

Traditional and Community Knowledge Toolkit  
for the Tłegóhłı (Norman Wells) 2024 Public Listening Session:

*Caribou Conservation, Climate Change, and Wildfire\**

February 20-22, 2024

*\* ʔekw'ó heots'edıgha go ʔeʔá, ʔehdagókégha, nek'e areyone gok'erek ó (Tulít'a Got'ıne)  
ʔyah hehkgudı yant'a ʔadęʔagodin, ne ké ʔedeli (Délıne Got'ıne)  
Sahtú ʔekwe ʔeʔá, dırınéné k'e guluʔagotı, nek'e k'ó yarék'ó (K'áhsho Got'ıne)*

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## Executive Summary

In the past fifty years, the northern NWT has been warming a rate much greater than the global average. In the Sahtú Region, mean annual temperatures are expected to rise significantly in the future. Sahtú knowledge-holders report widespread evidence of climate change, and many concerns in regards to how it may be impacting caribou habitat in the region. Some commonly identified environmental changes include:

- Melting permafrost leading to riverbank slumping, landslides, erosion, silting / changing waterways, and ‘sticky’ or muddy ground that caribou get stuck in.
- Change in timing of freeze-up and thaw.
- Unpredictable wind and weather.
- Warming temperatures.
- More rain on snow events – crust on snow can impair feeding, injure caribou, and make predation easier.
- Melting snow patches / insect refugia is changing caribou movement and behaviour patterns.
- Insect regime may be changing and stressing out caribou more.
- Changes in caribou migration timings.
- Landscape drying out in some places.
- More fires in some areas, and fires are burning hotter, more intensely and bigger than before. It takes a long time for caribou food to grow back.
- Vegetation is changing – e.g., more willows / shrubification in the Mackenzie Mountains and around Délı̨ne; some evidence of berry plants not doing well.
- Some new and invasive species – can have complex impacts on caribou (e.g., landscape dries out, new species move in, changes predator relationship); more wolves, more bears.
- Changing waterways and erosion, as well as unpredictable snow and ice conditions, affect how well caribou can travel and access food in winter / impact caribou migration and movement patterns (e.g., water crossings, etc). They also impact hunters.
- Hunters find it more dangerous and conditions less predictable for travel; wildlife is often less available than in the past.

Climate change effects differ across the Sahtú Region – for example, while the land around Délı̨ne may be drying out and experiencing changes in wildfire regimes, the land around Colville may be getting wetter, due to melting permafrost and changing waterways. As a result, the three different caribou ecotypes covered by this report – Barren-ground, Boreal, and Northern Mountain caribou – may be impacted differently by climate change, in different parts of their range, and in different seasons. The same is true of land-users, who may also be experiencing differing impacts of climate change and wildfire in the different communities. Nonetheless, because caribou are such an important species to Sahtú Dene and Métis, and as all three caribou ecotypes have a Species At Risk listing of Threatened or Special, it is important to consider the implications of climate change on Indigenous rights associated with maintaining harvesting practices, Traditional Knowledge, and future food security.

A limited review of existing sources of information on Indigenous-led and / or collaborative climate change adaptation planning points to the following key points that could help residents of the Sahtú Region plan for and maintain their relationships with caribou under future conditions:

- Because the impacts of climate change on Indigenous Peoples are unique in comparison to non-Indigenous, it is important to understand the unique ‘vulnerabilities’ of each community.
- Due to geographic, cultural, ecological, and socio-economic variation between areas and communities, plans can’t be ‘cookie-cutter’ but need to be tailored to local conditions.
- It is the very elements that make Indigenous Peoples vulnerable to climate change that can also provide guidance and a way forward.
- Traditional Knowledge needs to shape the ‘bigger picture’ in approaching climate change issues; plans should be rooted in traditional understandings of respect and reciprocity.
- Community conservation planning is one way to assert a more Indigenous framework and governance in managing for caribou.
- Approaches to climate change are based in the maintenance and assertion of Indigenous rights – there are issues of biocultural diversity, food security, cultural maintenance, etc. associated with climate change that need to be addressed.
- It will be important to work on barriers to Indigenous involvement in shaping climate change policy and adaptation strategy.
- It will be helpful to seek collaboration, as well as outside funding and capacity support.
- Adaptation planning should be informed by both Traditional and Western scientific knowledges.
- Collaborative wildfire management should also be considered – many Indigenous Peoples have traditionally used fire to manage landscapes; those with ‘fire-keeper knowledge’ may be able to provide insights into how fire could be used to protect important caribou habitat.
- Approaches demonstrated in community planning initiatives such as the Délı̨ne plan (e.g., ceremonial harvests, Traditional Knowledge education, maintenance of on-the-land activities and protocols, promotion of alternative harvesting, and land protection) will provide significant beneficial impacts to caribou and people under climate change, and work to re-enhance relationships between people and caribou.

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## Introduction

This literature review has been prepared to serve as an ‘Indigenous Knowledge Toolkit’ for use in the February 2024 Tłegóhtł (Norman Wells) hearing or Public Listening Session being conducted by the ʔehdzo Got’Inę Gots’é Nákedı (Sahtú Renewable Resources Board, SRRB). This is the third session in a series of five that focuses on the development of decisions and recommendations about how people in the Sahtú Region will continue to live with caribou into the future.

The objective of this toolkit is to provide the best available Traditional and Community Knowledge (TKCK) relating to the central question of the Tłegóhtł proceeding, **“What should people’s role be in addressing the impacts of climate change and wildfires on caribou?”**

The main questions driving this session and compilation of information are:

1. *What are the impacts of climate change and wildfires on people, caribou and caribou habitat?*
2. *How do caribou respond to climate change and wildfires?*
3. *What mitigation and adaptation should occur for climate change and wildfires related to caribou conservation?*
4. *How can Hıdó Gogha Séné gots’ıá (Planning for the Future - PFF) reflect and respond to climate change and wildfires?*
5. *What is the minimum content for a Hıdó Gogha Séné gots’ıá) process and written plan?*

While caribou populations are known to cycle in abundance over time, over the last 20 years there have been increasing concerns amongst northerners that the dramatic declines currently being seen in some populations are unprecedented, and likely linked to a rapidly changing Arctic climate. The signs of climate change are primarily showing up in the Sahtú Region as extreme and unpredictable weather patterns, changes to freeze / thaw cycles and vegetation, new species, melting permafrost, increased erosion, changing waterways, and increased extent and severity of wildfires.

The summer of 2023 was an extraordinary year for wildfires in the Northwest Territories (NWT); it will likely have impacts on caribou, habitat, and people for many years to come. It is hoped that this compilation of Indigenous and local knowledge about climate change and wildfire will assist in future planning and conservation efforts.

## Limitations and a note on sources

There is relatively little information that has been documented about Indigenous and Community Knowledge of the impacts of wildfires and climate change on caribou and people in the Sahtú Region. No comprehensive sources of recent, regional research on this topic were found during this review, despite the fact that these issues are regularly raised in community meetings as of great concern.

- ***The impacts of climate change and wildfire on people of the Sahtú is a particularly noted and important information gap. Only one project documenting topics about health and climate change was found for Délıne (Roche 2010), and one for Tulıt’a (SRRB 2014).***

Due to the lack of information found on impacts of climate change on people, this report mainly focuses on impacts to caribou and caribou habitat. There are several recent compilations that include some climate change observations from the Sahtú, such as:

- Traditional Knowledge of wildfire and climate change impacts documented and compiled for the NWT Cumulative Impacts Monitoring Program (Headwater Group 2021a & b, 2022a & b).
- NWT Species Status Reports for:
  - Boreal Caribou (SARC 2022)
  - Northern Mountain Caribou (Woodland Caribou [Northern Mountain Population]) (SARC 2020).
  - Porcupine Caribou and Barren-ground Caribou (SARC 2017).
- ACCWM status reports and community engagement report (ACCWM 2023-2019, 2014).

These are some of the major sources that informed this work. It should be noted that these are considered 'secondary' sources – that is, they include information that has generally not been recorded by the author / researcher, but compiled from other, primary sources. While it is preferable in an academic context to consult primary sources, this was not feasible under the scope of this work; instead, readers are directed to consult the sources listed in the reference section for further information.

### How information is organized

Generally, information provided throughout this report is identified as Indigenous Knowledge (IK) when the source is known to be Indigenous, or TKCK (Traditional and / or Community Knowledge) when it is not possible to identify if the source was Indigenous or not.

While many Indigenous Peoples do not differentiate caribou by ecotype or herd, specific knowledge regarding differences in habitat, behaviour, body shape / size / coloration, etc. between the different types of caribou is common and acknowledged. Because climate change and wildfire impacts vary in different parts of the Sahtú, their impacts to the different types and herds of caribou also vary. For management purposes, information is organized here by ecotype, herd, and Sahtú district or community as much as possible.

Information from the Sahtú Region has been prioritized for this review, however, in cases where few Sahtú-specific sources of information were found, relevant information from nearby regions has also been included.

Information in this report is organized into two main sections as follows:

- **Section 1: What do we know?** Provides an overview of existing, publicly-available Traditional and Community Knowledge about the impacts of wildfire and climate change on caribou.
- **Section 2: What should we do?** Presents ideas for planning, mitigation, and adaptation that could help sustain caribou into the future.

## Section 1: What do we know?

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This section addresses two questions important to the 2024 Tłegóhtłı Public Listening Session:

- *What are the impacts of climate change and wildfires on people, caribou and caribou habitat?*
- *How do caribou respond to climate change and wildfires?*

Information provided in these written sections is also summarized in an accompanying table in **Appendix A**.

### Background information: Caribou status

Western science differentiates three caribou ‘ecotypes’ within the Sahtú Region: barren-ground, boreal, and northern mountain. They have different distributions, ranges, seasonal movement patterns, and habitat needs; as a result, they can be impacted by a very wide range of environmental change across the region, often with differing levels of intensity. A brief summary of Traditional and Community Knowledge regarding population trends or status of each type of caribou is provided below to provide context to following discussions. This information is also summarized in a table in **Appendix A**.

#### Barren-ground Caribou / Nq̄dele / ʔədə / ʔekwé

Based on available TKCK and Western science, the Species at Risk Committee (SARC) assessed the status of barren-ground caribou in the NWT as **Threatened** in 2017 (SARC 2017). This means that barren-ground caribou are “*likely to become endangered in the Northwest Territories if nothing is done to reverse the factors leading to their extirpation or extinction,*” (SARC 2017:vi).

#### Bluenose-West Herd / ʔədə / Neregha gōekwé

The Advisory Committee for Cooperation on Wildlife Management (ACCWM) has determined the population status of the Bluenose-West (BNW) herd to be ‘orange’ – that is, ‘intermediate and decreasing across its range’; this status has remained unchanged for several years (see ACCWM 2023, 2022, 2021, 2020, 2019). Member Boards, including the SRRB, noted that while there are some positive factors described by both community and scientific representatives, there remains a lack of indicators of population growth, and that ongoing conservation actions are needed to help the herd recover (ACCWM 2022). A rise in signs of climate change was identified as concerning in regards to BNW caribou at a roundtable meeting, with attendees noting that the impacts of increasing landslides, slumping, and warmer temperatures are hard to predict (ACCWM 2023).

In the Sahtú, information regarding BNW caribou is often provided by representatives of the Behdzi Ahda First Nation (Colville Lake), as harvesters in Déljñę have not been encountering these caribou as much as in the past (ACCWM 2020). Colville knowledge-holders indicate that while the herd is more ‘spread out’ lately, and their migration route has shifted further north, their numbers seem to be about the same as previous years, and are currently considered stable (ACCWM 2023, 2021, 2020; SRRB 2020).

### *Bluenose-East Herd / ʔedə / ʔehdaɣla ɣəkwe*

Throughout the range of ʔehdaɣla ɣəkwe or ʔedə (Bluenose-East caribou) in the Sahtú, community members have been consistently reporting fewer caribou, especially since 2018 (ACCWM 2021, 2020, 2019; Headwater Group (HG) 2022b, 2021b). In 2021 Déljñe harvesters reported that caribou were staying far from the community and as a result, there are few observations they could share about the herd (ACCWM 2022). Knowledge-holders have consistently expressed concern over the declining availability of these caribou, saying that they are not seeing them around their usual places or in their usual numbers (ACCWM 2020).

During meetings held in 2018, 2019, and 2020 the ACCWM determined the status of the Bluenose-East (BNE) herd to be ‘red’ or low (ACCWM 2021, 2020, 2019). In November 2021 the Member Boards were unable to reach consensus regarding the status of the herd, as community reports indicated several positive trends (e.g., increased twinning of calves and a rise in sub-adult population numbers in 2021), but the scientific data indicated no statistically significant change in population since 2018, and no increase in the number of adult females (ACCWM 2022). In April 2022 the Boards decided on a hybrid status of ‘red’ (low) / ‘yellow’ (intermediate and increasing) to acknowledge the positive indicators while still highlighting the fact that there are concerns about this population (ACCWM 2022).

In November 2022 the ACCWM determined the BNE status to be ‘yellow’ or intermediate and increasing (ACCWM 2023). While the SRRB was unable to present much community information during that meeting, information from knowledge-holders in the nearby Wek'èezhì (Tłchq Region) and Kugluktuk area indicated that BNE caribou are healthy, productive, and increasing in abundance; one elder described them as ‘coming back’ after watching their most recent migration (ACCWM 2023).

### *Boreal (Woodland) Caribou / Tqdzì*

The status of Boreal Woodland Caribou (BWC) was assessed by the Species At Risk Committee as **Threatened** in May 2022, saying, “*There is concern expressed by knowledge-holders that the species is likely to experience severe declines in the NWT, in its abundance, habitat quality/quantity, movements, and/or range, within their grandchildren’s lifetimes,*” (SARC 2022:3). However, Traditional and / or Community Knowledge (TKCK) of BWC distribution in the NWT was identified as an information gap in the SARC report as follows; “*There is relatively little community or Indigenous knowledge documented regarding trends in the distribution of boreal caribou. It is generally difficult to identify changes in the distribution of boreal caribou as this type of information is not typically sought in Indigenous knowledge studies,*” (SARC 2022:250).

### *Northern Mountain Caribou / Shúhta Goxepe*

The status of Northern Mountain Caribou (Woodland Caribou [Northern Mountain Population]) was assessed as **Special Concern** in the NWT in 2020, meaning they “*may become threatened or endangered in the Northwest Territories because of a combination of biological characteristics and identified threats,*” (SARC 2020:3). The report noted that the continuing effects of climate change within their habitat and localized threats will need to be managed effectively (SARC 2020).

The population trend of Northern Mountain Caribou (NMC or mountain caribou) in the NWT is not clear based on available TKCK sources, however, there are indications that their numbers are declining in



certain areas, and have possibly been declining since the 1930s (SARC 2020). Shúhtaot'ıne, Métis, Tu Łidlini (Ross River) Dena, and other local knowledge-holders in the Mackenzie Mountains attest that specific subpopulations of Redstone caribou have been in decline over the last 10-15 years; some knowledge-holders also indicate that there are fewer prime bulls in some locations in recent years (Winbourne 2019, 2017a & b).

### Climate change in the Sahtú

In the past fifty years, the northern NWT has been warming a rate much greater than the global average. In the Sahtú Settlement Area (SSA), mean annual temperatures are expected to rise significantly into the future. Already, the impacts of climate change have been seen to affect travel out on the land, as well as wildlife and associated harvesting practices and food security (SRRB 2014; Roche 2010). Sahtú knowledge-holders report widespread evidence of climate change, and many concerns in regards to how it may be impacting caribou habitat in the region. Some of the most commonly identified environmental changes attributed to a shifting climate include:

- Melting permafrost.
- Fewer ice patches / snow for caribou refuge.
- Increased icing events / crusted snow.
- More erosion, landslides, and slumping along rivers.
- Changes in caribou migration routes.
- Unexpected and unusual weather.
- Warmer air and water temperatures.
- Changing water levels.
- Longer ice-free periods.
- More wildfires.
- More willows and shrubby vegetation.
- More swampy ground (HG 2022a, b; ACCWM 2022, 2021, 2020, 2019; DEWG 2021; SARC 2017; SRRB 2014).

Some of these changes are causing changes to how people travel on the land, impacts to peoples' health, and to animal behaviour (SRRB 2014; Roche 2010).

In Délıne, people generally report that the climate is getting warmer; this causes water levels to rise, results in more erosion, and affects how caribou travel on the land and navigate water crossings (HG 2022b; DEWG 2021; SARC 2017). Hotter weather has also resulted in warmer surface waters in Great Bear Lake (HG 2022b). Around Délıne, people say the land is drier, and əkwé seem to be travelling differently on the land (DEWG 2021). In other locations of the Sahtú, people say the land is getting wetter and caribou are seen getting caught / bogged down in the mud (HG 2022a). Wind and weather patterns have also changed; increased frequency of freezing rain or rain-on-snow events make it hard for caribou to travel and access their food in winter (ACCWM 2021, 2020, 2014; SARC 2017). Overall, there is a worry that there is less good habitat for caribou to survive now.

Unfortunately, there are no comprehensive published sources available that document climate change observations in the Sahtú in the last 20 years. In 2003, a series of focus groups were conducted in Délıne

as part of a study looking into environmental change in the Great Bear Lake watershed (Macdonald 2003). At that time participants reported that they were already starting to see widespread change in the area that could be attributed to climate change. Some of the findings of the study include:

- Virtually all participants reported changes in the environment and how they affected their use of the land. Changes were observed in the physical environment, but also in the traditional foods that the people had been consuming for virtually all their lives.
- Changes noted included the loss of some bird species and the presence of new species; changes in the quality and/or quantity of important traditional foods like caribou, trout, and herring; differences in ice conditions and snowfall timing; lower water levels in the lake; declines in some berries and the presence of new types of berries. Many of these changes seem to reflect a warmer, drier climate than in the past.
- There were large differences in the types of observations reported by different focus groups, i.e., men typically reported on changes in the numbers of certain species and larger changes on the water or land, while women reported changes in the quality of traditional foods and the abundance of foods such as berries (Macdonald 2003).

Other changes in the environment and/or species reported during the focus group included:

- Changes in furbearers and pelts.
- Observations of different types of insects and more insects.
- Few ptarmigan, sandpipers, robins, and whiskey jacks.
- More migratory birds like geese, and migratory birds returning up to a month earlier.
- Possibly fewer ducks.
- Vegetation changes – e.g., differences in berry types and a decline in abundance and size, changes in spruce tree branches, differences in flowers.
- Lower water levels in lakes, including Great Bear Lake.
- Thinner ice, later freeze-up and snow comes later; this affects vegetation cycles. Less snow in some places.
- Caribou can't break through the ice to get to the lichens, so they have to travel further to find food. Caribou meat is a different texture and taste.
- There are more white spots of pus on fish and caribou meat now.
- Some fish are smaller now. People are catching few herring and they are not healthy looking (Macdonald 2003).

With changing temperatures and vegetation come new and potentially invasive species. In some areas people are seeing species that were not previously present, including both predators and 'competitors' (SRRB 2023; Winbourne and Benson 2020). Muskoxen are currently expanding their range and numbers in the Sahtú; moose and boreal caribou are also thought to be increasing in abundance in some areas. Increasing numbers of predators such as wolves or bears, and / or increased levels of predation have also been reported in many parts of caribou habitat (see ACCWM 2023, SRRB 2023, SARC 2017, and ACCWM 2014 among others). Knowledge-holders attest that a complex relationship exists among wolves, caribou, and other wildlife, which has been influenced by the impacts of climate change. This occurs when other wildlife, such as muskoxen or moose, serve as alternative prey for wolves, especially during the absence of caribou herds (HG 2022b; Winbourne 2021). Some of these changes may be

attributable to climate change; whether they are or not, the impacts of these shifts in other species' ranges and abundances on caribou are complex and extremely difficult to predict (SRRB 2023).

- ***While some of these impacts will affect all three ecotypes of caribou in a similar way, they are not occurring consistently across all parts of caribou range, meaning there can be a lot of variation in what people are seeing in regards to the extent and magnitude of impacts. In the sections below, information is separated out by ecotype and / or herd based on how the information was originally documented, but it is possible that the impacts described here affect more than one type of caribou.***

#### Barren-ground Caribou / Nòdele / ʔədə / ʔekwé

The SARC 2017 status report on barren-ground caribou compiled climate change-related effects on BGC from throughout the body of available TKCK literature, representing observations made in every region where barren-ground caribou are found and at every stage of their life cycle. The report states that the number of community observations and discussions about climate change are increasing (SARC 2017).

In some parts of BGC range, increased variability in weather patterns has resulted in hotter, drier summers; this in turn increases the chances of large forest fires (SARC 2017). More frequent freezing rain events are making it difficult for caribou to access their winter forage; changing climatic conditions are also causing changes in the range and abundance of predators, as well as habitat alterations resulting from melting permafrost and erosion (SARC 2017). Many impacts of climate change discussed in the 2017 report are thought to have adverse effects on barren-ground caribou.

The effects of climate change on barren-ground caribou can be both direct (such as icing events) and indirect (e.g., increasing number or intensity of forest fires). Changing weather conditions may also influence caribou health, body condition, and mortality, as extreme weather events, especially cold conditions during the calving season, may increase the mortality rate of calves. Snow conditions can also have a large impact on caribou – for example, deep snow may also influence the ability of caribou to move across the landscape. During the summer, extreme heat events lead to heat exhaustion and exacerbate stress from biting insects (SARC 2017). Some relevant impacts on caribou health attributed to climate change are include in the table in **Appendix A** and in a text box the following page.

#### Boreal Caribou / Tòdzi

Participants in a study documenting Indigenous and community knowledge in the Sahtú said that weather plays a significant role in the health and well-being of boreal caribou, and that increasing extremes in annual temperatures and flooding negatively impacts the animals (McDonald 2010). Recent changes in climate were considered significant by study participants, including warmer temperatures, increased rain in November, milder winters, and increasing summer storms. It was noted that boreal caribou and their food sources can be affected by fall and winter precipitation; during these times, food can become less accessible as it is covered by more snow, making it harder for caribou to access (McDonald 2010).

*A note regarding climate change and barren-ground caribou health and body condition*

Climate change manifesting as deep snow and icing conditions caused by freezing rain were both noted as factors that negatively impact the body condition and health of barren-ground caribou on many parts of their range in the SARC 2017 status report.

Barren-ground caribou physical condition and productivity may also be negatively affected by disease and parasites; the degree to which they impact caribou varies across the NWT (SARC 2017). Caribou physical condition tends to be assessed by harvesters using a number of common indicators such as: condition of fur and internal organs, fast or slow movements, body condition (fat and muscle tone), meat quality, herd size, whether the head is held erect, and presence of a strong leader (see SARC 2017). Prior to 2017 there were indications that in general, the number of diseased barren-ground caribou was increasing, and there were new and different types of diseases and conditions being reported, including, for example, lungs stuck to rib cages, pus in joints, tape worm cysts, and 'sandpaper skin' (SARC 2017).

Harvesters in both the Inuvialuit and Sahtú regions are reporting healthy-looking Bluenose-West caribou in recently, with good levels of body fat and few signs of disease (HG 2021a, b). An overall trend in health / body condition of Bluenose-East caribou is not as clear, with mixed observations and sometimes limited observations in areas where caribou are not being encountered as much now (HG 2021a, b). It is possible that climate change is having varied impacts on caribou body condition and health across the different regions and habitat types, or that each herd is in a different phase of a naturally-occurring cycle

Sahtú harvesters of Bluenose-West caribou said that bull to cow ratios seem to be roughly 1:1 lately and that animals are as healthy and fat as they normally are (ACCWM 2021, 2020; SRRB 2020). There were some reports in 2019 that some caribou did not have as much fat on them, suggesting that maybe they were having troubles grazing (ACCWM 2019). In Délı̄ne, a recent harvest of 12 caribou at Caribou Point indicated that eight females were pregnant and in fair condition, and it was reported that a group of caribou observed in April were in fair condition with some chafing on legs from ice crust on snow (ACCWM 2020). Several years ago, Sahtú knowledge-holders had reported that caribou were not as fat as in the past (ACCWM 2014); others have noted that insects cause caribou stress, so any increases in insect abundance may affect caribou health negatively (DEWG 2021). High numbers of insects cause caribou to run around in an attempt to seek refuge, resulting in decreased body condition and, in extreme cases, mortality from heat exhaustion (SARC 2017).

In an even earlier Sahtú study, 85% of participants were already noting warmer winters than in the past (Zimmer *et al.* 2002). Knowledge-holders had differing opinions as to whether snow accumulation patterns had changed, but there were numerous suggestions that the amount of snow that falls over the winter has decreased during the lifetimes of the participants, and that river and lake ice may not form as quickly nor as thick as it did in the past (Zimmer *et al.* 2002). Boreal caribou were said to be generally healthy at the time of that study.

Climate change was a factor identified as having negative impacts on boreal caribou in the NWT in the 2022 SARC status report; some of the effects include changing snow conditions, warmer summers and winters, changes in the distribution and abundance of predators, and changes in habitat due to melting

permafrost. The report also describes icing events, decreased water levels and flows in the Mackenzie River Basin, earlier break-up and later freeze-up, extreme weather events, vegetation changes, and permafrost thaw, among other factors, as all impacting boreal caribou (SARC 2022).

### Northern Mountain Caribou / Shúhta Goōepe

Knowledge-holders familiar with the Mackenzie Mountains say they are witnessing several types of direct and indirect impacts on northern mountain caribou in that area that are attributable to climate change. Some of these include:

- Changes to timing of spring thaw / melt and fall freeze-up.
- More frequently unfavourable snow conditions (e.g., increased icing events that create difficulties for caribou to get to their food through the snow crust).
- Shrubification / willow growth.
- Rapid snowmelt resulting in dangerous river crossings.
- Drying tundra in places.
- Warmer summer months and increased insect harassment.
- Fires are increasing in size and intensity so much that they threaten important caribou habitat. (Winbourne 2019, 2017a & b).

As noted above for other ecotypes, ecological changes such as these may also alter the distribution of other ungulates and predators, further threatening mountain caribou (Winbourne 2019). For example, some elders worry that earlier spring weather could bring bears out of hibernation earlier, resulting in greater predation pressure during the calving period. Others mentioned high numbers of grizzly bears hunting caribou as a concern (Winbourne 2017a). There are complex predator / prey interactions associated with climate change that may result in some species expanding their range northward into northern mountain caribou habitat, or endemic species shifting their distribution; for example, more willows at higher altitudes might result in moose shifting their distribution, with a corresponding shift in wolf distribution and impacts to caribou (Winbourne 2019).

In addition, when caribou suffer from environmental changes, they may be more susceptible to other factors, such as predation and / or parasites, and may then be less productive (SARC 2020). Outfitters pointed out that if climate change results in a warming trend in summer that increases fly activity, there could be an impact on caribou body condition (Winbourne 2019). Climate-driven environmental change was identified as a threat to mountain caribou in the 2020 SARC status report as follows:

*Climate-driven environmental change (e.g., warming, shrubification, shrinking ice patches and glaciers, variability in snow pack, timing of melt, icing), is already occurring and is believed to be causing serious impacts to some herds (e.g., changes to migration, displacement, insect harassment) (SARC 2020:24).*

Local knowledge-holders identified several different types of changes in mountain caribou habitat they are witnessing in the Mackenzie Mountains; of prime concern is the rapid disappearance of critical habitat components such as ice patches (Winbourne 2017a; Andrews *et al.* 2012). TKCK indicates that ice patches (a habitat component of critical importance to northern mountain caribou) and glaciers are

disappearing quickly due to environmental change – this habitat decline is expected to continue (SARC 2020; Winbourne 2019). Wildfires may also be increasing, and could also have a negative impact on habitat quality and availability; this trend is also expected to continue SARC 2020; Winbourne 2019).

The SARC 2020 status report concluded that habitat change caused by climate change is one of the main threats northern mountain caribou are currently facing.

*Habitat change appears largely to be an outcome of climate change – greater frequency of wildfires, more frequent unfavourable snow conditions, shrubification, rapid snowmelt that results in dangerous river crossings, and in some cases a drying of the tundra. The timing of seasonal movements may be disrupted, leading to a chain of events that influence distribution (SARC 2020:13).*

Many knowledge-holders indicate they have witnessed changes in northern mountain caribou distribution and movement patterns in recent years, yet it remains unclear whether these changes are a result of environmental change (Winbourne 2019).

*Twenty-five years is a relatively short time in the scale of a caribou population; it's easy to see the old trails, and they indicate movement of large numbers of caribou over long periods of time, even though you don't see them using those trails now. We have seen over the last 25 years, maybe due to weather or predator distribution and density, but Redstone caribou are little bit later coming out to the north, and they don't usually come right out in as big numbers as they used to. They're establishing higher up and are more dispersed – it could be a lot of reasons... changes in predation, everything's tied together, (Tavis Molnar in Winbourne 2019:15).*

Tulít'a hunters also noted that northern mountain caribou migration routes and movements around the Keele River and Caribou Flats in the Sahtú changed (Winbourne 2017b; Olsen *et al.* 2001). By 2000, harvesters in Tulít'a were reporting fewer animals at Caribou Flats in the fall compared to previous years (Olsen *et al.* 2001). Shúhtaot'jne oral histories indicate that the caribou used to travel much further north in their migrations. Now there is some uncertainty about what the caribou are doing and where they may be going, but people say they are witnessing them move away from their usual areas (Winbourne 2017a). Overall, Indigenous and non-Indigenous knowledge-holders alike say that patterns in mountain caribou distribution and habitat use are hard to predict, as they often vary from year to year. It may be that one of the greatest threats of climate change is the unpredictable nature of these environmental changes, and an increasing frequency of unfavourable conditions (SARC 2020).

Because there were relatively few recent or comprehensive sources regarding climate change observations in the Sahtú found during this review, and due to the relevancy of climate change observations in neighbouring regions, some information is also provided for the Inuvialuit, Gwich'in, and Tłı̄chq Regions below.

## Climate change in nearby regions

### Inuvialuit Settlement Region (ISR)

Inuvialuit knowledge-holders attribute many environmental changes they are observing to climate change, and say these signs are increasing in recent years. Some main themes heard in the ISR include:

- Seasonal timings have changed – Freeze-up is 2-3 weeks later and thaw / break-up is 2-3 weeks earlier; snow comes later in the season (ACCWM 2022, 2021, 2014; HG, 2021a); each year there is less ice on the lakes (ACCWM 2022); some Tuktoyaktuk harvesters have seen barren-ground caribou calving earlier in April now instead of May (ACCWM 2019); caribou are coming south later in fall and coming out of the treeline later in spring (ACCWM 2022, 2021, 2020, 2014).
- There is more permafrost melt and exposure – People see increasing evidence of coastal erosion, more landslides, and slumping; the land is soft underfoot and it is becoming harder to travel (ACCWM 2022, 2021, 2020, 2019; HG 2021a). Caribou are seen getting stuck in the mud recently (ACCWM 2022).
- Vegetation is changing – Some years there are hardly any berries; each year there are more willows and alders (ACCWM 2022; HG 2021a).
- Caribou distribution and movement patterns have changed – Changing climactic patterns affect where caribou go and their distribution and migration routes have shifted as a result (ACCWM 2022, 2020, 2019; HG 2021a).
- Weather is different – Temperatures are warmer and there are increasing icing events / frozen crust on snow, making it harder for caribou to get to their food, and damaging their legs (HG 2021a; ACCWM 2020). Wind and storm patterns have changed and become unpredictable (ACCWM 2020). There is more rain now (ACCWM 2022).

Annual and geographic variability is also noted by Inuvialuit harvesters – for example, some suggest that the cooler, wetter summers over the past few years have likely benefited caribou, as there were fewer bugs and less need for animals to travel to the coast for insect avoidance, making for healthier caribou; also, while there was freezing rain in the past couple of years, it was not likely bad enough to make crust on snow that would limit access to food (ACCWM 2022, 2021, 2020). In contrast, for caribou near Paulatuk, poor summer weather and extreme icing events in December / January likely had a strong negative effect on caribou (ACCWM 2019).

### Gwich'in Settlement Area (GSA)

Some of the observations from the ISR are reflected in those of Gwich'in knowledge-holders, who also say that they are concerned about the things they are seeing due to climate change. Main messages in the GSA are that it used to be colder – it's generally warmer and wetter now than it used to be – and people are seeing a lot of landslides and melting permafrost (ACCWM 2022, 2020, 2019, 2014), as well as forest fires, erosion, changes to caribou movement patterns, extreme icing events, growth of willows, and changes to seasonal timings (ACCWM 2022; Benson 2015). People concluded that weather may be having the greatest negative impact on caribou today, with harsh or strange weather and icing events causing them to starve (Benson 2015; ACCWM 2014).

The impacts of climate change on caribou were recorded during Indigenous and community knowledge research specific to boreal caribou in the GSA (Benson 2011). Gwich'in participants observed changing habitat, habitat or food availability, and weather conditions that are seen to impact caribou. Climate

change is thought to impact the boreal caribou's ability to feed due to widespread slumping and melting permafrost. The ground can absorb more moisture than it used to, leaving less water on the surface of the land. Increased rainfall may cause river flow patterns to change, among many other changes. Warmer temperatures are changing vegetation which may decrease the amount of caribou food available; an increase in brushy growth such as willows in previously passable areas makes travel difficult for both caribou and Gwich'in hunters. The timing of the changing of the seasons is also noted to be shifting and these changes can directly or indirectly impact boreal caribou. A change in the timing of freeze-up or the spring thaw, for example, may no longer relate to when a caribou grows or sheds a winter coat. Rain in the winter, once very rare but increasingly seen, can produce a near-impassable crust on the snow which impedes caribou movements and causes injury to their legs. Freezing rain also covers vegetation with ice and is implicated in the death of some caribou in the recent past. Warm winter winds (which may be a regular occurrence instead of due to climate change) can also cause ice formation (Benson 2011).

### Wek'èezhìi (Tłı̄chǫ Region)

Climate change is also thought to be impacting caribou in the Wek'èezhìi (Tłı̄chǫ Region) (TRTI 2022), where it is presenting as warmer winters with less snow – this makes it easier for caribou to find forage but also makes it easier for predators to hunt; there are a lot more areas with thin ice now, and caribou have been seen falling through the ice (ACCWM 2020, 2014). Some say that the snow condition has changed from a dry snow to a soft, slushy snow (TRTI 2022). There are observations that berries and vegetation are not as rich or plentiful as before, and there are more warble flies some years (ACCWM 2022, 2020). Knowledge-holders have noted that lichens are the prime food for caribou, but when the weather gets too hot they dry up; there is evidence that climate change is resulting in drier summers, less permafrost, more winter ice, and more forest fires (TRTI 2022). Overall, climate change means changing vegetation, younger forests, less insect and heat refuge, and changes in food quality and quantity that can impact caribou (TRTI 2022). These drying trends and warmer temperatures are likely also influencing the frequency and intensity of wildfires in some regions (see CIMP 2022).

### Impacts of wildfires

#### Barren-ground Caribou / Nǫdele / ǰǰǰǰ / ǰekwǰ

Wildfires are considered to be one of the main threats to barren-ground caribou habitat in the NWT; knowledge-holders generally agree that fires can have a significant adverse impact on habitat, often leaving it unsuitable for decades (SARC 2017). Although forest fire is a dominant concern in BNE winter range (which tends to be below treeline), there are also concerns about wildfires in the summer ranges of some of the herds, especially calving grounds, suggesting that fire may be an issue throughout the range of barren-ground caribou (SARC 2017).

Traditional and Community Knowledge regarding the impact of wildfires across the NWT was summarized in the 2017 SARC status report on barren-ground caribou as follows:

*The loss of winter range and forage from forest fires has a significant impact on barren-ground caribou. The number, intensity, and duration of forest fires appears to be increasing in the NWT. Traditional knowledge-holders generally agree that fires dramatically impact habitat, often leaving it unsuitable for decades, if not centuries, and forcing barren-ground*



*caribou to relocate to more desirable habitat. These large-scale impacts to habitat reduce survivability of calves, reduce physical condition of adults, and also influence migration patterns. (SARC 2017:xiv)*

TKCK across the NWT suggests that it can take anywhere from 10-100 years before lichen has grown back enough that barren-ground caribou migrations and cycles return to burned areas; the threat from forest fires is seen as imminent in the NWT, and likely to increase in the future (SARC 2017).

While 2014 and 2023 were particularly bad years for fires in the NWT, Sahtú communities have been consistently raising concerns about the impacts of fire on caribou and caribou habitat for years. Knowledge-holders in many parts of the Sahtú say that there are more wildfires now than in the past and that for the most part they are not being fought unless they are seen to be directly putting infrastructure or communities at risk (HG 2022a, b; DEWG 2021; SRRB 2016). Although people in the range of BNE caribou see fire as a natural part of the ecosystem, in recent years people report higher numbers of fires and more intense fires than in the past (HG 2022a, b; DEWG 2021; ACCWM 2014). Some of the direct impacts to caribou include tree stands reduced by fire, resulting in less shade for caribou and a lengthy habitat recovery time due to the fact that barren-ground caribou forage such as lichen can take decades to grow back) (HG 2022a; SARC 2017; ACCWM 2014).

In the nearby Wek'èezhii (Tłı̄chǫ Region), elders also attest that there is much more wildfire today than in the past (TRTI 2022). There are consistent observations that forest fires have already had a substantial impact on caribou habitat and behaviour; knowledge-holders there have observed that caribou will avoid burned areas for many years afterwards, and with the growing extent of wildfires in that region, caribou are thought to be having a harder time finding enough to eat (ACCWM 2020, 2019, 2014). In the forested winter range of BNE caribou wildfires have impacted herd movements and access to key wintering areas (TG and ENR 2022; WRRB 2016).

- ***While there have been many community concerns raised regarding the increasing intensity and scale of wildfires impacting caribou and their habitat in the NWT, there was relatively little information on this topic in the available Sahtú Traditional and Community Knowledge sources reviewed for this report. This could in part be due to the fact that two recent summers were reported as being colder and wetter than usual, and that wildfire is not identified as a major concern in more northerly parts of barren-ground caribou range. Nonetheless, because 2023 was an extremely bad year for fires in the NWT, this topic is likely to increasingly be a priority to communities and governance organizations in the near future.***

### Boreal Caribou / Ṯǫdzi

Based on TKCK sources, fire was identified as a threat to boreal caribou populations in the 2022 status report, and climate change has been blamed for increasing the size and severity of fires and impacting boreal caribou habitat (see sources in SARC). It was noted that areas burned by fire or disturbed by industry are generally not used by boreal caribou until the habitat recovers, and that habitat recovery takes many decades, possibly longer now with today's bigger and more severe fires (SARC 2022).

Wildfires can impact the ability of boreal caribou to acquire food and can force them to relocate to more desirable locations (McDonald 2010). In the Sahtú, interviewees expressed differing opinions regarding how long burns may affect boreal caribou; some interviewees stated that boreal caribou return to burned areas once there is new growth, while others stated that caribou will never return to these sites again (McDonald 2010). Fires were reported by knowledge-holders as a threat to boreal caribou populations more than 20 years ago (Zimmer *et al.* 2002).

In the nearby Tłı̄ch̄q region, wildfires are believed to be the main cause of habitat loss and boreal caribou population declines (SARC 2022). Elders report that fires destroy caribou habitat—both lichen, which is needed for winter forage, and cover habitat, which caribou need to hide from predators (see sources in SARC 2022). Suggested timelines for animals returning to burned areas in the GSA range from several years to several decades, and may be dependent on the type of habitat burned as well as the intensity of the burn (Benson 2011). It was noted that plants start to grow back in burned areas within five years, and grasses and small trees will recover enough to draw animals in the summer after 8-10 years, however, it takes longer for boreal caribou to come back as tall trees have not yet returned. Elders reported that it takes 15-25 years for caribou to return to an area in the winter, because it takes this long for regeneration to provide shelter and protection from predators (Benson 2011).

#### Northern Mountain Caribou / Shúhta gōepé

Wildfires were identified as a threat to northern mountain caribou in the SARC 2020 status report; *“Wildfire is damaging northern mountain caribou habitat, especially winter range. Wildfires are increasing in number and damage. This threat is already occurring and may be causing serious impacts to some herds,”* (SARC 2020:24). Wildfires can destroy mountain caribou core winter habitats and the lichen that the caribou depend on for food; this is causing the caribou to move away from their wintering areas (Winbourne 2017a). It can also cause travel disruptions if fires go through migration corridors (Winbourne 2017a). The timing of seasonal movements may also be disrupted, leading to a chain of events that can influence distribution. Knowledge-holders attest that at least three areas of northern mountain caribou winter range had already been destroyed by fire by 2014 (Winbourne 2017a). The greatest concerns about habitat change related to climate change center on increased wildfires (especially on winter range), decreased occurrence of ice patches (perhaps exacerbated by higher densities of noxious insects), unfavourable snow conditions (depth and hardness), and rapid run-off that creates dangerous river crossings (Winbourne 2019, 2017). *“Most impacts [on mountain caribou] to date are relatively small, but potential impacts are high, much depends on management... Climate change is suspected to dramatically alter fire regimes which could impact winter ranges,”* (Olsen *et al.* 2001:18).

The SARC 2020 status report on northern mountain caribou concluded that the amount of area occupied by mountain caribou is likely to be affected by wildfire if nothing is done.

## Section 2: What should we do?

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This section provides information on the following three questions for the 2024 Tłegóhłj Public Listening Session:

- **What mitigation and adaptation should occur for climate change and wildfires related to caribou conservation?**
- **How can *Hıđo Gogha Séńégots'ı́a (Planning for the Future - PFF)* reflect and respond to climate change and wildfires?**
- **What is the minimum content for a *Hıđo Gogha Séńégots'ı́a (Planning for the Future – PFF)* process and written plan?**

### Implications: What does this mean for the Sahtú?

Climate change is accelerating at an extremely rapid rate in Canada's north and threatening caribou, caribou habitat, and people's livelihoods and lifeways (see Fawcett *et al.* 2018, Courchene *et al.* 2017, and SRRB 2014, among others). In this section, the implications of the impacts outlined in **Section 1** are considered in the context of the Sahtú. It is not possible to provide a comprehensive review and compilation of existing and available information under the scope of this work, however some relevant key lessons, recommendations, resources, and actions being undertaken in other parts of the world are presented here, in the hopes these ideas will assist in climate change adaptation planning in this region.

### Indigenous Climate Change Adaptation: The Bigger Picture

#### *Upholding and Asserting Indigenous Rights in a Changing Climate: International Movements*

The United Nations Declaration on the Rights of Indigenous Peoples recognizes the inherent collective right of Indigenous Peoples to self-determination, nonetheless there remain barriers that hinder meaningful participation and consultation within the United Nations Framework Convention on Climate Change (UNFCCC). In response to this exclusion, Indigenous Peoples from around the world formed an 'International Indigenous Peoples Forum on Climate Change' (Indigenous Climate Action 2023a). The forum acts as a mechanism for developing positions, implementing effective strategies, and engaging in advocacy during and between UNFCCC meetings and sessions; their efforts led to the creation of the 'Local Communities and Indigenous Peoples Platform' in 2015, which aims to strengthen knowledge, technologies, practices, and efforts of local communities and Indigenous Peoples related to addressing and responding to climate change (Indigenous Climate Action 2023a; United Nations 2023).

In December 2023, Indigenous Climate Action released a new report highlighting Indigenous Peoples' participation in international climate change forums and the failure of state actors to uphold international law within their climate policies (ICA 2023b). The report focusses on the principal Indigenous rights that are particularly affected by climate change and have concrete implications for the design and implementation of climate policies, including:

- The right to self-determination;
- The right to participate and to free, prior and informed consent;

- The right to culture and Traditional Knowledge;
- The right to lands and resources; and
- The right to health, food, water and an adequate standard of living (ICA 2023b).

The analysis found that while many states refer to engaging or consulting with Indigenous Peoples, they fail to acknowledge their rights to participate in decision-making and to veto climate policies that harm their rights. The report revealed that Indigenous Peoples participated in the design of only a minority of climate policies, violating their rights to self-determination and free, prior, and informed consent, as well as potentially increasing the risk that these policies could promote climate action efforts that will violate other Indigenous rights (ICA 2023b). The ICA report concludes:

*In order to fully and effectively recognize the rights and sovereignty of Indigenous Peoples in the context of climate governance, governments are obligated to ensure the full and effective participation of Indigenous Peoples, to protect Indigenous knowledge systems, and to recognize and respect Indigenous jurisdiction over land (Indigenous Climate Action 2023b:21).*

#### *Unique Impacts of Climate Change on Indigenous Peoples*

Considering the rights implications of climate change is critically important because of the fact that Indigenous Peoples' tend to be uniquely impacted and disproportionately impacted by climate change – this is especially true in the north, where climate change is happening faster than anywhere else in the world (see SRRB 2014, Nakashima *et al.* 2012, and Roche 2010, among others).

*Climate change is expected to affect animal and plant species that [I]ndigenous people depend on for their livelihoods, health and cultural practices. The impacts of climate change on forests and other ecosystems that are home to many of these species require tribal engagement in climate change research, assessments, and adaptation efforts (Chief *et al.* 2014:161)*

Researchers in the US identified several factors that make many Native American tribes especially vulnerable in regards to both climatic and non-climatic stressors, such as:

- A reliance on natural resources for spiritual and socio-cultural practices;
- Dependence on local natural resources; and
- Relatively poor socio-economic conditions (see sources in Chief *et al.* 2014).

Research demonstrates there is a need for increasing awareness, interest, and understanding about the unique ways in which climate change will affect tribal cultures, lands, and traditional ways of life. As a result, understanding the unique vulnerabilities of local Indigenous Peoples is an essential first step in planning for future conditions under climate change (see Chief *et al.* 2014 and Nakashima *et al.* 2012, among others).

*Particular social, political, cultural, and economic circumstances define the unique vulnerabilities of different communities. Foresight of vulnerabilities can help communities*

*develop local capacities for successful adaptation to climate change. A complete understanding of vulnerabilities and capacities can help land management and other agencies modify existing policies and create new policies more relevant to particular communities (Chief et al. 2014:162).*

Understanding a particular Indigenous group's vulnerability to climate change requires thoughtful consideration of values, history, and other local socio-economic and political contexts, as well as local understandings of climate change, impact assessment, appropriate adaptation planning, and local response capacity.

*... [I]ndigenous peoples must prepare for how to absorb substantial economic costs, threats to cultural practices, and increased political pressures. From this perspective, we must explore what capacities need to be developed by Indigenous Peoples in order to best cope with a rapidly changing world. The vulnerabilities and potential negative impacts of climate change on tribal forests, water, and other natural systems can be understood as both ecological and governance issues. They can be described as ecological issues in the sense that they involve environmental changes that have ramifications for the relationships between natural systems and human cultural systems. For example, invasive species in forests threaten the sustainability of intrinsically valuable relationships that tribal members have maintained with certain species since time immemorial. At the same time, ecological issues are often deeply interwoven with governance issues, particularly when it comes to tribes (Chief et al. 2014:171).*

One example given by the authors is in regards to anticipating the need to protect a culturally and economically important fish species as water conditions threaten their survival:

*... rights to protect the lake may not be enough to control the ecological conditions required for spawning of [the fish] under climate change impacts. In these cases, there are governance concerns regarding whether tribal political relations with federal, state, and local governments and agencies are adequate to give tribes the space to exercise their culturally-motivated adaptation strategies and to influence the strategies of their non-indigenous partners. When such relations are insufficient—whether due to inadequacies in funding, unclear policies, force of policy mandate, or inflexible implementation plans—the ecological issues compound and become substantial burdens on tribal communities. This highlights the need to strengthen governance institutions such as government-to-government relationships, tribal consultation, and networks with non-indigenous parties in order to improve tribal governance and maximize tribes' adaptive capacity (Chief et al. 2014:172).*

The authors stress that climate change will alter relationships between culturally significant species, natural systems, and practices, as well as the jurisdictions of tribal governance – citing the example that the movement of a culturally important species outside of a treaty area may challenge existing jurisdictions (Chief et al. 2014). In cases like that, Indigenous groups may need to develop networks with partners from a broader geographic scope and with whom they may have never worked before.

There appears to be some progress being made on these issues in the United States, where researchers and tribal peoples have been calling for better consideration and accommodation of Indigenous needs and rights in climate change strategies and policies for more than a decade. The issues facing US Indigenous communities are very much the same as those in parts of the NWT, including: the loss of Traditional Knowledge; impacts to forests, ecosystems, traditional foods, and water; thawing of Arctic sea ice and permafrost; and relocation of communities (Chief *et al.* 2014).

In their comprehensive review of key issues and impacts Indigenous Peoples are facing in relation to climate change in the US, Chief *et al.* (2014) found that it is a characteristically strong and multifaceted dependence on natural resources and systems that makes Indigenous populations particularly vulnerable to climate change, and that changes in the range and distribution of culturally significant plant and animal species will disproportionately affect tribal cultures, economies, and resources for governance (see sources in Chief *et al.* 2014). They further point out that these impacts result from activities that benefit those who view freshwater, terrestrial, and marine resources and systems as commodities for extraction and exhaustion, in comparison to Indigenous perspectives that are most often founded on a relationship of reciprocity (see sources in Chief *et al.* 2014).

#### *Indigenous Self-Determination: A Key to Climate Action*

If climate change is seen as a result of colonial systems, then Indigenous self-determination is a critical part of climate solutions. Around the world people are increasingly echoing a similar sentiment: it is not only a technological shift that is necessary to address climate change, but a deep shift in social and ecological priorities. In her 2018 thesis, Laura Cameron identified decolonization as a critical piece of addressing climate change in Canada, specifically noting ‘disrespect and disconnection from Mother Earth’ as one of the problems leading to climate change.

*Participants contrasted their worldviews and embodied connections with the land to that of a western worldview, which views the land as inanimate and humans as separate from, and superior to, nature. Some participants shared beliefs that these western ideologies and separation are at the root of the ecological imbalance that humanity faces today, treating lands and resources as commodities without considering the costs to the environment and social impacts to Indigenous Peoples. This separation has distanced people from the land, and some said has also created divisions and competition among people (Cameron 2018:82)*

This is likewise identified by the Climate Atlas of Canada as the root of ‘imbalance’ that has led to climate change today (2023).

Importantly, Cameron’s results point out that Indigenous Knowledge must be understood not only as a source of environmental observations, but of relational philosophies and values that can inspire the cultural shift necessary to address climate change; “*In an era of sustainability and reconciliation discourses in Canada, it is critically important to center Indigenous perspectives and leadership in addressing climate change,*” (Cameron 2018:ii).

Cameron’s study results illustrate that while Indigenous communities are being impacted by the cumulative effects of climate change and other colonial stressors, many are also bringing forward environmental solutions that further their social well-being and self-determination. Through diverse community-led actions – such as community-owned renewable energy projects, land-based education programs, cross-cultural conversations on climate, and ceremony – communities are reconnecting with their Traditional Knowledges, cultures, spiritualities, and lands, and leading solutions with broader benefits for the earth and humanity (Cameron 2018).

In discussions of solutions, community members drew on their experiences in the following five areas of action:

1. Land-based and cultural education.
2. Community-owned renewable energy projects.
3. Grassroots action and activism.
4. Cross-cultural dialogues.
5. Ecological restoration initiatives (Cameron 2018).

Figure one shows some examples of Indigenous solutions and common themes identified by participants in the 2018 study.



Figure 1: Examples of Indigenous solutions (inside) and common themes (outside) from interviews with participants in the Canadian Prairies (reproduced from Cameron 2018:94).

During her doctoral research, Cameron discovered that while some study participants discussed mitigating greenhouse gas emissions and shifting energy systems, others discussed more holistic approaches to climate change and the broader, associated problems based on reconnecting with the land and rebuilding relationships (Cameron 2018). Some participants explained that taking action to

reconnect explicitly aims to repair and heal the disruptions and disconnections caused by colonialism; climate change solutions were described as “acts of resurgence, re-empowerment, revitalization, reconnection, and decolonization,” (2018:83). In this sense climate change action is not only about mitigating environmental impacts, but about re-establishing Indigenous Peoples’ identities and working for justice.

#### *Existing Indigenous Adaptive Capacity*

Because Indigenous ethics of reciprocity entail systems of creating and maintaining useful knowledge of how humans can be good stewards of the earth, Indigenous ways of understanding relationships among species, ecosystems, and ecological processes can therefore play a vital role in climate change assessment and adaptation efforts (see sources in Chief *et al.* 2014, Nakashima *et al.* 2012, among others). There are indications that the international community have begun to realize the effectiveness of Traditional Knowledge systems and regional, Indigenous-led research efforts in addressing climatic changes (see Bell 2023, and Nakashima *et al.* 2012, among others). Tribal cultures, practices, and knowledges possess abundant adaptive capacity; for land management agencies, it will be critical to tailor governance instruments, including policy, to facilitate and support rather than obstruct tribal capacities to pursue their own adaptive strategies in numerous ways.

*Tribal communities and Indigenous Peoples across the United States are re-envisioning the role of science ... working to strengthen government-to-government relationships in climate change initiatives; and leading climate change research, mitigation and adaptation plans through indigenous ingenuity. Unique adaptive capacities of tribal communities stem from their ethics and knowledge, and help frame and guide successful adaptation (Chief et al. 2014:161).*

When Indigenous Peoples can shape climate policies, foster strong economies, engage in sustainable development, and are part of natural resource management decisions, they become more resilient (Chief *et al.* 2014). There have been increasing calls for US tribes to be ‘at the table’ as decisions are made about natural resource management, research design and implementation, and future policies. Recently, tribal initiatives and activities have increased to address climate impacts and large-scale environmental changes on forests through research collaborations, public awareness, information campaigns, and restoration projects, including forest management treatments, hazardous fuels reduction and prescribed burns (see sources in Chief *et al.* 2014). There is a need for research collaboration, government-to-Indigenous government partnerships, and meaningful involvement of Indigenous Peoples in all aspects of policy and strategy development (Chief *et al.* 2014).

*As many indigenous societies are socially and culturally distinct from mainstream society, decisions, policies and actions undertaken by the majority, even if well-intended, may prove inadequate, ill-adapted, and even inappropriate. There is therefore a need to understand the specific vulnerabilities, concerns, adaptation capacities and longer-term aspirations of indigenous peoples and marginalized communities throughout the world...*

*Indigenous and rural peoples, however, are not only potential victims of global climate change. Attentiveness to environmental variability, shifts and trends is an integral part of*



*their ways of life. Community-based and local knowledge may offer valuable insights into environmental change due to climate change, and complement broader-scale scientific research with local precision and nuance. Indigenous societies have elaborated coping strategies to deal with unstable environments, and in some cases, are already actively adapting to early climate change impacts. While the transformations due to climate change are expected to be unprecedented, indigenous knowledge and coping strategies provide a crucial foundation for community-based adaptation measures (Nakashima et al. 2012:6).*

#### *Decolonizing Climate Adaptation: Action at Home*

In Canada, there have been increasing partnerships between researchers and Indigenous communities to collaborate on documenting impacts and responses to climate change and co-producing knowledge to inform policy (see sources in Cameron 2018, among others). Indigenous Climate Action (ICA) is an Indigenous-led organization guided by a diverse group of Indigenous knowledge-keepers, water protectors, and land defenders from across the country. The group's work is rooted in the knowledge that Indigenous Peoples' rights and knowledge systems are critical to developing solutions to the climate crisis and achieving climate justice (Indigenous Climate Action 2023a). ICA has developed programming and resources that speak to the wants and needs of Indigenous communities in regards to empowering knowledge and awareness of climate change issues, and how they are intricately connected to Indigenous rights and sovereignty. Program areas include: Climate Leadership Training, Youth Leadership, Just Transition, Decolonizing Climate Policy, Indigenous Divestment, and Healing Justice (Indigenous Climate Action 2023a).

Also initiated in Canada, the 2017 Onjisy Aki International Climate Summit brought together Indigenous Knowledge Keepers, scientists, and other climate leaders in a cross-cultural dialogue on Indigenous-led climate solutions (Climate Atlas 2023b). Across participants and case studies, several interconnected themes emerged in discussions of solutions:

- Indigenous leadership;
- Building capacity and self-sufficiency;
- Generating sustainable economic development;
- Connecting with and sharing Indigenous Knowledge;
- Connecting with and learning from the land;
- Building relationships; and
- Bridging Indigenous Knowledge and Western science (Climate Atlas 2023b).

Summit participants drafted the 'Onjisy Aki International Calls to Action' within themes of ancestral knowledge, sovereignty, relationships, and transformation (Courchene et al. 2017). These calls to action are included in the text box on the following page.

*Oniisay Aki International Climate Calls to Action*

1. To support education and training disciplines throughout Indigenous homelands based on the wisdom of Elders and Knowledge Keepers.
2. To support the development of “Ancestral Schools of Knowledge” overseen by the Elders who facilitate intergenerational knowledge transmission between Youth and Elders.
3. To support revitalization of Indigenous languages, which are foundational to stewardship.
4. To support ancestral knowledge being shared around the globe, beginning with North and South America, building on existing relationships and further fulfilling the prophecy of the Eagle and the Condor.
5. To support Indigenous communities in defining their own Nationhood, based on their ancestral laws and understandings of the natural world, as the foundation of governance of their territories.
6. To support the Indigenous Leadership Initiative’s Guardianship Network that promotes Nationhood and stewardship over Indigenous homelands.
7. To support the right of Indigenous communities in developing and having Sovereign control over their energy systems.
8. To support individuals in being guided by ancestral knowledge for healing and strengthening of the spirit and identity.
9. To build alliances between Indigenous communities, government bodies, and nongovernmental organizations that share common values of Earth stewardship, who are working in the area of climate and energy justice.
10. To build alliances between keepers of both Indigenous knowledge and scientific knowledge, provided this is done in a respectful manner that equally values their respective contributions to understanding the challenges and opportunities of our time.
11. To build alliances between Indigenous communities and corporate and industrial partners working in areas related to renewable energy and clean technologies, to help usher in a social, ecological, and economically sustainable future for the Earth and its human and non-human inhabitants.
12. It is our sacred duty and responsibility to carry out the original ancestral instructions that we were all given, and to pass this knowledge to the Youth of today, for them to become true peaceful stewards of the Earth. Working peacefully, in alliance with ancestral and natural laws to support the above mentioned actions, will initiate a planetary transformation that creates a healthier future for our children, grandchildren and seven generations to come (Courchene *et al.* 2017).

There is also a lot of collaborative work and research underway between numerous Canadian universities and Indigenous communities. The University of Winnipeg’s Climate Atlas of Canada is an example of work being done that combines climate science, mapping, and storytelling with Indigenous Knowledge and community-based research to inspire awareness and action (2023). Their work points out that there are some common principles across Traditional Knowledge Systems which can be

important in the context of addressing climate change, such as concepts of relationality and stewardship (Climate Atlas of Canada 2023).

*Many Indigenous prophecies foretold of this time of climate change. They talk about Indigenous communities bringing forward their knowledges to provide guidance to all people on how to live in relationship with the earth and with each other. 'It was prophesized that we would reach a point in our history where we would have to teach the settler population essentially how to be human... What that means. How to cohabitate, how to share and learn and grow from each other (Mi'kmaq Water Protector Michelle Paul, Climate Atlas of Canada 2023)*

Some of the diverse community-led initiatives moving this concept forward include: community-owned renewable energy projects, land-based education initiatives, cross-cultural climate conversations, language revitalization programs, and ceremony (Climate Atlas of Canada 2023).

For the founder of Indigenous Climate Action, it is essential that climate solutions are rooted in a process of decolonization.

*... real climate solutions are not caught up in maintaining the status quo of capitalism, of colonialism... real climate solutions are rooted in a return to the land, a return to and of the land, and are rooted in decolonization... Real climate solutions are decolonial climate solutions, because they're taking us back to reconnections with the land, to being on the land, to reconnecting with that intimate understanding of how to not just live and survive on the land, but how to adapt and change with it (Eriel Deranger, Climate Atlas of Canada 2023).*

Currently, the position of the Dene Nation is that while reducing greenhouse gas emissions is important, adaptation is the most effective way for people to cope with climate change. Adaptation plans need to be regional in nature to be responsive to local climate variations, and they need to use both Western science and Traditional Knowledge to help Dene and fellow northerners adapt to climate change (Dene Nation 2023).

- ***There are many Indigenous-led and / or collaborative climate change adaptation programs, resources, strategies, and planning initiatives underway in Canada; providing a comprehensive review was beyond the scope of this 'toolkit', however several potentially useful resources are included in Appendix B. The reader is advised that this is just a sample of the countless resources available online.***

## Indigenous Climate Change Adaptation: Nuts and Bolts

### *Understanding Sahtú 'Vulnerabilities'*

Many direct and indirect impacts of climate change and wildfire on caribou and caribou habitat were included in **Section 1** of this report. Some of those climate change factors which are also expected to have direct, significant impacts to people in the NWT and Nunavut include:

- Land instability;
- Advance melting of snow and ice cover in the spring;
- Earlier break-up and later freeze-up of river and lake ice;
- Declining wildlife habitats, wetlands, and nesting sites and influx of invasive species;
- Shorter winter road seasons;
- Increase in summer storms;
- Increase in forest fires;
- Degradation of sea ice and negative impacts for ice dependent species;
- Longer periods of open water and more storms reaching the shore;
- Increase in environmental contaminants and persistent organic pollutants; and
- Health and cultural impacts due to a decreased ability to harvest traditional foods (Dene Nation 2023).

Other NWT-specific information provided by Environment and Natural Resources (GNWT-ENR) offers a first synthesis of the overall impacts of climate change on GNWT activities and the actions that are being taken to adapt (ENR 2008). Projections about future climate change point to the necessity of taking a more proactive approach to adaptation responses in order to minimize risks and vulnerabilities. The climate is expected to continue warming for decades, even with global efforts to reduce greenhouse gas emissions. The report outlines both factors requiring ‘Immediate Consideration’ as well as longer-term vulnerabilities (2008).

Municipal and Community Affairs (GNWT-MACA) is involved in community energy planning in all NWT communities; through this process, MACA has heard many examples of how communities are already feeling the effects of climate change, and seeing the need to develop community adaptation plans (ENR 2008). MACA participated in the City of Yellowknife Adaptation Plan process both to support the city and to learn how to assist smaller communities with their adaptation plans. MACA is also working on a template for emergency plans and will include hazard identification relating to climate change as one item for communities to consider (ENR 2008).

Nonetheless, Indigenous Knowledge and the first-hand experiences of northern communities are an essential foundation for the formulation of locally-relevant adaptation strategies (Nakashima *et al.* 2012). Particularly in the Arctic / subarctic environment, Indigenous Knowledge provides the basis for risk management, as well as safety and survival skills. Erosion of these skills among younger generations can be a concern for elders, especially given the increase in weather unpredictability due to climate change. Systematic local observations of climate change impacts, complemented by scientific data, can frame local adaptation efforts (Nakashima *et al.* 2012).

- ***Listing expected impacts in the Sahtú can be the first step of understanding particular ‘vulnerabilities’ for this region (see Chief et al. 2014). Two other sources of potentially important information that could contribute to this work were found during the course of this review, including climate change and health studies done in Délı̨ne and Tulı́’a.***

During 2009-2010, Délı̨ne undertook a major health-climate change study entitled ‘Envisioning Adaptations with Elders and Youth’ to explore how traditions carried in Dene stories shared between

elders and youth are used to identify, analyze, and address health risks in the context of climate change (Roche 2010). The 'Learning About Changes' report demonstrates how the Délı̄nę First Nation took a deliberate, systematic approach to understanding and planning for the impacts of climate change, especially in regards to impacts on health and well-being (Roche 2010). This project opened up a space for elders, adults, and youth to begin a dialogue about the nature of the changes being experienced on the land, and the health risks that may come with those changes. This was part of a partnership between the Délı̄nę Renewable Resources Council and the Délı̄nę Knowledge Project, who obtained funding for a three year International Polar Year program called, 'Building local capacity to address climate change in the Great Bear Lake Watershed' (Roche 2010).

This was an important initial opportunity to exchange TK and scientific knowledge about climate, with a core discussion about the implications of climate history / monitoring for community health (especially safety and survival on the land). A science-based weather monitoring station was set up in Délı̄nę and a system for maintaining the station and data was established. Additional project activities / areas included: mapping local knowledge and histories in regards to climate / environmental change and health impacts; sessions on planning for changing health in the community; an investigation into how stories are used to identify, analyze, and address health risk in the context of climate change (Roche 2010). This work could provide important foundational steps for further climate change research and planning.

Research on issues related to community health and climate change were also done in Tulı́t'a (see SRRB 2014). This project explored the following questions from a community perspective:

- What can be learned from other Sahtú communities that have investigated the health risks associated with climate change?
- What can be learned from the knowledge of elders / harvesters as well as the knowledge of Western scientists that will help us protect health amidst a rapidly changing climate?
- What specific adaptation strategies and actions should Sahtú communities adopt to protect health from climate change-related impacts?
- How can these adaptation ideas be creatively communicated so people will listen and support local efforts? (SRRB 2014)

An emphasis was placed on Traditional Knowledge in the discussion of climate change impacts and adaptation measures in Tulı́t'a and the Sahtú. Reports on the project are a valuable source of stories and personal observations of climatic and other environmental changes included predictions of warming temperatures, experiences with permafrost degradation, changing wildlife patterns, and new challenges in travelling out on the land; participants also spoke about lessons around the earth as a living entity, and the importance of environmental stewardship. A central theme that was raised repeatedly by participants as both a source of community vulnerability and potential resilience was Dene language, identity, Traditional Knowledge, stories, and way of life, including the land upon which many of these things are based (SRRB 2014). Points were made about the need for improved access to health resources in response to the impacts of climate change.

Recent work undertaken in both the Dehcho Region and Inuvialuit Settlement Area may also provide useful information and guidance for identifying local vulnerabilities and then developing adaptation

plans in the Sahtú Region to address those vulnerabilities. The project in the Dehcho Region looked into local observations regarding changes to the environment, as well as impacts on the traditional cultural activities and overall health of the Jean Marie River First Nation (JMRFN) community (Bell 2023). The analysis of climatic changes was done to better understand how Dene knowledges, values, and culture could be applied in the creation of an effective climate change adaptation strategy for JMRFN.

Bell recorded observations of climate change amongst members of the JMRFN that echo those heard in the Inuvialuit, Gwich'in, and Sahtú regions, and how these impacts are affecting members of the JMRFN. Due to their relevancy to the Sahtú, they have been reproduced here in Table 1. Readers should consult Bell 2023:48-60, for a much fuller description of how these factors are impacting the community.

Table 1: Significant climatic impacts affecting Jean Marie River First nation community members (Bell 2023:51).

<b>Climate Change Impacts</b>	<b>Impact on the JMR Community</b>
Change in Temperature / Seasonal Patterns	<ul style="list-style-type: none"> <li>• Significant impact on harvesting of plants important to the community (i.e., berries, traditional medicines).</li> <li>• Continual drop in annual snow quantity.</li> <li>• Much warmer winters when compared to past.</li> <li>• Increase in forest fire prevalence and severity.</li> </ul>
Changes to the Mackenzie River	<ul style="list-style-type: none"> <li>• Mackenzie River continues to rise annually (increased risk of flooding in the community).</li> <li>• Due to the rising of the Mackenzie its banks have seen significant erosion (leading to slumping events along its banks).</li> <li>• Between seasons the Mackenzie's water level fluctuates heavily (makes it unpredictable for the JMR community and its harvesters).</li> <li>• Ice on the Mackenzie no longer completely freezes over (concerning for hunters / harvesters, puts them at risk when going out).</li> <li>• The water in the Mackenzie has become murkier (potentially due to the erosion of its banks into the river).</li> </ul>
Permafrost thaw	<ul style="list-style-type: none"> <li>• Drying of muskeg surrounding the JMR community.</li> <li>• Thawing of permafrost surrounding the community has led to a large quantity of 'drunken trees' (fallen trees) (this is concerning to the community as it blocks game trails and makes harvesting more difficult).</li> <li>• Observed slumping surrounding the community (sinkholes observed in the bush and areas of the bush have become unstable due to slumping).</li> </ul>
Fish quality and quantity	<ul style="list-style-type: none"> <li>• Significant / commonly caught species (e.g., grayling) are becoming much harder to catch and net (water becoming warmer, fish are moving deeper into the river).</li> <li>• Spawning areas surrounding the community have become harder to find due to the water become deeper and murkier.</li> <li>• Reduction in the quality of fish caught: fish are covered in sores, flaky skin and have brown colouring internally.</li> <li>• High mercury content in fish so many are hesitant to consume them.</li> </ul>
Changes in wildlife / plant species	<ul style="list-style-type: none"> <li>• New plants, birds, and fish observed around the community.</li> <li>• Bison have been observed moving closer to the community (bison are not commonly seen near JMR community).</li> <li>• Seasonal changes have led to disruptions in animals mating / rutting seasons.</li> </ul>

Participants in the JMRFN study shared that in recent years significant slumping events have been occurring along the riverbanks of the Mackenzie, and at a higher level of frequency than before (Bell 2023). Community members attributed the slumping to a significant rise in water levels on the Mackenzie River in recent years; this increase in river levels was attributed to melting permafrost draining into the Mackenzie. Other authors have discussed the expected effects that melting permafrost will have on existing infrastructure in the north (see sources in Bell 2023, as well as ENR 2008). JMRFN members also talked about how Dehcho Dene are suffering the impacts of climatic changes on traditional land use activities such as hunting, trapping, and fishing, and have many concerns in regards to how climate change will impact important traditional activities in the future (Bell 2023).

Recent research done in the Inuvialuit Settlement Region is also potentially relevant and useful to consider, as some of the changes being experienced by Inuvialuit are similar to those of Sahtú residents. Notably, the 2018 work by Fawcett *et al.* indicates that Inuit hunters are impacted in two main ways by climate change: changes to travel and risks associated with travel, and changes to the quality and availability of wildlife. While wildfire is not identified at the same level of risk in the ISR as in parts of the Sahtú, the study findings about impacts to travel and wildlife availability are directly relevant. Some of the specific risks and adaptations noted by Inuit hunters are presented in Figure 1 Figure 2 below.

Exposure-sensitivities	
2005	2016
<b>Travel risks and compromised travel routes</b>	
Early and rapid spring melt	Spring melt is early and becoming more rapid
More variable and less predictable weather	More variable and less predictable weather
Longer autumn and less snow in some years	Snowfall is occurring later and affects travel
Rapid seasonal transitions and hazardous conditions lead to more hunters being stranded or injured	Seasonal transitions continue to be rapid but fewer hunters reported being stranded or injured
Changing sea ice dynamics	Sea ice is thinner leading to a greater flux in safe conditions and more travel on land in the winter
Sea ice is taking longer to freeze (or is not freezing) and melting earlier, becoming more unstable	Consistent trend towards later sea ice freeze-up and earlier break-up
Variable winds and increasing storminess, changing wind-ice regime	Winds are stronger and more consistent and variable in direction, leading to smaller windows of opportunity and increasing precautionary costs
<b>Quality and availability of wildlife</b>	
Decrease in the number and body condition of ringed seals and Peary caribou	Fewer seals in the area, partially due to sea ice decline
Shift from caribou to muskox, but muskox are getting further away	Muskox are further away, leading to less hunting success and access constraints
Access to eider ducks restricted by changes to sea ice, wind and boat cost/access	Changes to sea ice and shorter migration window are restricting access to eider ducks
Limited access to Dolphin Union caribou due to wind, distance and equipment requirements	Wind conditions make caribou hunting more dangerous, costly, and increase time constraints
<b>Financial and time constraints</b>	
	Increasing time and financial constraints are sometimes forcing travel in risky conditions

Figure 2: Results from interviews with Ulukhaktok hunters in 2005 and 2016 about the impacts of climate change on hunting. A dark grey background indicates an increase (e.g. more, later) between 2005 and 2016; white indicates a decrease (e.g. fewer, earlier); and pale grey indicates factors or conditions that remained relatively consistent between 2005 and 2016 or were reported for the first time in 2016 (reproduced from Fawcett *et al.* 2018:123).

Overall, the researchers summarized some Inuit adaptations to climate change as follows:

*The data reveal that many of the climatic changes recorded in 2005 that adversely affected hunting activities have been observed to be persisting or progressing, such as decreasing sea ice thickness and extent, and stronger and more consistent summer winds. Inuit are responding by altering travel routes and equipment, taking greater pre-trip precautions, and concentrating their efforts on more efficient and accessible hunts. Increasing living and subsistence costs and time-constraints, changes in the generation and transmission of environmental knowledge and land skills, and the concentration of country food sharing networks were identified as key constraints to adaptation. The findings indicate that the connections between subsistence activities and the wage economy are central to understanding how Inuit experience and respond to climate change (Fawcett et al. 2018:119)*

The work by Fawcett *et al.* included documenting adaptive strategies being used by Inuit hunters to mitigate these climate change impacts; these included taking extra precautions, having flexibility in response to changing conditions, food-sharing networks, and community hunts (2018). These results are reproduced here in Figure 3.

Adaptive strategies	
2005	2016
<b>Extra precautions</b>	
Taking extra precautions and supplies/gas	More precautionary supplies required, sometimes constraining adequate preparation
Travel in groups and closer to town	Travel in groups and communicate travel plans
Increasing use of communication and/or navigation technology	Increase avoidance of risky conditions Technology is widely used, often within the context of individual skills and knowledge
<b>Flexibility – transportation, routes, species, timing</b>	
Change routes and locations	Flexible use of equipment and trails (e.g. caribou hunt by ATV)
Increasing use of boats in shoulder seasons as ice melts earlier – costs can restrict access	
Shift from muskox to caribou	Muskox are under pressure/further away, more difficult to be flexible when hunting them
<b>Sharing networks and diet change</b>	
Changes to species harvested	Changes to species harvested, more concentration on a few specific species
Sharing networks are an important adaptive strategy, starting to be restricted	Increased concentration of sharing networks to enable fewer hunters to be active full-time
Supplement diet with store food	Supplement diet with store food
<b>Community hunts</b>	
	Provide those who may not otherwise have access to a reliable source of country foods with country food

Figure 3: Descriptions of key adaptive strategies identified by Ulukhaktok hunters in 2005 and 2016. The dark grey background indicates an increase (e.g. more, later) between 2005 and 2016; white indicates a decrease (e.g. fewer, earlier); and pale grey indicates factors or conditions that remained relatively consistent between 2005 and 2016 or were reported for the first time in 2016 (2018:126).

Hunters also identified key constraints to their ability to adapt, including capital resources and time, hunting economics, and environmental knowledge and land skills (Fawcett *et al.* 2018). It is expected



that if a similar study was done amongst Sahtú Dene and Metis hunters, the results would also indicate that climate change is compromising travel routes, increasing risks and costs, as well as making it harder to find important subsistence species.

*‘Climate Change and Our Lands’: A Yellowknives Dene First Nation Example of Adaptation Planning*

Other nearby, relevant work includes a project complete by the Yellowknives Dene First Nation. In 2015 the K’alemi Dene School in Ndilq received funding to do a local project about climate change adaptation through Health Canada’s First Nations and Inuit Health Branch Climate Change Adaptation Program (Institute for Circumpolar Health Research 2023). The objective of the project was to document how climate change is impacting the health of community members in Ndilq and Yellowknife, and for students to create an adaptation strategy. The resulting adaptation plan presented by the youth in the resulting film included the following steps:

1. **Traditional Living:** We can reduce our greenhouse gas emissions by participating in traditional activities.
2. **Alternative Transportation Options:** We can carpool, take the bus, walk, or use bio-fuel to power our vehicles.
3. **Just Go Outside:** Be physically active! Play sports! The more time we spend outside the less fossil fuels will be used.
4. **Use Wood Pellet Burners:** They are a cleaner option than propane.
5. **Use Solar Panels:** Solar energy is a renewable resource and doesn’t emit greenhouse gasses.
6. **Be Prepared:** Always have extra supplies in case you fall through the ice.
7. **Help Each Other:** Help Elders and your family if they become ill from forest fire smoke.
8. **Take Care of the Land:** When we take care of the land, the land takes care of us (Institute for Circumpolar Health Research 2023).

There are also numerous actions posed in the current Déljñę ‘Caribou for All Time’ plan that are relevant to climate change adaptation; some relevant ideas are included below for consideration.

*Belare wile Gots’ę ʔekwé – Caribou for All Time: A Déljñę Got’jñę Plan of Action for 2021-2023*

Due to their concerns about the impacts of climate change on caribou, the Déljñę ʔekwé Working Group (DEWG) has included ideas in their caribou plan about how to help caribou survive in a changing climate, as well as ways to minimize the ‘climate change footprint’ in the Déljñę District (DEWG 2021). As conditions on the land are changing, the latest version of the plan includes details on caribou habitat, including strategies and approaches for protecting habitat and mitigating climate change, while recognizing that more information is needed still:

*The community feels that many of the problems we are currently facing on the land are connected to climate change. As in many other parts of the north, the conditions and environment in the Sahtú are changing so rapidly that it is difficult to know how best to help ʔekwé survive or adapt to this new landscape. We will need to do more work to understand how ʔekwé are affected by people and their actions, what the cumulative impacts of human activities may be, and what it may take to maintain ʔededáhk’á for ʔekwé over the long-term (DEWG 2021:20)*

The plan outlines a three-point strategy to help caribou at this time, including:

- A. Neh Karıla K'ets'edi (Habitat Protection),
- B. ʔehdanagokwı ʔeghálaeda (Working on Climate Change), and
- C. Addressing Impacts of Other Wildlife.

Déłıne feels strongly that more needs to be done to address the causes of the changes, not just adapt to them. The Working Group would like to see the governments of the Northwest Territories and Canada take a stronger stance on the international stage related to climate change, and make it a high priority in order to protect caribou habitat and Dene way of life with caribou (DEWG 2021). The plan outlines the need not just for national and international climate change policies, but also a policy for the Sahtú Region. The Working Group is looking into international efforts to address the causes of climate change as a means of preserving the habitat that caribou need, as well as the lifestyle of Dene people. There are several international climate change actions and accords identified in the plan that could address the implications of climate change in regards to biocultural conservation, such as:

- Indigenous Climate Action 2016 – developing a collective Indigenous Climate Action Plan; and
- UN Framework Convention on Climate Change (Article 2) – work to prevent dangerous anthropogenic interference with the climate system, ensure food production is not threatened, and enable sustainable development (DEWG 2021).

At the same time Déłıne is working to minimize their own climate change footprint; *“Under self-government, Déłıne will need to develop policy to minimize emissions that are known to be causes of climate change. The Working Group will be looking for ways that the community can be a model of practices that minimize the ecological impacts of our northern life,”* (DEWG 2021:25).

### Planning for Wildfires

One of the main climate change impacts facing communities in the Sahtú is the increased risk and intensity of today’s wildfires. This arose as a major concern in recent cross-regional planning for caribou in the Mackenzie Mountains.

*... we have to do something about these fires that are burning out key winter habitats... We know it’s one of the problems that is preventing caribou from coming back to these areas. Science says it takes about 60 years for lichen to grow back. These large areas is where these lichen have burnt out and 60 years is a long time. We have to find ways to fight those fires. Right now key infrastructure like hydro lines, they protect those and they protect small communities, but when it comes to sacred areas, gravesites, they don’t care really. That shouldn’t really prevent us from pursuing our wildfires (Norman Sterriah in Winbourne 2017a:21).*

The scale and intensity of the 2014 and 2023 fire seasons, and the suggestion that climate change is likely to bring even hotter and drier summers to some regions of the NWT, point to the need to consider what affect current fire management practices are having or could have on the future stability of

caribou, and to mitigate the degree and / or immediacy of forest fire as a threat (SARC 2017). While wildfires are considered a natural part of some northern landscapes, there are increasing suggestions that people would like to see fires fought as a part of habitat management; people are calling for more action on suppressing wildfires in other Sahtú, Gwich'in, and Tłı̨chq communities (see Benson 2015 and sources in SARC 2022, among others).

#### *Collaborative Fire Management: A Look at Reinstating Cultural Burning Practices*

Indigenous Nations have used fire as a tool for resource management and community protection for millennia in many parts of the world (see Hoffman *et al.* 2021, Lake and Christianson 2019, Kimmerer and Lake 2001, among others). Cultural burning can significantly reduce wildfire risk by lessening fuel loads, enhancing the frequency, timing, and severity of fire, and assisting with the management of complex resources for the benefit of all Canadians (see Christianson *et al.* 2022, Hoffman *et al.* 2022, among others).

For thousands of years, Indigenous Peoples across Canada practiced cultural burning as an effective forest management approach to care for the land and sustain traditional practices (see Christianson *et al.* 2022; Hoffman *et al.* 2022; Kimmerer and Lake 2001; Lewis 1982, 1978; and Lambert N.D., among others). Historically, there were at least 70 different uses of fire by Indigenous Peoples in Canada; cultural burns were done at various intensities, at different times of the year, and in specific locations based on fire-keepers' knowledge (Hoffman *et al.* 2022; Kimmerer and Lake 2001; Lambert N.D.). While often intended to promote the growth of certain types of culturally significant plants (e.g., food, medicine, grasses for wildlife, woody shrubs for baskets, cultural burning can also result in the reduction of wildfire risk through the reduction of fuel loading (Hoffman *et al.* 2022; Nature Conservancy 2021; Lambert N.D.).

In the boreal forest, Indigenous Peoples have also applied fire on their landscapes to fulfill numerous objectives (Christianson *et al.* 2022). Starting in the early 1900s, cultural burning practices were made illegal, eventually leading to the thickening of forest layers that left coniferous stands prone to destructive wildfires and infestation (Lambert N.D.). However, there are indications that cultural burning practices had disappeared from the forests of eastern Canada as early as the early 1700s; this fire suppression has had long term consequences on forest health and structure (Fort Nelson First Nation 2015; Kimmerer and Lake 2001; Ray *et al.* 2012).

- ***Similar to policy in the NWT, the Province of Saskatchewan implemented a controversial policy in 2004 that dictates fires should be allowed to burn until they encroach upon 'valued' landscape components (e.g., human life, community structures, public infrastructure, commercial timber), with some viewing the policy as an affront to Indigenous sovereignty (Zahara 2020).***

Increasing evidence in the late 20th century indicated that a century of intense wildfire suppression in the western US had removed a natural counterbalance to growth and produced 'overstocked' forests (see sources in Ray *et al.* 2012). In 2000, this trend was thought to contribute to catastrophic wildfires that burned across the western US and inspired a national approach for reducing wildfire risk; the 'Healthy Forests Initiative' of 2002 and the 'Healthy Forests Restoration Act' of 2003 sought to counter

increased wildfire hazard by reducing forest fuel loading and restoring historic stand structure (see sources in Ray *et al.* 2012).

Indigenous communities in Canada have unique vulnerabilities to large and high-intensity wildfires as they are predominately located in remote, forested regions that are experiencing disproportionate impacts of climate change, and they often lack financial support to mitigate wildfire risk (Bell 2023; Christianson *et al.* 2022; Hoffman *et al.* 2022). Only a limited set of scholars have worked with Indigenous Peoples to document contemporary and historical relationships with fire in Canada; this should be considered an information gap in existing research and literature (Christianson *et al.* 2022).

Few examples of uses for caribou or managing wildfire in the north were found in the sources reviewed for this report. Table 2 shows examples found in Christianson *et al.* 2022.

Table 2: Use of fire in relation to caribou and caribou habitat identified in Christianson *et al.* 2022)

	<b>Indigenous Nation</b>	<b>Location</b>	<b>Reason for Burning</b>	<b>Key References (in Christianson <i>et al.</i> 2022)</b>
Woodland caribou	Tahltan Innu	NW BC Labrador	Approach animals downwind under cover of smoke, promote small patches of early succession forest, change migration patterns, hunting.	Oberndorfer, E. 2020. What the Blazes!?! A people’s history of fire in Labrador. <i>Journal of the North Atlantic</i> , 2020, 40:1-16.  Deur D, Turner NJ. Keeping it living: traditions of plant use and cultivation on the Northwest Coast of North America. University of Washington Press; 2005.
Barren-ground caribou	No Nation specified	Southern limits of BGC winter range	Stimulate the growth of lichens and other forest plants through removal of bryophytes (liverworts, hornworts and mosses) in upland forest and muskeg.	Lewis HT. A time for burning. Edmonton. Occasional Publication No.17. University of Alberta, Boreal Institute for Northern Studies; 1982.

As wildfire activity in the boreal forest of North America is expected to increase from fuel loading and climate change, an appreciation for Indigenous fire knowledge in the boreal forest is growing (Christianson *et al.* 2022; Kimmerer and Lake 2001). This has resulted in some partnerships between Indigenous Nations and wildland fire management agencies (see Christianson *et al.* 2022, Zahara 2020, and Lambert N.D., among others). Nonetheless, there is much work still to be done to shift the power dynamics around wildfire management decision-making (Christianson *et al.* 2022).

As early as 1981 the Dene Nation and the territorial Government asked the Department of Indian Affairs and Northern Development for more control in making firefighting decisions, including a proposal for a Dene management firefighting board, and essentially asking for complete control over firefighting to be handed over to Dene Nation (Native Press 1981). Yet Indigenous perspectives have often been overlooked in fire management in North America (Christianson *et al.* 2022). In the context of

environmental change, managers, fire ecologists, and politicians alike are increasingly looking to reintroduce fire as a way of restoring ‘natural’ forest landscapes while reducing fire suppression costs (Hoffman *et al.* 2022; Nature Conservancy 2021; Zahara 2020; Ray *et al.* 2012). Researchers have highlighted the necessity of collaborative fire management, including Indigenous partnerships, leadership, and direction within fire management practices on Indigenous territory, which may include fire suppression (Zahara 2020). However, significant barriers exist for re-engaging in cultural burning (Hoffman *et al.* 2022; Fort Nelson First Nation 2015; Kimmerer and Lake 2001).

It is important to note that ‘prescribed’ burning is distinct from ‘cultural’ burning in objectives, techniques, and who is conducting the burn (Hoffman *et al.* 2022). In Canada, First Nations retain the right to undertake cultural burning on reserve lands, but significant wildfire agency oversight and control is often required, leading to tensions when cultural burning goes ahead with no formal government approval (Hoffman *et al.* 2022). There are also major barriers to utilizing cultural burning across broader Indigenous territories, which is considered Crown land under the statutory authority of provincial or federal governments. Shared governance and the right to burn across territories, including areas covered by historical and modern Treaties, has yet to be fully realized by provincially run wildfire agencies (Hoffman *et al.* 2022). The historical and contemporary uses of cultural burning have been largely omitted from strategic land-use plans, wildfire mitigation strategies, and community risk assessments.

#### Barriers to Burning

Despite growing concerns over wildfire risk and agency-stated intentions to establish Indigenous Peoples as partners in wildfire management, power imbalances and barriers still exist (Christianson *et al.* 2022; Hoffman *et al.* 2022; Kimmerer and Lake 2001). The future and coexistence with fire in Canada needs to be a shared responsibility and led by Indigenous Peoples within their territories. Hoffman *et al.* presented the benefits of cultural burning and identify five key barriers to advancing Indigenous fire stewardship in Canada in their 2022 paper. They also provide ‘calls to action’ to help reduce preconceptions and misinformation, and focus on creating space and respect for different knowledges and experiences.

#### *Calls to action to revitalize and support cultural burning practices:*

1. Establish a National Indigenous Wildfire Stewardship working group, which includes regional hubs of Indigenous fire practitioners and resource managers across provinces and territories.
2. Introduce governance processes that equally prioritize Indigenous knowledge systems to correct power imbalances
3. Reduce wildfire science and management gate-keeping by opening up prescribed fire training and accreditation outside of wildfire management agencies
4. Develop a network of Indigenous and non-Indigenous fire practitioners and researchers within each province and territory to identify key policy barriers for reintroducing cultural burning, including (but not limited to) jurisdiction, liability, and land governance
5. Increase financial support for Indigenous fire stewardship that preventatively and economically reduces wildfire risk within community interface areas and across territories (Hoffman *et al.* 2022).

Removing these barriers and creating space for different knowledges, perspectives, and experiences will be critical to reviving Indigenous fire stewardship in Canada.

*Correcting power imbalances, increasing capacity, and supporting cultural burning without significant agency oversight are necessary steps in respecting Indigenous governance structures and community practices while upholding UNDRIP. Importantly, consultation and engagement must happen early, often, and include attention to broader questions of land governance, tenure, and non-Indigenous values that currently inhibit cultural burning. Long-held colonial preconceptions, misinformation, and marginalization of Indigenous knowledge continue to impede cultural burning. Increased Indigenous, social, and scientific communication of the benefits of Indigenous fire stewardship is needed to shift colonial perceptions of cultural burning for the benefit of all Canadians (Hoffman et al. 2022:476).*

#### Relevant Research and Collaborative Wildfire Initiatives:

There are relatively few contemporary examples of Indigenous-led fire management initiatives in Canada that are relevant to the Sahtú Region. The most extensive relevant research program on cultural burning found in this review was conducted by Henry Lewis and Theresa Ferguson in the 1970s on the use of fire by Dene and Woodland Cree in northern Alberta (see Lewis and Ferguson 1988, Lewis 1982 and 1978, among others). Their work focused on understanding the use of fire as a practice and a tool in achieving certain ecological conditions. One of the most important contributions of their research has been the extensive list of ‘reasons for burning’ based on archival research and ethnographic interviews they did. These included the maintenance of meadows, opening up grasslands, burning deadwood, extending the growing season, obtaining firewood, improving settlements and campsite areas, making and maintaining trails, opening up animal habitat, increasing berry production, reducing pests, religious reasons, and esthetic benefits (Lewis and Ferguson 1988 in Christianson et al. 2022). Although the study did not focus directly on wildfire mitigation, Lewis and Ferguson found that Indigenous Peoples wanted to use traditional burning practices around their communities in the spring to mitigate future wildfire risk in the more dangerous hot and dry months. Lewis also detailed techniques for burning and associated knowledge that was required to achieve desired cultural objectives; he found Indigenous keepers of fire knowledge were highly knowledgeable about seasonality, timing, fuel conditions, relative humidity, wind, other general weather conditions, slope steepness, and natural fire breaks as they related to burning. They spoke about the frequency and severity of fire needed to achieve specific burning outcomes, which was dependent on what they wanted to achieve (Lewis 1982 and 1978).

Another example that may have relevance to the Sahtú is provided by the Fort Nelson First Nation in northeastern BC, who documented Cree and Dene oral history focusing on how fire has been and continues to be an integral part of life in the north as well as the respectful and purposeful interaction with bison through time (FNFN 2015). The resulting documentary ‘Imagine the Fire’, highlights the history and benefits of controlled burning – previously unprecedented documentation of traditional fire use in compatibility with the natural world and species, specifically the Wood bison, and the FNFN traditional territory (FNFN2015).

Several other potentially useful examples and collaborative research projects are outlined below.

*Using Traditional Ecological Knowledge to understand wildfires and climate change impacts in Alaska*

In Alaska, research conducted by Natcher *et al.* found that two different Athabascan groups had very different perceptions of wildfire and cultural burning (2007). The Koyukon in the western interior considered fire a destructive force and had no recollection or oral history of using fire for landscape management; a low density of lightning-strikes and moist climate constrained the effects of lightning fires, and a subsistence dependence on salmon (a predictable resource in time and space), resulting in specific residency patterns (Natcher *et al.* 2007). It was found that in this environment, the occurrence of wildfire would have negatively impacted territorial use and the use of wildlife. In contrast, Gwich'in of the eastern interior actively used fire to manage the landscape; the Gwich'in territory experienced a higher lightning-strike density and a corresponding increase in wildfire activity (Natcher *et al.* 2007). Gwich'in used cultural burning to clear underbrush, improve habitat, and aid in locating / pursuing game; they also used fire to signal one another, create dry firewood, and combat insects (Natcher *et al.* 2007). Because important subsistence food like moose and caribou tend to be less predictable in time and / or space, it meant that they could avoid and / or target a range of habitats affected by wildfires. The researchers concluded:

*Some of the factors that have contributed to this regional and cultural variability may include differences in the terrain between the Gwich'in and Koyukon territories, lightning-strike density and the occurrence of natural disturbance, and differences in subsistence and settlement patterns. Together, these factors offer some explanation for why the Gwich'in and not the Koyukon used fire to modify the landscape (Natcher et al. 2007:9).*

Another study involving two Koyukon communities in a remote part of western interior Alaska looked at integrating Traditional Ecological Knowledge of wildfires for management purposes (Ray *et al.* 2012). While many resident Koyukon do see wildfire as a destructive force (largely due to disruptions to forest access and traditional wild food use), forest users / knowledge-holders were interviewed regarding their observations of contemporary wildfires, and researchers documented descriptions of the driving factors that influence wildfire severity and the resulting effects on lands and resources (Ray *et al.* 2012). Because of the similarity to observations reported in the Sahtú, some of those study results are included here and reproduced in **Appendix C**.

Although interview questions did not cover wildfire severity, respondents described drivers of landscape flammability in terms of effects on wildfire severity and on subsistence resources after a wildfire (Ray *et al.* 2012). The combined responses identified four primary components of landscape flammability: fuel type and condition (moisture), wind, and temperature. Several respondents also recognized two distinct phases of the boreal fire season – earlier season conditions conducive to moderate severity wildfires, and later season, drier conditions conducive to more severe wildfire activity that affects soil and permafrost (see figures of results in **Appendix C**) (Ray *et al.* 2012).

It is important to note that when the study was conducted over ten years ago, respondents were already reporting changes in both the landscape and climate that increased landscape flammability. The most commonly reported changes included drying lakes and sloughs, milder winters, more overgrown vegetation, hotter drier summers, and thawing permafrost – each of these factors are also reported in numerous regions of the NWT. Koyukon participants also noted the positive effects of wildfire on berries and moose populations, but negative effects that included the loss of important places, difficulties trapping, displacement of caribou, and deaths of small animals (Ray *et al.* 2012).

### Snowchange: Monitoring, Planning, and Responding to Increasingly Harmful Fire Regimes in NE Siberia

In the boreal regions of Siberia and Finland, wildfires are similarly becoming more extensive and damaging than ever before – likely because these latitudes are warming at a faster rate than the rest of the planet (see sources in Snowchange 2022a). Snowchange is working with communities to document new baselines, using photography and workshops to support and build resilience, introducing monitoring programs and early response and other solutions in order to try to understand how the new tundra fires are impacting reindeer pasture and food security (Snowchange 2022a).

Key messages being learned from community-led initiatives in Siberia include:

- It is very important to establish Indigenous Knowledge / science baselines to understand novel events and position them within an historic timeframe and scale.
- Community-led teams are useful for early detection, documentation, and response; local communities are ready and need support and capacity, know the landscapes, and maintain nomadic lifestyles central to knowledge of ecosystem change.
- Central coordination efforts and regional centers are needed to be linked with community teams and science institutions to provide an overall view of upcoming fire seasons.
- Satellite images and feeds could be provided in near real-time to central authorities and the community teams to track the progress and speed of fires to avoid harm and protect people and animals (Snowchange 2022b).

Snowchange is also working in boreal forests of Finland, using both TK and science to better understand ‘new’ or unprecedented fires in that area; “... *fires have been a part of the life in the boreal – the increased intensity, extent and impacts of these fires are the ‘new fires’ we need to understand around the boreal in order to navigate the future and risks it holds,*” (Snowchange 2022a). Part of the work involves documenting fire observations of Indigenous Peoples around Lake Baikal through community workshops and archival research, among other work (Snowchange 2022c).

Based both on the science and Indigenous Knowledge collected during their work, Snowchange offers four key recommended actions as vital for protecting the landscape from more harmful fires:

- 1. Early detection and suppression of fires is a key action:** Communities around the region should be resourced, trained, and equipped with capacities to establish early warning systems. Fire fighters, rangers, and land guardians should be enabled to respond in a timely way, especially to new spring fires that evolve into devastating summer blazes.
- 2. Observations of change must be increased:** Scientific monitoring stations across the region are needed, as is comprehensive Indigenous Knowledge monitoring, and an appreciation of cultural indicators, including local place names and linguistic knowledge. Supporting and resourcing land and water guardians are examples of actions that can happen today.
- 3. Positioning the changes and monitoring missions to Arctic and northern international feeds:** Organisations and processes such as Arctic Passion, NASA Earth Observatory, Northern Forum Working Groups, and Arctic Council, could provide future highly significant warning systems.
- 4. Enforcing and restoring the protection of natural systems:** Poor ‘management’, poaching, logging, mining and other extractive land uses are worsening fires. As a result, legal enforcement of existing protected area status and sensitive management is vital, as well as exploring the potential of rewilding and restoring habitats where required, in order to lessen the speed, scale and severity of the new fires, and repair the damages already done (Snowchange 2022c:29-30).



### Yukon First Nations Wildfire

In the Yukon, Yukon First Nations Wildfire (YFNW) is incorporating innovative strategies and Traditional Knowledge into their wildland firefighting and emergency responses (YFNW 2023). YFNW is a partnership of nine Yukon First Nations stakeholders, providing emergency management and training services. Through various projects such as bolstering fire resilience in the Yukon, fuel mitigation, wildfire resiliency and training summits, their work aims to foster community resilience and facilitate financial reconciliation for First Nations partners (YFNW 2023).

### Indigenous Peoples Burning Network: Revitalizing Traditional Fire Cultures

Started in 2015, the Indigenous Peoples Burning Network (IPBN) is a support network among Native American communities that are revitalizing their traditional fire cultures in today's context (The Nature Conservancy, TNC 2021a). Administered by TNC but led by a volunteer team of Indigenous fire practitioners, the IPBN is making significant progress in California, New Mexico, the Great Lakes, the Pacific Northwest, and Texas (TNC 2021b). The network is also serving as a resource for non-Indigenous fire teams aspiring to build equitable partnerships with Indigenous communities (TNC 2021a). Activities include strategic planning for revitalization of fire culture, fire training (including federal qualifications and culturally-based controlled burning), and promoting intergenerational learning (TNC 2021b).

The IPBN is part of the PERFACT<sup>1</sup> cooperative agreement, led by staff from The Nature Conservancy's North America Fire Initiative. They work closely with staff from the Watershed Research and Training Center (who facilitate the Fire Adapted Communities Learning Network and other strategies) and from University of California Cooperative Extension, the Conservancy's Global Diversity, Equity and Inclusion Team, and the USDA Forest Service. Partners in PERFACT landscape and community efforts span a full range of affiliations, from federal, state, local and tribal agencies; businesses; non-profit organizations and universities to private landowners and engaged residents. Interests are equally varied, and this diversity helps build strong, resilient networks (TNC 2021b).

### Reinstating Cultural Burning Practices. Shackan Indian Band and Xwisten First Nation, BC.

In one BC location, the Shackan Indian Band, the Xwisten First Nation, and the Yunesit'in First Nation, are collaborating with the First Nations' Emergency Services Society's Forest Fuel Management Department and the BC Wildfire Service to look into how Indigenous cultural burning practices could be incorporated into provincial and federal programs as a means of reducing the risk of loss due to wildfires (Lambert N.D.). Partially funded through the First Nation Adapt Program of Indigenous Services Canada and the Canadian Council of Forest Ministers, the project conducted interviews to collect information about the value system underpinning traditional burns, as well as specifics regarding where, how, when, and why traditional burns were done. This information was then used to develop a community-based burn management plan that considers climate change risks in wildfire mitigation. Two traditional burns under a prescribed burn plan were completed in 2019. The goal was to revive cultural burns, in order to reduce hazards and to heal the land so that it will produce culturally significant plants. The project turned out to be an important way of knowledge sharing and shifting perspectives from avoiding fires to one of applying fire to accomplish ecosystem restoration (Lambert N.D.).

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<sup>1</sup> Promoting Ecosystem Resilience and Fire Adapted Communities Together (PERFACT) is a cooperative agreement between The Nature Conservancy, USDA Forest Service, and agencies of the Department of the Interior.

#### BCIT: Collaboration for Holistic Wildfire Management

Researchers such as Justin Perry at the BC Institute for Technology (BCIT), Natural Resources and Engineering Department, are currently exploring holistic approach to fire management in British Columbia through working more collaboratively with Indigenous groups. As in many parts of Canada, cultural burning practices were lost for about 100 years in BC due to government policy. Drawing on Indigenous traditions and practices, researchers are now looking at the use of prescribed burning in combination with technology such as drones to develop custom plans based in Indigenous cultural and ecological knowledge of particular ecosystems and areas (Global News 2023).

## Conclusion

It is clear that unprecedented environmental change is being experienced in the Sahtú Region. Very knowledgeable people are finding things like weather and availability of animals much harder to predict today than in the past. Due to their long-term, intimate ties to the land and to species like caribou, Indigenous Peoples in the north of Canada are particularly vulnerable to the effects of climate change. Nonetheless the frameworks, experiences, protocols and teachings inherent in Indigenous / Traditional Knowledge systems in this area can provide the foundation and guidance necessary to adapt to a changing world.

The traditional, adaptive systems characteristic of Indigenous cultures are rooted in spiritual principles of respect and reciprocity, with practical harvesting protocols such as switching to alternate foods in different seasons or when those foods are less available. When these attributes are paired with powerful modern tools such as habitat protection and monitoring, this will likely prove to be the best approach to maintaining both cultural traditions and food security over time even when future conditions are uncertain. However, in order for this approach to be successful, Indigenous Peoples will need to continue to make progress on having their rights and authorities respected and heeded on local, regional, national, and international stages. Once Indigenous rights and authorities are secured at a very foundational level, collaboration on the problems facing all northerners can become more balanced and productive.

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Appendix A: Summary Table – Sahtú Knowledge of Wildfire and Climate Change Impacts on Caribou

	Sahtú Region Observations <sup>2</sup>				
	BARREN-GROUND CARIBOU			WOODLAND CARIBOU	
	BLUENOSE-WEST ᑲᑦᑲᑦ / Neregha goᑲekwé	BLUENOSE-EAST ᑲᑦᑲᑦᑲᑲ goᑲekwé	GENERAL OBSERVATIONS – BARREN-GROUND Nᑲᑲᑲ / ᑲᑦᑲᑦ / ᑲᑲᑲᑲ	BOREAL WOODLAND ᑲᑲᑲᑲ	NORTHERN MOUNTAIN Shúhta Goᑲᑲᑲ
<p><b>Status and trend observations</b></p> <p>(Including: abundance, distribution, range &amp; movement patterns, migration changes, etc.)</p>	<ul style="list-style-type: none"> <li>Colville: Number of ᑲᑦᑲᑦ is about the same as previous years and stable, but more spread out now. (ACCWM 2023, 2021, 2020; SRRB 2020)</li> <li>Colville: Caribou are staying near the barrenlands; migration has changed in recent years. Hunters have to travel farther to get to caribou, so it is hard to make observations. (ACCWM 2023, 2021)</li> <li>Délᑲᑲ: One or two ᑲᑲᑲᑲ were seen at Neregha; they are in much smaller numbers now. (ACCWM 2020)</li> </ul>	<ul style="list-style-type: none"> <li>Délᑲᑲ: People are not seeing as many ᑲᑲᑲᑲᑲᑲ in recent years. People are consistently seeing fewer caribou since 2018. (ACCWM 2023, 2021, 2020, 2019; HG 2022b, 2021)</li> <li>Délᑲᑲ: Caribou are not around traditional places like Caribou Point; community members are very concerned about the barren-ground caribou populations. (ACCWM 2020)</li> <li>When people have gone to look for caribou, they are not in large groups but alone or in pairs. (ACCWM 2020)</li> <li>BNE caribou didn't come near any Sahtú communities in 2018. (ACCWM 2019)</li> </ul>	<ul style="list-style-type: none"> <li>People are seeing fewer caribou – there are concerns about their declining availability. (HG 2022b; HG 2021b)</li> <li>Movement patterns were different in 2020 as there was less snow. Some caribou are not migrating, but staying in the mountains or on islands in Great Bear Lake. (ACCWM 2021)</li> <li>Délᑲᑲ: People looked for ᑲᑲᑲᑲ at Neregha in fall and summer 2020 and saw nothing. Community continues to be concerned about lack of availability; this concern has heightened from 2019. (ACCWM 2021)</li> </ul>	<ul style="list-style-type: none"> <li>There is limited new information available about current boreal caribou population trends in Indigenous and Community Knowledge sources. (SARC 2022)</li> </ul>	<ul style="list-style-type: none"> <li>Overall population trend is unclear, but likely declining in several localized areas. (SARC 2020; Winbourne 2019)</li> <li>Distribution appears to be changing, but it is unclear if this is a decline, a natural shift, or a response to climate change. (Winbourne 2019)</li> <li>Tulít'a: Migration routes and movements around Keele River and Caribou Flats have changed. (Winbourne 2017b; Olsen <i>et al.</i> 2001)</li> <li>Shúhtaot'ᑲᑲ oral histories say caribou used to migrate further north. Now there is uncertainty about what they are doing and where they are going, but they seem to be moving away from usual areas (Winbourne 2017a).</li> </ul>
<p><b>Climate and climate change</b></p> <p>(Including comments on weather, habitat / condition changes, and new species)</p>	<ul style="list-style-type: none"> <li>Colville: There is less snow when you get close to the barrenlands and more snow in the trees. (ACCWM 2023)</li> <li>Colville: There were no fires in 2020, but permafrost melts have led to changes in habitat. (ACCWM 2021)</li> <li>Colville: Migration route shifted further north about 10 years ago, possibly in response to warming weather patterns. In March 2019 the weather warmed up unexpectedly fast and caused the caribou to leave the area a month earlier than normal. (ACCWM 2021)</li> </ul>	<ul style="list-style-type: none"> <li>Délᑲᑲ: There are concerns about the impacts of climate change on caribou. (ACCWM 2022)</li> <li>Délᑲᑲ: The land is drier. There are more shrubs on the tundra now. ᑲᑲᑲᑲ behaviour is changing, they seem to be travelling differently on the land, possibly not travelling as far as they normally would. Snow and ice conditions are changing, and affect how well ᑲᑲᑲᑲ can travel and access food in winter. There is less ᑲᑲᑲᑲᑲᑲᑲ (good home, habitat) for ᑲᑲᑲᑲ to survive in. (DEWG 2021)</li> <li>At ᑲᑲᑲᑲᑲ, lots of snow (about 2 to 2.5 feet) with a hard crust on top on April 20/21. Caribou food was hard to get at.</li> </ul>	<ul style="list-style-type: none"> <li>It is getting warmer. Water levels are increasing. People are seeing more erosion, this is affecting how animals travel on the land and navigate river crossings. (HG 2022b)</li> <li>Délᑲᑲ: Water in the top 2' of Great Bear Lake has changed temperature. (HG 2022b)</li> <li>There are changes in the permafrost and increased melting. Caribou are getting caught/bogged down in the mud in some areas. (HG 2022a)</li> <li>Overall it is getting hotter in the Sahtú. This is causing a number of trends and changes:</li> </ul>	<ul style="list-style-type: none"> <li>Climate change is increasing the size and severity of fires, which may result in a larger impact as habitat takes longer to recover. Other key environmental concerns are changes in snow, ice and permafrost, which contribute to habitat fragmentation and degradation. (SARC 2022)</li> <li>Weather plays a significant role in the health and well-being of boreal caribou; increasing extremes in annual temperatures and flooding negatively impact animals. (McDonald 2010)</li> <li>Recent changes in climate have been significant, and include warmer temperatures, increased rain in November, milder winters, and increasing summer storms. Boreal caribou and their</li> </ul>	<ul style="list-style-type: none"> <li>Climate-driven environmental change (e.g., warming, shrubification, shrinking ice patches and glaciers, variability in snow pack, timing of melt, icing), is already occurring and believed to be causing serious impacts to some herds (e.g., changes to migration, displacement, insect harassment). (Winbourne 2019, 2017a,b)</li> <li>There are several types of direct and indirect impacts on northern mountain caribou that are attributed to climate change, including: <ul style="list-style-type: none"> <li>Changes to timing of spring thaw / melt and fall freeze-up.</li> <li>More unfavourable snow conditions (e.g., increased icing events that create difficulties for caribou to get to their food through the snow crust).</li> </ul> </li> </ul>

<sup>2</sup> Harvesters from Colville mostly encounter and hunt caribou from the Bluenose-West herd. Délᑲᑲ harvesters may hunt caribou from both the BNW and BNE herds, but have not been encountering BNW caribou much in recent years. In the Sahtú or Great Bear Lake region, Délᑲᑲ Got'ᑲᑲ use the term ᑲᑲᑲᑲ to refer to barren-ground caribou; neregha goᑲekwé refers to caribou encountered on the north shore of Great Bear Lake (Bluenose-West habitat), and ᑲᑲᑲᑲᑲᑲ goᑲekwé refers to barren-ground caribou usually encountered in the ᑲᑲᑲᑲᑲ area (corresponding to habitat of the Bluenose-East herd). Nᑲᑲᑲᑲ refers to barren-ground caribou in the Shúhtaot'ᑲᑲ dialect.

	<ul style="list-style-type: none"> <li>• Colville: People are seeing a lot of changes – more landslides and erosion, changing waterways, changes in migration timing, more snow crusts, more wolves, more bears. It is getting warmer; there were more caribou when it was cold. ACCWM 2019)</li> </ul>	<p>ᑭᑦᑲᑦᑲᑦ were staying on the lake and in open areas. (ACCWM 2020)</p>	<ul style="list-style-type: none"> <li>○ It is too hot for caribou, and they're changing their behaviour.</li> <li>○ There are fewer ice patches/snow to protect the caribou.</li> <li>○ There is more permafrost melting, icing / crusted snow, erosion, more willows, swampy ground.</li> <li>○ Lakes are not frozen for as long.</li> <li>○ Lake surface temperature is getting warmer.</li> <li>○ There are more wildfires.</li> <li>○ There has been an increase in shrubby vegetation in the Mackenzie Mountains and there are more willows growing in forested areas; these changes are not yet occurring in the tundra.</li> <li>○ Insects are more active with warmer climate. (HG 2022a, b; ACCWM 2022, 2021, 2020, 2019; DEWG 2021; SARC 2017)</li> <li>• Délı̄ne: Insects cause ᑭᑦᑲᑦᑲᑦ stress, so any increases may affect caribou health. (DEWG 2021)</li> <li>• Délı̄ne: There was lots of rain and no fires in 2020 – both of which can be good for caribou – but there was rain in December which would have been hard on them. (ACCWM 2021)</li> <li>• Climate change is increasingly affecting people and caribou. (SRRB 2016)</li> <li>• Weather and wind direction have changed. Rain on snow events make it hard for caribou to survive. (ACCWM 2014)</li> <li>• People have been seeing changes in the land and vegetation, different species, changes to traditional food quantity and quality, differences in ice conditions and snowfall timing,</li> </ul>	<p>food sources can be affected by fall and winter precipitation. During these times, food becomes less accessible as it is covered by more snow, making it harder for caribou to access. (McDonald 2010)</p> <ul style="list-style-type: none"> <li>• In a Sahtú study, 85% of participants said that winters are warmer now than in the past. Participants had differing opinions on whether snow accumulation patterns have changed, but there were numerous suggestions that the amount of snow that falls over the winter has decreased during the lifetimes of the participants, and that river and lake ice may not form as quickly nor as thick as in the past. (Zimmer <i>et al.</i> 2002)</li> </ul>	<ul style="list-style-type: none"> <li>○ Shrubification / willow growth.</li> <li>○ Rapid snowmelt resulting in dangerous river crossings.</li> <li>○ Drying tundra in places.</li> <li>○ Warmer summer months and increased insect harassment. (Winbourne 2019, 2017a &amp; b)</li> <li>• Distribution and movement patterns appear to be changing, as well as frequency of unfavourable conditions. (Winbourne 2019; Olsen <i>et al.</i> 2001)</li> <li>• Climate change can cause changes in other types and numbers of animals that can further threaten mountain caribou (e.g., there are concerns about higher numbers of grizzly bears hunting caribou, and the impacts species like muskoxen and bison can have on caribou when they move into an area. (Winbourne 2017a)</li> </ul>
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<p><b>Wildfires</b></p>			<p>and changing water levels for 20 years. (Macdonald 2003)</p> <ul style="list-style-type: none"> <li>• Many of the observed changes indicate that the climate is warmer and drier than in the past. (Macdonald 2003)</li> <li>• There are more wildfires now and they are more intense than in the past. (HG 2022a; DEWG 2021; SRRB 2016; ACCWM 2014)</li> <li>• Tulít'a: Previous generation only used to see wildfires once in a while. (HG 2022b)</li> <li>• Reduced tree stands mean less shade for caribou in forested areas. (HG 2022a; SRRB 2016)</li> <li>• Déljne: There were no fires in 2020. (ACCWM 2021)</li> <li>• Déljne: There is more risk of fire now. (DEWG 2021)</li> <li>• Even though fires are seen as part of the natural system, people are concerned about impacts to caribou. (SARC 2017)</li> <li>• People are very concerned about present and future impacts of fire on ɔekwé and their habitat. (SRRB 2016)</li> <li>• Forest fires have impacted caribou habitat – once an area is burned it takes a long time for lichen to grow back. (ACCWM 2014)</li> </ul>	<ul style="list-style-type: none"> <li>• Areas burned by fire are generally not used by boreal caribou until the habitat recovers; habitat recovery takes many decades. (SARC 2022)</li> <li>• Climate change is increasing the size and severity of fires, which may result in a larger impact as habitat takes longer to recover. (SARC 2022)</li> <li>• Wildfires can impact the ability of caribou to acquire food and can force them to relocate to more desirable locations. (McDonald 2010)</li> <li>• There are different observations regarding how long it takes before boreal caribou return to a burned area; some say it's as soon as there is new growth, others say they never return. (McDonald 2010)</li> <li>• Fires are a threat to boreal caribou populations. (Zimmer <i>et al.</i> 2002)</li> </ul>	<ul style="list-style-type: none"> <li>• Wildfires were identified as a threat to northern mountain caribou, due to the fact that they are damaging habitat, especially winter range, and increasing in number and level of damage. This is already occurring and may be causing serious impacts to some herds. (SARC 2020)</li> <li>• Fires are increasing in size and intensity; they threaten important caribou habitat and are a concern, especially on mountain caribou winter ranges. (Winbourne 2019, 2017a &amp; b)</li> <li>• Wildfires have destroyed some key mountain caribou winter habitats and the lichen caribou depend on for food; this causes them to move away from wintering areas. Fires can also cause travel disruptions if they go through migration corridors, and eventually lead to a chain of events that influences distribution of caribou, other ungulates, and predators. (Winbourne 2019, 2017a,b)</li> <li>• At least three areas of mountain caribou winter range had already been destroyed by fire by 2014. (Winbourne 2017a)</li> </ul>
<p><b>Caribou health / condition</b>  <b>(Including productivity, recruitment &amp; adult composition)</b></p>	<ul style="list-style-type: none"> <li>• Harvested caribou are healthy and fat. Bull to cow ratio is about 1:1. (ACCWM 2021)</li> <li>• The more isolated caribou are from people, the more stressed they are by wolves. (ACCWM 2021)</li> <li>• Colville: ɔədə remain as fat as always; caribou seem to be in normal good health. (ACCWM 2020; SRRB 2020)</li> <li>• A lot of caribou do not have much fat on them, suggesting they have trouble grazing. (ACCWM 2019)</li> </ul>	<ul style="list-style-type: none"> <li>• Déljne: In 2021 harvesters again said that caribou are staying far from the community and there are few observations they can share about the herd as a result. (ACCWM 2022)</li> <li>• Déljne: Insects cause ɔekwé stress, so any increases may affect caribou health. (DEWG 2021)</li> <li>• Déljne: harvest at Caribou Pt., 8/12 caribou were pregnant and in fair condition. (ACCWM 2020)</li> <li>• Group of ɔehdájla ɔekwé observed on April 21 were in fair condition with some chafing on legs from ice crust on snow. (ACCWM 2020)</li> </ul>	<ul style="list-style-type: none"> <li>• Déljne: Insects cause ɔekwé stress, so any increases may affect caribou health. (DEWG 2021)</li> <li>• Caribou are not as fat now. (ACCWM 2014)</li> </ul>	<ul style="list-style-type: none"> <li>• Weather plays a significant role in the health and well-being of boreal caribou, and increasing extremes in annual temperatures and flooding can cause negative impacts. Recent changes in climate include warmer temperatures, increased rain in November, milder winters, and increasing summer storms. Boreal caribou and their food sources can be affected by fall and winter precipitation. During these times, food becomes less accessible as it is covered by more snow, making it harder for caribou to access. (McDonald 2010).</li> </ul>	<ul style="list-style-type: none"> <li>• When caribou suffer from environmental changes, they may be more susceptible to other factors, such as predation and / or parasites, and they may be less productive. (SARC 2020)</li> <li>• If climate change results in a warming trend in summer that increases fly activity, there could be an impact on caribou body condition. (Winbourne 2019)</li> </ul>

	<ul style="list-style-type: none"><li>• Colville: There are more grizzlies; they are staying out of the den and hunting longer. Snow is crustier; wolves can get around easier. (ACCWM 2019)</li></ul>			<ul style="list-style-type: none"><li>• Boreal caribou are generally reported to be healthy. (Zimmer <i>et al.</i> 2002)</li></ul>	
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## Appendix B: Sample of Indigenous-led and / or collaborative climate adaptation online resources

**Assembly of First Nations National Climate Strategy:** <https://afn.ca/environment/national-climate-strategy/>

**Canada's Partnership with Indigenous Peoples on Climate:**  
<https://www.canada.ca/en/environment-climate-change/services/climate-change/indigenous-partnership.html>

**Climate Atlas of Canada:** <https://climateatlas.ca/>

**Conservation Through Reconciliation Partnership:** <https://conservation-reconciliation.ca/biocultural-projects/indigenous-use-of-fire>

**Crown-Indigenous Relations and Northern Affairs Canada:** <https://www.rcaanc-cirnac.gc.ca/eng/1100100034249/1594735106676>

**Dene Tha' First Nation Climate Change and Health Adaptation Program:**  
<http://www.climatetelling.info/adaptation-planning.html>

**First Nation Adapt Program:**  
<https://www.rcaanc-cirnac.gc.ca/eng/1481305681144/1594738692193>

**Government of Canada Climate Change and Health Adaptation Program:** <https://www.sac-isc.gc.ca/eng/1536238477403/1536780059794>

**Indigenous Climate Action:** <https://www.indigenousclimateaction.com/>

**Indigenous Climate Hub:** <https://indigenousclimatehub.ca/>

**Indigenous Peoples Burning Network:** <https://www.nature.org/en-us/membership-and-giving/donate-to-our-mission/gift-and-estate-planning/newsletter/forever-forests/>

**Intergovernmental Panel on Climate Change - Climate Change 2022: Impacts, Adaptation and Vulnerability:** <https://www.ipcc.ch/report/ar6/wg2/>

**International Indigenous Peoples' Forum on Climate Change:**  
<https://unfccc.int/documents/631003>

**Institute for Catastrophic Loss Reduction – Wildfire resources:** <https://www.iclr.org/wildfire/>

**Jean Marie River First Nation Climate Change Adaptation Planning:**  
<https://data.researchlicensing.ece.gov.nt.ca/Scientific/16919>

**2030 NWT Climate Change Strategic Framework and Action Plan:**  
<https://www.gov.nt.ca/ecc/en/services/climate-change/2030-nwt-climate-change-strategic-framework>

**Snowchange Cooperative:** <http://www.snowchange.org/>

**UN Platform to Boost Indigenous Peoples and Local Communities' Climate Action:**  
<https://lcipp.unfccc.int/homepage>

## Appendix C: Koyukon observations of factors affecting wildfire severity in relation to climate change

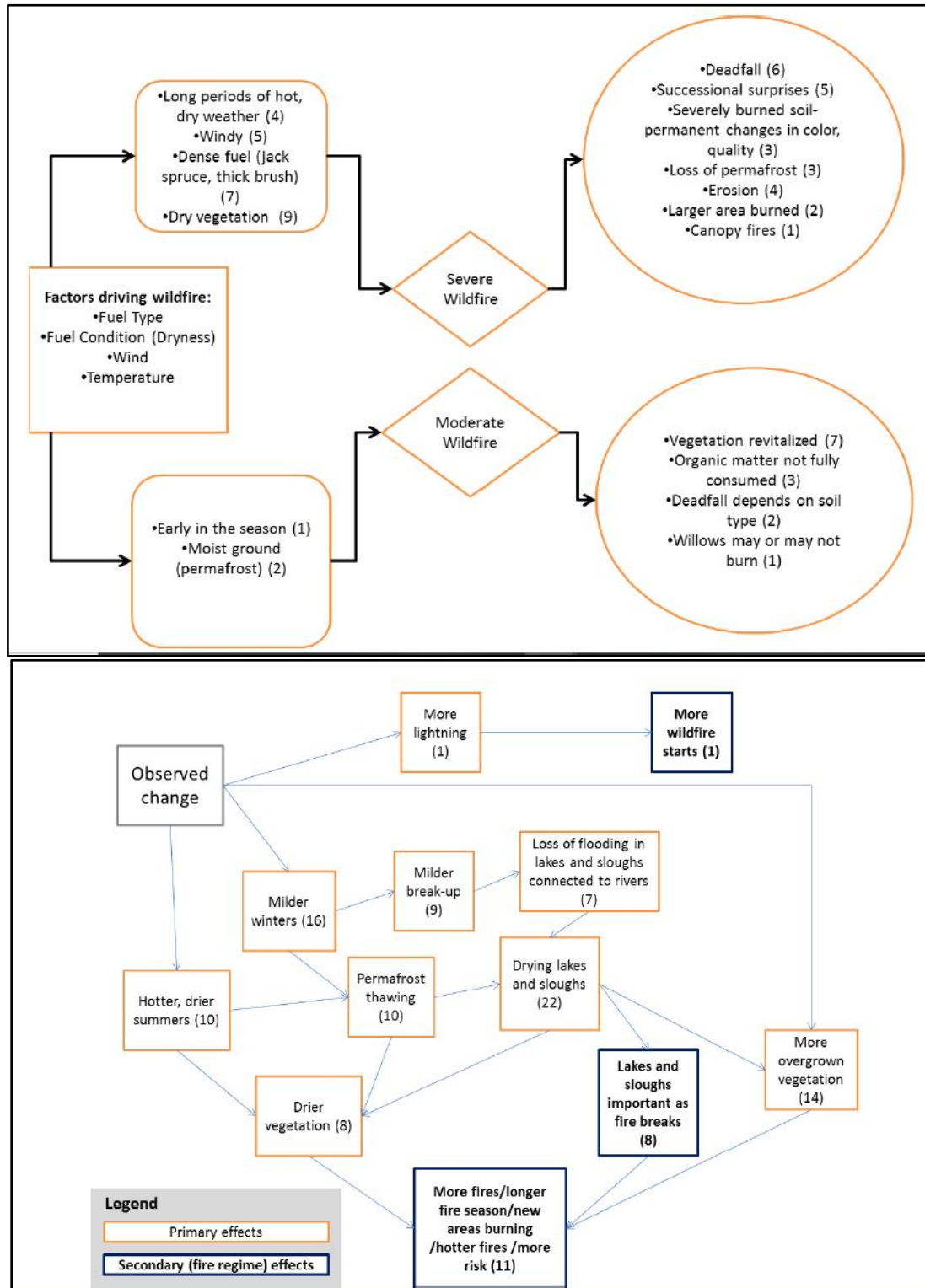


Figure 4 & 4: Koyukon land user descriptions of factors influencing wildfire severity and resultant effects on lands and resources; and observations of changes in landscape and climate influencing wildfire regime (numbers in brackets refer to number of respondents who provided that response). Reproduced from Ray et al. 2012:6).

