-reserve (+12.8%) and off-reserve

(+49.1%) First Nations over the period 2006 to 2016 (Statistics Canada, 2017). While most Inuit lived in Inuit Nunangat in 2016, approximately 27.2% lived outside its borders; of those, 56.2% lived in a metropolitan area of at least 30,000 people, with the largest Inuit populations living in Ottawa-Gatineau, Edmonton, and Montreal (Statistics Canada, 2017). Of the three Indigenous groups, Métis are most likely to live in a city, with 62.6% living in a metropolitan area of at least 30,000 people. Winnipeg has the highest Métis population in Canada, followed by Edmonton, Vancouver, and Calgary (Statistics Canada, 2017).



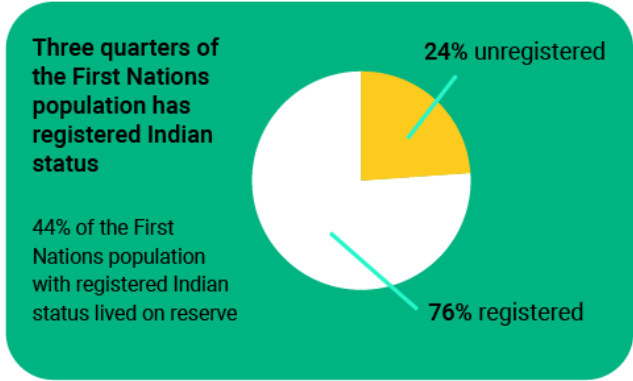
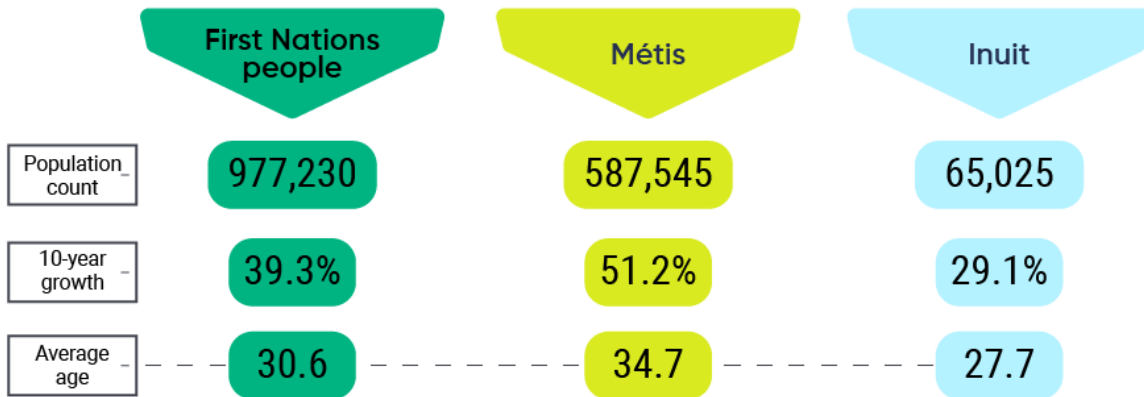
³ In September 2019, the Inuit Tapiriit Kanatami Board of Directors approved a unified orthography for Inuktitut called Inuktitut Qaliujaapait. This standardized writing system was developed by Inuit for Inuit to strengthen Inuktitut across Inuit Nunangat for future generations (ITK, 2019a).

⁴ There are eight Métis settlements in Alberta: Paddle Prairie (or Keg River), Buffalo Lake (Caslan), East Prairie, Elizabeth, Fishing Lake (Packedhawanis), Gift Lake (Ma-cha-cho-wi-se), Kikino (Goodfish Lake), Big Prairie (now Peavine). These settlements are the only government-recognized Métis land base in Canada (The Royal Canadian Geographical Society, 2018).

Figure 2.1 The Indigenous population in Canada. Source: Statistics Canada, 2016.

The Indigenous population is young and growing

| | | |
|---|--|--|
| Total population in 2016: 1,673,785 (4.9% of Canada's total population) | Growth (2006 to 2016): +42.5% | Average age: 32.1 years (almost a decade younger than the non-Indigenous population) |
|---|--|--|



Eight Census Metropolitan Areas had a Métis population of more than **10,000** people...

- Vancouver
- Calgary
- Edmonton
- Saskatoon
- Winnipeg
- Toronto
- Ottawa-Gatineau
- Montréal

...which made up one-third (34%) of the Métis population

More than **70** Indigenous languages were reported on the 2016 Census.

36 of those had at least 500 speakers.

The majority of the Inuit population lived in Inuit Nunangat, the homeland of Inuit in Canada

METHODS AND APPROACH

This report is a synthesis of publicly available peer-reviewed and grey literature, as well as alternative media sources (e.g., videos, news articles) focused on climate change risks to First Nations, Inuit, and Métis peoples' health in Canada and on the role of Indigenous knowledges in climate change adaptation, policy, and research efforts. It is important to note that this is the first time an Indigenous-specific report has been included as part of Canada's national climate change and health assessment. Emphasis was placed on literature specific to Canada published since the 2014 assessment on human health in *Canada in a Changing Climate: Sector Perspectives*

on *Impacts and Adaptation* (Berry et al., 2014), although older sources and international literature were included, as appropriate.

Sources were identified through a search of academic databases (e.g., BioMed Central, PubMed, and Science Direct), Google, and Google Scholar using the following search terms: “First Nations/Inuit/Métis/Indigenous” and “climate change” and “adaptation/infectious diseases/natural hazards/mental health/air quality/food security/water safety/water security/health services” and “Canada” and “traditional knowledge/traditional ecological knowledge/Indigenous knowledge.” This

search was supplemented with manual scanning of citations in key publications and a targeted search of relevant websites, including Indigenous and non-Indigenous government agencies and organizations (e.g., national Indigenous organizations, Indigenous Services Canada). Additional sources were included based on peer-review feedback of this report.

Of the relevant publications identified, the majority were peer-reviewed and focused on Inuit populations in the Arctic, with the remainder focused on First Nations or Indigenous populations generally in rural and Northern Canada. Specific populations are distinguished in this report, where possible, to highlight the diverse perspectives and experiences within and among First Nations, Inuit, and Métis peoples and communities. However, some generalizations are made depending on the number and nature of citations used (e.g., more than one Indigenous group is being referenced) and in instances where there are potentially shared experiences (e.g., health inequities and determinants).



Significant gaps identified from this review include literature related to climate change health risks affecting Indigenous populations in other regions of Canada (e.g., Prairies, Maritimes), Métis and urban Indigenous

populations, and gendered perspectives on climate change (see section 2.7 Knowledge Gaps). The focus of research in the North is due to the more rapid warming in that region and the greater severity of current

and projected impacts (Ford, et al., 2014; IITK, 2019b). The gaps also point to the limitations of Indigenous health research and data in Canada more generally (see box below).

Indigenous health data and research in Canada

In assessing climate change risks to health, it is important to recognize the limitations and challenges of Indigenous health data and research as they currently exist in Canada. Relevant, high-quality data are challenged by a lack of disaggregated and longitudinal First Nations, Inuit, and Métis-specific data; the absence of relevant, consistent, and inclusive Indigenous identifiers in population health data sources; and a lack of strengths-based and community-driven health and wellness indicators (Smylie, 2010; Smylie & Firestone, 2015). Some geographic areas and populations are over-represented in core population health data sources (e.g., Status First Nations living on reserve or Inuit living in Inuit Nunangat), while others are severely under-represented (e.g., non-Status First Nations, Métis, or other Indigenous Peoples living in urban areas) (Young, 2003; Smylie, 2010; Kumar et al., 2012). This substandard health data result in generalizations across diverse First Nations, Inuit, and Métis populations and an under-estimation of the health inequities between Indigenous and non-Indigenous people (Smylie & Firestone, 2015). Working in partnership with First Nations, Inuit, and Métis peoples and their representative and governing organizations to govern and manage the data collected from them is critical to addressing these challenges (Smylie & Firestone, 2015).

Research on Indigenous health has, and continues to be, dominated by non-Indigenous researchers (Brown, 2018; Anderson, 2019) and by scientific knowledge paradigms that consider Indigenous methodologies, epistemologies, knowledges, and perspectives less rigorous than Western science (Saini, 2012; Hyett et al., 2018). It is also tainted by a history of unethical policies and practices, including the “misappropriation and abuse of Indigenous knowledge, property, culture and biological samples,” as well as a “failure to share data and resulting benefits; and the dissemination of information that misrepresented or stigmatized entire communities” (Hyett et al., 2018, p. E616). Consequently, much of the health research conducted to date is not relevant to First Nations, Inuit, and Métis peoples’ health needs or priorities (Young, 2003; Wilson & Young, 2008; Hyett et al., 2018). Although ethics guidelines and community-based and partnership approaches are improving the practice of health research involving First Nations, Inuit, and Métis peoples (Hyett et al., 2018), there is still considerable work to be done to ensure research is respectful, relevant, reciprocal, and responsible. Guidance on best practices for research with Indigenous Peoples and communities have been developed by non-governmental organizations, national Indigenous organizations, and government agencies, and complement resources developed by communities and other organizations (RCAP, 1996; NAHO, 2011; CIHR, 2013; First Nations Information Governance Centre, 2014; CIHR, NSERC, & SSHRC, 2018; Hyett et al., 2018; IITK, 2018; Kilian et al., 2019).

HEALTH INEQUALITIES AND INDIGENOUS PEOPLES' HEALTH

“Rapid climate change is yet another layer of stress cast over our already stressed society”⁵

Although Indigenous Peoples are the most youthful and fastest-growing segment of Canada’s population, they do not enjoy the same benefits of good health as other Canadians. First Nations, Inuit, and Métis individuals, families, and communities experience a disproportionate burden of ill health compared to non-Indigenous people, including significantly higher rates of infant and child mortality, unintentional injury and death, chronic and infectious diseases, suicide, exposure to environmental contaminants, malnutrition, and a reduced life expectancy (Gracey & King, 2009; Greenwood et al., 2018; PHAC, 2018a). Health disparities are influenced, in part, by the social determinants of health, or the conditions in

which individuals are born, grow, live, work, and age (CSDH, 2008). Key social determinants of health include income and social status, employment and working conditions, education, early childhood development, physical environments, social supports and coping skills, health behaviours, access to health services, gender, culture, and race. These conditions are, in turn, the result of complex structures and systems operating at the local, national, and global levels that determine the distribution of money, power, and resources within and among countries (Marmot, 2007; CSDH, 2008; Reading, 2018). Together, the determinants of health and their structural drivers contribute to a social gradient of health, where

the most socio-economically disadvantaged populations experience the greatest burden of ill health (Marmot, 2007).

Indigenous-specific determinants of health are linked to past and contemporary colonial policies and practices, including dispossession of traditional lands; forced relocation to reserves or settlements; child apprehensions related to Indian residential schools, the Sixties Scoop⁶ and subsequent child welfare policies; forced relocation to tuberculosis sanatoria and Indian hospitals;⁷ oppression through the Indian Act; and systemic discrimination (Gracey & King, 2009; Greenwood et al., 2018). These determinants serve to perpetuate structural inequities and systemic

⁵ Natan Obed, as quoted in ITK (2016, p. 28).

⁶ Indigenous Peoples continued to experience trauma, loss, and grief because of the rapid expansion of the child welfare system in the 1960s. During this period, commonly known as the “Sixties Scoop” (Sinclair, 2007), disproportionate numbers of Indigenous children were placed in foster care. By the end of the 1960s, “30% to 40% of the children who were legal wards of the state were Indigenous children – in stark contrast to the rate of 1% in 1959” (Fournier & Crey, 1997, as cited in Kirmayer et al., 2000, p. 609).

⁷ Indian hospitals were racially segregated institutions, originally serving as tuberculosis sanatoria, but later operating as general hospitals overseen by the Indian Health Service. They were poorly funded, understaffed, and overcrowded, and many Indigenous people experienced abuse, coercion, and medical experimentation in them (Lux, 2016; McCallum & Perry, 2018).

disadvantage across the lifespan and across generations. Such intergenerational impacts are evident in the disturbingly high rates of substandard or overcrowded housing, poverty, food and water insecurity, unemployment, child apprehension, incarceration, as well as lower rates of educational attainment and poorer access to quality health care (Reading & Wien, 2009; NCCAH, 2012; NCCAH, 2017). In contrast, factors such as spending time out on the land, having a strong sense of Indigenous identity, cultural continuity, supportive kinship and community relationships, and expressions of self-government and self-determination can promote protective factors such as resilience, self-reliance, and self-confidence to facilitate more positive health outcomes (Chandler & Lalonde, 1998; Petrusek MacDonald et al., 2013a; Kielland & Simeone, 2014). Health determinants intersect and manifest differently among First Nations, Inuit, and Métis peoples, influencing risk and protective factors associated with health status in distinct ways across the lifespan (Reading & Wien, 2009).

Determinants of health frameworks, and perspectives of health and well-being generally, vary considerably within and among First Nations, Inuit, and Métis peoples. At a national level,

some key documents articulating these perspectives include:

- *The First Nations Health Transformation Agenda by the Assembly of First Nations* (AFN, 2017).
- *Social Determinants of Inuit Health in Canada by Inuit Tapiriit Kanatami* (ITK, 2014).
- *Métis Life Promotion Framework*© (MLPF) (Martens et al., 2010).

The status of determinants of health can increase or decrease vulnerability to health risks associated with climate change. Existing health inequities and inequalities can compound vulnerability to climate-related health risks. This results in increased exposure and sensitivity to climate hazards and decreased ability to cope and adapt (Islam & Winkel, 2017).

Gender as a Determinant of Indigenous Peoples' Health

Before colonization, “Indigenous categorizations of gender emerged within other cultural and social practices, and were as diverse as Indigenous cultures themselves” (Hunt, 2016, p. 7). Historic and ongoing colonial processes imposed new social norms and legal rights that

altered these often egalitarian and matrifocal gender roles and responsibilities, creating significant gender inequalities as well as discrimination against gender fluidity and homosexuality (Vinyeta, et al., 2015; Hunt, 2016). In the context of climate change, gender intersects with other determinants of health — such as education, race, income, and social status — to create unique climate change vulnerabilities, resiliencies, and lived experiences among First Nations, Inuit, and Métis women, men, boys, girls, and gender-diverse people (WHO, 2014; Vinyeta, et al., 2015; Williams et al., 2018). In Canada, the majority of gender and climate change research conducted with First Nations, Inuit, and Métis populations to date has focused on food security, mental health, unintentional injury, and deaths (Sellers, 2018); attitudes and behaviours toward climate change (Bunce, 2015; Bunce et al., 2016); and environmental governance (Natcher, 2013; Staples & Natcher, 2015a; Staples & Natcher, 2015b; Sellers, 2018).

Climate change impacts are experienced differently across genders due to cultural differences in gender-based responsibilities. In a study by Bunce (2015), activities such as picking berries, making clothing, and preparing and preserving

food were identified as central to identity and the well-being of Inuit women. Changes in berry production, thickness and duration of sea ice, and the quality and quantity of furs and pelts can hinder fulfillment of these traditional roles and the transmission of these skills to younger generations (Dowsley et al., 2010; Pauktuutit, 2011; Bunce, 2015; Bunce et al., 2016). For First Nations, Inuit, and Métis women, a key part of female identity is the special relationship to water and the responsibilities to care for and protect it (Anderson, 2010; McGregor, 2012; Szach, 2013; Powys Whyte, 2014). Climate change may affect the availability and quality of fresh water, which can significantly affect emotional, mental, and spiritual health and well-being (Longboat, 2013; Szach, 2013).

It is well recognized that warming temperatures are expected to increase the frequency and intensity of extreme heat events and the range and survival of vectors of infectious diseases, such as mosquitoes and ticks. Kovats and Hajat (2007) found that men are more likely to be active in hot weather, which makes them more vulnerable to heat stress. Pregnant women are at increased risk of poor health outcomes from placental abruption in full-term pregnancies (He et al., 2018). Since First Nations, Inuit, and Métis men spend considerable time outdoors



engaging in land-based activities (e.g., hunting, fishing, trapping), climate change can be expected to disproportionately place Indigenous men at increased risk of heat-related conditions and vector-borne diseases such as Lyme disease and West Nile virus (Vinyeta et al., 2016; Sellers, 2018).

However, at present, there is a lack of surveillance and reporting on these types of climate-related impacts. For example, despite the expanded range and frequency of vector-borne illnesses such as West Nile virus, Lyme disease, and Zika virus, and recognition of the importance of vector-borne disease surveillance and monitoring programs, including among First Nations communities (PHAC, 2018b), systematic vector surveillance does not occur in all provinces and territories (Awuor et al., 2019), and Indigenous status has

not been identified in human case surveillance data. As a result, there are no publicly available data from surveillance programs that identify the prevalence of vector-borne illnesses among specific populations, including Indigenous populations.

Indigenous men may also be at greater risk of accidents as the environments in which they carry out their traditional activities become more hazardous (Vinyeta et al., 2016). Changes in weather and climate, including decreases in wildlife populations or safe access to hunting areas, can also limit the transmission of gender-based knowledge and skills to younger generations (Jacob et al., 2010; Downing & Cuerrier, 2011; Pauktuutit, 2011; Bunce, 2015; Bunce et al., 2016).

Emotional responses and coping strategies related to climate change effects may also be

gendered. For example, Inuit women experienced stronger emotional reactions (e.g., fear, distress, helplessness, anger, sadness, and frustration) to climate change effects than Inuit men, while men were more likely to experience anxiety in response to climate change (Cunsolo Willox et al., 2012; Sellers, 2018). Inuit women are also more likely to share their feelings with others

and manage stress in healthy ways, including becoming strong activists in climate change actions at global and local levels (Bunce, 2015; Williams et al., 2018; Hania, 2019; Santisteban, 2020). First Nations, Inuit, and Métis men may experience increased stress as a result of losing access to places and resources critical to masculine identities, especially those tied closely to livelihoods,

which may exacerbate problems of substance abuse, suicide, and family violence that have been associated with colonization and cultural loss and are particularly prevalent in some First Nations and Inuit communities (Cunsolo Willox et al., 2012; Cunsolo Willox et al., 2015; Vinyeta et al., 2016).



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CLIMATE CHANGE RISKS TO INDIGENOUS PEOPLES' HEALTH

“The respect that we need to show the land and its relatedness to us. We are the land. If the land is sick then it ain't going to be very long before we're going to get sick.”⁸

The impacts of climate change on the land, and on Indigenous Peoples' relationships to the land, are already evident in communities from coast to coast to coast, not just in terms of effects on physical health, but also on the emotional, spiritual, psychological, and cultural well-being of Indigenous Peoples (ISC, 2019a). The dramatic, unprecedented rate of change has led some Indigenous communities and organizations to declare climate change states of emergency. In May 2019, the Vuntut Gwitchin First Nation (Old Crow, Yukon) was the first to issue a formal state of emergency, asserting that their traditional way of life was under threat from the rapidly changing landscape (Yeednoo Diinehdoo Ji'heezrit Nits'oo Ts'o' Nan He'aa Declaration, n.d.). Vuntut Gwitchin First Nation Chief, Dana Tizya-Tramm, noted, “It's going to be the blink of an eye before my great grandchild is living in a completely different

territory, and if that's not an emergency, I don't know what is” (Avery, 2019, n.p.). The Assembly of First Nations (AFN) subsequently declared a global climate emergency at its July 2019 annual general meeting, along with calls to develop a First Nations–led climate strategy and to convene a national gathering to advance climate advocacy, which was held in March 2020, in Whitehorse, Yukon (AFN, 2019, AFN, 2020).

In Inuit Nunangat, which is warming at almost three times the global average (Bush & Lemmen, 2019), the Inuit Tapiriit Kanatami (ITK) has responded to this unprecedented rate of change and impacts by developing the Inuit Priorities for Canada's Climate Strategy: A Canadian Inuit Vision for Our Common Future in Our Homelands report (ITK, 2016) and the National Inuit Climate Change Strategy (ITK, 2019b).

In October 2016, the Métis National Council (MNC) passed a resolution on climate change and the environment at a special sitting of its general assembly. Couched in a nation-to-nation, government-to-government approach, the resolution supports meaningful Métis engagement and review of federal environmental legislation, policy, protection, management, and assessment processes (Métis National Council, 2016). The MNC has also conducted a national climate change and health vulnerability assessment (JF Consulting, 2020).

The health impacts of climate change on First Nations, Inuit, and Métis peoples are far-reaching, and have already been observed in many regions of Canada. The following section provides a broad overview of climate change risks to First Nations, Inuit, and Métis peoples' health and well-being associated

⁸ Batchewana Elder quoted in Tobias & Richmond (2014, p. 29).

with natural hazards, mental health, air quality, infectious diseases, food safety and security, water safety and security, and health systems. Risks are discussed in the context of existing First Nations, Inuit, and Métis peoples' health inequities and the unique sensitivities of Indigenous Peoples to climate change. Examples of Indigenous adaptation projects and initiatives from across Canada in response to climate change are also provided.

Natural Hazards

First Nations, Inuit, and Métis peoples are uniquely sensitive to the health impacts of climate-related events, given their close reliance on the environment for their sustenance, livelihoods, and cultural practices (Ford, 2012; Kipp et al., 2019b). The related health impacts are experienced both directly and indirectly. In the Arctic, rising temperatures

are affecting permafrost stability, ground snow cover, sea ice extent and thickness, sea levels, and weather patterns (Ford et al., 2014; Durkalec et al., 2015; ITK, 2016). These changes are exacerbating the loss of knowledge and land skills related to weather prediction, transportation to hunting grounds, and wildlife patterns, leading to increased risk of injuries and fatalities, more

“The sea ice has really changed. I used to travel both by dog team and skidoo to and from Pond Inlet. In my recent trip, the snow has changed. The snow on top and snow condition on top has changed. Normally, in the spring, the snow on the top will freeze at night. This process is called qiqqsuqqaqtuq. This frozen layer can be seen when the day just starts getting daylight; it is sparkling because of the recent freeze up on top. I noticed it wasn't like that anymore. This process, the freezing, isn't happening anymore.”⁹

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⁹ Palluq (2007) as quoted in Dowsley et al. (2010, p. 156).

search and rescue missions, and reduced access to country foods¹⁰ (Lemelin et al., 2010; Andrachuk & Smit, 2012; Pearce et al., 2012; Sheedy, 2018). For example, the rate of unintentional injuries was more than three times higher than the Canadian average among Inuit land-users in Nunavut over the period 2006 to 2015, and the number of search and rescue operations has more than doubled over the past decade due to changes in temperature and ice (Clark et al., 2016a; Clark et al., 2016b). The loss of knowledge and land skills also threatens Inuit identity and well-being by decreasing opportunities for land- and sea-based activities and for sharing and teaching knowledge and skills, particularly for youth (ITK, 2016).

Permafrost degradation, heavy storms, and coastal erosion can result in the destruction of places that have cultural significance, with potential mental health impacts (Government of Nunavut, 2010; Government of Nunavut, 2012; Donatuto et al., 2014). Such events can also destabilize housing, pipelines, and local civic water, wastewater, and transportation infrastructure and systems, increasing the risk of injury, water-borne illnesses, and environmental contamination, as well as causing disruptions in supply chains (Government of Nunavut, 2010; Government

of Nunavut, 2014; Berner et al., 2016; FRMFNMES, 2016). In the Inuvialuit hamlet of Tuktoyaktuk, for example, coastal erosion is already forcing residents to relocate their homes further inland onto higher ground (Faris, 2019). Such impacts place additional financial strains on Inuit households and communities in the context of high living costs, low household income, low population base, and inadequate local government revenues (ITK, 2016). In response to these changes, local Inuit youth formed a filmmaking collective — Tuk TV — and captured these experiences in the documentary *Happening to Us*, which was screened at the 25th session of the Conference of the Parties (COP 25) to the United Nations Framework Convention on Climate Change (UNFCCC) in Madrid, Spain, in 2019.¹¹

Warming temperatures and changes in precipitation patterns have led to the increased frequency and severity of extreme weather events such as flooding, wildfires, and heat events (Berry et al., 2014; Bush & Lemmen, 2019). Some First Nations, Inuit, and Métis communities are more vulnerable to these events because of their geographic location, as well as existing socio-economic conditions and infrastructure (CIER, 2008; Christianson et

al., 2012; Collier, 2015; McNeill et al., 2017). Over the period 2006 to 2016, approximately 67 First Nations communities experienced a combined total of nearly 100 flooding events, causing significant property and infrastructure damage, disruptions to community services, and impacts to health and well-being (McNeill et al., 2017).

Climate change has contributed to an increased number of extreme heat events and droughts, and to a proliferation of pests such as the mountain pine beetle, which, in turn, is increasing the prevalence, magnitude, and intensity of wildfires and the devastation of forests. These are taking a tremendous social, psychological, emotional, and financial toll on First Nations and Métis communities across Canada (Scharbach & Waldram, 2016; Howard et al., 2017; Dodd et al., 2018a; Dodd et al., 2018b; ISC, 2018). Many Indigenous communities are located in regions that are expected to see increased wildfire activity over the next 40 years, including parts of British Columbia's coast and Haida Gwaii, Northeastern Alberta, central Saskatchewan, Southern Manitoba and Ontario, and the Northwest Territories (B.J. Stocks Wildfire Investigations Ltd., 2013).

¹⁰ Country foods include “those harvested from the land sea, comprising primarily wild game, sea mammals, fish, and berries” and can vary from region to region (McGrath-Hanna, et al., 2003).

¹¹ The documentary *Happening to Us* is available by request from Tuk TV.

The increased prevalence and severity of extreme weather and climate-related events can have both direct and indirect impacts on human health. Extreme weather events can lead directly to increased injuries and fatalities (Kipp et al., 2019b). Droughts can affect respiratory health, mental health, exposure to environmental toxins, food security, water security, and rates of injury and infectious diseases, as well as causing increased stress on water treatment systems (Yusa et al., 2015). Flooding can result in water and food contamination from the release of environmental contaminants, bacteria, and other pathogens (Patrick, 2011; Huseman & Short, 2012; Daley et al., 2015). This can lead to

increased water- and food-borne infections, skin conditions, and birth defects, as well as obesity, diabetes, hypertension, mental stress, heart disease, liver disease, kidney problems, neurological problems, immunopathology, cancers, thyroid conditions, and infant mortality (Bradford et al., 2016). Flooding and wildfires can damage fish and wildlife habitat important for species reproduction, with subsequent impacts on food security (Kipp et al., 2019b). Wildfires can degrade air quality, contributing to high rates of respiratory and cardiovascular diseases (Liu et al., 2015; Reid et al., 2016), as well as leading to psychological impacts such as stress, anxiety,

and depression (Cunsolo Willox et al., 2015; Dodd et al., 2018a; Dodd et al., 2018b; Manning & Clayton, 2018). Extreme heat can result in heat-related illnesses and mortality, especially in Southern Canada and urban centres (Council of Canadian Academies, 2019). While research on Indigenous populations and extreme heat is limited, a comparative study of climate-related morbidities among urban and rural Indigenous populations in Ontario found that urban populations may be at greater risk because of inequities associated with access to health services, health status, poverty, housing, and political marginalization (Tam, 2013).

Hazard mapping in Kashechewan First Nation

In the flood-prone Cree community of Kashechewan, located in Northern Ontario, Indigenous knowledge about changing seasons, snowmelt, and runoff were used in conjunction with data from geographic information systems to gain a more comprehensive understanding of flooding and its effects on the community (Khalafzai et al., 2019). The federal government has made multiple, unsuccessful attempts to mitigate flooding since the 1990s; heavy ice jams continued to cause erosion and damage to the community's water treatment plant, leading to an *Escherichia coli* (*E. coli*) outbreak in 2005. The community has been evacuated at least 12 times since 2004, at significant financial, emotional, and psychological cost. By 2015, engineers reported that the dyke was "deteriorating and inadequate to protect the growing community" (Khalafzai et al., 2019, p. 4).

In 2016, Kashechewan participated in a study documenting Indigenous knowledge related to spring flooding that used several participatory methods (e.g., in-depth interviews, flood mapping workshops, on-site walks) (Khalafzai et al., 2019). Findings revealed that the warming climate was increasing the frequency and scale of spring ice breakup and ice jams, resulting in earlier and more intense flooding events and greater potential for damage in the community. Participants also identified a number of landscape and human-induced factors that exacerbated the impacts of flooding on the community, including inadequate community infrastructure (e.g., water treatment plant) and flood protection, the region's topography, and resource development activities in the region. These ecological changes have affected local hunting and harvesting practices, sociocultural activities, and the intergenerational transmission of knowledge. Findings from this study may be useful for ongoing flood monitoring and disaster risk-reduction activities in the community.

Climate-related emergencies can also lead to temporary evacuations or long-term displacements from traditional territories, which affect all aspects of Indigenous health and well-being. They disrupt lives; create financial hardship; increase stress, anxiety, and post-traumatic stress disorder; and can bring back historical traumas associated with forced relocations and government interventions in the lives of Indigenous Peoples (Thompson et al., 2014; Scharbach & Waldram,

2016; Bedard & Richards, 2018; Dicken, 2018; Hassler et al., 2019). First Nations people living on reserve, in particular, have been disproportionately affected by displacement due to climate-related events. For example, over the period April 2017 to March 2019, nearly 15,000 First Nations residents were evacuated because of floods, fires, and extreme heat (ISC, 2019, as cited in Parliamentary Information and Research Service, 2020). Going forward, emergency responses to these

climate-related events will require adequate funding for emergency planning activities; capacity-building and training; the inclusion of Indigenous Peoples in coordination activities; the use of Indigenous knowledges and expertise; direct and immediate emergency response; evacuation processes that are sensitive to Indigenous Peoples; as well as ongoing efforts for Indigenous communities to recover from such events (Standing Committee on Indigenous and Northern Affairs, 2018).



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Peavine Métis Settlement FireSmart Program

Many Indigenous communities are located in fire-prone forests where climate change is elevating wildfire risk (Christianson et al., 2014). FireSmart Canada works with federal, provincial, and territorial governments and organizations to increase community resilience to wildfires across Canada by implementing principles and best practices for wildfire prevention, mitigation, and preparedness (Christianson et al., 2012; ISC, 2019b; FireSmart Canada, 2020). Using both Indigenous knowledges and scientific information, community members learn and share information about forest, vegetation, and ecosystem management; traditional burning practices; fireguard and fuel break strategies and activities; protection of homes and community infrastructure; and first response, among other issues (Government of the Northwest Territories, 2010; Christianson et al., 2012; Environment and Natural Resources, 2015; Environment and Natural Resources, 2016; Dodd et al., 2018a; Dodd et al., 2018b).

The Peavine Métis Settlement's FireSmart Program involves conducting mitigation activities at residential and community levels. In addition to select, unique community projects, which occur twice annually, the program includes six ongoing activities (Christianson et al., 2012):

- A lawn tractor program encourages residential lawn cutting.
- Agriculture 50/50 supports the conversion of forest to agricultural land vegetation thinning.
- The New Homes Program supports clearing and thinning vegetation from future building sites.
- Fire breaks, or gaps, in vegetation are being installed to help slow or stop wildfire spread.
- The Aboriginal Junior Forest Rangers crew assist with summer FireSmart projects such as vegetation management.
- A volunteer fire department manages fires.

Cultural norms and values influence a community's perception and response to fire risk and mitigation (Christianson et al., 2014). For the Peavine Métis Settlement, these included the importance of assistance to community Elders, participation in subsistence activities on the land, traditional knowledge (TK), social relationships and support for community members, trust, pride in aesthetics, intergenerational knowledge transfer, and self-sufficiency. Each of these values is incorporated into some element of the community's FireSmart Program (Christianson et al., 2012; Christianson et al., 2014).

Mental Health and Well-Being

Climate change threatens the cultural dimensions of Indigenous Peoples' lives and livelihoods that are central to identity, community cohesion,

and a sense of place and belonging (Adger et al., 2013). The impact of climate change on mental health and well-being can disproportionately burden some groups, including Indigenous women, children, and individuals from socio-economically

disadvantaged communities, as well as Elders, who can be deeply disturbed by the changes they are witnessing (FNMFNMES, 2016; Manning & Clayton, 2018). Since First Nations, Inuit, and Métis peoples have disproportionately higher rates of suicide, substance

abuse, and violence as a result of intergenerational trauma and socio-economic marginalization (Aguiar & Halseth, 2015; Kumar & Tjepkema, 2019), these climate change impacts can compound existing mental health issues.

First Nations, Inuit, and Métis peoples have a deep economic, social, and spiritual connection to their lands as a source of food, clothing, teaching, recreation, and connection to past, current, and future generations (Mecredi, 2010; Tobias & Richmond, 2014), and see it as “intertwined and interconnected” to other determinants of health (Harper et al., 2015c, p. 6). Engaging in land- and culture-based activities can provide mental, emotional, social, cultural, and spiritual benefits that support individual and community resilience in the face of climate change. These activities can, for example, help to replenish the spirit, reduce stress, increase physical activity and nutrition, facilitate access to traditional medicines, build self-confidence, foster positive relationships, enhance cultural identities, and increase opportunities for intergenerational knowledge transmission (Cunsolo Willox et al., 2012; Nisga’a First Nation, 2012; Arias-Bustamante, 2013; Cunsolo Willox et al., 2013a; Ulturgasheva et al., 2014; Durkalec et al., 2015; Harper et al., 2015c).

Climate change can disrupt Indigenous Peoples’ ability to



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hunt, fish, trap, forage, and spend time on the land, which can negatively affect their mental and emotional health and well-being. It can introduce new hazards, leading to increased stress and anxiety about the safety of family members travelling on the land (Harper et al., 2015c). It can disrupt the transmission of intergenerational knowledge and land skills to younger generations, which is critical to the formation of a strong cultural identity and resilience (Chandler & Lalonde, 1998; Kral & Idlout, 2009; Wexler, 2013). Extreme climate events, such as wildfires, and resulting evacuations, along with impacts from slow-onset climate change effects can cause stress or worries about the future (Cunsolo Willox, 2012a; Cunsolo Willox, 2012b; Cunsolo Willox et al., 2012; Scharback & Waldram, 2016; Asfaw, 2018; Dodd et al., 2018a; Dodd et al., 2018b; Manning & Clayton, 2018).

Indigenous Peoples may also experience ecological grief from past and future climate change-related losses of land, ecosystems and species, environmental

knowledge, and cultural identity (Cunsolo & Rigolet Inuit Community Government, 2014; Cunsolo & Ellis, 2018; Meloche, 2018). As the climate warms, anxiety, stress, and “ecological grief” are expected to become increasingly more common (Cunsolo Willox et al., 2013b, Bourque & Cunsolo Willox, 2014; Cunsolo Willox et al., 2015; Harper et al., 2015c; Cunsolo & Ellis, 2018; Cunsolo et al., 2020). Responding to increasing mental health issues will be difficult and challenging, especially given that many First Nations, Inuit, and Métis communities lack adequate mental health services (Mental Health Commission of Canada, 2016; Standing Committee on Indigenous and Northern Affairs, 2017; Carrière et al., 2018). Jurisdictional fragmentation of health care between federal and provincial governments and a lack of dedicated long-term funding for mental health services continue to be significant barriers to achieving health and well-being in First Nations, Inuit, and Métis communities (Boksa et al., 2015).

Improving mental health and resilience among Selkirk First Nations youth in the face of climate change

Participation in land- and culture-based activities is considered by many First Nations, Inuit, and Métis communities as a pathway to mental health and well-being, particularly for youth (Cunsolo Willox et al., 2012; Auger, 2019; Selkirk First Nation, & Arctic Institute of Community-Based Research, 2019). In the Yukon, the Selkirk First Nation relies on salmon as the mainstay of their diet, and harvesting salmon in fish camps is critical to their mental, physical, emotional, and spiritual well-being as a people (Richards et al., 2019). The community noticed a dramatic decline in the salmon population, which not only threatens their food security, but also the essence of their cultural identity — the age-old tradition of the fish camps. In 2015–2016, Selkirk First Nation received funding through the federal government’s Climate Change and Health Adaptation Program to conduct a community-based research and adaptation project related to maintaining food security and TK and culture around the fish camps to ensure the well-being of its community members.

The Selkirk First Nations project had the following short- and long-term objectives:

- engage community members to collectively address issues of climate change;
- build youth capacity in understanding climate change and conducting research;
- build relationships and cohesion in the community;
- present youth perspectives on mental well-being through photography;
- compile community strategies to adapt to climate change impacts to the fish camp and develop a community adaptation plan for climate change and the role of fish camps in youth mental health;
- understand climate change and health from a regional and Northern perspective;
- raise the voices of the Selkirk First Nation on issues of health and climate change while protecting traditional lifestyles; and
- support youth leadership in this area.

The research project was directed by an advisory committee of Elders and community members, while youth carried out surveys of the fish camps so they could learn first-hand the value and role of these camps and the impacts that climate change was having on their lands, community, and culture. The youth learned from the Elders the importance of connecting with TK and cultural traditions for promoting mental health and fostering resilience in the future. They learned valuable skills from on-the-land activities at a winter fish camp for youth, as well as skills involved in conducting community-based research. The “Keeping our traditions for the health and wellbeing of future Selkirk First Nation generations: ‘What do we do at the fish camp when there is no fish?’” project resulted in an adaptation strategy that identified a number of actions focused on supporting youth mental health and resilience, including teaching youth about traditional values, lifestyles, and laws; reconnecting them to the land; and supporting cultural activities such as art and dancing (Selkirk First Nation in collaboration with the Arctic Institute of Community-Based Research, 2016).

Exploration of the mental health impacts of climate change for First Nations, Inuit, and Métis peoples is an emerging area of study and has focused primarily on the strong emotional and psychological responses experienced in the face of rapid ecological changes. For Inuit, these responses include intense feelings of anxiety, fear, stress, anger, sadness, disorientation, grief, loss and lament, increased drug and alcohol use, suicide ideation and attempts, violence, and decreased place-based mental solace (Cunsolo Willox, 2012a; Cunsolo Willox, 2012b; Cunsolo Willox et al., 2013a; Cunsolo Willox et al., 2013b; Petrusek MacDonald et al., 2013a; Petrusek MacDonald et al., 2013b; Ulturgasheva et al., 2014; Cunsolo Willox et al., 2015; Harper et al., 2015c; Bunce et al., 2016). As noted by Durkalec and colleagues (2015), climate change is reinforcing environmental dispossession for Inuit, compounding disruption and denigration of Inuit knowledge and ways of life. Research on the mental health impacts of climate change on First Nations and Métis peoples is more limited. One study focused on the impacts of a summer of wildfires on the health and well-being of

four First Nations communities in the Northwest Territories. Participants in this study reported experiences of evacuation and isolation, as well as feelings of fear, stress, and uncertainty about the future (Dodd et al., 2018a; Dodd et al., 2018b).

Indigenous Services Canada provides funding for several targeted national strategies, including the National Aboriginal Youth Suicide Prevention Strategy, the National Native Alcohol and Drug Abuse Program, mental health counselling, and the Indian Residential Schools Mental Health Support Program (ISC, 2019c). Most of these programs are accessible to only a relatively small proportion of First Nations and Inuit¹² and do not provide the range and quality of services required to address the complex mental health problems that exist in First Nations, Inuit, and Métis communities (Maar et al., 2009; Boksa et al., 2015). Greater cooperation is needed among federal, provincial, and territorial governments to ensure that these communities have sustainable, dedicated funding to meet the potentially growing need for mental health services in response to climate change impacts.

Air Quality

Weather and climate can affect indoor and outdoor air quality and have impacts on human health (Kinney, 2008). Warming temperatures can increase levels of air pollutants (e.g., ground-level ozone, particulate matter) and the production of aeroallergens (e.g., pollens, molds) that are associated with a greater risk of cardiovascular and respiratory diseases, as well as premature death (Berry et al., 2014; Reid et al., 2016). First Nations, Inuit, and Métis peoples experience a disproportionate burden of chronic respiratory diseases, such as asthma¹³ and chronic obstructive pulmonary disease,¹⁴ compared to non-Indigenous people, and these diseases can become exacerbated by poor air quality (Gershon et al., 2014; Ospina et al., 2015; Carrière et al., 2017; PHAC, 2018a; Koleade et al., 2018). Higher rates of respiratory infections, such as bronchitis, bronchiolitis, pneumonia, and tuberculosis, are also reported for First Nations, Inuit, and Métis children (Kovesi, 2012; Konrad et al., 2013). The risks of exposure to poor air quality are greater for First Nations, Inuit, and Métis

¹² Under current jurisdictional arrangements, federal funding for most mental health programs and services is provided for community-based services accessible to status First Nations living on reserve and Inuit living in Inuit communities. In smaller, remote communities, access to mental health services may be very limited or non-existent (Boksa et al., 2015). Additionally, non-status First Nations and Métis peoples are not currently entitled to these same services and benefits.

¹³ First Nations people living off reserve and Métis have rates of asthma 1.6 times higher than Canadian-born non-Indigenous peoples (PHAC, 2018a).

¹⁴ Indigenous populations have a prevalence rate of 6.5% for chronic obstructive pulmonary disease, compared to 4% for non-Indigenous populations in Canada (Bird et al., 2017).

peoples because of underlying health determinants such as poor housing conditions (e.g., homes in need of repair, overcrowding, poor ventilation, mold) in many communities, increased exposure to tobacco smoke and wood/oil heating, and geographic proximity to forests that are prone to wildfires and consequent smoke (CIER, 2008; B.J. Stocks Wildfire Investigations Ltd., 2013; Dodd et al., 2018a; Dodd et al., 2018b).



Yellowknife's Summer of Smoke, 2014

During the summer of 2014, the Yellowknife area experienced an extreme wildfire season referred to as the “Summer of Smoke.” These fires resulted in a massive spike in air pollution to dangerous levels, confining many residents indoors for extended periods of time (Howard et al., 2017; Dodd et al., 2018a; Dodd et al., 2018b). The poor air quality associated with this wildfire season negatively affected First Nations communities, particularly children and the elderly. For example, the fire season corresponded to significant increases in emergency room visits for respiratory problems (42% over previous years), especially among children up to 4 years old (114% over previous years), as well as more cases of cough, pneumonia, and asthma (Dodd et al., 2018a). Confinement indoors during fires, disruptions in land-based activities, and physical inactivity also contributed to mental health impacts such as stress, anxiety, and depression.

“All that smoke we breathed in, where are you to go? It’s not only me. It’s the babies and the Elders. And then the vegetation and the runoff from the smoke and the rain all affects the ecosystem right to the water.”¹⁵

To counteract cabin fever and physical inactivity, the First Nations communities of Kakisa and N’Dilo planned alternative physical and social activities to get away from persistent smoke, including hosting activities at the community hall that promoted physical activity among children and provided opportunities for community members to socialize. In Yellowknife, user fees were waived for recreational centres to encourage indoor physical activities. A documentary of the communities’ experiences, entitled Summer of Smoke, can be found at <https://vimeo.com/373958783>

¹⁵ Quote from Roxane Landry, Dene, Fort Providence from Summer of Smoke <https://vimeo.com/373958783>.



Food Safety and Security

Food insecurity is an urgent public health issue in Canada (Tarasuk et al., 2014), particularly for Indigenous Peoples in geographically remote regions with high rates of poverty (Loring & Gerlach, 2015; Bhawra et al., 2017; Human Rights Watch, 2020). Many Northern, remote communities rely on traditional or country foods to meet their nutritional needs (Earle, 2011). For example, Statistics Canada data indicate that 65% of Inuit, 35% of Métis, and 33% of First Nations living off reserve hunted, fished, or trapped in 2017, while 30% of off-reserve First Nations and 47% of Inuit gathered wild plants or berries¹⁶ (Kumar et al., 2019). Traditional or country foods are high in nutritional value and offer a number of physical and mental health benefits (Bunce, 2015; Bunce et al., 2016; Cyre & Slater, 2019).

Harvesting traditional or country foods promotes physical activity, contributes to social cohesion through food sharing, facilitates spiritual renewal and cultural expression, and plays a role in the development of personal and community self-sufficiency and food sovereignty (Receveur & Kuhnlein, 1998; Earle, 2011; Cidro et al., 2015; Hirsch et al., 2016).

Climate change is affecting the size, distribution, health, and behaviours of wildlife, fish, fowl, and other traditional sources of foods which, in turn, affect the ability to harvest and share them with family, Elders, and other community members (Organ et al., 2014; Statham et al., 2015; Archer, 2016; Spring et al., 2018). These impacts can be both positive and negative for enhancing food security. Warming temperatures have introduced new wildlife and plant species, allowed certain species

to flourish, and lengthened growing seasons, making it easier for Northern communities to grow their own foods (Sheedy, 2018). However, a warming climate has altered the timing of harvesting periods and changed ecosystems and habitats in ways that negatively affect species reproduction, leading to declines or disappearances of specific species that constitute traditional livelihoods.

Considerable research has already been undertaken on various climate-related aspects of food security for Indigenous populations, especially studies assessing the availability of traditionally important food sources. For example, many First Nations have been worried about declining numbers of some fish, shellfish, and goose species; the availability and quality of specific berries; and changes to caribou population size, health,

¹⁶ The authors provide no data on the proportion of Métis who gathered wild plants or berries beyond stating that this proportion remained relatively unchanged from the previous Aboriginal Peoples' Survey.

distribution, and migration patterns (Mecredi, 2010; Hermann et al., 2012; Teslin Tlingit Council, 2012; Arias-Bustamante, 2013; Donatuto et al., 2014; Kluane First Nations & AICBR, 2016; Parlee & Caine, 2018; Spring et al., 2018; Human Rights Watch, 2020). Inuit have also been alarmed by the changing population size, health, distribution, and/or migration patterns of caribou and other Arctic species, including muskox, seals, whales, and polar bears (Pauktuutit, 2011; Henry et al., 2012; Cuerrier et al., 2015; MacDonell, 2015; Quinn, 2016a; Quinn, 2016b; Mallory & Boyce, 2017; Parlee & Caine, 2018; Waugh et al., 2018). While little research has been conducted

specifically on the climate-related food security impacts on Métis people, some have expressed concerns about a shortened goose hunt; changes in the movement and location of fish and their habitat; changes to the health, behaviour, and distribution of caribou and moose; changes in

the availability and quality of specific berries; and the impacts of warmer weather on food preservation methods (Guyot et al., 2006; North Slave Métis Alliance community members, Shiga, Evans, King, & Keats, 2018).



Enhancing food safety and security for urban Indigenous populations in the face of climate change

While Indigenous Peoples in Canada have become increasingly urbanized, there is also a high degree of geographic mobility between rural areas and cities (Norris & Clatworthy, 2011; Snyder & Wilson, 2015). This population trend can result in a loss of Indigenous knowledge and skills that are critical for enhancing nutrition, well-being, and self-reliance in the face of climate change impacts. Indigenous food and food systems are intrinsic to the health and well-being of First Nations, Inuit, and Métis peoples, regardless of whether they live in rural or urban spaces (Ray et al., 2019). Providing urban Indigenous populations with opportunities to learn about traditional practices and connect with TK around food is a way of strengthening Indigenous food sovereignty.

Some urban First Nations Health Access Centres offer programs that foster relationships with the land and coordinate traditional practices in urban spaces to provide opportunities for the transmission of Indigenous knowledge and skills. For example, the Shkagmik-Kwe Health Centre, located in Sudbury, Ontario, prepares traditional medicines in-house and holds annual medicine camps to enhance cultural teachings and practices around medicine picking and preparation (Ray et al., 2019). They also support traditional subsistence by organizing community and family hunts, providing basic hunting equipment and financial support for licensing fees to community members (Ray et al., 2019), collecting locally hunted and harvested food that is offered to struggling families through its Wild Food Bank (McLeod-Shabogesic, 2013), and teaching traditional food preparation and cooking methods to its members (Shkagamik-Kwe Health Centre, 2015).

First Nations, Inuit, and Métis populations share a common concern about the unpredictability of weather and environmental conditions related to climate change and their ability to travel on the land to access traditional foods. These impacts can place pressure on already stressed food systems, leading to increased food insecurity in Indigenous communities and a greater reliance on retail foods (Statham et al., 2015; Sheedy, 2018). The move away from traditional or country foods to market foods, often of inferior quality, can exacerbate already high rates of chronic diseases prevalent among Indigenous Peoples, including obesity, diabetes, and cardiovascular diseases (Kolahdooz et al., 2015; Reading, 2015).

The challenge that climate change poses for heightening food insecurity is compounded by the negative environmental impacts of resource development on the safety of traditional foods and a food system imposed

“Water is what sustains us. Water is what brings us into this world, and water is what keeps us in this physical world. And so it’s our life.”¹⁷

through colonization that leaves Indigenous Peoples increasingly reliant on imported market-based foods (Penner et al., 2019). The ability of Indigenous Peoples to exercise autonomy over their lands and traditional foods is crucial for redressing the colonial narrative of socio-economic marginalization and health disparities (Coté, 2016). This autonomy is embodied in the concept of “food sovereignty,” a human-rights-based model founded on the notion that Indigenous Peoples have a right to “healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and [the] right to define their own food and agricultural systems” (Sélingué, 2007, as cited in Coté, 2016, p. 8). Indigenous food sovereignty recognizes *mino-pimatwisin*, the Anishinaabe term for “good life,” and *maligit*, the Inuktitut term for “balance” in *Qaujimajatuqangit* (Inuit TK) (Penner et al., 2019). Innovative examples of Indigenous food sovereignty have

been initiated across Canada, including school and community gardens, greenhouses, traditional foods education programs (e.g., conservation), market garden and food cooperatives, country food harvesting and sharing programs, wild food banks, and fish-buying clubs (Thompson et al., 2011; Thompson et al., 2012; Kamal et al., 2015; Martens, 2015; Robin, 2019).

Water Quality, Safety, and Security

Climate change impacts, such as increased precipitation, flooding, and drought, can significantly affect the quality, quantity, and accessibility of water (Berry et al., 2014), exacerbating health risks related to water quality, safety, and security challenges already present in many First Nations and Inuit communities in Canada. Inadequate water and wastewater systems, a lack of trained staff, and increased exposure to pollutants or environmental contaminants have led to dozens



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¹⁷ Jan Longboat, as quoted in Anderson (2010, p. 7).

of short- and long-term boil water advisories (White et al., 2012; Medeiros et al., 2016; Wright et al., 2018a; Wright et al., 2018b; ISC, 2020a; ISC, 2020b; ITK, 2020). While some progress has been made in improving the quality of drinking water in many Indigenous communities across Canada, a recent federal government report noted that Indigenous Services Canada was not on track to meet its 2015 commitment to eliminate all long-term drinking water advisories on reserves by March 31, 2021 (Office of the Auditor General of Canada, 2021). For example, there were 51 long-term (as of June 16, 2021) and 26 short-term (as of July 15, 2021) drinking water advisories in place for First Nations public water systems¹⁸ (ISC, 2021a; ISC, 2021b). A further six boil water advisories and seven “do not consume” advisories were in place in First Nations communities across British Columbia as of June 31, 2021 (First Nations Health Authority, 2021). Many Inuit communities have a single established water source, which leads to challenges around water infrastructure, water shortages, municipal water treatment, environmental contamination of water sources, and boil water advisories. The Inuit Tapiriit Kanatami (2020) notes that 298 boil water advisories were issued in 29 Inuit communities between January 2015 and October 1, 2020. The

result is that these communities face water emergencies under certain climatic conditions or must rely on trucked water and drinking water stored in containers, thus increasing the risk of contamination (Medeiros et al., 2016; Wright et al., 2018a). As recently as October 12, 2021, the Government of Nunavut flew in 80,000 litres of bottled water to Iqaluit after a state of emergency was declared following the detection of fuel in the community’s drinking water (CBC News, 2021).

High-visibility events like boil water advisories can increase distrust in water quality and lead to avoidance of the use of household drinking water supplies (Ekos Research Associates, 2011; Allaire et al., 2019). Small water systems face drinking water advisories as often or more frequently than large municipal water systems and often lack the proper resources to adequately address the advisory (Lane and Gagnon, 2020). Examinations of boil water advisories in Canada have identified that advisories are most often issued for operational or process-related concerns (Environment and Climate Change Canada, 2018; Lane and Gagnon, 2020). Climate-related events, such as intense rainfall, severe storms, dry spells, extremely hot days, and storm surges, can damage water supply infrastructure, diminish the availability of water resources, and reduce the quality of water

used for consumption (Kohlitz et al., 2020). Increased pressures on drinking water infrastructure at small drinking water systems are forecasted as climate change accelerates (Kohlitz et al., 2020).

Climate change has already had a significant impact on water security in Indigenous communities. Numerous First Nations communities have reported rapid declines in water levels, with significant impacts on the availability of fish resources and the migration and movement of other animal resources that are important for food security (Mecredi, 2010; Nisga’a First Nation, 2012; Teslin Tlingit Council, 2012; Harper et al., 2015a; FRMFNMES, 2016; Sheedy, 2018). In the Arctic, climate change has increased evaporation of the freshwater supply, the contribution of groundwater to river flows, and permafrost degradation. These impacts will place increasing pressure on the availability of drinking water, diminish water quality as a result of the release of stored environmental contaminants, and place cumulative and increasing pressure on freshwater resources (Nilsson et al., 2013; Goldhar et al., 2014; Bakaic & Medeiros, 2016; Medeiros et al., 2016).

The lack of access to clean, safe water can make it difficult to maintain personal hygiene and contributes to the increased spread of water-borne infectious

¹⁸ These statistics exclude British Columbia and the Saskatoon Tribal Council.

diseases such as gastrointestinal illness (Harper et al., 2015a; Harper et al., 2015b; Bradford et al., 2016; Chen, 2016), as well as infectious illnesses such as influenza, coronavirus (COVID-19), and methicillin-resistant *Staphylococcus aureus* (Boyd, 2011; Sarkar et al., 2015; Bharadwaj & Bradford, 2018; Stoler et al., 2020). In a scoping review of drinking water quality in Indigenous communities and health outcomes in Canada, Bradford et al., (2016) found gastrointestinal infections

were the most commonly reported health concern in the studies reviewed. Other health concerns reported in relation to contaminated drinking water included skin conditions, such as eczema and skin cancer, increased infant mortality and birth defects, as well as elevated levels of obesity, diabetes, and cardiovascular diseases resulting from a reliance on carbonated and sugary drinks in the absence of clean drinking water (Bradford et al. 2016).

The potential mental and spiritual health impacts of climate change on water security cannot be overstated. Several studies across Canada indicate that water insecurity is linked to mental health issues and psychosocial distress in Indigenous individuals (Anderson, 2010; Hanrahan et al., 2014; Sarkar et al., 2015; Cruddas, 2017). Considered life-giving and sacred by First Nations, Inuit, and Métis peoples, water is often used for

Water quality, safety, and security adaptations in the Yukon and Inuvialuit Settlement Region

Yukon

The Yukon River Inter-Tribal Watershed Council conducted three phases of work to address water-quality concerns from the release of environmental contaminants as a result of climate change impacts (Wilson et al., 2015; Yukon River Inter-Tribal Watershed Council, 2017). In Phase 1, Indigenous knowledge was used in conjunction with scientific data collection processes to identify 95 sites of concern. Activities included focus groups, a mapping exercise, and key informant interviews. Phase 2 also brought together TK and Western science to develop climate adaptation strategies. This work also included training youth and community members in field methods for contaminant monitoring and water sampling, along with data collection and manipulation technologies (e.g., databases, geographic information systems). In total, water samples were collected at 25 sites. Phase 3 brought First Nations leaders from across the Yukon to a workshop in which results from Phase 1 and 2 were presented, and actions to address concerns related to water and climate change were discussed. A regional, Indigenous-centred climate adaptation plan for water health and governance was then developed.

Inuvialuit Settlement Region

The *Monitoring and Surveillance of Water Borne Diseases in the Inuvialuit Settlement Region: Adapting to a Changing Climate in the North* project took place from 2009 to 2010. The project included the development of a water sampling program in the Inuvialuit Settlement Region to determine the level of microbes and contaminants in the water, including heavy metals, parasites, and bacteria. Youth were brought into the project to learn about taking care of water and water testing in the communities of Atlatvik, Tuktoyaktuk, and Ulukhaktok (Institute for Circumpolar Health Research, 2017).

ceremonial and cultural purposes (Anderson, 2010; McGregor, 2012; AFN, 2013; Omosule, 2017). It is also needed to pursue cultural practices and livelihoods (Bharadwaj & Bradford, 2018). Gathering water from the land is an important part of subsistence culture and Inuit identity, as well as a potential source of healing (Watson, 2017; Wright et al., 2018b). Negative impacts on water security can thus affect mental and spiritual well-being (Powys Whyte, 2014; Lam et al., 2017). Given the physical, emotional, and spiritual importance of water, greater Indigenous sovereignty is needed to protect First Nations, Inuit, and Métis communities from environmental harms to the quantity, quality, and accessibility of water resources arising from climate change and natural resource development projects in their territories.

Infectious Diseases

Changes in weather patterns, such as warmer temperatures, increased precipitation, and more frequent drought and wildfires, are expected to affect the incidence and distribution of water-borne, food-borne, vector-borne, and zoonotic diseases (Greer et al., 2008; Berry et al., 2014; Chen, 2016). Indigenous Peoples globally and across Canada have significantly higher rates of infectious diseases than non-Indigenous populations (Gracey & King,

2009; Hotez, 2010), placing them at greater risk for climate-related infectious diseases. Determinants of health, such as poverty, malnutrition, decreased access to health care, and poor socio-economic conditions, influence an individual's resistance to infection, the progression of disease, and the treatment and management of disease (CPHO, 2013).

First Nations, Inuit, and Métis peoples are at an increased risk of exposure to climate-related infectious diseases because of a strong reliance on traditional or country foods. Recent studies, for example, indicate an increased prevalence of parasites in wildlife, causing trichinellosis in walrus and polar bear, brucellosis in caribou, lungworm infection in muskox, giardiasis in beaver, as well as tularemia, rabies, and cryptosporidiosis (Jenkins et al., 2013; Jenkins et al., 2015; Quinn, 2016a; Quinn, 2016b; Yansouni et al., 2016; Tomaselli

et al., 2017; Sheedy, 2018). These diseases have the potential to be transmitted from animals to humans, either directly, from the consumption of traditional foods, or indirectly, through exposure to domestic animals carrying these pathogens (Himsworth et al., 2010; Goyette et al., 2014; Bowser & Anderson, 2018).

A high burden of parasitic and food-borne infectious diseases has been detected among some Indigenous populations in Arctic regions. Associations have been found between the consumption of marine mammals and outbreaks of trichinellosis (Yansouni et al., 2016). A disproportionately high burden of acute gastrointestinal illness, which can be related to both water- and food-borne disease, has been reported in several Inuit communities (Harper et al., 2015a; Harper et al., 2015b). More specifically, a high prevalence of giardiasis has been detected in Northern



Canada (Yansouni et al., 2016), while rates of cryptosporidiosis appear to be extremely high among Inuit in the Qikiqtani region of Nunavut (Goldfarb

et al., 2013) and the Nunavik region of Quebec (Thivierge et al., 2016) compared to the Canadian average. While acute gastrointestinal illness is generally

mild and easily self-resolves, it remains a leading contributor to infant mortality among young children in the Arctic (Yansouni et al., 2016). There is also some

A potential role for Indigenous knowledges in mitigating the spread of *Toxoplasma gondii* and other climate-related infectious diseases

Toxoplasmosis, caused by the parasite *Toxoplasma gondii* (*T. gondii*), is an important health issue in the Arctic, and is expected to increase in prevalence due to climate change. Warming temperatures are expected to expand the habitat of felid (wild cat) hosts and the migrating range of infected intermediate hosts such as birds and mammals, opening up new transmission routes to humans, including contaminated water (Reiling & Dixon, 2019). The disease can pose serious health risks, especially in immunocompromised individuals and women infected for their first time during pregnancy (BC Centre for Disease Control, n.d.; Jenkins et al., 2013).

Northern Indigenous populations are at increased risk of acquiring the disease and experiencing adverse health outcomes because of the harvesting, processing, and consumption of country foods, sometimes raw (Reiling & Dixon, 2019), and because many of these communities have poor water-treatment infrastructure and lack access to safe and clean drinking water (Douglas, 2017). Some adaptations to address this health risk include cooking the meat or freezing it for several days to kill the pathogens present in the tissue cysts (El-Nawawi et al., 2008); improving climate and *T. gondii* information collection and monitoring to enable better prediction and early detection of risk; strengthening drinking water treatment systems, water quality monitoring, and operator training; and implementing community education campaigns related to safe food preparation and storage (Douglas, 2017; Bachand et al., 2019).

Indigenous knowledges can be used with scientific knowledge and methods to determine the health of country foods and inform adaptation measures. For example, in a study by Sudlovenick (2019), hunters from Iqaluit were interviewed about the health of ringed seals (*nattit*) to determine whether they were safe to eat based on the presence of five pathogens (*Brucella canis*, *B. abortus*, *Erysipelothrix rhusiopathiae*, *Leptospira interrogans*, and *T. gondii*) and heavy metals. This information was combined with a serological survey to determine the presence of these pathogens in seals. Some clinical signs of *T. gondii* include lethargy, anorexia, and a rash at the flippers. While participating hunters were unable to identify the presence of specific pathogens such as *T. gondii*, they were able to identify and reject sick seals or parts of seals that should not be consumed because they could be unhealthy. They also expressed concerns about the health of harp seals, many of which appeared to be ill. As one hunter noted, “The one thing that I’ve seen really increase in illness is the harp seals. Young seals you’ll see that they are covered in algae, they’re covered in lesions, they’re skinny. ... But, really sickly. If I see one, I’ll shoot them and leave them. I don’t even want to touch them with my hook. Cause it would contaminate.”¹⁹

The serological survey identified *T. gondii* antibodies present in nearly 10% of the seal samples. While small scale, the study highlights the potential value of Indigenous knowledge in mitigating the spread of infectious diseases like *T. gondii* and the importance of intergenerational knowledge transmission about the health of country foods as a climate change adaptation strategy.

¹⁹As quoted in Sudlovenick (2019, p. 50).

evidence that increasing exposure to infected marine and terrestrial animals may be contributing to increasing prevalence of toxoplasmosis among Inuit, with rates ranging from 60% to 87% in some communities (Lavoie et al., 2007; Messier et al., 2009; Elmore et al., 2012; Jenkins et al., 2013; Goyette et al., 2014). Toxoplasmosis manifests most severely in immunocompromised people and in women infected for the first time during pregnancy, leading to miscarriage, stillbirth, and fetal deformities (Jenkins et al., 2015). In addition to physical health impacts, the potential increase in environmentally transmitted parasites and pathogens can have a significant impact on the sustainability, availability, and suitability of animal species that have nutritional, material, cultural, and economic importance to Indigenous Peoples (Government of Nunavut, 2010; Dudley et al., 2015; Sheedy, 2018), which can have implications for mental and spiritual health as well.

A rise in the abundance of mosquitoes, ticks, and other biting insects is also evident across Canada, including in Northern regions, with the

potential to transmit new vector-borne diseases, such as Lyme disease and West Nile virus (Nickels et al., 2002; Cuerrier et al., 2015; Chen, 2016; Wudel & Shadabi, 2016; Nelder et al., 2018; Awuor et al., 2019; Bouchard et al., 2019). West Nile virus and Lyme disease have already expanded across all provinces and are recognized as potential health risks by some First Nations (First Nations Centre, 2004; PHAC, 2018b). While enhanced surveillance and monitoring for vector-borne diseases in Canada is needed (Awuor et al., 2019), it appears that Arctic communities are not yet at risk of sustained transmission of such diseases (Chen, 2016).

Health Systems

First Nations, Inuit, and Métis peoples face unique challenges in accessing health care, including mental health services. Inadequate health human resources, high staff turnover, low population density, geographic remoteness, jurisdictional conflicts over health care provision, lack of health and/or transportation infrastructure, reduced political power, increased travel costs,

and a deficit of information on Indigenous Peoples' health to inform evidence-based practices all present significant challenges (Ford et al., 2010b; NCCIH, 2019). In rural and remote Indigenous communities, individuals and families must often leave the community for medical emergencies, hospitalization, or appointments with medical specialists, and to access mental health counselling and addictions rehabilitation services (Rondeau, 2012; Harper et al., 2015c; NCCIH, 2019).

Climate-related events can disrupt or damage communication, hospital, and transportation infrastructure, which can restrict travel for health services outside the community. They can also delay the supply of essential pharmaceuticals and medical supplies, compromise patient safety, leave communities isolated and unable to reach help in an emergency, and make it challenging to implement cultural land-based programs focused on promoting health and well-being (Health Care without Harm, n.d.; Paterson et al., 2014; Harper et al., 2015c; Canadian Coalition for Green Health Care, 2020). With climate change expected to have



considerable impacts on human health, especially in Northern populations, existing health systems may be strained beyond capacity to address emerging health issues such as pandemics. To respond to climate risks, it will be important to draw on local, Indigenous, and scientific knowledges to develop climate change responses that meet needs in locally specific contexts and build the capacity of the health sector and emergency response systems (Kipp et al., 2019b).

Additionally, to ensure Indigenous health systems and services can effectively respond to extreme weather and climate events, broader-level

determinants of health need to be addressed. Specifically, there is a need to (Ford et al., 2010a):

- address the material conditions and behaviours associated with poverty that increase Indigenous Peoples' sensitivity to climate change and capacity to adapt;
 - enhance surveillance in remote regions to more quickly identify emerging health risks and vulnerabilities;
 - develop comprehensive, culturally specific, health assessment measures to assess climate change impacts;
- address issues related to inequitable access to health information, diagnosis, and treatment in Indigenous communities;
 - respect the rights and needs of Indigenous Peoples to address continued and persistent inequalities that exacerbate climate change health vulnerability; and
 - resolve the jurisdictional issues that limit the ability to identify and prepare for climate change risks and address inequalities.

Health system adaptations to reduce risks facing First Nations and Inuit

Arctic Climate Change Vulnerability Index

Aviation and marine transportation systems play invaluable roles in the Arctic, not only in supplying perishable goods, food, and mail, but also in accessing timely medical care (Debortoli et al., 2019). Climate change has the potential to disrupt these transportation systems, with significant impacts on health, well-being, and economic vitality in the region.

Researchers have developed an Arctic Climate Change Vulnerability Index to assess the physical and social factors that influence exposure, sensitivity, and adaptive capacity to climate change that is reflective of Inuit values and sensitive to the ways in which communities are represented (Debortoli et al., 2019). The index draws on scientific indicators to assess exposure, sensitivity, and vulnerability, as well as qualitative data from Statistics Canada and ISC's Community Well-Being Index to reflect adaptive capacity and resilience. This includes data on socio-economic and housing conditions, age demographics, and Indigenous knowledges. The latter was determined using data on the ability to speak Inuktitut coupled with data on the proportion of the community that consists of new immigrants, who were seen as having limited land skills or knowledge of the Arctic and no Inuit traditional knowledge. The index allows the effects of various climate change scenarios to be projected on air and marine transportation systems and may be useful for health system decision makers to inform adaptation plans.



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INDIGENOUS KNOWLEDGES

Indigenous knowledge, traditional ecological knowledge (TEK), traditional knowledge (TK), and Inuit knowledge or Inuit Qaujimagatuqangit²⁰ are all dynamic and living concepts that denote the understanding, interdependence, and relationality between Indigenous Peoples and the lands they call home, including all Creation and beings (animate and inanimate) within that land (McGregor, 2014). According to the Inuit Circumpolar Council (n.d., para. 4), Indigenous knowledge can be defined as “a systematic way of thinking applied to phenomenon across biological, physical, cultural and spiritual systems. It includes insights based on evidence acquired through direct and long-term experiences and extensive and multigenerational observations, lessons and skills. It has developed over millennia and is still developing in a living process, including knowledge acquired today and in the future, ... [as] passed on from generation to generation.” TEK is the “knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by

cultural transmission, about the relationship of living beings, including humans, with one another and with their environment” (Berkes, 2012, p. 7). The direct translation of Inuit Qaujimagatuqangit is “that which Inuit have always known to be true” and it is governed by four natural laws:

1. working for the common good;
2. respecting all living things;
3. maintaining harmony and balance; and
4. continually planning and preparing for the future” (Nunavut Department of Education, 2007; Tagalik, 2010, p. 1).

According to concepts around Métis peoples’ TEK, “understanding the natural world, building skills and behaviour adaptable and applicable to other facets of Métis life... contribute[s] to personal and community spiritual, physical, intellectual and emotional health and development” (Vizina, 2010, p. 13).

Indigenous knowledges are embedded within Indigenous languages and transmitted to younger generations through community knowledge (Task Force on Aboriginal Languages and Cultures, 2005; Battiste, 2010; Tagalik, 2010; Wilder et al., 2016). This includes observations about the land, plants, insects, forests, waterways, sea, sea ice, soil, weather conditions, and migratory patterns of animals (Tagalik, 2010; McGregor, 2014; Sandoval et al., 2016; Windchief & Ryan, 2018). Cosmological, medicinal, pharmacological, agricultural, and botanical knowledges, for example, are shared through direct observation and participation in them, as well as through storytelling, prayers, dance, art, protocols, teachings, and ceremonies (Neeganagwedgin, 2013; Kulnieks et al., 2016; Reo et al., 2017). Indigenous knowledges inform ethical, social, political, legal, governance and moral practices, and are pivotal for community survival and continuity, as well as resource management and sustainability (Alexander et al., 2011; McGregor, 2012; Windchief & Ryan, 2018).

²⁰ Inuit Qaujimagatuqangit is the preferred term for Inuit knowledge in Nunavut.

“Indigenous people have drawn on Indigenous knowledge and science for millennia to understand and respond to climate and environmental changes they faced.... What is different and challenging today is the rate of manmade climate change and our ability to respond to it. We must correct the path we are walking on and return to the special relationships, the teachings, the knowledge and practice that maintains respect, honor, and relationship with the natural world.”²¹



Indigenous Knowledges and Climate Change

Indigenous knowledges have been critical to the survival and resilience of Indigenous Peoples since time immemorial. Although these knowledges are increasingly recognized as equal to scientific information in understanding and adapting to climate change, the meaningful engagement of Indigenous Peoples and their knowledge systems in climate change research and policy remains a challenge. Indigenous-focused content has, for example, been under-represented in the Intergovernmental Panel on Climate Change (IPCC) assessment reports, as well as in policy discussions surrounding the United Nations Framework Convention of Climate Change (UNFCCC) (Ford, 2012; Ford et al., 2016b; Belfer et al., 2019).

This disconnect is rooted, in part, in how Indigenous Peoples and Indigenous knowledge systems have been framed in the Western climate change discourse — as powerless victims with static knowledge that is increasingly undermined or made irrelevant by the rapid pace of climate change (Ford et al., 2016b). Critiques of the IPCC and UNFCCC suggest this contributes to the homogenizing of knowledge, cultures, and ways of knowing, and situates Indigenous Peoples alongside marginalized or vulnerable social groups without contextualizing their unique lived experiences or cultural and colonial realities (Ford et al., 2016b). Increased participation of Indigenous scholars, knowledge holders, and organizations is slowly expanding through procedural changes, such as

the establishment of the Local Communities and Indigenous Peoples Platform (LCIPP) at the UNFCCC Conference of the Parties (COP) 21 in 2015 and the Facilitative Working Group at UNFCCC COP 24 in 2018. The LCIPP is the first “formal, permanent, and distinct space” created for Indigenous Peoples and is focused on knowledge, capacity for engagement, and climate change policies and actions (Belfer et al., 2019, p. 27). Although recognized as an important first step, the LCIPP has the potential to “silo” Indigenous Peoples’ concerns exclusively to the platform (Reed, 2019) and arguably undermines Indigenous Peoples’ status and rights by “grouping and conflating Indigenous Peoples with local communities” (Inuit Circumpolar Council, 2020, p. 2).

²¹ Suzanne Benally, as quoted in Frank (2017, para. 4).

The use of Indigenous knowledges in climate change and health research is evolving. Indigenous knowledges were initially used in conjunction with scientific knowledge to document observations of climate and environmental changes (Riedlinger & Berkes, 2001). More recently, they have been used as part of community-based studies that engage and are led by Indigenous Peoples in identifying their exposure and vulnerability to climate change effects, real and perceived impacts to their health and well-being, and potential adaptation strategies (Cameron, 2012; Donatuto et al., 2014; Cunsolo Willox et al., 2015; Rosol et al., 2016; Ford et al., 2018; Sawatzky et al., 2018; Kipp et al., 2019a; Sawatzky et al., 2020). Indigenous and scientific knowledge systems can accentuate and strengthen one another, since they identify different types of impacts brought about by climate change (Royer et al., 2013; Baldwin et al., 2018; Makondo & Thomas, 2018). Indigenous knowledges can enrich understanding of environmental change because they focus on the dynamics of the whole system under multiple stressors rather than on a single phenomenon (Mantyka-Pringle et al., 2017).

Indigenous knowledges can inform climate change and health-related decision-making

at a variety of levels to benefit diverse stakeholders, including researchers, decision makers and community members (Finn et al., 2017; Mantyka-Pringle et al., 2017). They have been used to establish multiple ecosystem indicators and baselines, which are useful for identifying priority areas for environmental monitoring, protection, and potential remediation (Uprety et al., 2012; Sanderson et al., 2015; York et al., 2016; Baldwin et al., 2018; Gérin-Lajoie et al., 2018). Indigenous knowledges have been used to develop predictive models for identifying climate change vulnerabilities and adaptation options, such as potential impacts on traditional livelihoods and subsequent health implications (Turner & Spalding, 2013; Research Northwest & Herschfield, 2017; Flynn et al., 2018). Indigenous knowledges can and have been used with scientific knowledge to improve risk assessments, enabling individuals to make informed decisions about weather-related risks and hazards associated with traditional harvesting and land-use activities (Riedlinger & Berkes, 2001; Pennesi et al., 2012; Deemer et al., 2018), and aiding the planning and location of future infrastructure (Turner & Spalding, 2013; Flynn et al., 2019). The foundational values and traditional teachings related to Indigenous knowledges around reciprocity, inter-relationships,

and spirituality can teach environmental stewardship and enhance governance of biodiversity and ecosystems for human health and well-being (Tengö et al., 2014; Hansen & Antsanen, 2018). This aspect of Indigenous knowledges is relevant not just for Indigenous communities, but also for non-Indigenous communities, nationally and globally (Maldonado et al., 2016; Hansen & Antsanen, 2018).

In the past, the inclusion of Indigenous knowledge systems in adaptation interventions has been variable (Ford et al., 2017). This stems not only from the fact that climate change considerations are often secondary in decision-making, but also from confusion remaining across all levels of government about what it means to include Indigenous knowledge systems in these interventions and how best to do so (MacDonell, 2015; Ford et al., 2017; Ford et al., 2018). Examples are emerging in which Indigenous knowledge has been incorporated into the design, monitoring, and evaluation of adaptation interventions (Debels et al., 2009; Champalle et al., 2015; Ford et al., 2018). Key tenets of these interventions are the adoption of community-driven, participatory, and collaborative approaches and the integration of science and Indigenous knowledge systems, using knowledge

co-production²² frameworks that seek to address the challenge of inequitable power differentials. Several knowledge co-production case studies suggest this approach helps foster community engagement and buy-in, ensures Indigenous Peoples' needs and interests are meaningfully incorporated, reflects local context in terms of available resources and capacity for implementation, and enables learning to maximize adaptive capacity (Armitage et al., 2011; Reid et al., 2014; Schuttenberg & Guth, 2015; Ford et al., 2016a; Diver, 2017). Latulippe & Klenk (2020, p.7) caution knowledge co-production scholars, however, to “move away from seeking to better ‘integrate’ Indigenous knowledges into western science” and instead make way for Indigenous research leadership and Indigenous knowledge sovereignty.

Indigenous Peoples in Canada and globally have increasingly reframed the discussion around

climate change, research, and policy within a rights-based, distinctions-based approach. For well over two decades, Inuit have reported how a rapidly changing climate has affected their practices and knowledge around a way of life that is based on the land, sea, and ice. They have also voiced the direct and indirect impacts to their health and human rights caused by climate change (Prior & Heinämäki, 2017; ITK, 2019b). For example, in 2005, Sheila Watt-Cloutier, then chair of the Inuit Circumpolar Conference, presented an “Inuit Petition” on behalf of Inuit in Canada and the United States to the Inter-American Commission on Human Rights that sought “relief from human rights violations resulting from the impacts of climate change” due to greenhouse gas emissions from the United States (Sabine Center for Climate Change Law, 2005, p.1). Although the petition was never resolved, various bodies of the United Nations have acknowledged

the threat that climate change poses to “the enjoyment of all human rights, including the rights to health, water, food, housing, self-determination, and life itself” (Office of the High Commissioner for Human Rights, 2018, p. 1). The need for climate justice,²³ and the participation of those disproportionately impacted in finding solutions to climate change, have also been recognized. Climate change is “inherently discriminatory” in that Indigenous Peoples, like other populations, are the most vulnerable to climate change, yet have contributed the least to it (UNHRC, 2016, p. 19). As a consequence, decisions around climate change adaptation interventions, “must accord with the obligations owed to those peoples, including, where applicable, the duties to facilitate their participation in the decision-making process and not to proceed without their free, prior and informed consent” (UNHRC, 2016, p. 20).

²² Knowledge co-production is a research practice that seeks to co-produce, with local decision makers and stakeholders, knowledge that is useful and usable (Latulippe & Klenk, 2020).

²³ The Mary Robinson Foundation – Climate Justice (2020) defines climate justice as a human-centred approach to addressing climate change that safeguards the “rights of the most vulnerable people and [shares] the burdens and benefits of climate change and its impacts equitably and fairly” (para. 1).

Using Indigenous knowledges in climate change adaptation

Indigenous knowledges and worldviews provide important teachings about environmental stewardship to reduce the severity of climate change (Hansen & Antsanen, 2018). The Indigenous Guardians Pilot Program “supports Indigenous rights and responsibilities in protecting and conserving ecosystems, developing and maintaining

stable economies, and continuing the profound connections between Canadian landscape and Indigenous culture” (ECCC, 2020a, para. 2). The program establishes guardians in Indigenous communities to monitor, manage, and provide stewardship over their lands and waters (Nature United, 2020). Funded by a \$25 million federal government investment over a five-year period (2017 to 2021), the program is implemented jointly with First Nations, Inuit, and Métis peoples to ensure that their distinct perspectives, rights, responsibilities, and needs are respected and recognized.

“Our land is very important to us. We live on it. We breathe it. We work on it. It gives us life. Without it we don’t have an identity.”²⁴

Global in scope, these programs are Indigenous-led and -managed community-based initiatives that focus on intergenerational capacity building, leadership and knowledge sharing, and provide First Nations, Inuit, and Métis peoples with greater opportunities to exercise responsibility in stewardship of their traditional lands, waters, and ice (Government of Canada, 2019). Each program is different, but they all employ staff to undertake some or all of the following activities: educate, conduct outreach, inform, influence, implement, collaborate, connect, analyze, monitor, patrol, observe, collect data, research, protect, report, enforce, and undertake cultural activities (Nature United, 2020). In the first year of the program, 28 communities (24 First Nations, three Inuit, and one Métis) received funding, and 33 communities (22 First Nations, six Inuit, and five Métis) received funding in the second year (ECCC, 2020a).

A recent report identified a range of social, economic, cultural, and environmental values and benefits of Indigenous Guardians programs for First Nations communities along coastal British Columbia. The report noted that, for First Nations people participating in the study, the program contributed to taking care of their territory, nurturing cultural well-being, improving general health and community well-being, advancing governance authority for the respective Nations, increasing community capacity, opening and promoting economic opportunities, and providing financial capital inflows to the community (Epi EcoPlan International Inc., 2016). A return of a least 10 times on each dollar invested was estimated for participating First Nations communities. The Indigenous Guardians Toolkit (Nature United, 2020) provides a forum that allows Indigenous communities to share their experiences, learn from each other and get support for their community projects.

²⁴ Norway Rabliauskas, Councillor, Poplar First Nation, Manitoba, as quoted *Indigenous guardians — caring for the land* (YouTube video) (n.d). <https://www.indigenousguardianstoolkit.ca/node/40/resources>

INDIGENOUS PEOPLES' RIGHTS AND NATIONAL AND INTERNATIONAL COMMITMENTS

“It is our right to keep on living the way we used to and also the right to adapt for a better future.”²⁵

First Nations, Inuit, and Métis peoples have a distinct constitutional relationship with the Crown as rights-holders under Section 35 of the *Constitution Act, 1982*, including the inherent right to self-government over their lands, natural resources, and ways of life (Minister of Justice and Attorney General of Canada, 2018). In line with the Government of Canada’s commitment to reconciliation and the Truth and Reconciliation Commission’s *Calls to Action* (2015), 10 overarching principles were developed in 2018 to support a renewed “nation-to-nation, government-to-government, and Inuit-Crown relationship based on recognition of rights, respect, co-operation, and partnership as the foundation for transformative change” (Minister of Justice and Attorney General of Canada, 2018, p. 3). The *Principles Respecting the Government of Canada’s Relationship with Indigenous Peoples* address national commitments, such as

treaties or other agreements and negotiations between the Crown and Indigenous Peoples, and acknowledge that distinctions-based approaches are needed to “ensure that the unique rights, interests and circumstances of the First Nations, the Métis Nation and Inuit are acknowledged, affirmed, and implemented” (Minister of Justice and Attorney General of Canada, 2018, p. 17).

The principles also address international commitments, including the *United Nations Declaration on the Rights of Indigenous Peoples*, which was adopted by Canada without qualifications in 2016. This declaration recognizes the urgent “need to respect and promote the inherent rights of Indigenous Peoples which derive from their political, economic and social structures and from their cultures, spiritual traditions, histories and philosophies, especially their rights to their lands, territories and resources” (United Nations,

2007, p. 3). Additionally, it states that “Indigenous knowledge, cultures and traditional practices contribute to sustainable and equitable development and proper management of the environment,” and that Indigenous Peoples have “the right to the conservation and protection of the environment and the productive capacity of their lands or territories and resources” (United Nations, 2007, p. 4, 21). Similarly, the United Nation’s Sustainable Development Goals articulate a 15-year agenda to eradicate poverty in all its forms and address the global challenge of sustainable development, including goal 13, to take urgent action to combat climate change and its impacts by strengthening resilience and adaptive capacity. Respecting and promoting these rights supports Canada in meeting its domestic and international commitments and is central to climate change efforts going forward.

²⁵ Sam Hunter, Weenusk First Nation, Ontario, as quoted in Human Rights Watch (2020).

Roles and Responsibilities in Indigenous Peoples' Health and Climate Change

Robust adaptation requires collaboration at all levels of government and across a range of sectors. At the federal level, the *Pan-Canadian Framework on Clean Growth and Climate Change* (PCF) (ECCC, 2018) and the report *A Healthy Environment and a Healthy Economy: Canada's Strengthened Climate Plan to Create Jobs and Support People, Communities and the Planet* (ECCC, 2020b) articulate Canada's commitment to reduce greenhouse gas emissions to meet 2030 targets, to build capacity to adapt to the impacts of climate change, including risks to human health, and to support clean

technology in collaboration with provinces and territories. The PCF reiterates Canada's commitment to a renewed relationship with Indigenous Peoples, including mitigation and adaptation action that is based on the recognition of rights, respect, cooperation, and partnership, and the importance of Indigenous knowledges in understanding climate impacts and adaptation measures (ECCC, 2018). As part of this process, the Assembly of First Nations, Inuit Tapiriit Kanatami, and the Métis National Council are working collaboratively with government through distinctions-based senior bilateral tables to ensure a structured, collaborative approach for ongoing engagement in the implementation of the PCF (ECCC, 2019). The proposed

objectives of the distinctions-based senior bilateral tables are to (Trudeau, 2016):

- jointly develop real and meaningful approaches for Indigenous Peoples that position them as leaders of climate action, with clear timelines, objectives, and reporting in support of the PCF and other climate change activities;
- ensure inclusive, meaningful, and adequately resourced Indigenous engagement that emphasizes collaborative planning and participation in decision-making;
- advise on and track progress on the implementation of relevant acts, regulations, policies, and programs, such as advancing clean energy solutions for Indigenous Peoples;
- share information and jointly identify and monitor levers, indicators, and results, contributing to transparent reporting on the implementation of the PCF; and
- provide local and regional views, perspectives, and proposals on the implementation of the PCF to federal, provincial, and territorial intergovernmental structures.



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These tables also support broader First Nations, Inuit, and Métis-specific clean growth and climate change priorities and actions, including those related to human health and well-being. In 2019, Inuit Tapiriit Kanatami (ITK) developed a National Inuit Climate Change Strategy that laid out objectives, actions, and long-term outcomes for the following five priority areas:

- knowledge and capacity;
- health and well-being, and the environment;
- food systems;
- infrastructure; and
- energy.

A rights-based approach to the development of any climate policies and actions affecting Inuit Nunangat is central to this strategy, with the understanding that climate change is one of many socio-economic and health inequities that challenge their populations and communities (Huntington et al., 2019).

In addition to the work of the Assembly of First Nations, Inuit Tapiriit Kanatami, and the Métis National Council at the national

level, grassroots Indigenous-led organizations, such as Indigenous Climate Action, are also playing an important role in climate change in Canada by pushing for the incorporation of Indigenous rights and knowledges in climate change discussions and solutions. Through a series of community engagement activities and grounded in Indigenous rights and knowledge, the organization is developing resources and programs to assist Indigenous communities to take action on climate change.

Several federal policies, programs, and services are already in place to support Indigenous Peoples' health and climate change mitigation and adaptation. At the federal level, the Department of Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC)²⁶ is responsible for the Climate Change Preparedness in the North²⁷ and First Nations Adapt²⁸ programs that work with Indigenous communities, territorial and regional governments, and other relevant stakeholders to identify climate change vulnerabilities and adaptation priorities (INAC, 2018a; INAC, 2018b). CIRNAC also funds the Indigenous Climate Hub,²⁹

which includes stories, tools, and resources by Indigenous Peoples across Canada in order to exchange information on how they can monitor and adapt to climate change. Other CIRNAC programs include the Indigenous Community-Based Climate Monitoring Program, which supports the use of Indigenous knowledges and scientific knowledge, collaborative approaches to data management and information sharing systems, as well as the Northern Responsible Energy Approach for Community Heat and Electricity to reduce diesel fuel use for electricity and heating in Northern communities. CIRNAC also has several initiatives that address the determinants of health and can enhance First Nations, Inuit, and Métis peoples' resilience to climate change effects. These include the Nutrition North Program, which subsidizes the cost of healthy foods to address food insecurity in the North; the Harvesters Support Grant Program, to help lower the costs associated with traditional hunting and harvesting activities; and a Working Group on Food Security to focus on sustainable food systems. An Arctic and Northern Policy Framework has also been

²⁶ In 2017, the federal department of Indigenous and Northern Affairs was dissolved and two separate departments were created to deal with Indigenous matters — Crown-Indigenous Relations and Northern Affairs Canada and Indigenous Services Canada.

²⁷ For Indigenous communities north of 60 degrees north latitude.

²⁸ For First Nations communities south of 60 degrees north latitude.

²⁹ See <https://indigenousclimatehub.ca/>

developed in collaboration with First Nations, Inuit, and Métis communities; national Indigenous organizations; and provincial and territorial governments. The framework aims to reorganize and reprioritize federal activities in the Arctic related to infrastructure, sustainable and diversified economies, environmental protection and conservation,

the strengthening of peoples and communities, Arctic science and Indigenous knowledge, and Arctic sovereignty and leadership (Government of Canada, 2018).

Other stakeholders have a role to play in supporting Indigenous Peoples' health in relation to climate change mitigation and adaptation. Provincial governments, for

example, work with the federal government to adapt their own targets and take their own actions to reduce greenhouse gas emissions from various economic sectors. They may also take actions to improve health outcomes, develop comprehensive strategies to address climate change, undertake climate change disaster mitigation and infrastructure planning, and

Indigenous Services Canada's Climate Change and Health Adaptation Program

Indigenous Services Canada works collaboratively with partners to improve access to services for First Nations, Inuit, and Métis communities, including access to health services, water and wastewater systems, community infrastructure, housing, education, social programs, and emergency management. Each of these areas plays a critical role in the ability of First Nations, Inuit, and Métis communities to adapt to climate change. In 2008, the Department implemented the Climate Change and Health Adaptation Program (CCHAP), which provides funding to Inuit and First Nations communities north of 60 degrees north latitude to engage in community-based participatory research aimed at identifying climate change-related health issues and developing health-related adaptation plans and communication materials. In 2016, the program was expanded to include First Nations communities south of 60 degrees north latitude. The projects are community-led and employ a multidisciplinary, collaborative approach that incorporates various approaches to science, including Indigenous knowledge and Western science (ISC, 2019d; Richards et al., 2019).

Since the beginning of the program, the CCHAP has funded 227 climate change and health projects, such as numerous film and photo-voice projects that engaged Elders, youth, and community members; community-based ice monitoring, surveillance, and communication networks; adaptation plans; assessments of the impacts of climate change on food security and on the health impacts of wildfire smoke; and information products related to land, water, and ice safety, drinking water, food safety and security, and traditional medicines. Profiles of many of these projects are available at *Climate Telling* (Climate Telling, 2020) and are summarized in *Community Voices on Climate Change and Health Adaptation in Northern Canada* (ISC, 2019d)



develop new technologies and zero emission strategies. All sectors of the economy, including the natural resources sector, have a responsibility to help reduce greenhouse gas emissions, which can be done through the adoption of more environmentally friendly practices. In remote Northern Indigenous communities, mitigating greenhouse gas

emissions will have limited impact on slowing the speed of climate change, given the absence of a sizeable industrial base and limited consumption levels; thus, priority must be given to adaptation in these areas (Ford et al., 2010b). In this process, Indigenous stakeholders and communities play important roles

in monitoring climate change effects, as they are often the first to observe and experience them. They must also work cooperatively with decision makers to assess vulnerability and develop effective interventions to reduce risks and adapt to climate change (Ford et al., 2010b).



KNOWLEDGE GAPS



There are significant knowledge gaps regarding climate change and First Nations, Inuit, and Métis peoples' health in Canada. Both the population and geographic focus of the research is uneven, with the majority focused on Inuit populations and the Canadian Arctic, which is recognized as a “global hotspot” for climate change (Ford et al., 2014; ITK, 2019b). Relatively little research exists on First Nations communities outside the North, especially First Nations communities in the Prairies and the Atlantic provinces. Métis peoples across Canada are significantly under-represented in climate change research. There is also limited research on climate change in the context of urban First Nations, Inuit, and Métis populations, which is problematic, given that over 50% of Indigenous Peoples in Canada live in urban centres. Similarly, few studies examine the intersection of climate change and gender, particularly the experiences of gender-diverse people. The perspectives of Indigenous Elders and natural resource users are over-represented in the literature, with fewer studies looking at children and youth. These gaps are linked, in part, to the inadequacies

of health data and research in Canada, including a lack of disaggregated and longitudinal data specific to First Nations, Inuit, and Métis peoples; the absence of relevant, consistent, and inclusive Indigenous identifiers in population health data sources; and a lack of strength-based and community-driven health indicators (Smylie, 2010; Smylie & Firestone, 2015). As noted in the box on page 14, Indigenous health research also continues to be dominated by non-Indigenous researchers and scientific knowledge paradigms (Saini, 2012; Brown, 2018; Hyett et al., 2018; Anderson, 2019).

In terms of climate change risks to Indigenous health, more research is needed to understand the holistic and long-term impacts of changing temperature and precipitation regimes on food and water safety and security, air quality, health infrastructure, personal safety, mental health, livelihoods, and identity within and among diverse First Nations, Inuit, and Métis peoples and communities. These climate-related risks to health also need to be examined in the context of existing First Nations, Inuit, and Métis peoples' health inequalities and inequities, and related

determinants of health. For example, more research is needed to understand how increases in air pollutants and aeroallergens will affect First Nations, Inuit, and Métis peoples who already experience a disproportionate burden of chronic and infectious diseases and poor housing conditions (e.g., homes in need of repair, overcrowding, and poor ventilation). Similarly, little is known about how infectious diseases, such as COVID-19, will affect Indigenous food systems that are already compromised by climate extremes (e.g., drought, record-breaking temperatures, and wildfires) and undermined by historic and ongoing colonization (e.g., land dispossession, social exclusion) (Zavalete-Cortijo et al., 2020). Although Indigenous Peoples are often described as simultaneously vulnerable and resilient in climate change research (Vinyeta et al., 2015), there are few studies that examine resilience and protective factors in regard to climate change.

Research on the direct impacts of climate change on traditional harvesting also dominates the literature, although few examine the indirect effects of potential new economic development

opportunities arising from climate change and how they may mediate the negative impacts of climate change to Indigenous Peoples' economy, health, and culture (Ford & Pearce, 2012). Studies on the determinants of adaptive capacity

are also limited, including access to financial resources, social networks, flexibility in resource management regimes, the role and potential of social learning in adaptation, and the role of government policies and programs in adaptive capacity

(Ford & Pearce, 2012). Similarly, there is a lack of research on the effectiveness of community-based adaptation initiatives and how Indigenous knowledges have been used in adaptation initiatives.



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CONCLUSION



Climate change represents one of the greatest threats to global health in the 21st century (WHO, 2018). For First Nations, Inuit, and Métis peoples in Canada, this threat is exacerbated by their close relationships with and reliance on land, waters, animals, plants, and natural resources for their sustenance, livelihoods, cultures, identities, and health and well-being (Ford, 2012; ILO, 2017; Jones, 2019). Although First Nations, Inuit, and Métis peoples in Canada, and Indigenous Peoples globally, contribute very little to greenhouse gas emissions, they are disproportionately affected by climate change due to pervasive health inequalities, inequities, and determinants of health, including historic and ongoing colonial oppression (Ford, 2012; ILO, 2017). The direct and indirect impacts of climate change are already being felt in First Nations, Inuit, and Métis communities from coast to coast to coast, particularly in geographic areas experiencing rapid change (Ford, 2012; ISC, 2019a). These impacts are interconnected and far-reaching, from increased food and water insecurity and infrastructure damage, to threats to personal

“Climate change is bad...we feel it in the north a lot more than people in the south...I’ve noticed in my 16 years of life that snow doesn’t get as high as possible because around my house we always had this big huge snowbank, like bigger than the house, about the size of the house. But now it barely comes up to your hips. That’s the one thing I’ve noticed as a child, that my favourite snowdrift hasn’t come back. If I’ve noticed this in such a young stage of life, I can’t imagine how the Elders would feel because they obviously have much more experience with the land around me. I am worried because I have noticed this change. Noticing it is the first thing, the next thing is to solve it.”³⁰

safety and basic human rights, all of which are experienced differently within and among First Nations, Inuit, and Métis peoples and communities. To address the growing threat of climate change, Indigenous Peoples are drawing on their unique and diverse knowledge systems and practices, passed down from one generation to the next, that have enabled them to respond, adapt, and survive changing environments for millennia. Indigenous knowledge systems are equal to scientific knowledge and are increasingly recognized as important to climate change mitigation,

adaption, research, and policy in Canada and internationally.

Significant knowledge gaps hinder effective adaptation and reflect a lack of distinctions-based, Indigenous-led, community-based participatory research on climate change and health in Canada. Continued focus and sustained research to address these gaps will ensure that First Nations, Inuit, and Métis peoples’ perspectives, experiences, knowledges, and voices are centred within climate change discussions, negotiations, and actions at all levels moving forward.

³⁰ Jordan Takkirug quoted in ITK (2018).

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