Boots on the Ground
Caribou Monitoring Program

2017 Results

Tłı̨chǫ
Traditional Knowledge
and Land Use Study

Dedats'eetsaa:
Tłı̨chǫ Research & Training Institute
www.research.tlicho.ca

2018

Boots on the Ground

2017 Results

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Tłı̨chǫ Yatıì

Placenames

Kokètì	Contwoyto Lake
Deèzàatì	Point Lake
Ek'atì	Lac de Gras
Ek'adìì	Island on Lac de Gras
Ewaànıt'ıtì	Courageous Lake
Nǫdìikahtì	Mackay Lake
Ets'àitì	Rawalpindi Lake
Łiwets'aɔòats'ahtì	Lac de Sauvage

Geography

Nǫɔokè	Water crossing
Tataa	Land between water bodies
Whatàa	Esker
Hozìı shìa	Low hill/ mountain on barrenland
Daka	High points
Tì	Lake/water
Taiɔaa	Meandering river
Dı	Island
Tabàa	Lake shore
Tı k'abàa	Shoreline (walking by the shoreline)
Nàłeèzheà	Caribou calving grounds
Dechı̨laa	Treeline

Animals

Ekwǫ̀	Barren-ground caribou
Hozii Ekwǫ̀	Bathurst caribou
Sahtì Ekwǫ̀	Bluenose east caribou
Ekwǫ̀ łexè k'eɔàa	Caribou herd
Ekwǫ̀ akwe etłee	Caribou leader / lead caribou
Edè	Caribou antlers
Ekwǫ̀ keè	Caribou tracks
Ekwǫ̀ ek'a	Caribou fat
Dìga	Male wolf
Digats'e	Female wolf
Diga woza	Wolf son/children
Diga nade	Wolf family
Diga eɔoo	Wolf den
Sah dek'oo	Grizzly bear

Hozìı edzıe	Muskox
Didi	Ground squirrel
Kw'ıh	Mosquito
Behk'òts'ı̨ą	Arctic tern
Tatsǫ̀ / Hatsǫ̀	Raven
Det'ǫcho	Eagle

Weather

Nı̨hts'ı	Wind
Chǫh	Rain
Nı̨hts'ı nàtsoo	Strong wind
Nàetsı̨ / nàɔetsı̨	Weather sign
Nı̨hts'ık'oò	Wind clouds
K'ozıı naets'ı	Wind blows under the clouds
Wetaı̨ts'ıı	Wind swirl in between the tall puffy cumulus clouds
Hodzıı	Bad weather conditions
Ekwǫ̀ nı̨hts'ı k'è k'eɔà	Caribou follow the wind

Foreword

This project was conducted by the Dedats'eetsaa: Tłı̨chǫ Research and Training Institute (TRTI). TRTI brings together academic, government, non-governmental organizations (NGOs), and corporate and local Tłı̨chǫ organizations to collaborate on research in social, cultural, environmental, health, and wellness concerns for the Tłı̨chǫ. The mandate of TRTI is to advance the study of Tłı̨chǫ lands, language, culture, and way of life through the promotion of research and its use in education, training, planning, and monitoring purposes.

TRTI pursues its mandate by promoting research projects and activities involving elders and youth; developing and training Tłı̨chǫ researchers; developing and using indigenous research design and appropriate community methodologies; publishing work in a variety of media including online at www.Tłı̨chǫ.ca; contributing to the Tłı̨chǫ Digital Database of oral history, maps, photographs, video, and other documentary resources; reviewing proposed research submitted for licensing through the Aurora Research Institute; and providing support and assistance to approved research projects while promoting collaboration with academic and corporate partners. For more information on TRTI initiatives and programs please visit http://www.research.Tłı̨chǫ.ca.

Introduction

Boots on the Ground (BOTG) is a caribou monitoring program based upon the Traditional Knowledge (TK) of Tłı̨chǫ and Inuit indigenous elders and harvesters. The program is a collaboration between the Tłı̨chǫ Government, Government of Northwest Territories-Environment and Natural Resources (GNWT-ENR), the Wek'èezhìi Renewable Resource Board (WRRB) and Dominion Diamond Mines ULC (DD). Funding was provided by Tłı̨chǫ Government, DD and the GNWT-Cumulative Impact Monitoring Program[1] (CIMP).

The program commenced in the summer of 2016 and is expected to extend to 2021 or longer. The objectives are to monitor the conditions of Bathurst caribou on the post-calving range herd, focusing on four key indicators: (1) habitat; (2) caribou; (3) predators, and (4) industrial development.

This document is a yearly report presenting the results from the second field season of summer 2017. It provides the context and background of the program, and specifically:

- The TK framework of "We Watch Everything," a holistic monitoring approach combining biological and cultural perspectives;
- The field-based methodology named "Do as Hunters Do;" and details involved in recording knowledge in the field;
- The results from the second field season of summer 2017; and,
- A discussion of the results; focusing on the current state of caribou and cumulative impacts from mining infrastructure, predation and climate change.

[1] This article is Project CIMP94 of the Government of the Northwest Territories Department of Environment and Natural Resources, Northwest Territories Cumulative Impact Monitoring Program. CIMP coordinates, conducts and funds the collection, analysis and reporting of information related to environmental conditions in the NWT. More info can be found at: http://www.enr.gov.nt.ca/en/services/cumulative-impact-monitoring-program-nwt-cimp

Changes from the Previous Year

Fulfilling our mandate to continuously add or improve to the traditional knowledge collected regarding the Bathurst caribou and its habitat, and the methodology employed to collect, analyze, and present Traditional Knowledge, this year's report differs from the 2016 report in several aspects including:

- ✓ **A new chapter distribution.** Contents have been reorganized to reflect improvements in the program methodology and new results.
- ✓ **Redefinition of the TK framework.** Using the feedback provided to the 2016 report, the TK framework has been further developed using in-depth perspectives from indigenous harvesters.
- ✓ **Discussion** includes new analysis of the ecological roles of industrial and human activity on caribou post-calving range, predation, the appearance of new wildlife species, and the effects of climate change on caribou around Contwoyto Lake.

As a work in progress this report is not intended to provide conclusive evidence, but rather paint a picture in time and space of conditions in the monitoring area. For information about monitoring activities and results from 2016, please consult the report on TRTI website http://www.research.Tłı̨chǫ.ca.

Teams

The monitoring program is conducted by two teams of six monitors for each team. Each shift length is three weeks, at the end of which the next team flies in to relieve the first (Teams A and B, respectively). Each team consists of one elder, a younger hunter, a hunter/safety person, two local guides and a TK researcher. Selection to the teams is based on knowledge of the study area and suitability to this TK program, fitness for duty, and a person with a Wilderness Safety Certificate who can provide first aid and wildlife safety. This safety position is also chosen based on his/her knowledge of caribou and on-the-land skills. The TK researcher (research team) is the group of TK researchers who have been involved in the

Photo 1: The 2017 monitoring teams at base camp by Fry Inlet. From left: Mercie Koadloak, Roy Judas, Joe Zoe, Narcisse Rabesca, Leon Ekendia, Petter Jacobsen, Russell Drybones, John Franklin Koadloak, and Tyanna Steinwand.

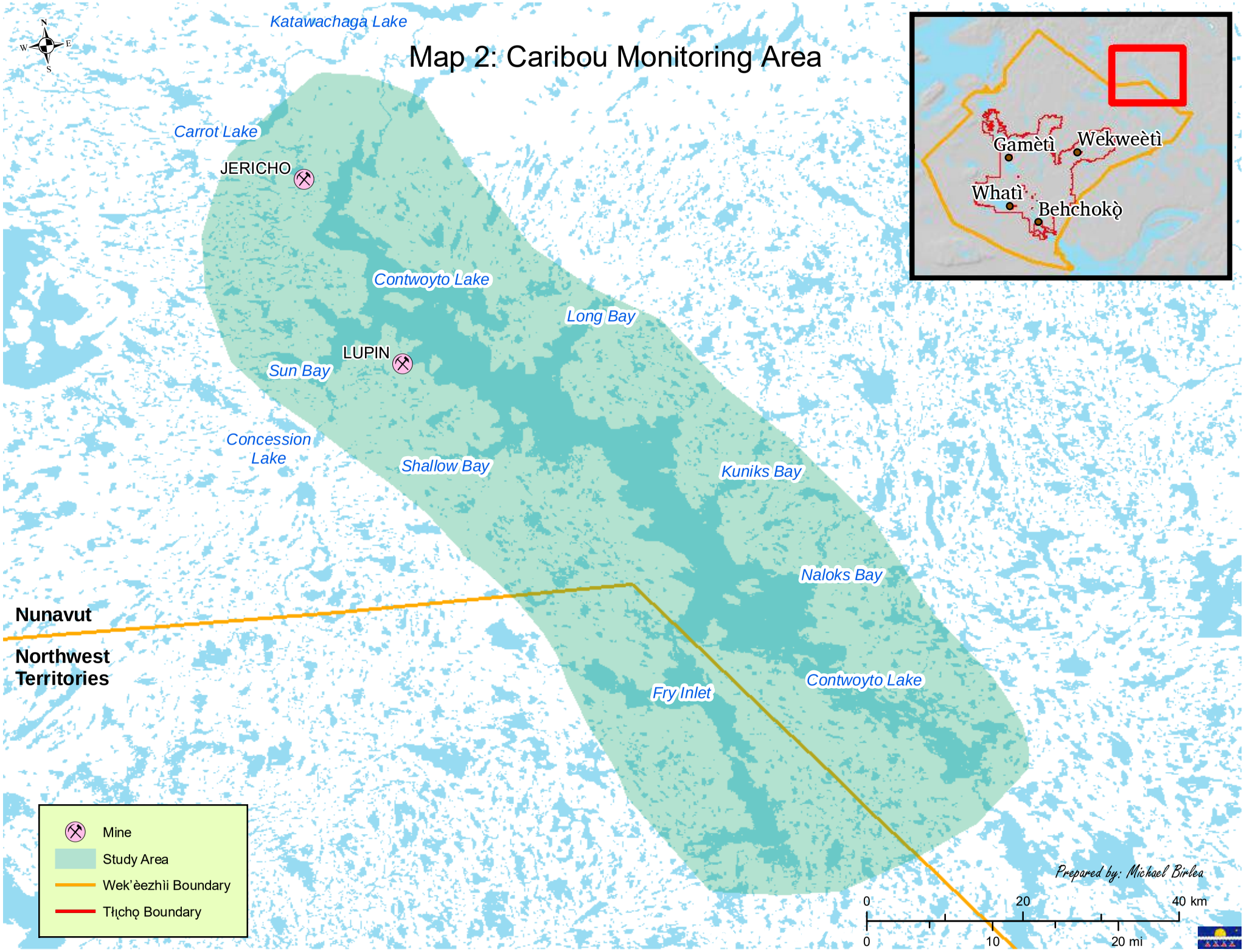
design, field implementation and refinement of the contents of this report. The TK researcher in the field documents observations using a participatory research approach and methods adapted from anthropological models.

Monitoring Area and Timeline

The monitoring area is comprised of Contwoyto Lake and Fry Inlet, and the surrounding land within one day's walking distance from these lakes (map 2). The monitoring continued for a six-week period between July 5th and August 15th. Specific monitoring locations within the study area were determined using the harvesters' traditional knowledge and Bathurst caribou GPS collar data collected every four days by ENR biologists. This monitoring area was chosen due to its ecological significance for caribou, and several under-researched factors in this region that could affect caribou health, behaviour and migration within its post-calving and summer ranges. These include: predators; climate change; insect harassment, and anthropogenic factors. The Tłı̨chǫ name for Contwoyto Lake is Kokètì, translated as "empty campsite lake," in reference to the many camps erected on this lake throughout history. Kokètì is southwest of the Bathurst caribou calving grounds, and the areas around the lake form part of the post-calving and summer range of the Bathurst caribou (Map 1). In July, during the post-calving aggregation, the herds of cows from the calving grounds mix with the bulls to form large herds numbering thousands of individuals. This area is therefore ecologically significant for caribou, during migration from their calving grounds and as the herds travel regularly between Kokètì and Ek'atì (Lac de Gras). Kokètì runs approximately northwest to southeast, bisecting the landscape. At its widest point, the lake is approximately 19 kilometres wide; numerous eskers, moraines, and islands form *nǫ̀ǫ̀kè* (water crossings) that caribou use to cross the lake yearly. The elongated shape of the lake creates a number of *nǫ̀ǫ̀kè* that caribou use to cross the lake, and established *ekwǫ̀ etǫ* (caribou trails) used by caribou annually. Hunters typically wait for caribou at these points.

Kokètì is the northernmost extent of Tłı̨chǫ traditional land use, and is an area shared by the Tłı̨chǫ and Inuit people for caribou hunting in summer and fall, fur trapping in winter, and as a trade route between the two cultures. Inuit and Tłı̨chǫ have a long history of meeting at historical caribou hunting locations. Contwoyto is accessible by canoe and floatplane during the summer; and in the winter months by snowmobile from Kugluktuk or southern communities. A winter road is built from Yellowknife through Contwoyto for mining resupply. There are currently two non-active mines (Lupin and Jericho) in the monitoring area, and several active mines south of the area (Ekati, Diavik, Snap Lake), as well as numerous abandoned exploration camps scattered across the landscape.

Map 1: Range of the Bathurst caribou herd, based on satellite-collared cows between 1996 and 2008 (Chen *et al* 2014).


Map 2: Caribou Monitoring Area
Katawachaga Lake
Carrot Lake
JERICHO
Contwoyto Lake
Long Bay
LUPIN
Sun Bay
Concession Lake
Shallow Bay
Kuniks Bay
Naloks Bay
Nunavut
Northwest Territories
Fry Inlet
Contwoyto Lake
Gamètì
Wekweètì
Whatì
Behchokǫ̀
Mine
Study Area
Wek'èezhìi Boundary
Tłı̨chǫ Boundary
Prepared by: Michael Birlea
0
20
40 km
0
10
20 mi

Climate and Vegetation

The study area is entirely within the Arctic Tundra climatic zone (Environment Canada, 1998) and a tundra biome (Map 3). Climate of this region is characterized by long winters and short summers, with an average growing season of 50 to 60 days and average temperatures range between -34°C in the winter and three to 12°C in the summer. Average precipitation, including melting snow, is variable but typically amounts to between 10 and 40 centimetres.

Climate data for Contwoyto Lake [hide]

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Record high °C (°F)	−2.4 (27.7)	−6.4 (20.5)	−2.8 (27)	5.6 (42.1)	16.7 (62.1)	24.4 (75.9)	27.2 (81)	26 (79)	16.7 (62.1)	8.3 (46.9)	0 (32)	6.1 (43)	27.2 (81)
Average high °C (°F)	−27.9 (−18.2)	−26.9 (−16.4)	−22.6 (−8.7)	−11.9 (10.6)	−0.9 (30.4)	9.5 (49.1)	14.9 (58.8)	12.8 (55)	4.7 (40.5)	−4.9 (23.2)	−16.4 (2.5)	−24.1 (−11.4)	7.1 (44.8)
Average low °C (°F)	−35.1 (−31.2)	−34.4 (−29.9)	−32.1 (−25.8)	−22.7 (−8.9)	−9.6 (14.7)	0 (32)	4.8 (40.6)	5.2 (41.4)	−0.8 (30.6)	−10.2 (13.6)	−23.9 (−11)	−31 (−24)	−15.8 (3.6)
Record low °C (°F)	−48.1 (−54.6)	−53.9 (−65)	−53.3 (−63.9)	−41.6 (−42.9)	−33.9 (−29)	−13.9 (7)	−2.2 (28)	−3.2 (26.2)	−11.9 (10.6)	−34.4 (−29.9)	−42.6 (−44.7)	−46.7 (−52.1)	−53.9 (−65)
Average precipitation mm (inches)	7 (0.28)	7.8 (0.307)	10.2 (0.402)	11.2 (0.441)	18.3 (0.72)	25.1 (0.988)	36.2 (1.425)	41.1 (1.618)	32.7 (1.287)	30.6 (1.205)	15.7 (0.618)	10.6 (0.417)	246.6 (9.709)

Source: 1961-1990 Environment Canada[3]

Figure 1: Temperatures and precipitation data for the study area.

The region is within the Laurentian Plateau (Canadian Shield), an area dominated by exposed Precambrian igneous and high-grade metamorphic rocks. Surface expression derives from glacial processes; the area is defined by undulating to hummocky terrain, with eskers, low hills and rocky outcrops overlooking numerous waterbodies, sediment basins, and wetlands. A layer of permafrost consisting mostly of gravel and finer material exists just below the surface. This semi-impermeable layer is covered by a layer of organics, soil, or bare parent material. The most common soil order of the study area is cryosolic soil formed in either mineral or organic material with permafrost within 1-2 meters to the surface (CSSC, 1993).

Due to the permafrost layer, water is retained in the upper portion of the ground. This phenomenon has contributed to the formation of wetland habitat and the retention of water near or around the surface, creating conditions for the development of shallow-rooted low shrubs, sedges, mosses, grasses, flowers, and lichens. Wildlife of the area include herbivorous mammals such as caribou, muskox arctic hares, squirrels, lemmings and voles, carnivorous mammals such as grizzly bears, artic foxes, wolverines, and wolves, and a wide variety of migratory bird and fish species.

Map 3: The monitoring area is located approximately 385 km north of Yellowknife and between the Northwest Territories and Nunavut, Canada.

The Tłı̨chǫ

The traditional territory of the Tłı̨chǫ is vast, and the network of hunting trails extends far into every corner of their lands. The four Tłı̨chǫ communities of Behchokǫ̀, Whatì, Gametì and Wekweètì are located in the boreal forest, and our land stretches far north of the treeline into the tundra, where many caribou hunting grounds are located. The traditional land use areas of the Tłı̨chǫ lie within the boundary known as "*Mǫwhì Gogha Dè Nı̨ıtłèè,*" which was outlined by Chief Mǫhwhıì during the negotiations of Treaty 11 in 1921 (Helm 1994). The traditional land consists of the area between Great Slave Lake and Great Bear Lake, from the Horn Plateau in the southwest, and as far north as the Coppermine River and Contwoyto Lake.

On August 4, 2005, the Tłı̨chǫ Agreement—the first land, resource, and self-government agreement in the N.W.T.—came into effect. This Agreement was signed by the Tłı̨chǫ and the Government of Canada, and established the Tłı̨chǫ Government's full powers and jurisdiction over 39,000 square kilometres of Tłı̨chǫ lands, wildlife and resources. The Tłı̨chǫ Agreement not only created the Tłı̨chǫ Government, but also set its mandate to preserve, protect and promote Aboriginal and Treaty rights and way of life—including culture, language, heritage, lands, economy and resources—for all Tłı̨chǫ today and for future generations to come.

The significance of the Agreement is that the Tłı̨chǫ people have ownership of 39,000 km^2 of land surrounding the four Tłı̨chǫ communities, including surface and subsurface rights to the area. The Agreement guarantees participation in the Wek'èezhìı Renewable Resource Board and the Wek'èezhìı Land and Water Board, the co-management boards governing the resources within Wek'èezhìı. The Tłı̨chǫ have their own lawmaking power over all Tłı̨chǫ citizens, including aspects of education, child and family services, income support, social housing, and other services.

Methodology

"We Watch Everything" Traditional Knowledge Framework

> *Certainly, Kluane people do not switch between their empirical knowledge of moose population and their non-empirical understandings of moose as other-than-human persons. The two are inseparable for them, each informing the other and imbuing it with meaning (Nadasdy 2003: 112).*

Boots on the Ground (BOTG) is an applied interdisciplinary research project that bridges observations of biological nature with cultural knowledge of local hunters (see figure 4 for overview of methodology. We adopt a biocultural approach to emphasize the Tłı̨chǫ as well as Inuit knowledge of the ecosystem in which they live. Biocultural approaches explore the link between biological and cultural diversity, and their interdependency with one another. The environment we live in has shaped our thoughts, actions and customs as much as humans have shaped the environment (Pilgrim and Pretty, 2010). A growing body of evidence suggests that global decreases in biodiversity are expressed in both biological and cultural terms. Furthermore, in this context, indigenous knowledge of ecological systems plays a key role in understanding reductions in animal abundance and distribution (Pretty et al, 2009; Pilgrim and Pretty, 2010). Our framework of research is based upon two methodologies developed over the course of the program named "We Watch Everything" and "Do as Hunters Do." The figure presented below illustrates the relationship and components of our methodology.

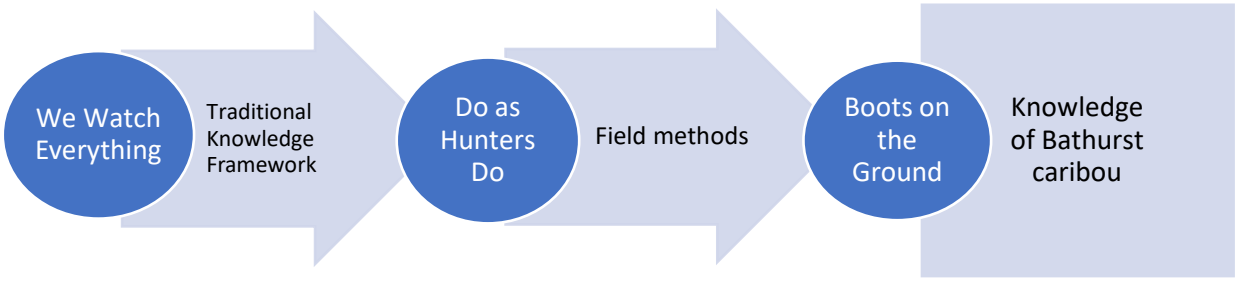


Figure 2: Relationship and components of Boots on the Ground.

We Watch Everything is a theoretical framework of Traditional Knowledge research founded upon participatory ethnographic research and a set of theoretical concepts shaping the way information is collected, analyzed and interpreted. The use of language, indigenous ontology and perspectives on nature form the pillars of the framework.

Language of Nature

Words and concepts within one's language set the mental maps which enable meaning and understanding to take place within the human brain. As knowledge of nature and of natural interactions is culturally situated and derives from the environmental adaptations of the culture that gave it its meaning, humans' experiences of nature are tied to their cultural interpretations. Using this notion, the idea that a universal truth of nature exists is avoided in favour of viewpoints based on cultural perspectives. Within different cultures and languages, a process in a physical environment may have quite different meanings. Furthermore, their response towards these processes might also be quite different depending on the pre-existing ideas and values within one's culture. The ideas and beliefs one holds of the environment direct one's actions towards nature (Ingold 2000; Sharp and Sharp 2015). Underlying the principle of "We Watch Everything" is an indigenous perspective on nature, and specifically that of Tłı̨chǫ and Inuit program participants. We let indigenous language and cultural practices related to caribou direct the monitoring so that their perspective on nature permeates the research program.

Developing a traditional knowledge environmental monitoring framework required that we recognize and adapt the values and ideas within the indigenous ontology. We use the word 'strive' to describe the process of translating and interpreting Tłı̨chǫ words and concepts into English, because words and cultural connotations related to nature often do not have direct parallels between the two languages. The interpretation of Tłı̨chǫ words and of their knowledge of nature requires awareness of cultural relativism and extensive efforts from both researcher and elders to ensure mutual comprehension. Concepts are explained using a common language and denominators established during the course of the research. An instance is the entry from the field journal recorded on the first year of the program, July 19th, 2016. After observing three muskoxen for over an hour, both the Tłı̨chǫ elder and Inuit harvester came to the agreement that they were "friends." When the researcher enquired as to the curious use of the word, the elder Moise Rabesca explained that their behaviour, posture, and the way they related to each other indicated a long-term association. The muskoxen "grew together," and now they were inseparable. From an ecologist's point of view, it would have been easy to discount the initial use of the word "friends" as a shallow characterization of Muskox's behaviour. Yet, such a notion would have failed to understand the depth of the hunter's empirical knowledge about muskoxen and the concept being presented. The elder

understood the association between muskoxen intimately because “if you kill one, the others will not let you go near the body. So, if you only need one you’ll need to take the other two” (Moise Rabesca). This knowledge of muskoxen behaviour was accumulated during numerous hunts and passed over from generation to generation across centuries of life on the land. Far from being shallow, it derived from an extensive and empirical set of observations conducted over a long period of time and specific to that area. This form of knowledge allowed the hunters to thrive in the arctic landscape. The statement also evoked times before the advent of firearms, and the ease in which hunters can now take the life of animals, whereas in the past each caribou or muskox had to be killed at close range, and often at great personal risk.

The Muskox example illustrates our approach following the elders’ teachings and way of interpreting the land to understand concepts, as opposed to classifying knowledge using Euro-Canadian standards. There is no word in English that closely resembles the connection described by the elders; however, through careful cultural interpretation and aided by the elders themselves, we can glimpse into a different worldview of interactions, one that is as ancient as the people who first hunted caribou in the landscape of Contwoyto Lake.

Land-based Theoretical Concepts

To achieve an indigenous perspective, the program employs Tłı̨chǫ words and cultural perspectives deeply ingrained in Tłı̨chǫ ontology. We call these perspectives theoretical concepts. In practice, while such concepts are abstract, they have a very concrete physical manifestation into the day-to-day thinking of Tłı̨chǫ hunters. An example is the concept of *dè*. *Dè* has a broader meaning than “land,” because it refers to a whole ecosystem or environment; “however, where the word ecosystem is based on the idea that living things exist in association with non-living elements, the Dogrib term *dè* expands the meaning of “association” to encompass the knowledge that everything in the environment has life and spirit” (Legat, Zoe & Chocolate, 1995). *Dè* is not an independent object “out there,” existing separate from culture and our daily lives, but rather is an all-encompassing, holistic system, of which indigenous culture is an integral part. As Allice Legat explained, “*dè* includes everything because all entities are in the state of existing and have spirit” (2012: 79). Surrounding the concept of *Dè* we defined four key theoretical concepts underlying the program’s traditional knowledge framework. These are sentience, interdependence, communication, and time immemorial (see Figure 3).

Photo 2: Joe Zoe and Mercie Koadloak fillet lake trout and char. The teams utilize local resources and fish is a stable diet.

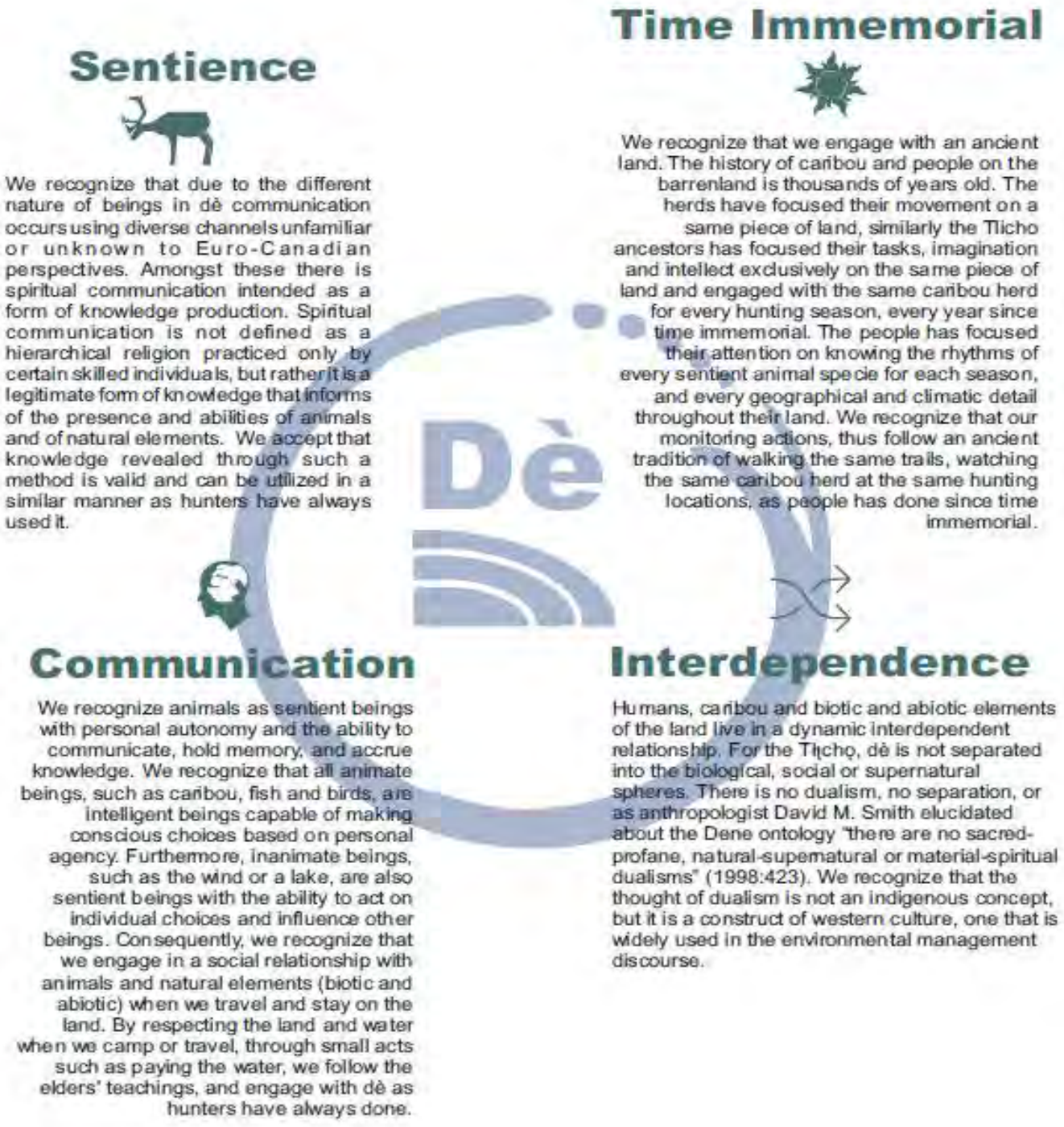


Figure 3: Elements of the traditional knowledge framework of Boots on the Ground.

Acting upon the principles of sentience, interdependence, communication and time immemorial, team members perform individual and collective rituals. One of the simplest and yet most powerful of these is "pay the land." Paying the land is done to neutralize our passage and become aware of our dependence on nature as human beings. This ritual involves simple acts of placing tobacco, or other valuable objects, in the water upon one's first arrival to a place. Other rituals are propitiatory in nature and performed to ask for safety. "Feeding" the fire is a ritual performed collectively to mitigate ones' presence and ask for safe passage and for harmony to be maintained. The *Nı̨hts'ı whìle agowedee* ritual is performed to calm down the wind. A fire is made of a small raft and accompanied with specific words is set to drift with the wind on a lake. The purpose is to communicate with the wind, to ask for safe passage or for the wind to calm.

Through such actions, the team communicates and engages with the land on a social level; "the land, then, is a living entity with powers that should be respected if harmony is to be maintained" (Legat 2008: 37). During such engagement, the land is comparable to ones' parents (Legat 2008), who provide everything for the people's sustenance. Tłı̨chǫ use the word *Dè Gogha Nàeɔ̀ı̨* ("the land shows favour to us") to understand how the land feels about our presence.

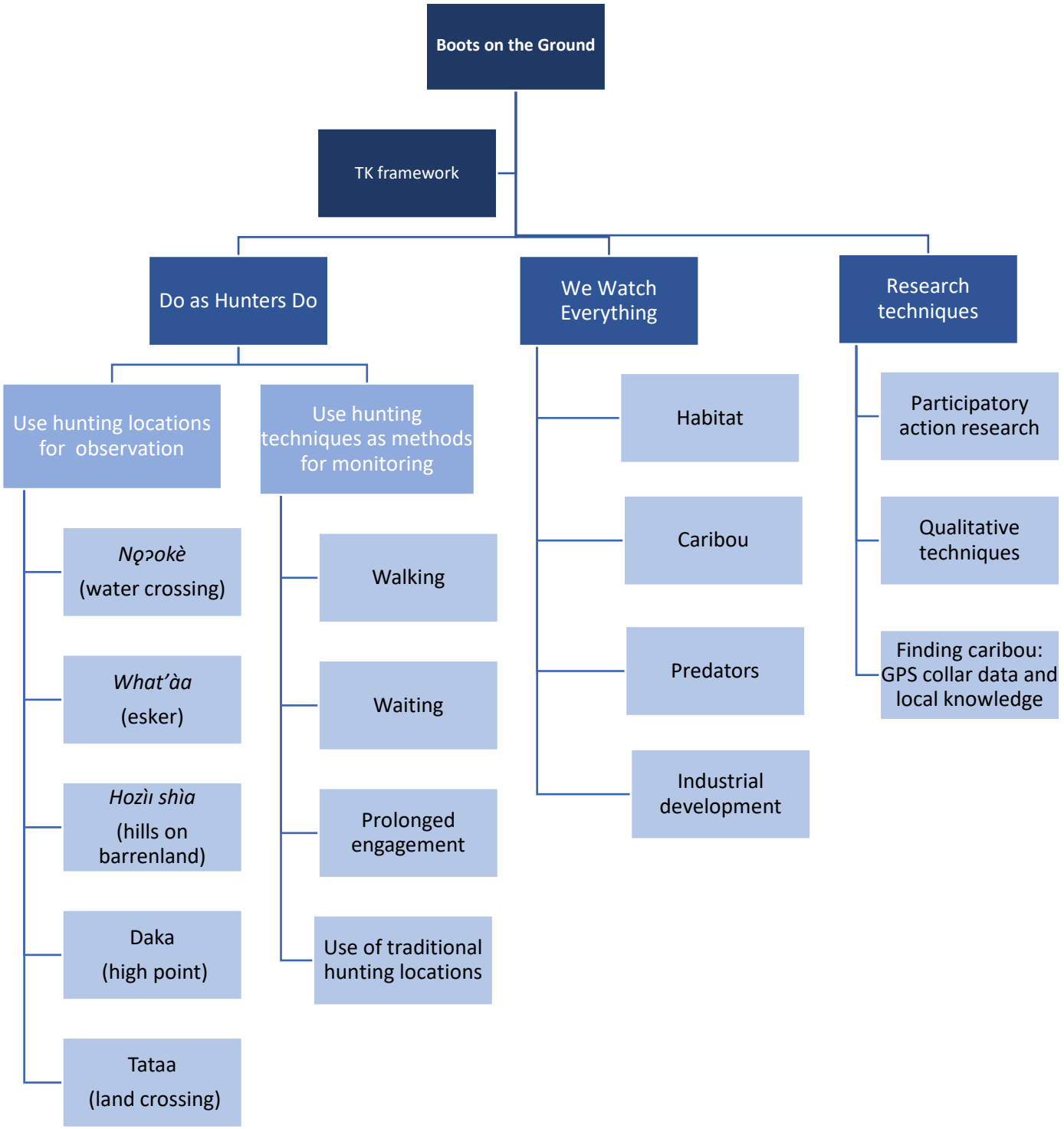
Field Methods: "Do as Hunters Do"

"Do as Hunters Do" is the practical implementation of the "We Watch Everything" methodology framework. The name was chosen because our research emulates traditional indigenous caribou hunting in the barrenlands (no real hunting occurred). Using a participatory action research approach, members of the "hunting party" travel to specific locations on the barrenlands to find caribou together, collectively participating, experiencing, and sharing knowledge. Using a PAR approach, the researchers become part of the "hunting team" under the direction of the elders and the local harvesters, as traditionally done in Tłı̨chǫ culture. This form of PAR research can be defined as a process of self-investigation shaped by collective decision-making among the team members.

The essence of "Do as Hunters Do" is the recognition that a TK monitoring program does not need to develop new methods; rather, it should learn from and adapt to the cultural practices developed, since time immemorial, by experienced indigenous harvesters to sustain their communities in the arctic environment. In order to comfortably live in the Arctic, Tłı̨chǫ and Inuit hunters developed sophisticated ways of looking at the landscapes surrounding them and locating animals as well as other sustenance sources. These were incorporated as effective tools within our research framework.

Photo 3: Joe Zoe watching herd at close range by Fry Inlet. July 21, 2017.

Figure 4: Overview of Boots on the Ground Methodology.



Overview of "Do as Hunters Do" Methods

The "Do as Hunters Do" field data collection process unfolds through a set of techniques and concepts that are specifically related to the landscapes of Contwoyto Lake. These techniques combine the Traditional Knowledge of harvesters with elements of anthropology and science and consist of using hunting locations for observations and the use of hunting techniques for monitoring.

Hunting Locations as Methods of Observation

The program makes use of *nǫɔokè* and *tataa* to understand how and where caribou herds will travel over the vast barren landscapes. By relying on these concepts, along with the collar information provided by ENR, the teams can place themselves in the best location prior to the arrival of the herds. Caribou monitoring and the recording of TK is inextricably related to the Tłı̨chǫ concept of land. Located in the barrenlands (tundra) region of the Northwest Territories and Nunavut, the vast subarctic prairies surrounding *Kokètì* are dominated by granitic outcrops, glacial outwash, eskers, moraines, and other landscape features created by continental glaciation. We considered such geomorphological features, as well as cultural associations to identify locations where caribou travel, feed, rest or move at certain times of the year. By conducting observations from the key locations described below, we document information about the factors affecting the herd.

Observations at *Nǫɔokè*

Nǫɔokè (watercrossings) are the closest points of contact between land across waterbodies, used by caribou to cross the numerous large lakes dotting the tundra. *Kǫketì*, the largest water body within our study area, has numerous eskers used as *nǫɔokè*. *Nǫɔokè* eskers are typically long twisted ridges formed by the movement of ice melt and deposits of sand and gravel reaching from shore, or between islands. As part of our methodology, waiting at a *nǫɔokè* allows the researchers to "Do as Hunters Do" and therefore:

- Observe animals in close proximity.
- Observe herd dynamics.
- Observe the behaviour of predators who are following or waiting for caribou herds.
- Determine the relative importance of attributes such as the presence of sand, rocks, and prevalent winds for caribou choice of crossing.

Nǫɔokè are crucial to understanding caribou migration. Local harvesters, sensing the landscape "as caribou would," developed expertise in identifying *nǫɔokè*, and know which *nǫɔokè* will be used by studying the details of the crossing, including, but not limited to: topography; surface materials; underwater hazards, and so on. Old campsites often reveal the location of the main *nǫɔokè,* as they were established by hunters to easily reach the crossing without interrupting the herd's movement. The Boots on the Ground program employs the same knowledge of geography and uses the old hunters' campsites close to crossings, to avoid further interrupting caribou movement.

Caribou are good swimmers, and often enter the water as a means to escape from predators or insect harassment. Their outer guard hairs are hollow and provide excellent flotation, while their wide hooves can transport them quickly forward. *Nǫɔokè* is a Tłı̨chǫ term that literally means "swim across." It refers to the interface between water, land, and caribou movement. When the herds travel over the vast land, they need to walk around large waterbodies on their migration routes. But at times they prefer to swim across water bodies rather than walk the long way around. In those circumstances, they often enter the water at the point of shortest distance to the other side (although, as pointed out by the elders, other

factors, such as the presence of large boulders or perceived hazards, may influence the herd's decision to cross).

Observations at *Tataa*

Tataa is another important word to understand caribou migration. It refers to caribou movement relative to water bodies, and literally means "in the midst of waters" (Whaèhdôö Nàowoò Kö 2002:21). The large lakes and numerous water bodies encountered on the migration routes create obstacles that the herds must travel around. A *tataa* is a channel of land between lakes—a land bridge that allows caribou to cross large lakes along their migration routes. A *tataa* can refer to either a small channel of land, such as the one between *Ek'atì (Lac de Gras)* and *Łiwets'aɔòats'ahtì* (Lac de Sauvage), or a larger land crossing, such as the one between *Nǫdìikahtì* (Mackay Lake) and *Ewaànıt'ıtı (Courageous Lake)*, or between *Ek'atì* and *Nǫdìikahtì*. The concept of *tataa* is also used by the elders to refer to a migration route, for example *Ek'atì tataa*. This *tataa* refers specifically to "land bound by Ekati [and Ewaànıt'ıtı and Nǫdìikahtì]" (Whaèhdôö Nàowoò Kö 2002:21). Used in various situations, the concept of *tataa* has several meanings depending on the context in which it is used. Observations at *tataa* include:

- Detailed understanding of caribou migration on local and regional scales.
- Details of herd dynamics.
- Migration patterns in relation to industrial infrastructure.
- Dynamics between predators and caribou migration.
- Details of migration routes in relation to valuable feeding grounds.

Follow *Ekwo Eto* (Caribou Trails)

Observations related to caribou trails include:

- Caribou forage and diet.
- Looking for fresh or older tracks. Direction and time of track demonstrate patterns of movement.
- Predator behaviour.
- Cow-calf relationships.
- Estimates of the number and health of injured animals falling behind, and their interaction with predators.

Ekwo eto are numerous and interspersed throughout the northern landscape. The location and significance of caribou trails is recorded to help locate animals across the land, determine animal distribution, and document caribou behaviour.

Follow *Tı K'abàa* (Shorelines)

The analysis of *tı k'abàa* is essential to understand both n*ǫɔokè*, constraints on movement, and presence of predators. By observing local shorelines, researchers can:

- Understand how shorelines are used in the context of n*ǫɔokè* and *tataa.*
    - Observe animal signs in soft material such as sand.
    - Observe predators, since they usually walk along shorelines to smell anything that comes downwind from the lake.

- Observe and record the locations of “white shores,” where caribou hair, dispersed by the herd during swimming, accumulates on the beach, giving the impression of snow or white foam.

Observations from *Daka* (high points)

Daka (high points) across the landscape such as *hozìı shìa* (hills on barrenland) and *what’àa* (eskers) were extensively used by the team to choose the direction of travel, locate features such as favourable pastures rich in lichen and other forage, track the progression of predators and other species, and as points of observation with limited insect harassment. Elevation points are useful to:

- Gain an understanding of caribou movement over various types of landscape features.
- Understand insect harassment and the factors affecting its intensity such as wind speed and weather.
- Assess vegetation quality and caribou forage areas.

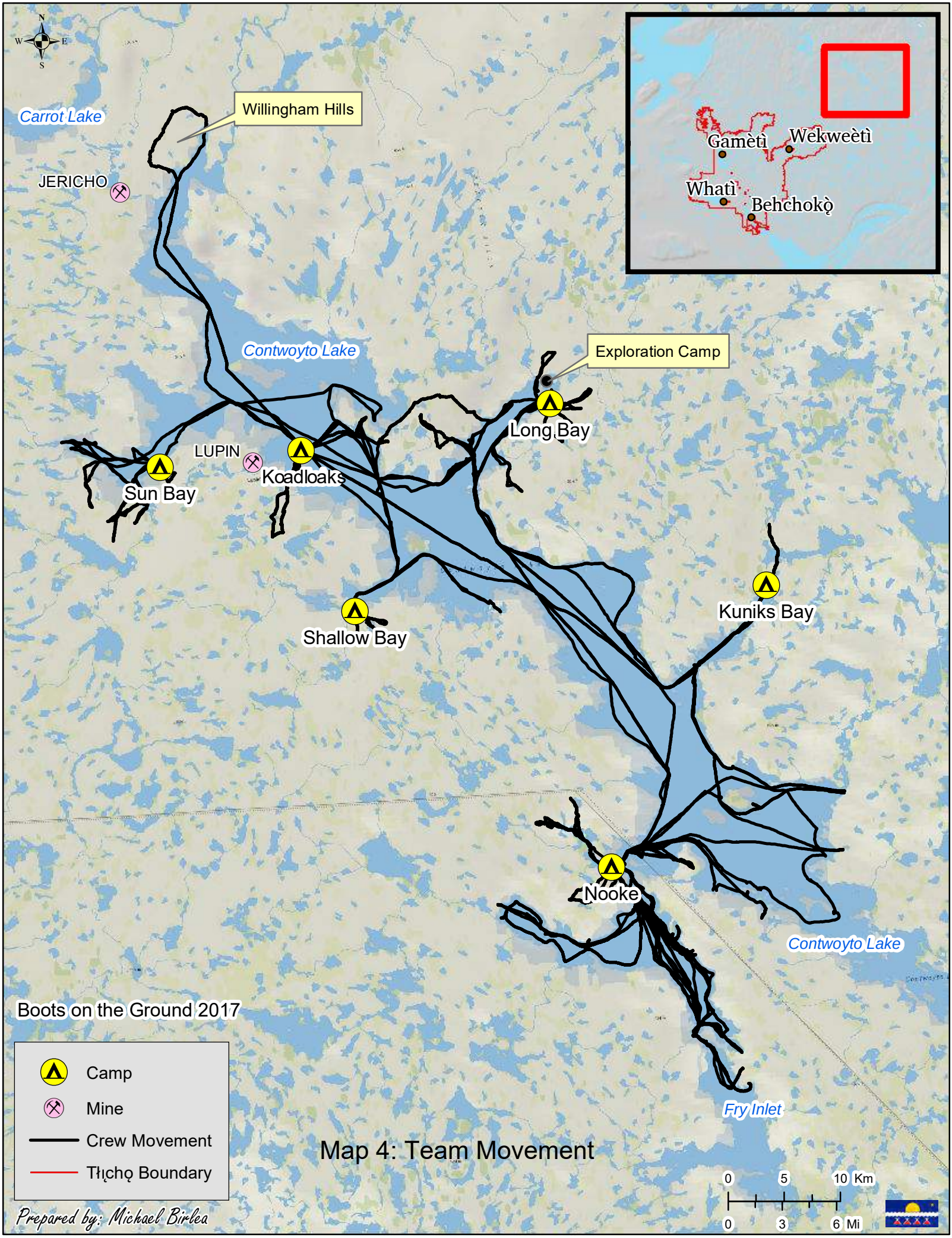
Photo 4: Joe Zoe, Russell Drybones and Narcisse Rabesca watching the land south of Lupin mine, July 17th, 2017.

Hunting Techniques as Methods of Observation

The location of our main camp, close to the *nǫ̀ɔ̀kè* (water crossing) between Kokètì (Contwoyto Lake) and Fry Inlet (see Map 4), in Northwest Territories, was located at the northernmost range of the Tłı̨chǫ land use. In times past, people travelled by birch bark canoes and later with canvas canoes along the waterways from their settlements south of the treeline to this location purely for caribou hunting. They followed shorelines by boat, then beached at known caribou water crossings. Families set their camps short distances from the crossings, so as not to disturb the potential movement of caribou. From camp, hunters walked to high points or eskers, where they waited and watched for any movement on the land surrounding the crossing. The waiting could take days, or weeks. Once animals were seen, the hunters would wait close by in their canoes. Along the shoreline, the women would often sit and wait behind boulders or in the low bushes, the *kwea* (dwarf birches). Once a herd started to swim across, the hunters would allow the first group to make their way through. Once the first herd had passed and made their scent marks on the trail, the hunters knew more caribou would follow. As the following herds entered the water and started swimming, the hunters would approach in their canoes to spear or shoot animals in the water. This strategy allowed hunters to approach their prey closely and select the animal they wanted to harvest. Once caribou were killed, the women would appear from their hiding places to butcher and process the meat. The killing was usually the first and easiest step in the long and strenuous process of preparing the meat and transporting it back to communities, sometimes hundreds of kilometres away.

Since the introduction of colonial government policies and settlement into communities, Tłı̨chǫ land-use has decreased in its geographical extent and intensity. Additionally, the advance of technologies, such as the airplane and snowmobile, have made transportation easier, but simultaneously, discontinued long and hard travel by canoe and dog teams—and thus the use of the traditional trail system into the areas farther away from the settled communities. This program sought to revive ancient traditions and trails by applying similar techniques and concepts. Observations from the *daka* (hilltop) such as *hozìı shìa* (hills on barrenland) and *what'àa* (eskers) were the main tools applied by the team to locate caribou. Hiking eskers to observe the land from its highest point was performed daily. In the early mornings, the team hiked to a high point close to camp to look for recent animal activity, direction of fresh tracks or circling ravens. At numerous high points dotting Contwoyto Lake, we found archeological evidence of previous hunting activity. Tent stone circles (Photo 5) were found at many of the high points along eskers. Previous hunters had set their tents at these best locations to spot caribou. At other eskers, we found arrowheads (Photo 5). Advised by local hunters, our main camp was established approximately two kilometres north of the main *nǫɔokè*. The camp location had been used for centuries by Tłı̨chǫ and Inuit. One kilometre west of the main camp was a long, tall esker, stretching in a north-south direction, where we could do as hunters have always done, and watch the land for animal movement surrounding the *nǫɔokè*.

Photo 5: From left to right: tent stone circle on *what'àa* (esker); iron arrow point; ivory scraper or arrowhead.


Willingham Hills
Carrot Lake
JERICHO
Contwoyto Lake
Exploration Camp
Long Bay
LUPIN
Koadloaks
Sun Bay
Shallow Bay
Kuniks Bay
Nooke
Contwoyto Lake
Fry Inlet
Gamètì
Wekweètì
Whatì
Behchokǫ̀
Boots on the Ground 2017
Camp
Mine
Crew Movement
Tłı̨chǫ Boundary
Map 4: Team Movement
0 5 10 Km
0 3 6 Mi
Prepared by: Michael Birlea

Waiting

The "Do as Hunters Do" methodology is inherently based on foot movement over the land and waiting at strategic places, such as higher elevations with a viewpoint or known *nǫɔokè*; places where caribou are expected to migrate. As caribou herds are constantly moving, it is necessary to meet them on their travels, and hunters identified the best locations to run into them. They regularly travelled to these locations and simply waited. By doing as hunters do, and including waiting in our methodology, we engaged with the land and became active participants in the research. From an anthropological perspective, there are numerous research benefits related to waiting for prey for prolonged periods of time. Waiting provided time for casual conversation about research topics, the land and culture. Furthermore, waiting was an opportunity to feel and become acquainted with the land. Every day, the team sat on the high esker west of the camp for hours, watching, listening, and feeling the weather. Sitting on the esker between two and eight hours each day, in morning, midday and evenings, we had the opportunity to observe weather systems move over us, feel the shifting wind, the rain and the cold, and—delightfully—the heat of the sun once the clouds cleared. Living in close contact with the land fosters a connection with elements of *dè* that goes beyond ordinary observations. As a traditional knowledge framework, we recognize that knowledge is at times revealed through "dreaming." Sitting in silence on the esker, watching for hours on the barrenland, one can close their eyes, and drift into a dreaming state while the other team members continue watching. In Tłı̨chǫ, the word to dream— "*nate*"—is the same word as to foresee ("*nate*"—pronounced "NAH-te") (Helm 1994, Goulet 1994). As the Tłı̨chǫ language reveals, one can foresee a situation by dreaming, just as in the dream the land and animal spirits can communicate with the dreamer. We use the word "dreaming" for the lack of a better English term and following the practice of other scholars when describing this action among the Dene (Helm, Goulet, Legat). It is important to recognize this potential and engage with the environment as people have done for generations while waiting for caribou on the eskers.

Waiting is therefore intended as a vigilant watch, a state of mind in which the team members engage personally with the landscape. Such prolonged personal engagement with the daily weather conditions, physical movement over various terrains and close encounters with local animals, shapes the mental state of each team member, and thus the overall team's ability to monitor caribou. In waiting, the hunter naturally acquires a great deal of knowledge about his local situation. Expending large amounts of time on the land was an essential part of our methodology, critical for our ability to conduct research and record information.

Time

The "Do as Hunters Do" methodology requires ample time due to its ground-based approach. Time is required, for example, to adjust to the daily and seasonal weather patterns. Weather decides everything on the barrenlands; the wind and waves direct all movements and actions; thus, plans get delayed and remade constantly. The most appropriate tool we can employ is time, implemented by waiting and watching. A long-term approach is necessary to get more than momentary observations, and to fully understand the life of caribou on the land. Long-term monitoring, defined in terms of years of repeated research periods, allows the researcher and the hunters to discern ecological patterns.

Walking

Walking is simultaneously the slowest form of transportation and the most intimate form of movement over any landscape. As a research method, walking provides the team with the time necessary to watch for details and identify clues of presence left behind by animals. The teams walked between five and 20

kilometres per day. After 40 days of field work this year, we had covered 1,186 kilometres by foot and boat. The long walks into the surrounding landscape from camp were made from *daka (high point)* () to *daka*, from one high point to the next. As we reached a *daka*, such as an esker or hilltop, we would sit, watch over the surrounding landscape, and wait. If no animal movements were seen for one to three hours, we proceeded to the next *daka*, and continued watching. This is the same method as hunters use when hunting for caribou on the barrenlands in the fall.

Walking along the caribou trails proved a valuable method for monitoring and an intimate understanding of the landscape, and therefore invaluable insights into animal behaviour. By walking caribou paths, we identified the herd's preference for types of terrain during migration, as well as the types of terrain avoided, which vegetation was foraged, and signs of other animals or predators in the vicinity of the herds. Walking is also the least intrusive form of monitoring, as no permanent marks remain and no excessive noise is made. As animals, we humans do leave a mark of scent, by rubbing our rubber and leather boots or clothes against rocks or vegetation. As directed by the elders and the harvesters, we took care to never walk directly through any caribou trails for two to three days after a herd had used them, to avoid disrupting the caribou scent on the trails, in case other herds would follow in their footsteps.

Photo 6: from left to right: walking the land following caribou trails by naloks; following esker north of Kuniks Bay.

Monitoring Indicators: *"We Watch Everything"*

Monitoring is based on the periodic assessment of key indicators, which were developed using interdisciplinary approach. In the first place, indicators were refined using the elders' knowledge of the Bathurst herd through *dè*. Second, we considered scientific wildlife monitoring indicators, and integrated or adapted some of these into our research. Based on the holistic Tłı̨chǫ concept of "We Watch Everything," the elders highlighted several related elements to be included for an analysis of caribou and habitat assessment. The resulting list of criteria guiding our research include: (1) habitat; (2) caribou; (3) predators, and (4) industrial development.

Indicator 1: Habitat

- Daily weather pattern (temperature, wind direction, humidity, barometric pressure)
    a. Caribou behaviour in response to weather
    b. Daily insect activity in response to weather
- Caribou and predator behaviour in response to weather/ insect activity

- Conditions of vegetation and caribou forage
- Effects of environmental changes on habitat and caribou

Indicator 2: Caribou

Caribou health

- Unhealthy: skinny; bony; fatigued
- Healthy: normal conditions. No bones visible on rump and back
- Healthy: Layer of fat shows on the neck and back, and back to rump. Look at tail: if it's short, then the animal is fat and healthy

Hide color

- Unhealthy: discoloured; patchy
- Healthy: nice color; no patches. In July: white colored hide (shed winter coat in June- July); August: darker color and shorter hair (new winter coat is coming)

Walking posture

- Unhealthy: walking with lagging head
- Healthy: prancing, or normal posture; head straight or slightly down when walking

Injured animals

- Number of caribou injured in the herd
- Types of injuries
- Signs of disease

Calves

- Cow-to-calf ratio
- Number of cows without calves
- Number of twins: sign of a healthy herd, as the cow is healthy enough to support two calves—demonstrates cows have not been under stress, and good habitat quality

Indicator 3: Predators

- Number and location of caribou predators
    a. Signs: tracks, kill sites
- Relationship between caribou and predators

Indicator 4: Industrial Development

- Caribou behaviour and movement affected by visible presence, noise, scent from industrial infrastructure and activities

Recording Knowledge

We chose to adopt a participatory action research approach (PAR) as the overarching framework for documentation during the field program. Participatory action research is a research approach emphasizing a close working relationship between the lead researchers and program participants, evolving research questions, and fact-finding through collective efforts. Contrary to other forms of investigation, participatory approaches democratize knowledge production and decision-making, and foster opportunities for empowerment for those involved (Legat 2012). The ability to become engaged as a team through participatory research ("Do as Hunters Do") enables researchers to learn and explore emotional, spiritual and cultural transformations. Taking a participatory approach provides opportunities for learning ways of knowing that are uncommon to western thought. The purpose of taking a personal experiential approach and using naiveté as experiential tool allows the researchers to be open to other

cultural ways of interpreting, perceiving and knowing the world (Young and Goulet 1998). Such an approach is necessary to focus on the emic (relating to internal cultural elements [I think a definition is necessary, this term is technical, and is not in my Oxford English Dictionary]) voice and actively avoid biased interpretations. Therefore, fieldwork not only entails the collection of information, but is a totalizing experience that engages the whole being of the participants (Okely 1992).

Qualitative Techniques

Documentation of TK occurs during monitoring sessions throughout the day, including discussions in the mornings and evenings. Having a TK researcher enables the team to record information through casual conversations and individual sessions with the elders. We follow standard Tłı̨chǫ Research and Training Institute (TRTI) methodology for traditional knowledge research (Tłı̨chǫ Research and Training Institute 2012, 2013, 2015 and 2016). This documentation technique applies to both the open-ended and semi-structured methods.

Field Notes Protocols

Field notes protocols were created to provide consistency between the researchers' observations. Table 1 provides an overview of the information collected by the researcher each day.

ITEM	**DESCRIPTION**
WEATHER (from portable weather station)	
Temperature:	Humidity:
Wind Speed:	Wind direction
Weather Notes: *describe daily weather*	
Weather/Insect: *describe insect harassment in relation to weather and wind speed*	
Weather/wildlife: *describe wildlife activity in relation to weather*	
WILDLIFE OBSERVATION NUMBER	
Number of animals:	Species:
Description: *describe animal activity, including location, behaviour, signs, and method and location of observation.*	
TK NOTES	
Title: *key word used for content analysis, i.e. caribou hunting on* Kokètì	Description: *Describe elder's knowledge*
END OF DAY SUMMARY	
Km travelled:	Total time of observation:
No. of animals: totals	Key Tłı̨chǫ words/concepts:
Highlights for the day:	

Table 1: Template for observations.

The template provides consistency to the daily observations and experience of the team. The recording is completed in a field journal, using Rite-in-the-Rain™ waterproof writing equipment. A designated number is assigned for each new observation. The template systemizes the recording, while the notes themselves are flexible and open-ended, to allow for different durations of each observations, and adjusting to the nature of the elders' descriptions. The note-taking is conducted throughout the day by the researcher, in accordance with explanations made by elders.

At the end of each day, the daily totals are tabulated into a master sheet saved in a shared drive. Photographs and spatial data in the form of tracks and waypoints are saved in separate folders, one for each day of fieldwork. Spatial data daily totals are analyzed each evening by the lead researcher to identify gaps in spatial coverage of areas, update team progresses, and identify new areas to present to the group for discussion. A morning meeting is held to discuss the previous day's observations and plans for the day's monitoring activities and locations.

Researcher and Elder

Personal knowledge, including the lead researcher's western academic, professional background can become a source of bias when working with indigenous peoples' knowledge of the land. It is often necessary for the researcher to undergo a process of acknowledging his or her own limitations, recognizing personal points of view and opinions, in order to avoid judgmental approaches and appreciate the differences between cultures and personal backgrounds. We define this process as maintaining naiveté, described as the skill of the researcher to be a novice, someone who genuinely wants to learn a new culture (Russel 2006). In this program, the relationship between the elder and the researcher is akin to that of an elder and a junior hunter and can be summarized into the role of teacher and participant-observer. From the researcher's perspective, participant-observers are insiders who participate, observe and record aspects of the life around them, in this case the TK of elders and harvesters.

Techniques for eliciting and documenting information are often based on the personal characteristics of each elder. Each elder has a different knowledge set and different ways of expressing him or herself. Some elders elaborated more than others and chose to communicate in long monologues. During such conversations, it is better to adapt to the characteristics of the elder and sit and listen without interrupting, rather than interrupt with a series of questions (Jacobsen 2011).

This method follows the cultural characteristics of learning among the Dene and Tłı̨chǫ cultures, in which knowledge is transferred mainly through personal observation, experience and storytelling, rather than solely by direct question-and-answer (Legat 2012; Goulet 1998). The Tłı̨chǫ and other Dene peoples share similar cultural attributes related to learning that differ from those of Euro-Canadian societies. The elder wants the researcher to learn in the same ways that they learn, preferably through personal experience and observation (Legat 2012, Goulet 1998, Guedon 1988, Ridington 1988). The use of direct questions often yields useful information and descriptive stories of the land, but open-ended conversations in which the elders take the role of teachers and explain the areas they feel important from their own experiences on the land are usually the most successful and insightful. This method of research is more in-tune with Tłı̨chǫ traditional forms of teaching and, thus, enhances the research process.

Analysis

The complex methodology of the TK program—combining ecological observations with cultural knowledge about landscapes—requires a multidisciplinary data analysis approach. Information collected in field journals during the pilot season were gathered using Participatory Action Research (PAR) and ethnographic documentation, and analyzed using content analysis, a technique that systematically categorizes and describes written, spoken, or visual forms of communication. This method was chosen as the primary technique of data analysis because it allows for qualitative text interpretation, while providing a framework for data analysis that can be employed for the duration of the multi-year program.

The field journals captured specific observations of wildlife and statements made by elders and monitors during daily observations and team meetings. Content analysis of the recorded field data was completed by TK researchers using standard TRTI research analysis methodology (Tłı̨chǫ Research and Training Institute 2012, 2016, 2017). Content analysis consisted of developing categories and identifying sub-themes and codes within each category. The categories parallel the monitoring focus of habitat and environment, caribou, predators and industrial development, while the emerging sub-categories and codes often cross between the categories. We approach content analysis using both quantitative techniques, for specific observations, and qualitative techniques for recorded TK statements.

Photo 7, left: waiting and watching; teams positioned on *daka* north on Long Bay July 11th, 2017.
Photo 8, right: teams positioned on *daka* in the Willingham Hills on July 14th, 2017.

The monitoring indicators were delineated prior to and during the field season. We identified main categories from the statements collected in the journals. The statements were divided into categories (i.e. caribou) and sub-categories (i.e. caribou migration). These categories were coded using keywords selected from the elders' statements; this way, each category was imbued with meaning and personal stories from the elders' lived experiences on the land. These were subsequently divided into sub-categories as required to provide the necessary definition to each topic (i.e. caribou health). The result of content analysis are tables of statements, from which inferences about trends, patterns, and correlations can be made.

Additional statements collected by the researchers relate to team experiences, often of multi-day events, as well as experiences of weather systems or recurring animal observations. By using the ethnographic and PAR format of data gathering, the researchers were able to observe and live each phenomenon from the point of view of the subject of the study, and document traditional knowledge. In TK research, it is often challenging to include knowledge that is shared privately between elder and researcher, as some types of knowledge are only shared in certain situations and to certain people. For example, knowledge of grizzly bears would not be discussed openly among team members in the field. Or, knowledge of spiritual aspects of caribou migration can/will only be shared to certain people. This form of knowledge often escapes the boundaries of theoretical classifications and categories. Therefore, in employing content analysis as the sole analytical technique, the researcher risks losing the depth and intensity of the lived experience as part of the "hunting team." As an attempt to avoid this, we combined content analysis with qualitative descriptions of experiences.

Finding Caribou

The main challenge for monitoring caribou is finding caribou. In general, caribou migrate southwest, from their calving grounds, in early July, toward the general area of Kokètì and Fry Inlet, and remains in the area throughout July and August. However, at a finer scale, the herd's movements are very unpredictable; different valleys, shorelines or specific *nǫʔokè* may be used in one season and not another. In our field program, the knowledge of the team's harvesters and scientific radio collar data received every four days allowed us to locate the herds and position ourselves in the right location.

Collar Data

Collar information provides a specific geographic location of male and female caribou. Every fourth day, ENR caribou biologists provided collar information over satellite phone. The collar information provides the exact location of caribou at a specific time every fourth day. The challenge for the program is knowing where the herds are during the four days in between. Following the movement south from the calving grounds, a post-calving aggregation happens in July; from that time, caribou spread out in larger herds. During the aggregation, the animals gather in large groups and move with purpose at a fast pace. If a herd is located on one side of a lake on the day we receive the collar information, it might have moved to the opposite side of the lake by the next day. Or one herd might split into two herds and move different ways.

Local Knowledge

Since herds can move long distances each day, local knowledge was necessary to identify where to best position ourselves to intercept caribou before they moved to areas inaccessible by our transportation methods. Building camp near frequently used *nǫʔokè* and waiting is the traditional and most efficient way to ensure meeting caribou. Local knowledge identified which locations would be best suited to have a semi-permanent camp. John Franklin Koadloak, who has lived most of his life on *Kokètì*, pointed out the best camp locations, and where to go by boat and foot to meet the herds. His detailed local knowledge of geography and topography, by land and water, proved vital for our ability to best position ourselves.

We learned that the success of the program is dependent on following exactly what local harvesters and elders have always done on the lake: travel similar routes; set camp at the same historical campsites and walk the same trails. The act of monitoring became an act of trying to position oneself at places where one anticipates caribou will move through. In Tłı̨chǫ, *Kokètì* literally means empty campsite lake, and refers to the many old campsites that have been made at the lake over time. These campsites were chosen for a purpose; namely, for protection from wind or proximity to hunting locations. The program used the same sites for the same reasons.

Results

The two teams camped in the study area for a total of 40 days (six weeks), divided into two shifts of three weeks each. Table 2 summarizes the total study time and distances travelled on foot and by boat.

Total On-Ground Time and Movement	
Field weeks	6
Field days	40
Hours travel by boat and foot	103
Hours of wildlife observation	106
Total hours moving & observing	209
Kilometres travelled by boat and foot	1,186

Table 2: Total study time and spatial movement of teams.

Over the course of 40 days, the two teams observed approximately 13,224 *hozìı ekwǫ̀* (caribou*/Rangifer tarandus groenlandicus*). We observed caribou on 25 of the 40 field days, and caribou were observed throughout the entire period of six weeks, except the last three days when all of the larger herds moved southeast of Contwoyto Lake (see map 6). It is possible that we observed the same caribou herds on multiple occasions, and these animals could have been counted twice; thus, the number of caribou observed is an approximate number. The teams also recorded other wildlife, including five *sah dek'oo* (grizzly bears*/Ursus arctos*), 18 *dìga* (wolf*/Canis lupus*), several *hozìı edzıe* (muskox*/Ovibos moschatus*), *didi* (arctic ground squirrel*/Spermophilus parryii*) and numerous avian species. These include the long-tailed jaeger, det'ǫcho (bald eagle), sandhill crane, short-eared owl (*Asio flammeus*), northern pintail (*Anas acuta),* and common eider (*Somateria mollissima*), as well as other species of migratory birds and waterfowl typical of the region. Table 3 summarizes the number of large mammals observed during the study. Location of all observations of caribou, wolf, bear and bald eagles can be found in Map 6.

Total Mammals Observed	
hozìı ekwǫ̀ / caribou	13224 (approximate number)
sah dek'oo / grizzly bears	6
dìga / wolves	18
det'ǫcho / bald eagle	4

Table 3: Observations of large mammals.

A note should be made on our description of animals in this report. As outlined in "We Watch Everything: A Methodology for Boots-on-the-Ground Caribou Monitoring" (TRTI 2016), the program "recognize[s] animals as sentient beings with personal autonomy and the ability to communicate, hold memory, and accrue knowledge" (TRTI 2017:9). In this view—and implicit to the descriptions in this report—a sentient

animal *chooses* specific strategies, and an animal *knows*; for example, caribou *know* weather will change. Furthermore, the report follows the Tłı̨chǫ tradition of addressing animals in a similar manner to people. For example, a bear is described as *him*, or a caribou leader as *she*. Or, a caribou cow with calf is addressed as a *mother,* or a yearling as *sister*, depending the relational context.

Indicator 1: Habitat

This indicator is intended to describe caribou habitat from a holistic perspective, including information about vegetation, forage and weather conditions, and collateral information about the arctic landscape, ecological interactions, and environmental changes observed during the course of the field program.

Vegetation and Caribou Food

Barren-ground caribou are generalist foragers. This means that, in winter, the main component of their diet is lichen, typically followed by moss and shrubs. In the spring and summer, as the availability of forage increases, caribou feed on a wider variety of grasses, sedges, shrubs and forbs according to the stage of plant growth rather than plant species (COEWIC, 2016). The selection of caribou habitat in the summer is based upon numerous strategies, including the availability of high quality forage, predator avoidance and reduced exposure to insect harassment. Human disturbance in the form of infrastructures and noise also play an important role in caribou habitat selection process.

Photo 9, left: *adzii* (caribou lichen) east of Long Bay, Contwoyto Lake.

Photo 10, right: sedges along caribou migration trail, northwest of Fry Inlet.

Field observations confirm that habitat selection was based primarily upon the availability of green and lush vegetation, combined with the ability to find respite from insect harassment. Caribou also tended to avoid excessively rocky areas, favouring broad slopes or flat plains with abundant vegetation. Weather-wise, caribou prefer strong winds and rain. Field notes recorded by the researchers on July 14th exemplify this: “caribou observed in valleys and hillsides grazing on luminous, dark green vegetation; resting and feeding.” The descriptors “moist” and “fluffy” recur in field notes on caribou’s preferred vegetation. The monitoring teams recorded details of caribou forage and vegetation:

Long Bay, northeast shore of Contwoyto Lake:

- July 7th: Vegetation is moist from heavy rain yesterday and during night: good quality forage for caribou.
- July 11th: The vegetation is moist and good quality after rain.

Kuniks Bay, east side of Contwoyto Lake:

- July 9th: dry vegetation along esker system. Warm temperatures and strong sun has dried up the caribou forage.
- July 12th: the caribou forage is in good quality conditions. The heavy rain in the last days has hydrated the ground and vegetation is currently very moist. The heavy rain is needed for vegetation growth and for berries.

Contwoyto Lake, north side:

- July 14th: the hillside is covered with green grass, sedges and moss the caribou feed on. Many animals lying down resting as others are walking slowly and grazing. Good quality forage for the herd in the valley and along hillside.
- Caribou forage is in "good and normal" quality, after the rain. The vegetation is lush and green in the valley bottom and along the hillside where the caribou are grazing.
- The vegetation in the south side of valley is green and lush after rain.
- The valley is in a luminous colour of light and dark greens from the lush moss, grasses and sedges.
- The *"wind makes vegetation tender, and good to eat."* Strong 30 km/h wind for two days, and vegetation is lush from wind and rain. Most animals are lying down resting and grazing. All animals are feeding well, while resting.

John Koadloak camp, northwest side of Contwoyto Lake:

- July 15th: lichen is "fluffy." The grasses and sedges show green colours—good quality forage for caribou herds.
- July 17th: the grass, sedges and caribou food are in "good and normal" conditions and show strong green colours.

Fry Inlet, east side:

- July 20th: vegetation: good and moist conditions. Plenty of good forage for herd along east shore of Fry Inlet.
- The flat lands and sloping hills up the eastern shoreline of Fry Inlet are good quality feeding grounds for the caribou herds. The herd walks back and forth, feeding.

Fry Inlet, southwest shore:

- July 21: vegetation is good quality. No dry or dead leaves or grasses observed.

Fry Inlet, southeast shore:

- July 21: good forage for caribou along the southeast shore.
- Vegetation: grass and mosses are "not too dry, nice and good food for caribou."

Fry Inlet, northwest side:

- July 23: Flat areas and long sloping hills – "this is good country for caribou." The area consists mainly of grasses and mosses, without too much rocks. All the vegetation is green in colour and in good conditions.
- Blueberries start to grow on eskers, the berries are large and soon ready to be picked.
- July 26: lots of blueberries growing on the eskers. The vegetation is healthy and good conditions—not "crunchy."

Sun Bay, northwest shore of Contwoyto Lake:

- August 6: blueberries starting to shrivel up. High temperatures and dry conditions for several days. Vegetation and berries are drying up.
- August 7: some vegetation starts to change colours and is becoming red.

In general, caribou forage on the post-calving range around Contwoyto Lake and Fry Inlet demonstrate "good and normal" quality. Dry vegetation was only observed for short periods at higher elevations, alongside hills or eskers. The high frequency of rain showers throughout July drenched the ground and the vegetation became moist and of good quality. The high temperatures that occurred in early August made vegetation dry on certain days. The elders noted how the long periods of strong wind coupled with rain "made the vegetation tender and good to eat."

Climate Change

Indications of climate change were readily observed by the Tłı̨chǫ and Inuit harvesters. Several signs were identified: (1) earlier spring melt; (2) disappearance of summer snow, and (3) the appearance of new species. These ecological changes affect caribou within our monitoring area. The main themes related to climate change found during this year's research are presented below. For full statements, please refer to Appendix 5.

Early Spring Melt

The first camp was located at the end of Long Bay, a long narrow inlet on the northeast shore of Kokètì (Map 3). At the time of arrival—July 6th—there were no sheets of ice or ice slush floating on the lake. The Inuit who live near the lake said the timing of spring melt was approximately two weeks earlier than usual. In earlier years, ice cover remained on the northern part of the large lake until mid or late July. This year, the entire lake and its numerous inlets were ice-free by late June. Higher than normal temperatures, occurring earlier than usual in June, melted the ice at a faster rate than normal. These observations are consistent with a host of scientific literature detailing the accelerated effects of climate change on arctic and subarctic regions (IPCC, 2014).

Melted Summer Snow

The higher temperatures, which came earlier in spring, had melted the snow cover on the land surrounding Kokètì by late June. In previous years, numerous snow patches covering crevasses or sun-shaded slopes were observed in various locations on the land until late July or even into August. This year, the remaining snow patches melted in late June and there were no snow patches left in early July. Usually

the snow patches remain through the summer months and meltwater from the snow patches continuously runs down hills and slopes and soaks the ground in low-lying areas.

Observation of New Species on the Post-calving Range

The distribution of wildlife across North America is shifting in latitude or elevation in response to climate change (Hirtch and Leberg, 2007; Chen et al., 2011). This northward shift may be the result of multidirectional range expansion for multiple species, derived from changing predator/prey relationships, as well the availability of plant species and terrestrial organisms in areas where they were previously absent. While this northward shift is widespread in nature and unfolds in interdependent ecological relationships, one of the most visible indicators on the barrenland is the overall expansion of the northern limits of birds with a southern distribution, followed by terrestrial mammal's changes in range and distribution, including caribou.

Warming trends and changes in wildlife distribution and range are of great importance to the indigenous harvesters, who depend on the availability of large terrestrial mammals, fish and birds for their primary subsistence. In the last decade, trends of climate change have been noted by local residents at Contwoyto Lake, who reported increasing observations of the following species new to the area:

- Bald eagle
- Scooter duck
- Mallard duck
- Ladybug
- Grasshopper
- Red squirrel

Case Study: The Bald Eagle

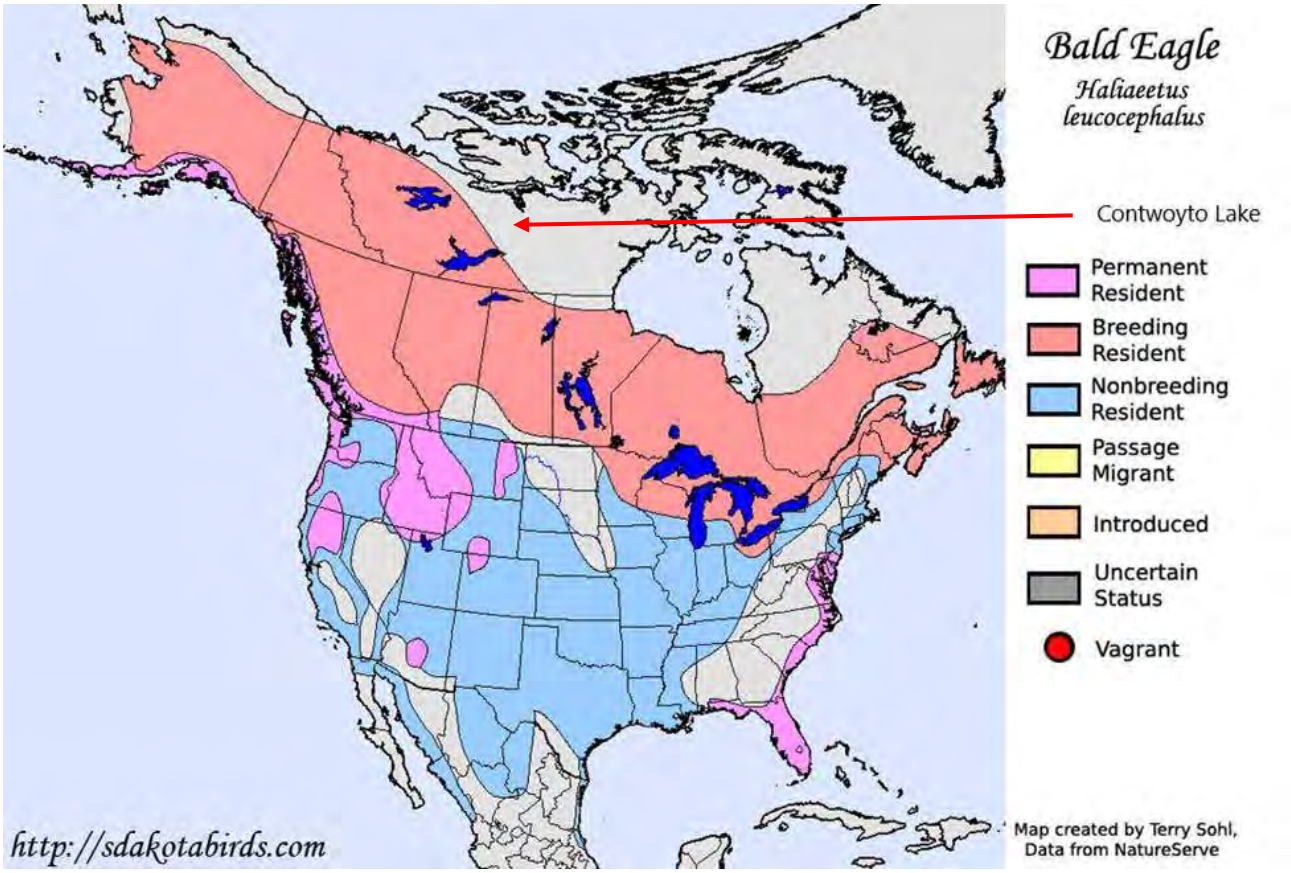
In historical-ecological research, the first observations of changing ecological phenomena often come from of indigenous knowledge (Santomauro et al., 2012). According to traditional knowledge of current residents of Contwoyto Lake, bald eagles (*Haliaeetus leucocephalu*) were never seen in or around the lake. To our knowledge, the first recorded observations of bald eagles in the area were in 2005.

The teams saw a total of four bald eagles, two of which may have included the first recorded nesting site of a bald eagle around Contwoyto Lake. The first observation occurred on July 8th and consisted of an adult of unspecified sex. On July 9th, the team noted a juvenile and an adult circling an esker; the team could not locate a nest; however, flying behaviour was described as territorial. On July 19th the last observation of an eagle flying over a caribou herd was reported.

Bald eagles are opportunistic feeders subsisting mainly on fish and therefore thriving near bodies of water such as wetlands, rivers, seacoasts, and other large bodies of water. With a natural range covering most of North America, where adequate food exists and human disturbance is somewhat limited, the bald eagle can be considered an "indicator" species signalling a rich aquatic habitat, as well as an "umbrella" species for conservation due to its characteristics as large predator. The northern border of the breeding summer range of this raptor generally follows the treeline from the northwestern corner of the NWT to the southern border of Nunavut and the NWT (Map 5).

While the landscapes of Contwoyto are characterized by extensive aquatic and fish habitats, this environment is not an ideal bald eagle breeding habitat due to the lack of tall vegetation and/or vertical cliffs. Eagles build their nests in tall vegetation—such as trees—often as early as February, in northern environment. The terrain surrounding Contwoyto Lake lacks tall trees or cliffs, and is characterized by lower arctic climatic conditions, which often see no waterbody surface melt until June.

A warming climate, earlier snow melt, and therefore the earlier availability of nesting habitat or more prey have the potential to create new opportunities for bald eagles in the area. The frequency of new observations and the TK of local Inuit imply that the new appearance of bald eagles in the area may signal an expansion of its summer range and potentially open the study area to breeding residency.



Map 5: Bald Eagle Range Map in relation to Contwoyto Lake.

Indicator 2: Caribou

The following section details observations of caribou from July 5th to August 14th, 2017. Large herds were observed following migratory routes and water crossings around Contwoyto Lake and Fry Inlet (see Map 6). Other caribou observations were of individual animals or smaller herds. Figure 5 illustrates the number of caribou observed per day. The approximate total number of caribou in the herd observed during this period was 13,224. Complete details of each observation can be found in Appendix 1.

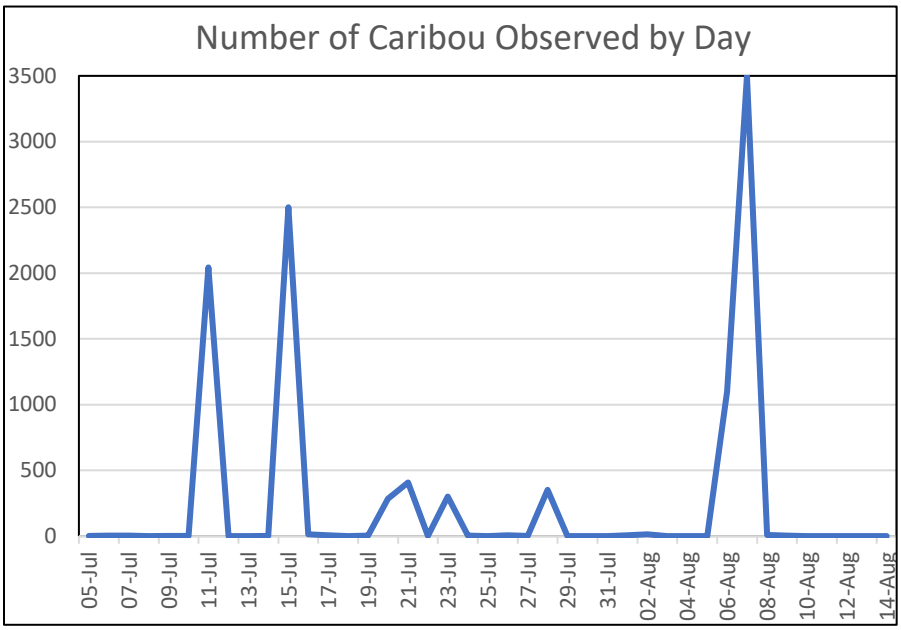


Figure 5: Number of caribou observed by day.

July 5th

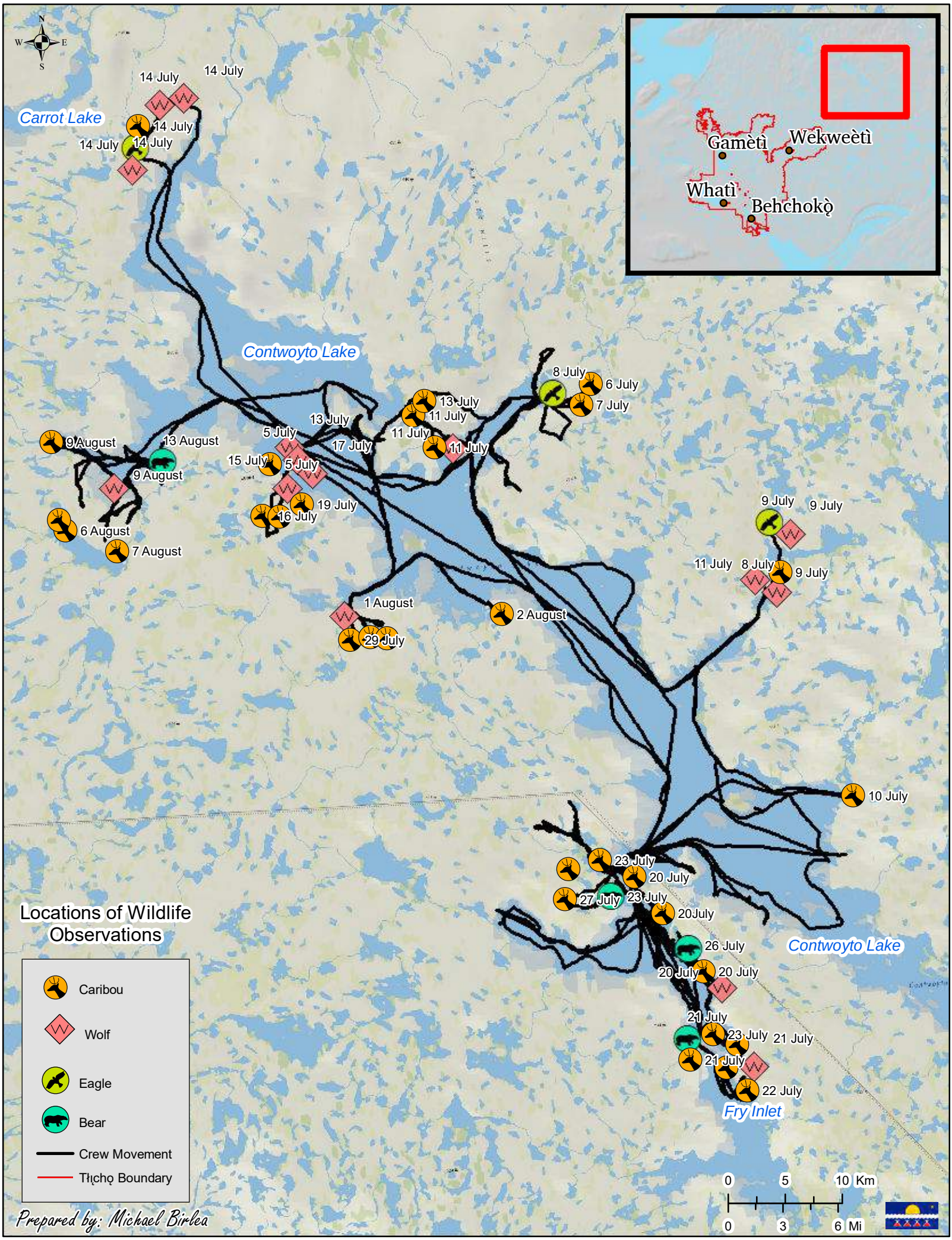
One caribou: by north side of Lupin mine. Feeding on sloping hills, north side of mine site, 200 metres down slope from the houses at mine site. Too far to see sex and details.

July 6th

One bull: white winter coat, healthy body condition.
One cow: brown coat. Healthy body condition.
One calf: 1-year old yearling—light brown coat. Healthy body condition.
Together the bull, cow and calf walk north along hill east of Long Bay camp towards Peacock hills. Walked in fast pace north into northwest wind.
One bull: white hair around neck. On esker north of camp 1. By itself, walking north on esker.

July 7th

One bull: Healthy condition. On sloping hill east from us. Feeding, walking slowly back and forth. White hair around neck—front part. Brown hair back side. The bull is following the same trail as bull and cow we observed on July 6th: south-north around Long Bay; along eastern shore of Contwoyto Lake.


Carrot Lake
Contwoyto Lake
Contwoyto Lake
Fry Inlet
Gamètì
Wekweètì
Whatì
Behchokǫ̀
14 July
14 July
14 July
14 July
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23 July
21 July
21 July
22 July
Locations of Wildlife Observations
Caribou
Wolf
Eagle
Bear
Crew Movement
Tłı̨chǫ Boundary
Prepared by: Michael Birlea
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One bull: white hair around neck, brown down the back of the neck. Fat body condition. Walked northwest along ridge into wind—to avoid mosquitoes, presumably. High insect activity when wind is calm.

One yearling: looking for its mother (Photo 11). Mother has abandoned it or it's separated from its mother. Healthy body conditions. White winter coat, chunks of hair falling off. White tail. Dark-coloured hair on all legs. Small short antlers. Dark colour fur around eyes, as characteristic of calves/ yearlings.
One bull: walking north. The yearling was following after the bull. White hair around neck, brown on the back of the neck.

Photo 11: caribou yearling wearing its winter coat on July 7th, 2017. East of Long Bay, Contwoyto Lake.

July 9th
One cow: 3-year-old. White winter coat. Healthy body condition. Walking on sand hills; no bugs on wind exposed sand ridges/eskers.
One bull: on sloping hills east of esker, about 2 km away. Eating and standing in flat muskeg/grass. Winter coat is coming off.

July 10th
One cow: on top of hill south of us. Too far to see details.

July 11th
One young cow: healthy condition. Has shed its winter coat. Running with her head up, and eyes fixed staring at us, at 50 metres distance.
Forty caribou: resting on side of hill top, on northwest side of peninsula. Some animals are lying down, relaxing, on the side of the high hill, into the southeast wind. The herd is feeding well on the hilltop. The vegetation is moist and good quality after rain. Numerous calves in the herd. More animals continue to join the herd, walking up from the backside of the hill.

Caribou herd (1,500+ individuals)*:* on the hilltop north of us. Herd standing on ridge/hilltop, facing into 18 km/h southeast wind. First, we observe approximately 50 animals. Then many more caribou appear, from the northside of the ridge. The herd move slowly east into the southeast wind, along the ridge line (Photo 12). More animals continue to appear from the backside of the ridge. After a low-pressure system moves over us with heavy rain, the ground is moist, and good forage for the herd. Very high insect activity after rain – caribou move to hilltop into the wind to avoid mosquitoes.

Photo 12: herd standing on ridgeline facing into southeast wind to avoid insects. July 11th, 2017.

Herd composition: mainly cows and calves. Calves are in good and healthy condition. Approximately 45% calves in the herd; large number of calves; the amount of calves is “normal” in the herd. Many calves lying down resting. High number of yearlings, with white colour hides. Most animals in the herds still have their winter coats. The overall herd seems white from a distance. Several big bulls in the herd. Some bulls have black colour hides on their heads.
High insect activity, when the wind calms. Herd walks slowly uphill in low-lying muskeg area (Photo 13) towards the southeast. Herd is stretching out over a large area, as some animals are grazing and walking slowly into the southwest wind. The animals do not seem overtly bothered by the high insect activity.

Photo 13: Herd spread out on peninsula north of Long Bay, July 11th, 2017.

Herd congregate in one large group and start walking southeast. High insect activity in low lying muskeg. The herd zigzags into the shifting wind over the sloping muskeg area. The herd fans out over a larger area, then congregates again. They slowly walk in a zigzagging motion up the sloping hill, in a southeast direction. Low dark clouds come over us with heavy rain. The herd skylines the hills to the east. As the clouds pass, the wind calms and insect activity become extreme.

500+ caribou on hills east of us - by the northern shoreline of Long Bay. Mainly bulls in this herd. The herd is skylining the hill. Hundreds of bulls’ antlers intertwine as they skyline the hill. The herd moves in a west/northwest direction onto the peninsula.
“These herds are just walking back and forth on this peninsula without really moving anywhere. These herds are 'waiting' for the larger herds with cow leaders before they start moving fast further south.”

One cow and one calf: healthy conditions. The cow and calf walk towards us from the small peninsula, as we stand on higher ground to avoid mosquitoes. Once they notice us, they turn around immediately and walked at a fast pace back out onto the peninsula.

July 13th
Tracks of 20-30 caribou moving west, onto the peninsula, on the northwest side of Long Bay. No tracks going east/off of peninsula. Herds must have either moved north or remain further out on the peninsula. We walked 20 km (8.5 hours) across the entire peninsula. We walk slow and look for tracks leading in or out of the peninsula. No sighting of caribou or wolves on the peninsula.

July 14th
One calf and two wolves: two wolves chase down one calf. The wolves run east, towards us, in the bottom of a wide valley. They catch and take down the calf.

2,500 caribou: herd grazing and walking slowly on south side of the long wide valley (Photo 8)—east of Carrot Lake and three kilometres north of Contwoyto Lake. 30 km/h strong west wind and 17 degrees Celsius: no insect activity.
Herd composition: 95% cows and calves. 40-45% calves: a normal amount of calves in the herd; only a few bulls in the herd.
The animals are all in healthy condition. The cows and calves are healthy conditions. One cow is injured and limping. She is walking in the back end of herd. Most animals have white winter coats, but there are a few with a darker brown colour.
The majority of the animals are lying down and resting, some sleeping with the heads down. Most of the calves are lying down resting. At one point, all the calves are resting. Their mothers are lying next to them or standing close by grazing. A few are lying down in the wet muskeg. Other animals are standing, grazing on the grass and sedges. Many have white winter coats, and several cows have darker brown coloured coats, with white around the neck and head. The vegetation is green and lush after the rain. The valley is luminous in colours of light and dark green from the lush moss, grasses and sedges (Photo 14).

Photo 14: Herd resting and feeding in valley north of Contwoyto Lake, July 14th, 2017.

The herd rests one hour and 30 minutes in the same location, then it moves southwest into the narrow valley next to Jericho mine airstrip. A wolf attacks them further up the narrow valley. The herd retreats and walks back out into the wide valley. Again, the herd stops on the flat valley bottom (Photo 8). Most animals are lying down, resting and grazing. All animals are feeding well, as they rest. Calves are lying down, resting and sleeping. Their mothers are standing close by and grazing. The herd rest for another two hours. In total the herd rests, three hours and 35 minutes on the south side of the valley.

July 16th
Fourteen caribou: seven bulls and seven cows: no calves. The animals have black hair on their feet, as their winter coats are coming off.
Bulls are healthy and starting to become fat. The herd walks northwest into strong wind.

July 17th
Four bulls: on hilltop one to two km south of us. Bulls with large antlers. They skyline the hilltop, then walk south out of our sight.
One bull: on the hillside 500m south of us. Large antlers and shovel (front piece of antler). Dark brown coloured coat, it has shed its winter coat. He continuously looks around and appears to be spooked, perhaps by our presence. No insect activity as it's too windy. We walk closer, but he runs away, then stops

and runs alongside us as we walk. He keeps a 200-metre distance but runs parallel to us. He is curious but scared. Runs away at the end.
Healthy body condition, no injuries, and runs with its head straight forward.
Two bulls: dark hide. Walking north at a fast pace, into north wind. Walk too fast to see details.

July 19th
Three bulls and one cow: walking on high hills, one to two km south of camp. No calves.
Caribou moving northwest along ridge, they are skylining into strong wind.

July 20th
One bull: Running fast along shoreline. Large antlers. Dark-coloured coat; it has shed its winter coat.
Sixteen caribou: Running into wind, in a northerly direction on peninsula across the lake from camp. The herd walks at a fast pace from the mainland, to the shoreline by the *nǫɔkè* between Contwoyto Lake and Fry Inlet. Turned around and ran back as they approached the water. Perhaps scared by our smell—they are downwind from us.

Four caribou: on flat ground, along the eastern shoreline of Fry Inlet. Animals running fast, back and forth on the flat ground by the lakeshore. High insect harassment. Blackflies are out in full. Ten to 15 km/h north wind. "This is what the caribou are running from. They [blackflies] are out in full now".
One cow: walking north along eastern shoreline of Fry Inlet towards *nǫɔkè.*
One calf: injured back leg. Both cow and calf walking north along the shoreline to the *nǫɔkè* on Fry Inlet.
Two cows: walking on hilltop above the larger herd. One cow has an injured front leg.
250 caribou: Large herd on eastern shore of Fry inlet. Herd walking north.
70% cows – mostly cows in herd. A cow with calf is the leader of herd. The herd moves in a zigzagging pattern along the sloping hill to the lake. High insect activity. Five km/h wind along flat ground (Photo 15).
Cows have healthy body condition. Not fat, but normal condition for this time of year.
Bulls are healthy. The bulls have large black antlers.
Calves: in healthy condition. High insect activity. Herd is not overtly bothered by the high insect activity.

Photo 15: Herd grazing on eastern shore of Fry Inlet. Notice the masses of mosquitoes among the herd, luminated by the setting sun. July 20th.

There is currently no wind in the low-lying flats we are on as the sun is setting. Herd is resting and drinking by the lakeshore. Few cows walking around feeding, then walking back to herd. Other cows walking around feeding.

July 21
Caribou swimming across *nǫɔkè:* peninsula in centre of Fry Inlet:

One cow; one calf; one yearling. One cow: injured front leg. Still walking fast with its calf. They walk together.
One bull: by itself.
One cow: no calf. By itself.
The east side is mostly grass and small knolls with scattered rocks, the west side of the crossing consists of large rocks all through the water and along the shoreline. The animals walk very slow out of the water through the rocks, in one single line. Very slow compared to sandy conditions on *nǫɔokè* further north. All animals follow the same trail through the bushes and among the smaller birch trees, in the little valley west of the crossing.

400+ caribou herd: large herd standing on point in a bay on east shore of Fry Inlet. Numerous animals are standing with their legs in the shallow water; some animals standing on shoreline. The herd is one tight unit. The animals are standing in the water to cool off their feet/hooves.
40% bulls: more bulls in this herd than observed in herd the day before;
One: one ratio - cow to calf; one cow injured; calves: every cow has a calf—"lots of calves in the herd."
The caribou are in healthy body condition. No signs of undernourished animals.

Photo 16: Herd moving though lowlands past the monitoring team, Fry Inlet, July 21st 2017.

The herd runs at a fast pace two to three km south through the lowlands along the shoreline, past the team (Photo 16). No animals lagging behind the main herd. All animals walk quickly in a single, tight herd.
Second observation of herd: southeast shore of Fry Inlet. The herd is standing in one tight group on flat ground, up from the lakeshore. Herd standing into south 15 km/h wind. After 15-20 minutes, the herd moves slowly to the lakeshore; some animals enter the water and stand with their hooves in the water. The herd faces into a strong south wind by the shoreline. The wind comes directly in from south across the lake. Most animals are lying down, resting into the wind by the water. Many animals stand with their feet in the water. No mosquitoes facing the south wind, wind comes directly in from the large lake. The herd lays down to rest and sleep for two hours by the lakeshore.
The herd start to walk up from shore and feed on the flats (Photo 17). The animals are shaking and twitching from high insect harassment. The animals are continuously shaking their body, every 20-30 seconds. They eat, shake their bodies to rid themselves of insects, then resume eating.

Photo 17: Herd feeding by shoreline. Fry Inlet, July 21st 2017.

The animals are communicating with each other by loud grunts, head shakes: the cows are telling calves what to do and where to go. Several calves start running around. Herd composition: many old/big bulls with large antlers; young bulls; yearlings; cows and calves: all mixed in the herd
Healthy body condition; all animals are in good healthy conditions: "really healthy caribou." One cow has an injured back leg. Calves are in healthy condition: running around. Several calves are nursing/suckling milk from their mothers.
Bulls are starting to accumulate fat reserves now. They look healthy and strong. Some have large, black antlers. Most bulls have shed their winter coats. Some still have hanging white coats, with clear dark brown hair underneath.

One cow, one calf: walking on hills south of us. Above the bay on the eastern shore of Fry Inlet. They are walking and feeding on the ridgeline into south wind. Too far to see details.
One cow: dry (no calf). Small, straight antlers. The cow is walking at a fast pace along the shore on the eastern side of Fry inlet towards the *nǫɔokè,* near the peninsula at the centre of the lake. It turns around and walks back east onto the peninsula.

July 22nd
One caribou: on the hills, southeast of camp, on the peninsula across Fry Inlet. Skylining the hills.

July 23rd
Herd (300+ individuals)
The herd swims across the *nǫɔokè* between Contwoyto Lake and Fry Inlet. The swimming herd appears as a "bridge" as the channel is full of caribou from one side to the other end (Photo 18). The herd moves at a fast pace in a northwest direction, into strong 20 km/h northwest wind. The herd is in good and healthy condition; every animal keep the same fast pace for the one hour we observed them. "Never seen a herd move that fast." Cow leader walks in front and keeps up a fast pace. She walks 30 metres in front. The whole herd follows right behind: "caribou leader must be fat and in good shape, as she walks fast and non-stop for long distance." No animals lagging behind. One cow injured.

Photo 18: herd swimming across *nǫɔokè* between Contwoyto Lake and Fry Inlet. July 23rd, 2017.

One bull: at *nǫɔokè,* on peninsula at centre of Fry Inlet. Young bull, by itself, swims across the *nǫɔokè,* to the west side of Fry Inlet. He continues in a westerly direction, uphill inland, into higher bushes, along same scent trail as caribou used during days before. Bull in healthy body condition, no injuries. Short antlers. Brown coat; it has shed its winter coat.
One caribou cow: on the eastern shore of Fry Inlet. Walking by the shoreline. Drinking water. By itself. Too far to see details.

July 24th
Two Caribou: on the high hills to the northwest of esker. Skylining the hills, following the same trail as the herd on July 23rd. Too far to see details.

One caribou: on peninsula, eastern shore of Fry Inlet. Too far to see details.

July 26
One bull and one calf: they swim across the inlet and ran up a hill on the western side of camp. Animals in healthy condition.
One Bull, one cow and one calf: walking into a westerly wind. All caribou are healthy.
One caribou: by itself. Too far to see details.
200 caribou: too far to see details
2,000 caribou: too far to see details.

27 July
One caribou cow: too far to see details.

28 July
One calf: on peninsula. Foraging alone, looks to be separated from its mother. The calf is healthy.

29 July
One caribou: feeding
250 caribou: the herd is travelling at a fast pace in a northerly direction. A cow leads the group. No injuries observed in the herd.

Photo 19: Caribou with its new summer coat. Remains of winter coat still on, July 29th, 2017. Photo: Tyanna Steinwand.

31 July
100 caribou: close to camp (photo 19). Thirty calves in herd. Herd is running away from bugs, in a tight group. Heading southeast. A cow leader is at front of the group. Herd is healthy.
One cow and one calf: walking about 0.5 km away from the group. Caribou move 20 yards away from us, on top of a hill. The herd keeps running around the south of our camp, probably trying to get away from the bugs.

1 August
Six caribou; walking close to camp. All animals show healthy body condition.

2 August
Two caribou: moving into the wind. Too far to see details
Seven caribou: three bulls, walking in rocky area. Too far to see details.
Four caribou: walking into wind. Too far to see details.

6 August
One cow: feeding, walking north into the wind, toward Concession Lake. The cow is in healthy condition.
1,100 caribou: walking in three herds on flat ground by the west side of Concession Lake:

- 300 caribou
- 200 caribou
- 600 caribou

7 August
2,500 caribou: near Concession Lake. Large herds walking and feeding in the flat areas around the lake.
1,000 caribou: near Concession Lake, walking around same area. Too far to see details.

8 August
Eight caribou: observed on skyline. Too far to see details.

9 August
Four cows. The animals show healthy body condition.
One cow: injured back leg.

Photo 20: Tyanna Steinwand, Mercie Koadloak, Roy Judas and Leon Ekendia walking the land close to Concession Lake. Photo: John Koadloak.

Predicted Health in July and August

Similar to our field work in 2016, we estimated caribou health by considering: (1) body fat and overall body condition; (2) hide conditions, (3) walking posture and (4) amount and type of injuries. Prior to observations in the field, the team set up descriptions of anticipated caribou health conditions for July and August (TRTI 2017). Variations exist in relation to the exact timing of post-calving and summer movements, and the statements provided below were used as guiding principles of expected conditions based on the elders' knowledge.

- In July, the animals do not have excessive body fat. During the post-calving movements, caribou congregate in large herds, travelling extensively in relatively high temperatures and spurred on by parasite insect harassment. The herds spend much time walking and running and less time foraging and resting. The herds are mostly grouped together as tight units as they move over the land.

- In August, the large aggregations of caribou split into smaller herds. As temperatures and insect harassment decrease, caribou run less, and tend to settle down in areas to properly forage. This is the time when caribou start to accumulate fat. Bulls will start to get fat "after their bone marrow becomes good." Large fat reserves start to become visible on their back, from the rump to the neck. In general, when the animal has a short tail, it is an indication that the animal is fat and has larger fat reserves on the upper part of its hind legs and rump. These large fat reserves often become heavy for the animals.

- At the end of August and into September the pace and progress of the migration is influenced by the weather. Caribou know that winter is soon approaching and are actively feeding all day before the coming of the first signs of winter and prior to the rut.

Caribou Health

We observed the overall health conditions of caribou in relation to the indicators described above. The Bathurst herd showed signs of strong and normal health between July 5th and August 14th on the post-calving range. Injuries were the only health issue observed.

Fat

- The observed caribou show healthy body conditions. The animals are not fat but show normal body conditions for this season. The majority of all caribou observed appeared to be healthy and generally did not show signs of undernourishment. Four animals—an injured bull and three dry cows (cows without a calf)—showed signs of being undernourished:
    - Three dry cows showed signs of being skinny. The harvesters emphasized that the dry cows *"are the last to get fat"* and anticipated the cows to feed properly during the coming summer months. Observed on July 14th, north of Contwoyto Lake.
    - One injured bull was undernourished. The bull had an injured front right leg. He was in pain and was limping badly. Observed on July 14th, north of Contwoyto Lake.
- Bulls started to become fat in early July: fat bulls were observed on July 7th, July 16th and on July 21st.
- Several bulls have large black antlers. Black antler colour is recognized as a sign of good health.

Hide Colour

- The caribou have retained their winter hides into mid-July. The winter hide is starting to fall off in early July and many animals appear ragged. Caribou lose their winter hide while swimming, and when they come up on shore they shake their bodies to lose their winter hides. There are not many large *nǫɔokè* between the calving ground and Contwoyto Lake, so the herds do have not many opportunities to shake of their winter hides until this point. Heavy rains will also make the winter hide come off.
- Several bulls have shed their winter coat earlier than the cows and yearlings. The bulls' hides show clear dark brown hides underneath their white winter fur.
- One bull observed on July 17th had already shed his winter coat and had dark brown-coloured hairs.

Walking Posture

- The fast pace of large herds is a sign of good health, as the animals can keep a fast pace for long distances. While observing a 300-animal herd on July 23rd, elder Joe Zoe remarked "caribou leader must be fat and in good shape, as she walks fast and non-stop for long distance, never seen a herd move that fast."
- During migration, no animals were seen lagging behind the large herds. When the herds moved at faster paces, the animals grouped together and walked as tight units. We did not see any injured or lame animals lagging behind the herds during these fast-paced movements.

Injured Animals

- Eleven animals were observed injured out of approximately 13,224 caribou observed between July 5th and August 14th. This was a considerably lower number than observed in 2016.
- The injuries were sustained by one bull, two calves, and eight cows. All injuries were on front or back legs. Both calves had injuries to back legs.
- In 2016, several injured or lame animals were seen walking at the back of herd during migration; this was most noticeable during *nǫ̀ɔokè* crossings. In 2017, we did not observe any animals lagging behind the herds during migration.

Specific journal entries of observed injuries can be found in Appendix 2.

Cow and Calf Observations

The large herds were comprised of a majority of cows and calves (specific journal entries of cow-calf observations can be found in Appendix 3). The number of calves were "normal in the herd." In most instances, a one-to-one cow-calf ratio was observed, where nearly every cow had a calf and it was noted that there were "lots of calves in herd." Several calves were observed nursing from their mothers (Photo 21). Outside of the large herds, smaller groups were observed, as well as separate cow-and-calf duos. A number of dry cows were observed among the large herds as well as in small herds. Each year, there are cows which do not have calves, and the number of dry cows observed in 2017 was considered normal. Only one herd, observed on July 11th, was comprised of mainly bulls.

Photo 21: Calves nursing from their mothers. July 21st, Fry Inlet.

The calves were often seen running around and we often heard them "talking" to each other, by means of loud grunts. After long migrations, the calves were observed lying down, resting or sleeping. On July 14th, we observed a herd of 2,500+ caribou resting in a valley north of Contwoyto Lake. The herd rested for a total of three hours and 35 minutes in the evening, and for a majority of the time, all or most of the calves were lying down, resting and sleeping. Their mothers were either standing or grazing close by (Photo 22). Overall, the calves showed signs of good health. Two calves were observed with injuries to their back leg. The cows with calves also appeared to be in good health.

Photo 22: Calves in the large herd lying down, resting and sleeping. Their mothers standing and grazing close by. Three kilometres north of Contwoyto Lake, July 14, 2017.

Caribou Migration in July and August

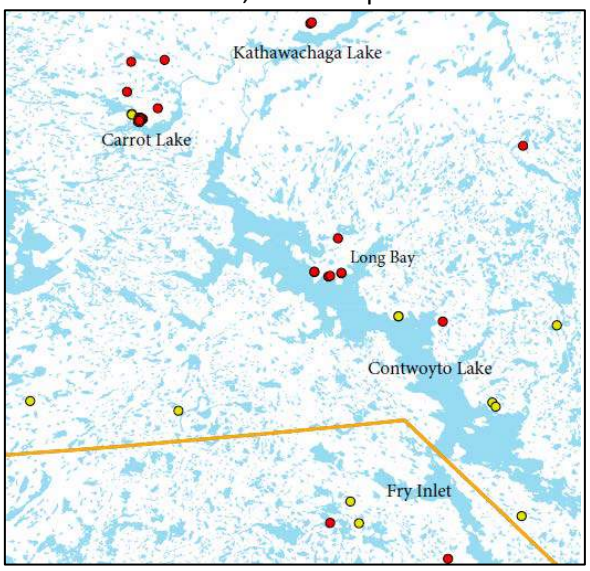
The caribou migration in July and August on the post-calving range around Contwoyto Lake was characterized by two forms of movement: (1) numerous smaller herds (comprised of approsimately how many individuals?) and individuals "being lost," and (2) mass congregation to specific areas following key cow leaders of the Bathurst herd (see Appendix 6 for field notes on caribou behaviour and migration).

From July 5th to 13th, numerous observations of individual animals and smaller herds were made by the monitoring team. These herds were wandering back and forth on the peninsulas and in the wide valleys along the eastern shore of Contwoyto Lake. On July 6th, five kilometres inland from Long Bay, we observed a "caribou family:" a bull, cow and calf walking north towards Peacock Hills. The cow and bull walked briskly and then stopped in the valley bottom and waited for their child—the calf. Once the calf rejoined its parents, the three-caribou group walked quickly together once again towards the northern hills. The elders explained that at times a caribou family will walk away from the main group. The cow does this to teach the calf to walk and how to move over the land.

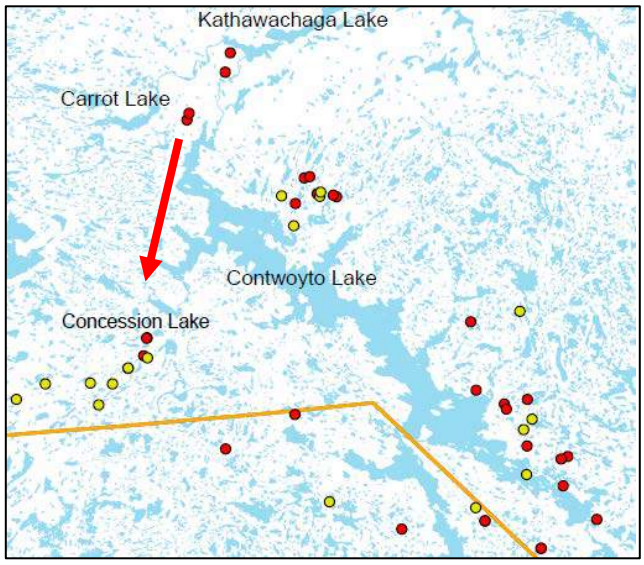
Over the next four days, we also observed individual animals—mainly bulls and some cows—at various locations, as we walked the hills and eskers inland from the eastern shore. These individual animals were walking back and forth in the local area waiting for a larger herd to follow. The elder described the behaviour of the animals as "being lost" and simply walking around until *ekwǫ̀ akwe etłee* (caribou leader) came to guide the way.

Many of these caribou followed sand ridges—eskers or sand bars—through the landscape. We noted their tracks and trails in the sand directly following the sand ridges, and the deep trails in the vegetation between sand bars. By following these sand ridges and eskers, the caribou expose themselves to the wind, and find relief from insects. They also likely find it easier to walk on the harder ground found on sand ridges.

On July 11th, 1,500 animals were sighted on the northern peninsula of Long Bay (Map 7: collar data July 11th). The herd was spread out over the sharp ridges and rocky hills. It moved slowly into the shifting wind, as the insect activity was high that day. At one point, the herd congregated along a high ridge and walked southeast together, zigzagging into the shifting wind over the sloping landscape. The herd walked towards the lakeshore on the north side of the peninsula and fanned out over a larger area, then congregated again, as they slowly moved up the sloping hills to the southeast. Eventually, the herd reached the top of the hill, and walked to the high hills further east on the peninsula. Low dark clouds descended on us, threatening heavy rain. We trekked the five kilometres back to our boat in a small inlet on Long Bay. As we walked south, we saw the herd skylining the hills east of us, walking in a southeast direction. Heavy rain and dark clouds continued to approach us from the northwest. As the dark clouds passed, the wind calmed and insect activity intensified. We covered ourselves with clothes and mosquito nets, while the herd moved to the highest ground in search of relief. Near the shoreline, a herd of 500 caribou—mainly bulls—walked towards us from the east. The herds paused for a moment on the hilltop, then resumed their walk westward, onto the peninsula.



Map 7: Caribou collar July 11th. Red dot: cow caribou; yellow dot: bull caribou. Source: GNWT ENR.



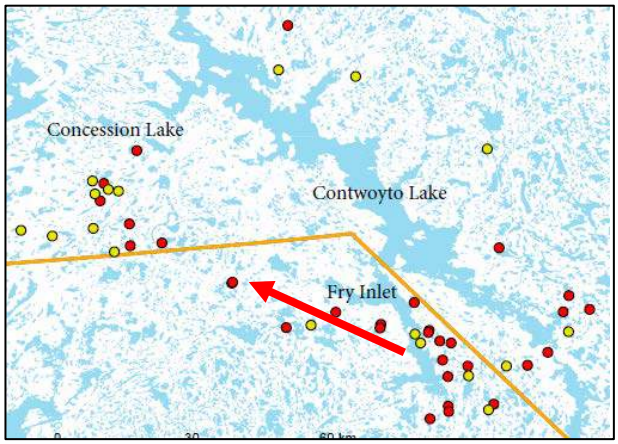
Map 8: Caribou collars July 18th. Red dots: cow caribou; yellow dots: bull caribou. Inserted red arrow indicate direction of movement. Source: GNWT ENR.

On July 13th, two days later, we returned to the peninsula and spent the whole day walking—a total of 20 kilometres—across the entire peninsula. All the herds had moved north and we observed no animals. We walked slowly, hour after hour, from hilltop to hilltop and looked for tracks, leading on or off the peninsula. We observed that the fresh tracks from 20 to 30 caribou had moved westward, onto the peninsula, while no tracks moved eastward into Long Bay. The herds had moved back north, and off the peninsula. Elder Joe Zoe explained, "these herds are just walking back and forth on this peninsula without really moving anywhere." The smaller herds do not have an *ekwǫ̀ akwe* etłee (caribou leader); they are waiting for the larger herds that do have leaders before they start moving faster further south." Joe Zoe continued to explain, "there is not boss ahead, these smaller herds have no leader, so they wait around. They go back and forth along the shoreline of the big lake until the larger herds, and the leader, arrive and show them where to go."

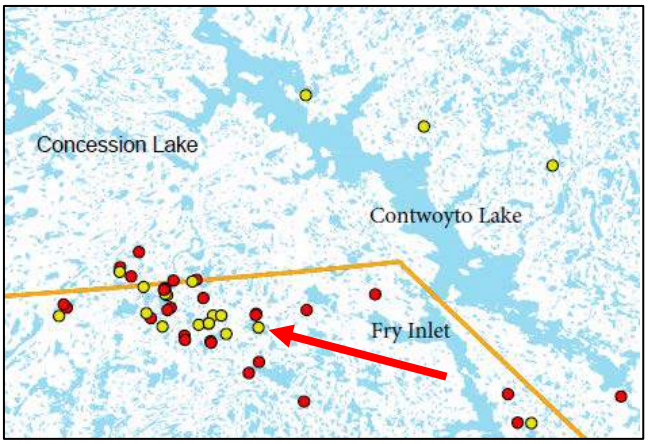
On the following day, July 14th, a large herd of 2,500 animals, consisting mainly of cows and calves—"moms and their kids"—with key cow leaders of the Bathurst herd, walked south into a wide valley on the northwest side of Contwoyto Lake. The large herd remained for several weeks around Kathawachaga Lake and Carrot Lake, and were trying to move south past Jericho mine, and further on to the rolling hills southwest of Concession Lake (see Map 8: collar data on July 18). The large herd, with cows and calves, have moved the relatively short distance from the calving grounds to the north end of Contwoyto Lake in over a month. Most animals still had white winter fur; only a few were starting to lose their white hair and show their darker-coloured hides. There are few large water crossings between the calving grounds and Contwoyto Lake, and thus the animals' winter hide still remains on for most of the animals. When the herds swim across rivers and lakes, they lose their winter hide in the water. The hide falls off while the caribou are swimming and when they shake off their wet fur upon emerging from the water.

We observed the large herd the entire day, as they attempted to move through the valley and cross the industrial infrastructure around Jericho mine. Resident wolves are aware of the geography of the area, and position themselves at strategic places, which further prevented the herds from travelling south past the Jericho mine industrial infrastructure. The herd was forced to retreat and walk back north into the valley. Over the next two days, however, the herd managed to cross the Jericho mine infrastructure and move to the feeding grounds south of Concession Lake, where it remained until the end of July (Map 9: collar data July 20).

Between July 16th and 22nd, we continued to observe scattered groups of smaller herds and individual caribou, who were "lost." As the elder explained, "there is not boss ahead," and the animals waited for the larger herd with a leader. On July 20th and 21st, we began to see caribou moving west, following the scent trails of leaders from east to west at *nǫɔokè* and *tataa* on Fry Inlet (see Map 9: collar data July 20).



Map 9: Caribou collars July 20th, 2017. Red dots: cow caribou; yellow dots: bull caribou. Inserted red arrow indicate direction of movement. Source: GNWT ENR.

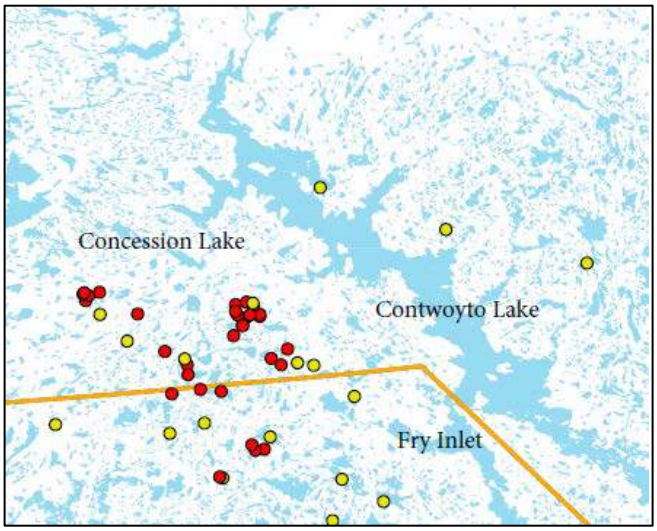


Map 10: Caribou collars July 24th, 2017. Red dots: cow caribou; yellow dots: bull caribou. Inserted red arrow indicates direction of movement. Source: GNWT ENR.

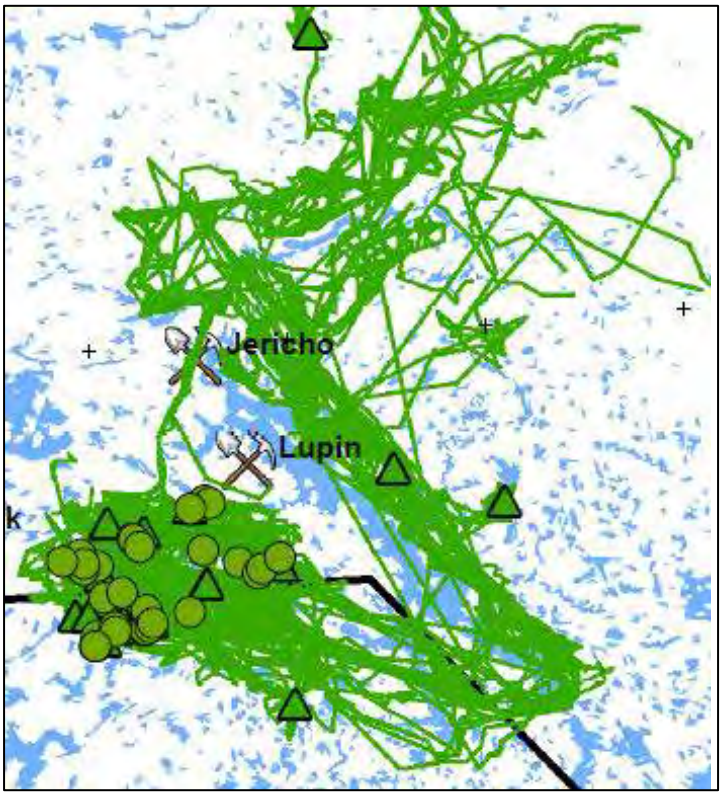
Eventually, on July 23rd, a large migration occurred across Contwoyto Lake and Fry Inlet. We sighted a herd of 300+ caribou swimming across a *nǫɔokè* between Contwoyto Lake and Fry Inlet and continuing at a fast pace in a northwest direction. The herd ran up from the water and walked rapidly over the rolling hills into the northwest wind. The elder Joe Zoe emphasized that he had "never seen a herd move that fast" and "the caribou leader must be fat and in good shape, as she walked so fast and non-stop for such long

distance." The herd moved quickly up the hills to the northwest of the water crossing and disappeared over them, without stopping or slowing down. Later in the evening, we observed several individual caribou swimming across a *nǫɔkè* on the southern portion of Fry Inlet. The animals walked slowly up through the boulders of this rocky *nǫɔkè,* but once on shore, the caribou followed quickly along the well-used trail to the west (see Map 10: collars on July 24th).

The large herd observed on July 14th had moved south to the area south of Concession Lake. Between July 22nd and 24th, almost all other herds around Contwoyto Lake and Fry Inlet travelled rapidly in pursuit of those key female leaders (see collar maps on July 20th and July 24th). The other smaller herds and individual animals travelled around the south end of Contwoyto Lake and Fry Inlet, while some crossed the *nǫɔkè* between Contwoyto Lake and Fry Inlet. The many smaller herds followed the scent trail from the bigger herds ahead, to join up with the female leaders, at certain locations west of Fry Inlet (see Map 10: collars on July 24th).



Map 11, above: Caribou collars July 27. Red dots; cow caribou, yellow dots; bull caribou. Source: GNWT ENR.



Map 12, right: Movement of Bathurst caribou based on collar locations from end of June to August 14th, 2017. Green dots; cow caribou, Green triangle; bull caribou. Source: GNWT ENR

Looking at the collar map update of July 24th, John Koadloak observed that "the area where the large herds are now, between Contwoyto Lake and Itchen Lake, is a lush and green area consisting of rolling hills, with good feeding grounds; "a good place to congregate. Further south, towards Yamba Lake, is much rockier and hilly, so where the herds are now [is] perfect for them." Most of the Bathurst caribou herd congregated in the area west of Contwoyto Lake and southeast of Concession Lake from the end of July

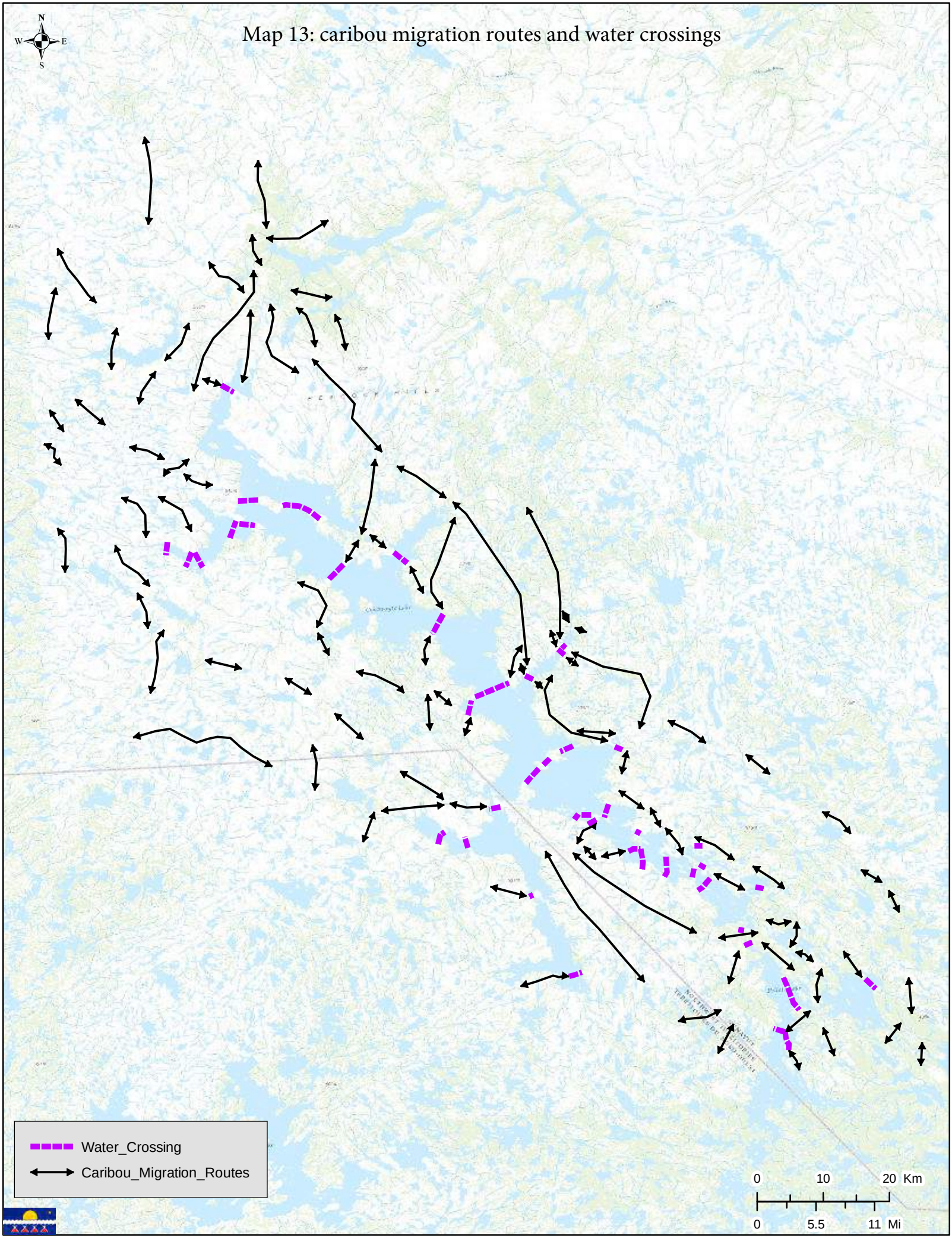
onward. The herds with cows and calves, as we observed on July 14th, started to congregate after July 20th and remained together in the valleys south of Concession Lake. These herds avoided travelling long distances and remained within a local area for long periods of time (see collar maps on July 27th). Map 12

illustrates the movement of caribou collars from end of June to August 14th, and a visual representation of the harvesters' explanation.

John Koadloak, who lives year-round at Contwoyto Lake, described how the herds usually return north, towards the southeast side of Contwoyto Lake in late September and early October for the rutting period. "The caribou herds come back up north to southern part of Contwoyto Lake. They stay in the area for two to three weeks, to feed, until the ice on the lakes is strong." After freeze-up, the herds have traditionally migrated southwest or west towards the treeline for the winter. However, in recent years, large caribou herds have remained all winter near Contwoyto Lake.

Map 13 (caribou migration routes and *nǫɔokè* around Contwoyto Lake) shows the caribou migration routes around Contwoyto Lake and Fry Inlet and the *nǫɔokè* used to cross the large lakes during the summer months. The routes follow the natural topography and the many *tataa* between the numerous waterbodies in the region. The map is based on traditional knowledge.

Map 13: caribou migration routes and water crossings



Indicator 3: Predator Observations

During the 40 days of fieldwork, we observed 18 wolves, six grizzly bears, and four bald eagles. Most wolves were observed on the north and east side of Contwoyto Lake, often inland from the large inlets. No wolves were observed around Fry Inlet, but fresh wolf tracks were observed on two occasions in the sand beaches on the eastern shoreline. One active wolf den was observed eight kilometres north of Kuniks Bay, east of Contwoyto Lake. The den was home to two adult wolves, male and female, and four cubs. No old or abandoned wolf dens were observed.

The bears were observed in the southwest of Fry Inlet and northwest side of Contwoyto Lake. No recently used dens were observed. We observed four bald eagles. These predators are newcomers to the barrenland and were first observed the area in 2005. Two adult eagles and one juvenile were observed on the eastern shore of Contwoyto Lake, and one eagle north of Contwoyto Lake. No eagles were observed around Fry Inlet.

Wolf Observations

5 July—John Koadloak's camp
One wolf—white fur. 200 metres south of John Koadloak's camp. The wolf walked from hill down towards shoreline. Walked slowly. According to John Koadloak, it is the same wolf that often comes around the area.

8 July—Camp Kuniks Bay
One wolf—young female. The wolf comes close to camp (100m) in Kuniks bay. Must have pups in den close by.
One wolf—adult wolf walking in northerly direction, west side of the esker system, and crossed the shallow river three km north of camp. Observation late evening, right before sunset.

9 July—esker north of Kuniks Bay
One wolf—male, white fur. 800 metres east of large esker system, where we were positioned. The wolf walks down into den. The den is located on top of a narrow sand bar.
One wolf—female, light brown fur. The female walks out of den on the sand bar, after male has entered.
Four pups—grey and brown-coloured fur. The pups come out of the den with the male wolf. They walk after the male to the north side of the sand bar, to another den. It appears the male wolf is digging a new den on the north side of the sand bar.
Den—on the flat top of a sandbar that runs in north-south direction. Den is on south side. Male is making a new den on the north end of the sandbar. Den has a view of low-lying area all around the sand bar. Den is dug from the top down into sandbar. A pile of sand is visible next to the den.

11 July—Camp Kuniks Bay
One wolf: observed at 00:30am by John from his tent. Walking around camp. White fur, possibly same wolf as seen near den on July 9th.

11 July—peninsula north shore Long Bay

One wolf: Large body size. Strong and healthy body. White fur with brown patches.
We boat into the small bay on the north side of Long Bay. We see one calf run inland, and a wolf chase after the calf. The wolf stops the chase and runs inland instead. He has most likely seen our boat and is scared by our presence. The wolf runs without carrying any meat. The wolf runs at a fast pace uphill to a small ridge, stops at the top, looks at us, and runs further inland, out of our sight. The wolf attack scares the herd on the peninsula by lakeshore, and the herds split up and run to hills further north (see caribou observations on July 11).

13 July - John Koadloak's camp
1 wolf: White fur. Same as last time we were at John Koadloak's camp. Wolf walking north alongside hill. Walking along same path as last time we saw him. We are watching him for up to an hour from the window of John's cabin.

Photo 23: Russell Drybones, Joe Zoe, John Koadloak and Mercie Koadloak watching caribou north of Contwoyto lake. July 14th, 2017.

14 July—north end of Contwoyto Lake, valley north east of Jericho mine.
One calf and two wolves. Two wolves chase after a calf. The wolves run towards us, in the bottom of a wide valley. They catch the calf. The chase and kill is fast. One wolf lays down in grass, eating the calf. Twenty minutes later, the wolf rests in the grass after the hunt. The wolf takes a nap after eating and does not move for over an hour. As we walk away, the wolf is still lying down, sleeping in the grass.

One wolf—white fur. The wolf runs behind the herd, coming in from the valley to the north, following the west side of the esker, and runs in front of the herd, and then hides. When herd tries to walk past the narrowest point, the wolf attacks from the side. The wolf tries to attack a small herd of 10+ animals but fails, as the caribou outruns the wolf.
The wolf tries several attacks after the herd. Wolf chases a smaller herd in a small crevasse and catches one caribou. The herd contracts and starts to walk east back into the wide valley. Then the herd stops. 10 minutes later, the herd starts walking southwest again into narrow valley. One cow leads the rest of the herd. The cow walks alongside the esker in a southwest direction past the mine. As herd walks past the esker, to the narrowest point of the valley, the white wolf returns and attacks a second time. The herd

reacts, then runs and fans out over the wide slope, and continues back north into the valley and regroups into a tight unit.
The herd is blocked in by mining infrastructure to the west and rocky hills to the east. The only route south, and to the southwest side of Contwoyto Lake, is through the valley and past the mine site. As they funnel into the narrow valley, the wolf continually attacks the herd. The white wolf appears again, in the same spot, by the outlet of the narrow valley. The wolf has got a kill.

Two wolves: both wolves have white fur. The 2,500+ caribou herd continues to walk back northward into the wide valley. The herd is a tight unit as it walks into the valley. The valley widens out and the herd walks into centre of valley. One wolf comes in from the east side and starts chasing caribou in the herd. A second wolf joins the chase from the south. The caribou outrun the wolves, then stop and watch the wolves standing still. The two wolves separate and one walks around the herd. The first wolf starts a chase, and the second wolf joins in from the opposite side. Again, the caribou outrun the wolf, then stop close by, standing still, watching the wolves. The wolves try again, and again. For 30 minutes, the wolves continue a non-stop chase of the caribou. The caribou outrun the wolves over and over. The large herd spreads out over a large area in the bottom of the valley and splits up into smaller groups. The wolves try to single out individual caribou. But the caribou outrun the wolves every time. We do not observe any successfully kill of caribou.
During the continuous attack, the herd moves further north into the wide valley (and farther away from us. It becomes hard to see the details). No successful attack on caribou is observed. The wolves, most likely, continue to hunt the herd as it moves further out of the valley, and further into the night.

One wolf—same as first observation—walks out of the narrow valley. The wolf carries a load of red meat in its mouth. The wolf walks along a low esker and into a small depression. The wolf leaves the meat untouched, and circles around in the depression, before disappearing from our sight. Most likely, the wolf has a den in the depression or close by in the large esker complex by the Jericho mine airstrip.

<u>15 July—John Koadloak's camp</u>
One wolf: on hilltop south of John's camp. White fur. The wolf is the same white wolf as the previous day. Wolf runs away when we approach.

<u>17 July—John Koadloak's camp</u>
One wolf: white/brown fur. Male wolf; same wolf as observed this morning at John's camp. The belly of the wolf is covered with fur; an indication of sex. This wolf shows full fur cover on its belly, and thus a male. On females with pups, the fur under its belly will be worn off from pups weaning. The wolf walks right up to John's cabin (Photo 24), sniffs the old caribou bones on the ground, grabs a bone and walks 20 metres away. There, the wolf sits down and eats the bone in grass. The wolf walks south, up the hillside, by itself. Walking slowly. Most likely, the wolf has a den somewhere close by the old cabins in the bay southeast of the Lupin mine.

<u>18 July – John Koadloak's camp</u>
1 wolf: white fur. Large size body. Walking on hill south of John's cabin. Same place the wolf walks regularly. Not the same as yesterday, but same as earlier days. Most likely a couple, with a den close by.

<u>20 July - Fry Inlet, East shore</u>
Wolf tracks: fresh tracks in sand on eastern shore of Fry Inlet. We beach the boat on a sand bar. Fresh tracks walking in southerly direction along shoreline.

Photo 24: Male wolf walking a few metres from John Koadloak's camp. July 17th, 2017.

21 July—Fry Inlet, eastern shore
Wolf tracks: fresh tracks in the sand. Two wolves. Large-sized prints. No predator observed.

1 August—Shallow Bay, northwest shore of Contwoyto Lake.
1 wolf: white fur. Wolf runs west of our camp, stops and continues to run away. Possibly looking for the herd we saw yesterday or attracted by smells from our camp.

9 August—Sun Bay, northwest shore of Contwoyto Lake.
1 wolf: white fur. The wolf is running in the hills nearby caribou.

Grizzly Bear Observations

21 July - Fry Inlet, southwest shoreline by rocky *nǫɔokè*
One bear: Light brown fur. Young adult. Standing in water near shoreline when we first observe him. On the north side of the *nǫɔokè,* western shore of Fry Inlet. The wet fur is a bit brighter and shinier than the surrounding dark rocks. Once he notices us, he runs uphill. The bear continues to run far uphill, then stops on a rock and looks at us for a few seconds, before he continues to run uphill and out of our sight.

23 July - *Nǫɔokè,* Fry Inlet
One bear. Light brown fur. Young adult. Thirty metres from us at first observation. At the base of esker near the *nǫɔokè* between Contwoyto Lake and Fry Inlet. The bear is standing in tall grass near a small pond, eating grass or resting. He is scared by our presence and runs at a fast pace away from us to the lakeshore. The bear jumps in the water and swims to the other side, eastern side of Fry Inlet. On the other side stands a herd of 37 muskoxen. The bear runs straight towards the muskoxen. He stops, stands up to watch, appears to be scared by the muskoxen, and runs at a fast pace in a southerly direction, straight

past the muskox herd. After he runs past the muskoxen, the whole herd of muskoxen turns and looks in his direction. The herd starts to walk south towards him. The bear runs out of our sight, into a small valley.

26 July—Fry Inlet
Bear tracks observed along shoreline on sandy beach.

27 July—*nǫɔokè*, Fry Inlet
One bear: Four-year-old bear. Light coloured, blonde/brown-coloured fur. Bear is standing on a sandy esker eating berries. Does not appear to notice us. Bear spots us, then sits down and stares at us. We shoot off bear bangers and the rifle, and the bear runs away. Bear appears to be in good, healthy condition.

13 August—Sun Bay, northwest shore of Contwoyto Lake.
Three bears—one mother and two large cubs (two-year-old cubs). The family near the southern end of a hill on an esker, eating berries. They are slowly moving east. The bears do not seem to notice us and are very unfazed by our presence and camp. The bears are in healthy condition.

Bald Eagle Observations

8 July—Long Bay
One eagle—adult bald eagle standing on top of boulder on a peninsula in Long Bay, eastern shore of Contwoyto Lake. The eagle is watching out over the lake and hills to the south of Long Bay.

9 July—esker eight km north of Kuniks Bay
Two eagles—one adult and one juvenile bald eagle. The eagles are flying around over a large esker complex, north of Kuniks bay, eastern shore of Contwoyto Lake. The adult eagle flies around over the large esker complex and a juvenile eagle sits on south-facing sloping hill of a large esker, overlooking the valley southward to Kuniks Bay. The juvenile bald eagle has lighter brown-coloured feathers.

Photo 25: Team observing eagle from esker north of Kuniks Bay. From left: Narcisse Rabesca, Joe Zoe, Russell Drybones, Mercie Koadloak and John Koadloak. July 9th, 2017.

July 14th—three km northeast of Jericho mine
One eagle—adult bald eagle, three kilometres north of Contwoyto Lake. Flying over 2,500+ herd of caribou, mainly cows and calves. The eagle flies low over the herd: 10-20 metres above the animals. No

attack attempted. After circling a number of times over the herd, the eagle flies out of sight. Thirty minutes later, the eagle returns, and soars high over the herd. The animals do not take notice of the eagle or change their behaviour in any visible way. The eagle does not attempt any attack on the herd.

Indicator 4: Industrial Development

Mines

In the monitoring area, there are two mines: the Lupin mine and the Jericho mine. Lupin is located along the northwest shore of Contwoyto Lake, while Jericho is located at the northern end of Contwoyto Lake. Both mines are in maintenance mode, meaning that there is no ongoing mining activity, but a small crew is stationed there to maintain the infrastructure. Both mines have active gravel roads in their vicinity. Each mine has a gravel airstrip with flights to southern locations.

Exploration Camps

There is one abandoned exploration camp in our monitoring area. The camp sits in the east end of Long Bay, on the northeast shore of Contwoyto Lake. The camp consists of two run-down cabins situated on a sandy esker above the lakeshore (Photo 27). The mining company left several refrigerators, oil barrels, wires, and rusty metal equipment scattered over the sandy esker in what appears to be a garbage dump, spilling into the lake. The camp is located directly in the path of the caribou migration route, which follows the eastern shoreline of the Contwoyto Lake, and on a *tataa*, a land crossing between two lakes (see Photo 26).

Photo 26: Exploration camp and caribou trails on *tataa*, Long Bay, Contwoyto Lake.

Photo 27: Exploration camp on eastern shoreline of Long Bay, Contwoyto Lake.

Survey Sticks and Drilling Rods

The valleys around the northeast and northwest side of Contwoyto Lake contain thousands of survey stakes. Every 25 meters, a stick has been driven into the ground, which, over time, has fallen and/or shifted with the wind and water. We walked the valleys and stepped over hundreds of stakes. These sticks are made of wood and are between 50 and 100 centimetres long. Local Inuit were hired by the exploration companies to set the sticks. In the valleys around the exploration camp in Long Bay, there are over 11,000 survey stakes, at times with flagging tape attached or paint degrading in the ground.

> *When I worked putting up claim stakes that year—1985 if I'm right—me and my dad put down approximately 5,600 pickets in a month in the ground on foot. Over time they will*

gradually degrade and disappear, but on the other hand, there are drilling rods that are still in the ground to this day from the 70s and 80s protruding out of the ground all over the land. In the late 90s they [mining companies] started to leave more of the rods exactly where they drill for future reference and to return to the exact spot in case they found minerals in the core samples. The rods are usually sticking out about 4' long and some a few inches which are dangerous to animals and hunters on snow machines in some areas heavily explored.

John Koadloak

Waste

The lack of concern for potential fuel spills and waste removal from companies operating in the area is clear from the numerous waste sites and garbage found in the area. Numerous oil drums scatter the shore of Contwoyto Lake. Around the exploration camp in Long Bay, oil barrels sit in the water and several are scattered on the ground around the abandoned camp. These abandoned oil drums belong to exploration and mining companies, who operated in the area, and from the Geological Survey of Canada, stationed on the lake during summers in the 1970s. Abandoned fuel drums and fuel containers have a high probability of contaminating soil, surface water and groundwater with hydrocarbons and heavy metals.

When walking the land, the monitors come across other garbage left behind by mining industry as well. A pile of empty tin cans (Photo 28) was found three kilometres south of Lupin mine. The cans were scattered over an area close to a small lake, and probably belonged to a camp that was established by the lake during exploration activity in the 1980s or 90s.

Photo 28: Garbage left on the land, July 15th, 2017.

Photo 29: Caribou antler caught in electrical wire. August 6th. Photo: Tyanna Steinwand.

On August 6th, we found an old caribou antler wrapped in wire (Photo 29). The antler is located approximately ten kilometres north west of Lupin mine, by Sun Bay. The wire was an electrical wire, normally used a bear protection fence around exploration camps. It is unclear if the wire was put on the caribou after it was dead, or if the caribou entangled itself into the wire. The area has been frequented by hunters, outfitters and exploration companies for decades. However, the wire itself is most likely left behind somewhere on the land by the mining industry.

Discussion

In this section, we provide a qualitative description to the field observations, connecting conversations and themes to describe the current state of caribou in the area and the cumulative impacts of industrial development, predation and climate change on the post-calving range of the Bathurst caribou herd.

The effects of past and present activities, as well as the anticipated trajectory of climate changes on the landscapes around Contwoyto Lake were the source of much debate within the harvesters group. This topic is now conversed on an almost daily basis in northern communities whose subsistence depends on a healthy ecosystem. Traditional knowledge of indigenous harvesters combines environmental, social, cultural and economic perspectives; it is a viewpoint we define as holistic. Using a Traditional Knowledge framework, our research has attested that change in the landscapes of Contwoyto Lake has taken many forms, some of which would not be recognizable without this holistic approach; concepts of animal sentience, communication, interdependence and time are essential to understanding how the absence of one element affects the other. The following sections discuss themes that proceed naturally from our observations on the land. We focused on (1) wolf population and decline of wolf hunters on the post-calving range; (2) the effects of mining infrastructure and wolves on caribou migration, and (3) the impacts of climate change on barren-ground caribou. The list of topics covered is by no means comprehensive. It is our hope that additional fieldwork will substantiate and provide inspiration for additional research along these lines.

Wolves and Wolf Hunters on the Post-Calving Range

From time immemorial until the 1980-90s the barrenland was populated with Inuit and Dene families. John Koadloak, a current full-time resident at Contwoyto Lake, described how his father used to run a trap line from Contwoyto Lake, to Almayer Lake and Artillery Lake and to the treeline. Additionally, John explained, several Inuit families lived and hunted along Contwoyto Lake as well as the large lakes further south to the treeline. From the treeline and north, Dene families lived and hunted as far north as Contwoyto Lake, and some harvested further north towards the Arctic coast. Elder Joe Zoe, from Gametì, recalled how his father hunted and trapped at Deèzàatì (Point Lake) and further north towards Contwoyto Lake. On numerous occasions, Inuit and Dene families met on the barrenlands. The Tłı̨chǫ families travelled by canoe and canvas boat to the barrenlands in the fall to hunt caribou. They camped in certain locations with a secure wood supply, such as Ts'iedaa on Ewaànıt'ıtì (Courageous Lake). Settling on the barrenland over freeze-up, they built sleds for winter travel from locally available material. Sleds were made from local spruce trees, cut, shaved and split, and sled bags were made from caribou hides. The ropes to harness the dogs were made from narrow strips of hide braided together (TRTI 2012:36). While the women and children remained in camp, the trappers ran their dog teams along the shoreline of the large lakes further north towards Contwoyto Lake. These harvesters hunted caribou and trapped wolves, white fox and wolverine throughout the winter months. When spring arrived with warmer temperatures and sunlight, the Tłı̨chǫ trappers and their families returned south while the ice was still strong enough to hold the dog teams.

In the 1980s and 90s, due to various colonial policies instituted by the Canadian government, many harvesters and their families started to remain permanently in the communities. Consequently, the yearly

trapping of wolves on the barrenland was significantly reduced. John Koadloak is currently the only remaining full-time wolf hunter living on Contwoyto Lake.

> *Before, families, Inuit and Dene families, used to live all over the land, all the way down to the treeline, and hunted around 500 wolves a year. Now, I am the only one left. There are lots of wolves on the land.*
>
> John Koadloak

The removal of hunters from ecosystems alters the balance that different predators (humans included) have maintained between themselves and with caribou. As harvesters, indigenous peoples have always constituted an integral part of a balanced ecosystem. However, due to numerous historical and current colonial processes aimed at removing the people from the land, the permanent presence of peoples on the land has declined. The consequences are imbalances in the ecosystem.

Photo 30: Old caribou hunting blinds by *nǫɔokè*; east shore of Contwoyto Lake. From left, John Koadloak, Russell Drybones, and Narcisse Rabesca. July 10th, 2017.

Photo 31: John Koadloak on the remains of his family's camp; east shore of Contwoyto lake. July 9th, 2017.

Historically, the Bathurst caribou migrated from their calving grounds near the Arctic ocean, southward toward the treeline every year. From there, the herd habitually remained in the southern forest during the winter months. However, in recent years, most of the Bathurst herd had remained north of the treeline and on the barrenlands through both summer and winter, instead of travelling south to the southern boreal forest. The presence of caribou on the barrenland, and specifically on the post-calving range throughout the year provides a secure and steady supply of available meat for the wolves in the area, like never before.

John Koadloak, as the only remaining full time wolf hunter, estimates that the wolf population on the post-calving range is high, and there are approximately 50 wolves around the northwest corner of Contwoyto Lake. Every year, John harvests between 30 and 50 wolves in this area. John only hunts in the direct vicinity of his camp as there is a high wolf population in the area. However, in all the other valleys and lakes on the post-calving range, where wolves chase after the caribou herds, they reproduce successfully without the harvesters' presence.

Mining Infrastructure, Wolves and Caribou Migration

Wolves leverage several features of the landscape to their advantage to hunt caribou. Narrow valleys or rock outcrops are strategically used to herd caribou into locations where they are more easily killed. The barrenland contains numerous large and small lakes, each of which create barriers for caribou on their long migrations. Over time, caribou leaders have developed certain migration routes to navigate between the numerous lakes. The Tłı̨chǫ have invented the word *tataa* (land crossings) to refer to the migration routes that travel over the land between waterbodies (TRTI 2016). The land between waterbodies becomes a funnel where the caribou are forced to walk. The word literally means "in the midst of waters" (Whaèhdôö Nàowoò Kö 2002:21). *Tataa* refers to a geographical detail, but also to the movement of caribou on their migration routes and thus, some *tataa* have names that describe their routes as for example *Ek'a*tì *tataa*. The word has no equivalent in English (TRTI 2016).

When mining infrastructure is built in between lakes, on a *tataa* and migration route, caribou are forced to select alternate and potentially more difficult terrain, as they are not able to travel preferred routes (TRTI 2017). The Jericho mining infrastructure is located at the southern end of a wide valley, between a lake to its west and the steep topography of the Willingham hills to the east. The local wolves are aware of the natural and man-made geography and use the industrial and natural land features to their advantage. As humans use *tataa* to hunt caribou, so do wolves.

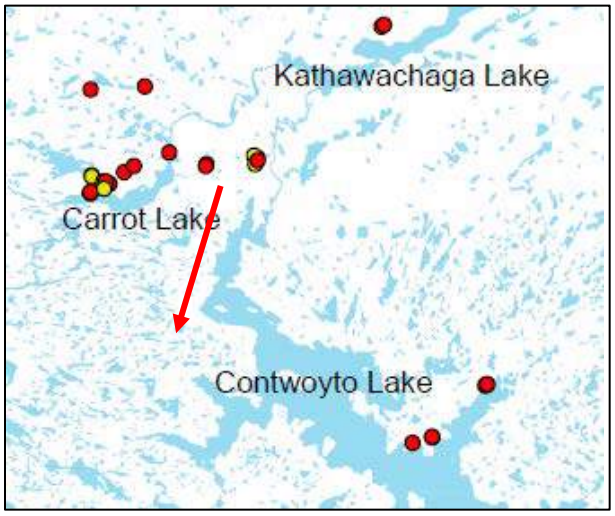
Photo 32: Monitoring team walking the land by Lupin mine. July 16th, 2017.

During the second week of July, large herds were stationary around Kathawachaga Lake and Carrot Lake for several days (Map 14). As the herds moved southwest from Kathawachaga Lake, they funnelled into a wide valley between Carrot Lake River to the west and the Willingham hills to the east. The valley narrows into a funnel between steep rocky hills and a sandy esker. At the end of the funnel sits the mining infrastructure. The Jericho mine airstrip is located directly west of the sandy esker, and the main mine facilities and road is at the end of the funnel created by the valley. The caribou migration trails are dug deep into the ground in the valley, indicating their yearly use over millennia. The herds enter the narrow valley, and instead of spreading out at the base of the valley, the herd's movement is blocked off by the mining infrastructure. Caribou are forced to move between the rocky Willingham hills to cross over the gravel road and the mining infrastructure. Local wolf populations are aware of the area's topography,

and how the caribou herds move through the narrowing valley on their yearly migration route from Kathawachaga Lake and southwest towards the valleys west of Contwoyto Lake. In these situations, the herds are vulnerable and the wolves use these natural and artificial barriers to their advantage in the hunt.

Wolf predation near Jericho mine

On July 14th (Appendix 1), the monitoring team was stationed in the high Willingham hills and watched a large herd of more than 2,500 caribou move into the valley, as described above. As we first entered the valley, two wolves chased down a calf. The wolves chased the calf directly towards us. The chase was fast and the calf was killed instantly. One wolf lay down to eat the calf, and then slept for more than an hour. As we turned away to follow the herd, after an hour, the wolf was still sleeping in the grass.



Map 14: Caribou collars on July 12th. Red dots: cow caribou; yellow dots: bull caribou. Inserted red arrow indicate direction of herd movement. Source: GNWT ENR.

After the chase, the herd moved about three kilometres into the narrowing valley. It then stopped and rested on a flat shelf overlooking the valley, and another large, tight unit of caribou remained resting in the valley bottom. There were numerous animals spread out over the valley bottom. The majority of animals lay down to rest; some slept with their heads down. Most of the calves lay down to rest. At one point, all the calves rested. Their mothers lay next to them or stood close by grazing (Photo 19).

After an hour and a half, the herd slowly moved westward into the valley. The valley narrows further southwest, into another narrow valley between, to the west, an esker system and the Jericho mine airstrip and, to the east, the high rocky Willingham hills. In between the esker and the rocky hills is a narrowing valley with hills on each side, prohibiting the herd from moving to the northwest or southeast.

The herd retreated and walked back out in the wide valley. Again, it stopped on the flat valley bottom. Most animals lay down to rest and/or graze for another two hours. Then the herd walked southwest in several lines that merged into one single line of animals down the narrowing valley. Together, they walked out of the open flat valley, and up to the flat area alongside the esker and the Jericho mine airstrip. The Jericho mine buildings, the airstrip and infrastructure were now approximately 500 metres west of the herd (Photo 33).

One white wolf walked along the side of the esker into the valley and ran in front of the herd. The wolf hid in a small crevasse in the esker complex. When the herd attempted to cross the narrowest point, the wolf attacked a small herd of approximately ten animals from the side but failed—the caribou outran the wolf. The wolf attacked again from various sides. But the caribou outran the wolf. The herd regrouped, stopped, then slowly attempted to enter the end of the funnel, and attempted to continue south into the narrowing valley. Eventually, the wolf chased a smaller herd into a crevasse, and caught one caribou, possibly a calf.

The herd contracted and started to walk back out of the narrow valley but stopped. Ten minutes later, the herd returned southwest into the narrow valley. A cow led the herd southwest, past the esker. As the animals passed the esker, the white wolf attacked a second time. The herd retreated and ran back into the valley, then fanned out over the wide slope, and finally returned to the valley to regroup into a tight unit.

Photo 33: Caribou herd by Jericho mine infrastructure. July 14th, 2017.

The herd was blocked in by the esker and mining infrastructure to the southwest and the Willingham hill to the east. The only route south, and to the southwest side of Contwoyto Lake, was through this narrow valley and past the mine site. As they funneled into the narrow valley, the wolf continually attacked the herd.

After three attempts to pass the Jericho mine via the narrow valley, the herd halted its migration south to avoid further wolf attacks. The herd contracted again into a tight unit and walked slowly back north into the wide valley. From our viewpoint on top of the Willingham hills, the white wolf appeared again on the side of the narrow valley. It had a kill. The wolf walked out of the narrow valley carrying a load of meat in its mouth, possibly a calf. Then it passed along a sandbar and into a small depression. There, the wolf left the meat in the bottom of the depression, circled around, and disappeared from our sight. Most likely, the wolf has a den in the depression or close by in the large esker complex north of Jericho mine airstrip.

As the tight herd walked back north into the wide valley, a dust cloud enveloped it. The setting sun shone through the dust cloud, creating a yellowish glow around the animals. Together, they moved along the eastern side of the valley, so as to avoid the wet muskeg areas in the bottom of the valley.

At 10:20 p.m., two other wolves appeared as the herd was returning to the centre of the wide valley. One wolf walked in from the east side and started chasing after single animals in the herd. The second wolf joined the chase from the south. The caribou outran the wolves, then abruptly stopped and watched the wolves, who had given up the chase. The two wolves separated and one circumnavigated the herd. The first wolf rejoined the chase, then the second wolf joined in from the opposite side. Again, the caribou outran the wolf, then stopped to watch the wolves. The wolves tried again, and again, and again. For 30 minutes, the wolves pursued the caribou non-stop. The caribou outran the wolves time and again. But the chase had divided the herd into smaller sub-groups. The wolves tried to single out individual caribou, but the caribou always outran them. We did not observe the wolves successfully kill any caribou. They continued to hunt the herd as it moved further out of the valley, and the herd moved farther away from us and further into the night, until it became hard for the monitoring team to observe accurate details.

After a few days, the herds eventually migrated south past the Jericho mine. But they paid a high price. We observed two caribou killed by wolves on July 14th alone. Due to strong winds the following days, the monitoring team was unable return and continue to watch the herd attempt again to walk through the narrow valley past Jericho mine.

Caribou in a Warming Climate

Summer snow patches used to be present as late as mid-August, and at times year-round in sheltered locations. In recent years, average temperatures in May and June have been higher, and the snow has melted by the end of June. In 2016, the monitors observed no snow patches around Contwoyto Lake, and in 2017, one snow patch were located on a steep rocky slope north of the lake, but the snow was melted by mid-July.

During summer months on the barrenland, snow patches used to be scattered over the land. The winter's remaining snow usually covers north-facing hillsides, crevasses, sun shades and slopes where the wind packs down the snow during winter, and overflow ice builds up along rivers. In late July and August, the temperatures melt the snow, which turns into ice as the overnight temperature cools. These snow patches are used extensively by caribou to control body temperature on hot days, and as refuge from insects. On very warm days with little wind, insect activity is extreme on the barrenland, and the herds gravitate towards the cooler snow to escape insects. Usually snow patches are located on prevailing wind hillsides, adding further deterrence from mosquitoes, blackflies, sandflies, warble and botflies (Appendix 5).

As longer periods of higher temperatures occur earlier in spring, the entire snowpack melts at a faster pace than previously observed. The local residents at Contwoyto Lake describe "no snow patches on the ground anymore." The snow patches usually melt slowly during summer months and feed the lower-lying flat muskeg and vegetation with moisture during the summer. Currently, with the snow patches gone, the only source of water is from rain and water trapped by permafrost; during prolonged periods of heat, vegetation becomes "dry and crispy" until the next rain shower.

For caribou, the earlier snow melt increases their exposure to insects and heat, and the herds respond by changing their behaviour and movement patterns. Instead of moving to sun-shaded high hills with snow, the herds tend to either continuously run into the wind to avoid insects or move towards waterbodies.

As there is no more snow to cool down on, the animals enter the water to cool down their hooves and bodies.

> *The caribou in the past, in the late 1980s and early '90s used to go on the hillsides where the sun wouldn't melt the snow patches. As the summer gets warmer, later on the snow patches would turn into ice and a lot of caribou would be on them. But now we don't see that no more, because of the climate change. Now we see them in the shoreline of lakes, ponds and streams, this is how they cool down.*
>
> John Koadloak

On two occasions, we did observe a herd standing in the water to cool down their bodies. On July 21st, we saw a large herd of 400 caribou standing on small point, in a bay on the eastern shore of Fry Inlet. The sky was clear, the sun was bright, and the temperature was 24 degrees Celsius. The south wind provided relief from the insects, and the herd was standing into the breeze on the south-facing side of the point. Almost half of the herd stood with their legs in the shallow water. More animals were standing on shoreline and on shore, while some calves ran around on the small point. We beached the boat on the opposite side of the bay and moved slowly through the vegetation. The herd started to move onshore from the water and slowly walked into the bay. The herd picked up speed and moved rapidly around the bay, right towards us. We hid in the vegetation, as the herd of 400 animals walked directly past us (Photo 34). We observed no animals lagging behind the main herd. All the animals walked rapidly together as a single tight unit, and no animals were injured or falling behind.

Photo 34: Caribou herd running in the lowlands by the lakeshore of Fry Inlet. July 20th, 2017.

The herd moved across a peninsula and to the southern end of Fry Inlet. We travelled by boat around the peninsula, through a narrow rocky channel and positioned ourselves further south of the herd. The herd had stopped on a small point jutting into the lake. We stopped about 500 metres away, across a small bay from the herd. The herd was standing on the point, in the 20 km/h south wind, which provided relief from the mosquitoes. The herd moved slowly to lakeshore. The herd walked slowly, ate, stopped, and continued down to the shoreline, where it entered the water. Many animals stood with their legs and hooves in the water. For two hours, from 5:30 to 7:30 p.m., the herd rested on the point. Most of the animals were lying down, though a few stood up, eating and walking around slowly. Elder Joe Zoe explained, "their feet are hot, so they stand in water. Same way as dogs do, to cool off their feet."

The animals in the water and by the shoreline faced into the south wind coming off the lake. These animals were resting. Other animals were standing a few metres from the shore and eating grasses and lichen. These animals constantly shook and twitched their bodies as an attempt to remove mosquitoes and blackflies from their bodies. Approximately every 30 seconds an animal twitched. The caribou continued eating, took short breaks to shake off the insects, and resumed eating. We observed the caribou from 20 to 50 metres' distance; some animals were close by and moved around while other were standing 50 to 100 metres away from the team. One cow walked ten metres from us and then stopped. She stood on

rocks facing into the south wind, then started to blow bugs out of her nose, with loud wet blows through her nostrils. The cow continued the loud wet blows for approximately 30 seconds, looking downward. Then she walked back to other animals who were standing feeding. A number of caribou faced us, 20 metres away (Photo 35); they were feeding. In the wind shadow, on the flat ground above shoreline, where these animals were standing, insect activity was high, and the animals were continuously twitching from insect harassment.

The monitoring team watched the herd at this location for more than two hours. Being in the same environment, we personally experienced the same harassment from mosquitoes and blackflies as the caribou. The south wind provided relief from insects but once wind calmed, we felt the same stressors—insects and heat. For hunters, the snow patches were also a secure place to find caribou during the summer months. Now, since the snow has melted, the caribou have changed their behaviour and movement patterns and thus harvesters do not know where to find caribou herds (TRTI 2017).

Photo 35: Herd of caribou surrounded by mosquitoes, southeast shore of Fry Inlet, July 20th, 2017.

Weather, Wind and Caribou

From July 5th to 10th, the weather was mainly sunny and windy. We observed only individual animals or small herds. On July 11th, however, a large, low-pressure system moved in from the southeast, bringing heavy rain and strong winds, with thunder and lightning day and night. This was the first day we saw the big herds of caribou moving in. This came as no surprise to the local Inuit and Mercie Koadloak, who said, "when caribou come – the weather always gets funny" (Appendix 7). Every year, when the caribou herds move south from the calving grounds to Contwoyto Lake, the weather changes and rain and wind ensues. "When caribou first come, we get rain for days," Mercie Koadloak explained, and added "Weather follows caribou, when caribou come the weather gets funny. They like the cold and wind—no insects." During the first field season in 2016, we experienced strong shifts in weather at the time the large caribou herds arrived in the area as well (TRTI 2016: 32). The rain has a functional aspect for the caribou during summer: "the rain is fixing the caribou," explained Mercie Koadloak. On days with heavy rain, the rain water will run down the hide and with it pull off pieces of the winter fur, thus the rain is "fixing" the caribou hide.

Prior to the cultural shifts created by colonialism, such as residential schools, many people had strong spiritual powers. These people were able to manipulate the weather, often for the benefit of the people. They could alter the weather conditions, and, for example, make the wind calm down or the cold weather approach faster. Different strategies were used to manipulate the weather. On the barrenland, weather dictates every movement, and the weather has a strong effect on caribou behaviour. The wind decides

the direction of caribou movement, as the herd will walk into the wind to avoid insects. On cool days with strong winds—over 25 km/h—the insects were deterred from harassment, and the caribou grazed peacefully. The herds simply "*ekwǫ̀ nɻhts'ı nìdǫǫ̀*" (stand into the wind). On such days, the insects keep to the ground and the herds walk in the direction of the wind. During such strong consistent wind, the elder Joe Zoe explained "*ekwǫ̀ nɻhts'ı k'è k'eɔà*" (the caribou follow the wind). The wind is also important during winter. During cold, windy days, although there are no insects, the herds will also face into the wind. "The wind is what keeps them alive in winter," explained John Koadloak. "The wind carries scent, and the animals can smell wolves and predators upwind from them." The ability to detect scent carried by the wind "keeps the animals alive."

Summary

Boots on the ground (BOTG) is a caribou monitoring program based upon the Traditional Knowledge (TK) of Tłı̨chǫ and Inuit indigenous elders and harvesters. The program commenced in the summer of 2016 and is expected to extend to the year 2021, and possibly longer. The program objectives are to monitor the conditions of Bathurst caribou on the post-calving range herd, focusing on four key indicators: (1) habitat; (2) caribou; (3) predators, and (4) industrial development.

Our field research observed caribou around Kokètì (Contwoyto Lake) for a period of 40 days. Overall, Bathurst caribou on the post-calving range displayed signs of being healthy. Animals were not noted to store excessive fat but showed normal body conditions for the season and no signs of undernourishment. Of 13,224 caribou observed, 11 were injured. During migration, no injured or lame animals were lagging behind the herds during these fast-paced movements. The large herds observed were comprised of a majority of cows and calves. The number of calves observed in herds were in the same range as previous observations; according to seasoned harvesters, they were "normal in the herd." In most instances, a one-to-one cow-calf ratio was observed, where nearly every cow had a calf and it was noted that there were "lots of calves in herd."

The effects of industrial activities, climate change, and predation affecting the landscapes of Contwoyto were examined using the program's Traditional Knowledge framework. This framework allowed us to identify new trends occurring in the region and explain them using holistic perspectives. Changes noted include the increased presence of new species in the Arctic, such as bald eagles, as well as changes in caribou behaviour.

Caribou now remain north of the treeline for most of the year; this shift in range now provides a steady supply of prey for wolf populations. John Koadloak, the only remaining wolf hunter, explained how the removal of indigenous harvesters from the landscape around Contwoyto Lake had profound impacts on predator/prey relationships between caribou, wolves, and humans. Industrial developments, roads, and human disturbance built between lakes or important corridors forces caribou to select alternate terrain for their migration. The Jericho mining infrastructure is located at the southern end of a wide valley, between a lake to its west and the steep topography of the Willingham hills to the east. The local wolves are aware of the natural and man-made geography and use the industrial and natural land features to their advantage. We observed a large herd attempt to move through the valley, eventually, the herds migrated south past the Jericho mine, but at a high cost. We observed two caribou killed by wolves on July 14th alone.

Several signs of climate change were identified, such as an earlier spring melt, the disappearance of summer snow, and the appearance of new species on the post-calving range. Increasing temperatures and the melting of summer snow patches altered caribou behaviour and exposed them to additional risks and stressors associated with insect harassment and heat. Instead of moving to sun-shaded high hills with snow, the herds tend to either continuously run into the wind to avoid insects, or seek lowlands and move to the lakeshore, as well as other water sources, such as ponds and streams, where they go into the water to cool down their hooves and core body temperatures. For the upcoming field season, in July and August, 2018, the monitoring teams will continue to focus on the monitoring indicators and in furthering our understanding of the complex nature of *dè* on the post-calving range around Contwoyto Lake.

Photo 36: Basecamp by *nǫɔokè* between Contwoyto Lake and Fry Inlet.

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Appendix 1: Observations of Bathurst caribou from July 5th to August 14th, 2017.

05-Jul	1 caribou: by Lupin mine. Feeding on sloping hills, north side of mine site, 200 metres down slope from the houses. We watched it as we moved gear from airstrip to dock. Too far to see sex and details.
06-Jul	1 Bull: white winter coat, healthy body conditions.
	1 cow. Brown coat. Healthy body conditions.
	1 calf – 1-year old yearling – light brown coat. healthy body conditions.
	Together they walk north along hill east of camp 1 towards Peacock hills. Walking fast pace north into northwest wind. High insect activity, in wind shades. Less insect activity on hill top. Bull and cow met up with calf in valley bottom north of us. First observed bull and cow, then later all three.
	Caribou family: First, observed bull and cow. Later, bull, cow and calf. The calf was separate from the cow. Walked further east/inland then the cow. Once cow reached valley bottom, she waited for calf, then all three joined together and walked northwest (into wind). Sometimes caribou family/group walks away from main group. Cow teaches calf to walk. Not really strong yet, when fall comes the calf will be on its own.
	1 bull, white hair around its neck. On esker north of camp 1. By itself, walking north on esker. Too far to see details.
07-Jul	1 bull caribou. Healthy condition. On sloping hill east from us. Feeding, walking slowly back and forth. White around neck – front part. Brown coat back side.
	The bull is following the same trail as bull and cow we observed July 6th: south to north around Long Bay, along east shore of Contwoyto Lake.
	1 Bull –White around neck, brown back part. Fat body conditions.
	On hills south of us. Walking northwest along ridge into wind – to avoid mosquitos. High insect activity when wind is calm.
	Vegetation is moist from heavy rain yesterday and during night: good food for caribou now.
	1 Yearling (1-year-old) – came walking right up to us. Looking for its mother. Mother has abandoned it/separated from its mother.
	Healthy body conditions. White winter coat, can see chunks of hair falling off. White tail. Dark color hide on all legs. Small short antlers. Dark color fur around eyes, as characteristic of calves/ yearlings.
	1 bull walking north of us, the yearling was looking/ following after the bull. Bull is same as earlier
09-Jul	1 cow – 3-year-old
	White winter coat. Healthy body conditions, no injuries
	Prefer to walk on sand hills, there are no bugs on wind exposed sand ridges/eskers.
	1 bull. On sloping hills east of esker, about 2 km away.
	Eating and standing in flat muskeg/grass. White winter coat is coming off. Too far to see details.
10-Jul	1 cow. On top of hill south of us. Too far to see details.
11-Jul	1 young cow. Healthy condition. Shed its winter fur. Running with her head up, and eyes fixed staring at us, as she runs by us at 50 metres distance.

	1500+ Caribou herd. on hill top north of us. Herd standing on ridge/ hilltop, standing facing into 18 km/h southeast wind. First, we observe approximately 50 animals. Then many more caribou appear, from northside of ridge, the herd moves slowly east into southeast wind, along ridge line. The animals continue to move up from backside of ridge, to its top, and walk slowly into wind. After low pressure system moved over us with heavy rain, the ground is moist, and good forage for the herd. Hordes of mosquitos appear – very high insect activity – caribou move to hilltop to be in wind away from mosquitos. High insect activity when wind calms and in flat/ low ground. Low insect activity in wind on hilltop we are observing from. Too far to see details.
	40 caribou: resting on a shelf on side of hill top, on horizon, on northwest side of peninsula. Some animals are lying down, relaxing, on the side of the high hill, into the southeast wind. Animals feeding well on hilltop/ridge. The vegetation is moist and good quality after rain. Numerous calves in the herd. More animals continue to join the herd, walking up from the backside of the hill. Too far to see details
	Herd compositions: mainly cows and calves. Calves are in good and healthy conditions. Large number of calves in the herd. Some calves lying down resting. The amount of calves is normal in the herd, approximately 45% calves.
	Big bulls in the herd. Bulls have black color hair on their heads.
	High number of yearlings, White color coat. Most animals in herds still has white winter coat on. The overall herd seems white from a distance.
	No visible injuries. No animals are lagging behind, when the herd start to walk in faster pace, southeast into southeast wind.
	High insect activity, as wind calms. Herd is slowly walking uphill in low-lying muskeg area towards southeast. Herd is stretching out over large area, as some animals grazing and walking slowly into the southwest wind. Low insect activity when wind gusts come (20 km/h wind), but very high insect activity when wind calms or sheltered areas. Many animals are lying down resting, other standing and eating, and slowly walking, and stopping again to eat. The animals do not seem overtly bothered by the very high insect activity.
	Herd start to walk southeast, congregate in one large group and start walking southeast. High insect activity in low lying muskeg. The herd movement is zigzagging into shifting wind over the sloping muskeg area. The herd fans out over larger area, then congregates again, as they slowly walk up the sloping hill, in southeast direction. Eventually herd reach top of hill and walk to the high hills further east on peninsula. Low dark clouds come over us with heavy rain. We walk 5 km back small bay on Long Bay, as we walk back we see the herd skylining the hills to the east as they walk in southeast direction. Heavy rain and dark clouds continue to come over us from the northwest. As the clouds pass, the wind calm and insect activity become extreme.
	500+ caribou on hills east of us - by northern shoreline of Long Bay. Mainly bulls in this herd. The herd is skylining the hill 1 km east of us. Hundreds of bulls antlers intertwined as they skyline the hill. The herd move west/northwest towards us. Hard to see details in terrain. Different herd than earlier, observed moving southeast.
	“These herds are just walking back and forth on this peninsula without really moving anywhere. These herds are 'waiting' for the larger herds with the cow leaders before they start moving fast further south.”
	1 cow: young. Probably same as we saw earlier in the day, at the same location.
	1 calf. The cow and calf are in healthy conditions. No injuries.

	The two animals walked towards us from the small peninsula, as we stand on higher ground, to avoid mosquitos, then they noticed us, turned around immediately, and walked fast pace back out on the peninsula, where they came from.
13-Jul	Tracks of 20-30 caribou moving west/ on to peninsula, northwest side of Long Bay. No tracks going east/out of peninsula. Herds must have either moved north, or still staying further out on the peninsula. We walked 20 km (8.5 hours) across large peninsula. We walk slow and look for tracks leading in or out of the peninsula. First, we walked 12 km in north direction from northern shoreline of Long Bay. When we reached the north side of peninsula, we walked 8 km west towards west shoreline of peninsula. No sighting of caribou or wolves. The peninsula, northside of Long Bay, was bare of animals. We saw tracks of large herd moving southeast on same spot we saw herd two days earlier on July 11.
	No/ low insect activity as strong 28 km/h wind and cold: 13 Celsius. On windy and cold days, like today, caribou walk around grazing as its windy and cold, and no need to avoid mosquitos. Yesterday, with heavy rain, the herds lying and resting in the rain.
14-Jul	15:30; 1 calf and 2 wolves. Two wolves chase after one calf. The wolves run towards us, in the bottom of a wide valley. They catch the calf. The chase was fast. One wolf lying down in grass, eating the calf. 20 minutes later, the wolf was resting in the grass after the hunt. The wolf was taking a nap after eating and did not move for over an hour. We walked away, the wolf was still lying down, sleeping.
	2500 caribou. Two herds grazing and walking slowly on north side of the long wide valley east - of Carrot Lake, north of Contwoyto Lake. One herd walk around a hill knob, while other herd is resting on flat ground on south side of hill. When the herds started moving west, the two herds merged into one large herd.
	Composition of herd resting by hill: 95% cows and calves. 40-45% calves: a normal amount of calves in the herd.
	The animals are all in healthy conditions. 1 cow is injured, and limping. She is walking in the back end of herd.
	The herd is grazing slowly on flat ground by hilltop and along sloping hillside. The hillside is covered with green grass, sedges and moss they feed on. Many animals lying down resting as other walking slowly, then stop, and continue grazing. The herd spread out over the hillside. Most animal has white winter coat, while few are darker brown color. Good quality forage for the herd in the valley and along hillside. There is no insect activity in the 20 km/h strong west wind.
	The 2nd herd walks up hillside from valley bottom. The are walking in quicker pace and cover much ground as we watch them. The herd is walking in one tight unit. The herd walk south past a little hill and out of our sight. Too far away from us to see details. This herd might have been scared by the wolf attack on the calf, and walking away in a tight group, in west direction away from wolves.
	3 caribou cows. Walking on rocky hill above us. One cow is standing on top of hillside 100 metre from us looking down at us.
	The cows are “dry cows” - they have no calves this year. They are in skinny condition. But these dry cows *“are the last to get fat.”*

	The whole herd start to walk southwest, into west wind, following south side of valley, up from the muskeg in the valley bottom, and walking through the boulder field, along high rocky hillside. The herd walk towards Jericho mine. As the herd walk southwest, we follow after. John and Mercie walk back to boat, to move the boat further south along the lake and can pick us up at one of the deep valleys traversing the rocky hillside. We see Jericho mine airstrip on west side of large sandy hill, right southwest of us.
	Caribou forage is in good and normal quality, after the rain. The vegetation is lush and green, in the valley bottom and along hillside where the caribou are grazing
	Herd walking is fast pace. A sign that they are healthy and in good shape.
	1 Injured bull. Front right leg injured. The bull is left behind as herd walked in fast pace. He is standing in rocky area with large boulders around. The bull is in skinny condition. He starts to walk west after the herd but is in pain and walks very slow.
	A second bull follows the injured bull. He is not injured. This bull walks alongside the injured bull and follow/lead the injured bull back to the larger herd. The bulls are scared off us as we came upon them and walk at first slowly ahead of us. The bull is severely limping. Then they start to walk in fast pace to catch up with the larger herd. As the herd rest on the flat sloping ground, they catch up and lie down to rest on a shelf overlooking the valley.
	Calves and cows. 2 cows and 2 calves: walking after the herd, trying to catch up with the larger herd, that moves in faster pace ahead. The cows stop and the calves are weaning from their mothers.
	The calves are all in healthy conditions. The cows/mothers are in good conditions.
	1 calf: left behind as herd walked fast. The calf starts to run after the herd. The mother notices her calf is gone, then stops and waits, and walks towards the calf. They reunite. Calf appear to be healthy.
	1 calf left behind. The calf is walking around and looks for its mother. The calf finds her mother, and they reunite. They stop and the calf weans from its mother. Calf and cow in healthy condition.
	2 cows and 2 calves. Last animals following the larger herd. They walk slowly into the wind towards the herd in front of them. The cows are healthy, the calves are healthy.
	The large herd is resting in on a flat shelf overlooking the wide valley. The large herd is spread out over the entire valley shelf, on the sloping hill down to valley and a large tight unit of animals are resting in the valley bottom. Numerous animals are spread out over the valley bottom.
	Herd composition: 90-95% cows and calves – only a few bulls in the herd.
	Strong 30 km/h west wind - no insects activity.
	The herd has stopped and are resting, after walking in fast pace, 2-3 km from our first observation. The majority of animals are lying down and resting, some sleeping with the heads down. Most of the calves are lying down resting. At one point, all the calves are resting. Their mothers are lying next to them or standing close by grazing. Some are lying down in the wet muskeg. Other animals are standing grazing on the grass and sedges. Many have white winter coat on, and several cows have darker brown color hair, while white around neck and head.
	The vegetation is green and lush after rain. The valley is in a luminating color of lighter and darker green from the lush moss, grasses and sedges.

	1 bald head eagle: flying over herd of cows and calves. The eagle fly low over the herd: 20-10 metre above the animals. No attack attempted, and eagle fly out of sight. 30 minutes later, the eagle return. Soaring high over the herd. The animals do not take notice of it, in any visible way.
	Over time, some cows and calves wander off, back north into valley, while grazing and walking slowly, then they return to herd. One bull wanders off southeast to high rocky hill top. 6 bulls follow after, walking up into rocky hills.
	1 cow: walking 500 metres behind herd. Cow is walking around and looking for its calf. We can not see the calf. Cow walked out of our sight. We can't see if she reconnects with calf.
	19:15. After 1 hour and 30-minutes resting in the same place, the herd is slowly starting to move west. Many animals are still lying down. Others walk along slowly further west into the valley. The valley narrows further southwest, into a narrow valley between sand hills and Jericho mine airstrip on west side and high rocky hills on east side. In between the sand esker and rocky hills is a canyon with hills on each side, prohibiting herd from moving west or east.
	Large herd moving slowly southwest into narrow valley next to Jericho mine airstrip. A wolf was trying to attack them further up the narrow valley, out of our sight. John Koadloak watched at the same time from higher into narrow valley, and saw a white wolf attempting to attack the herd. Then the herd retreated and walked back out in the wide valley, into our view. Again, the herd stopped on the flat valley bottom. Most animals are lying down resting and grazing. All animals are feeding well, as they rest.
	Calves are lying down, resting and sleeping. Their mothers are standing close by and grazing.
	All cows and calves are in healthy conditions.
	Numerous yearlings in the herd, yearlings don't have calves. The yearlings have smaller antlers.
	The vegetation is lush and green. The *"wind makes vegetation 'tender', and good to eat."* Strong 30 km/h wind for two days now, and vegetation is lush from wind and rain.
	No mosquitos or insects. 33 km/h wind gust and 17 degrees Celsius.
	1 cow: injured front right leg. She is limping.
	1 calf: injured back left leg.
	1 cow: injured back right leg.
	21:20: after another two hours resting, the herd start walking southwest in several lines that merge to one single line of animals down the narrowing valley. They walk out of the open flat valley, and up to flat area alongside esker and Jericho mine airstrip on north side and rocky hills on south side. Jericho mining buildings, airstrip and infrastructure is 300-400 metre west of herd.
	In total the herd rested, 3 hours and 35 minutes, on the side of the wide valley.
	At their current location the herd is blocked in the movement by mining infrastructure and esker on west side and the steep rocky hills on the east side. The whole herd is grouped together in one tight unit in front of rock wall/esker.
	1 wolf – white fur, runs behind the herd, coming in from the north, from wide valley, follows the side of the esker. Runs in front of the herd, and hides. When herd tries to walk past the narrowest point, the wolf attacks from the side. Tries to attack a small herd of 10+ animals but fails as the caribou outrun the wolf.

	Wolf attacks the herd from various sides. The herd regroups, stops, then slowly attempts to enter the end of funnel, and try to continue walking south into narrow valley.
	Wolf chases smaller herd in small crevasse. Wolf catches one caribou.
	The herd contracts and start to walk east back into wide valley. Then the herd stop.
	10 min later – herd start walking southwest again into narrow valley. Another attempt. One cow leads the rest of the herd. The cow walks first passed the esker in southwest direction passed the mine.
	As herd walk past the esker, the white wolf comes and attach a second time. The herd reacts, runs, then scatters and fans out over the wide slope, runs back north into valley and regroups into a tight unit.
	The herd is blocked in by mining infrastructure to the west and rocky hill to east. The only route south, and to southwest side of Contwoyto Lake, is through the valley and passed the mine site. As they funnel into the narrow valley, the wolf continuously attacks the herd.
	White wolf appears again. Stay in the same spot, by outlet of the narrow valley. The wolf has got a kill.
	After third attempt of going into narrow valley passed airstrip, then the herd contracts again into a tight unit and start to walk slowly back north into wide valley. As the tight herd walks north, a dust clouds envelope them as they stampede. The setting sun, shine through the dust cloud and create a yellowish glow or aura that envelopes the herd, as they walk north into the wide valley. The herd walk along the eastern side of the valley, on the side that slopes down to valley bottom, as to avoid the wet muskeg areas in the bottom of the valley. Finish obs# 22 – 22:10
	Obs #23: 22:20 – 2 wolves: white fur (not the same as obs#22) and the 2500+ caribou herd continue walking north into wide valley. The herd is a tight unit as it walks into valley. The valley widens out and the herd walk into centre of valley. One wolf walks in from the east side and starts chasing caribou in the herd. A second wolf, joins the chase from the south. The caribou outrun the wolves, then stop and watches the wolves standing still. The two wolves separate and one walks around the herd. The first wolf starts a chase, then the second wolf joins in from the opposite side. Again, the caribou outrun the wolf, then stop close by, standing still watching the wolves. The wolves try again, and again. For 30 min, the wolves continue a non-stop chase of the caribou. The caribou outrun the wolves over and over. The large herd is now spread out- split up into smaller groups. The wolves try to single out individual caribou. But the caribou outrun the wolves every time. We did not observe any wolves successfully kill any caribou.
	During the attack, the herd moves further north into wide valley (and farther away from us. It becomes hard to see the details).
	No successful attack on caribou was observed. The wolves, most likely, continued to hunt the herd as the moved further out of the valley, and further into the night.
	1 wolf – same as obs#22 – walks out of the narrow valley. The wolf carries a load of red meat in its mouth. The wolf walks along a low esker and into a small crevasse, seems to leave the meat, and walks around. He walks around in the crevasse and disappears from our sight.
	The wolf has den in the large esker complex by Jericho mine airstrip.
	The sun sets, wind calms, and insect activity increases to very high. We sit on hilltop watching the herd. The insect harassment becomes extreme. Finish obs# 23 - 23:30

16-Jul	14 caribou – observed at 20: 00. 7 bulls and 7 cows: no calves. Too far distance away to study health conditions. The animals had black color hide on feet, as winter fur is coming off. Most animals had shed its winter coat (compared to herd by Carrot lake, with lots of white winter coat).
	Bulls are healthy and starting to become fat.
	No injuries visible.
	The herd was walking northwest into wind. Strong wind and no insect activity. Walking northwest, the larger herds (collars) are further south, perhaps walking north from them. As they walk northwest, they need to walk around Lupin mine and tailings pond.
17-Jul	4 caribou: on daka/hilltop 1-2 km south of us. Skylining the hilltop, then walked further south out of our sight. Seems to be bulls, as they have large antlers. Too far to see details.
	1 bull caribou: on hillside 500m south of us. Large antlers and shovel. Dark brown color coat, it has shed its winter coat.
	We are upwind from him, and he can most likely smell us. As he is walking, he continuously looks around and appear to be spooked, perhaps by our presence. No insect activity as its too windy.
	We walked closer, and he is running away from us, then stops, turns and runs side by side of us as we walk, he keeps a 200 metres distance from us, but runs parallel to us. He is curious and keeps coming back, stops, looks at us, then runs away, then comes back again. He is curious but scared. Runs away at the end. Healthy body conditions, no injuries, walks/runs with head straight forward.
	2 bull caribou. Dark hair coat. Walking north in fast pace, into north wind. We only observed them for few minutes, they walked fast out of sight in north direction. Walk to fast to see details.
19-Jul	4 caribou. On daka/high hills, 1-2 km south of camp.
	3 bull, 1 cow, no calves.
	Caribou moving northwest along ridge, they are skylining. – into strong wind. Too far, and much heat waves distortion, to see details.
20-Jul	1 bull: Running fast along shoreline. 1 km south of us, on other side of lake. Perhaps scared by wolves. Large antlers. Dark color coat, has shed its winter coat. We watch him from our campsite.
	16 caribou: Running north on peninsula across lake from camp, running into wind. The herd walk fast pace from mainland, to shoreline by nǫɔokè. Turned around and ran back as they approached the water. Perhaps scared by our smell- they are downwind from us. They walk too fast right towards us, and too much heat waves, to see details.
	4 caribou: on flat ground along, east shoreline of Fry Inlet. Animals running fast, back and forth on the flat ground by lakeshore. High insect harassment. Blackflies are out in full. 10-15 km/h north wind.
	“This is what the caribou are running from. They [blackflies] are out in full now.”
	1 cow: walking north along east shoreline of Fry Inlet towards nǫɔokè. Observed from boat.
	1 calf. Injured back leg. Both cow and calf walking north along shoreline to nǫɔokè on Fry Inlet.
	2 cows: walking on hill top above larger herd. One cow has injured front leg. Too far to see further details.
	250 caribou: Large herd on east shore of Fry inlet. Herd walking north.
	70% cows – mostly cows in herd. Cow with calf is leader of herd.

	Zigzagging movement along sloping hill to lake. High insect activity. 5 km/h wind along flat ground.
	Cows have healthy body condition. Not fat, but normal condition for this time of year.
	1 cow, running back looking for its calf.
	1 cow. It is a dry cow – no calf.
	One cow is walking around and eating. She is picking up and eating mushrooms. She walks close up to us, 20 metres.
	4 dry cows: 2 cows with 2 yearlings: no calves from this year; 2 cows: with no calves.
	3 dry cows, walking north catching up with herd.
	1 cow with collar.
	1 cow – injured front foot.
	Bulls are healthy. The bulls have large black antlers. Black color antlers, sign of good health.
	Calves: in healthy condition. "lots of calves in the herd."
	1:1 ratio calf to cow.
	High insect activity. Herd is not overtly bothered by the high insect activity. There is currently no wind in the low-lying flats we are on, as the sun is setting.
	Herd is resting and drinking by the lakeshore. Few cows walking around feeding, then walking back to herd. Other cows walking around feeding. Few more animals walking down from higher ground, joining the herd.
	Herd walk right by us, 50 metre, and up to high ground further inland on peninsula.
21-Jul	1 cow; 1 calf; 1 yearling. Caribou swimming across rocky nǫʔokè: centre of Fry Inlet.
	1 cow: injured front leg. Still walking fast; 1 calf.
	Cow and calf walking back and forth along shoreline looking for a safe place to cross. Eventually they walk into water and swim across. They walk slowly up through the large rocks on the west side of crossing.
	1 bull
	1 cow: no calf
	The animals walk very slow up off the water through the rocks, in one single line. Very slow compared to sandy conditions on nǫʔokè further north. The nǫʔokè is rocky. The east side is mostly grass and small knolls with scattered rocks, the west side of crossing is comprised of larger pointy rocks all through the water and along shoreline. The caribou walk up from the water and into the tall shrubs above the shoreline, they all follow the same trail through the bushes and among the smaller birch trees, in the little valley west of the crossing. A small stream runs through the little valley.
	Vegetation is good quality in the area. Good quality feeding for caribou.
	400+ caribou herd: Large herd standing out on small point, in a bay east shore of Fry Inlet, close to rocky nǫʔokè. The whole bay is very shallow and large boulders in the water.
	Numerous animals are standing with their legs in the shallow water, some animals are standing on shoreline.
	The herd is one tight unit. Standing close together by lakeshore.
	The animals are standing in water to cool off their feet/hooves.
	40% bulls: more bulls in this herd than obs#30: observed in herd day before.
	1:1 ratio - cow to calf

	1 cow injured
	Calves: Every cow has a calf - “lots of calves in herd.”
	The caribou are in healthy body conditions. No signs of skinny in any animal.
	No animals lagging behind the main herd. All animals walk fast in a single tight herd, no one falling behind.
	Winter coat: Some animals still have white winter coat on. White hair falling off slowly.
	Wolf tracks: Fresh tracks in sand. 2 wolves. Large size prints. No predator observed.
	Vegetation: good quality, not dry or dead leaves, grasses. Good feeding for caribou in this area, east side of Fry Inlet.
	400+ animal caribou herd.
	Same herd as obs#32. East shore of Fry Inlet. South part of lake.
	The herd ran fast pace, from first observation, 2-3 km south along the shoreline.
	Large herd standing in one tight group on flat ground up from the lake shore. Herd standing into south 15 km/h wind.
	After 15-20 minutes, the herd move slowly to lakeshore. Walk, eat, stop, eat, walk, eat, down to shoreline. The herd walk right down to water, some animals enter water and stand with the feet/hooves into water.
	Herd facing into strong south wind by shoreline. The wind comes directly in from across the lake.
	Most animals lying down, resting into wind by water. Some standing in water.
	No mosquitos in wind: 15 km/h south wind, 20 Celsius.
	17:30 – 19:30: herd is lying down resting and sleeping. 2-hour rest for herd lying by lakeshore. Most animal lying down resting, a few stand up, eating, walking slowly, eating.
	Numerous animals standing in water. “feet are hot, so they stand in water. same as dogs do, to cool off feet.”
	The herd is resting completely. Eating and resting. Many animals standing with feet in water. No mosquitos facing the south wind, wind comes directly in from large lake.
	The animals on shore are shaking and twitching from insect harassment. They eat, shake their body to rid of insects, then resume eating. The animals are continuously shaking their bodies, every 20-30 seconds. We observe them from 20-50 metre.
	One cow, walks up close to us (10 m) then stops, and blows out bugs from her nose with loud wet blows through her nostrils. Continuous loud wet blowing for 30 seconds. Then walks back to herd. In wind shadow, on flat ground above shoreline, the insect activity of blackflies, mosquitos and botflies is high. Animals are continuously twitching from insect harassment.
	The animals are communicating with each other by loud grunts, shakes head: the cows are telling calves what to do and where to go. Several calves are running around.
	Herd details:
	1 cow injured back leg
	Many old/big bulls with large antlers; Young bulls; Yearlings; Cows and calves: all mixed in the herd
	Body conditions: all animals are in good healthy conditions. “Really healthy caribou.”
	Calves are in healthy conditions: running around.

	Calves are nursing/weaning from their mothers.
	Bulls start to accumulate fat reserves now. They look healthy and strong. Some have large, black antlers.
	Most bulls lost winter coat. Some still has hanging white hair, with clear dark brown hair underneath.
	No observation of predators. After we watched the herd close by, they noticed something was not right, and started to walk east up hill
	1 cow, 1 calf: walking on hills south if us. Above bay on east shore of fry inlet. Walking on ridgeline into south wind. Feeding. Too far to see details.
	Vegetation: grass and mosses are not too dry. Nice and good feeding for caribou.
	1 cow: dry cow. Small straight antlers. Cow walking fast pace along shore on eats side of Fry inlet towards rocky nǫɔokè. Turned around and walked back east onto peninsula. Probably saw our boat. The cow was by itself.
22-Jul	1 caribou. On hills, southeast of camp, on peninsula across Fry Inlet. Skylining the hills. Walks back and forth along ridge. Too far to see details. By itself.
23-Jul	300+ Caribou herd
	Herd swimming across nǫɔokè over Fry Inlet. Herd reaching the west shoreline and runs over sand beach and along hills in west direction.
	The animal in herd are in good by shape and everyone walks fast and follows the same pace for the hour we observed them. No animals lagging behind.
	1 cow injured.
	Herd moving in fast pace in northwest direction, into strong 20 km/h northwest wind.
	Cow leader walks in front and keeps a fast pace. She walks 30 metres in font. The whole herd follows right behind.
	“the caribou leader must be fat and in good shape, as she walks fast and non-stop for long distance”
	“Never seen a herd move that fast”
	Herd walk over small narrows between two smaller lakes. Continue in north direction in fast pace. They don’t slow down or stop but walk fast pace with determination to get somewhere.
	When they start to climb up the sloping hillside, the herd walk in one long line, following each other. On hills in northwest direction of us. Herd walked over hill to the northwest from us. We saw few animals skylining before they walked over the hillside.
	Flat areas and long sloping hills – good county for caribou. Not too much rocks. Mainly grass and mosses, all green color and good conditions now.
	No predators observed. No other herds/ other caribou following after this herd, during the 1 hour we observed the herd, from esker behind camp.
	1 bull caribou – at rocky nǫɔokè, halfway on Fry Inlet.
	Young bull. By itself. He swims across nǫɔokè, to west side of Fry Inlet. Then continues walking in west direction, uphill inland, into higher bushes. Appear to be healthy body conditions, no injuries. Same scent trail as caribou used the days before. Short antlers. Brown hair coat, shed its winter coat.
	1 caribou cow. On east shore of Fry Inlet. Walking by shoreline. Drinking water. By itself. Too far to see details.

24-Jul	2 Caribou. On high hills to northwest of esker. Skylining the hills, following the same trail as herd yesterday. Too far to see details.
	1 caribou. on peninsula, east shore of Fry Inlet. Feeding, walking slowly. Feeding. Too far to see details.
26-Jul	2 caribou. A bull and a calf. Swam across inlet and ran up a hill west side of camp.
	2 caribou. Bull, cow and calf. Walking into west wind.
	1 caribou alone
	200 caribou far away walking
	2000 caribou very far away
27-Jul	1 caribou cow
28-Jul	1 caribou calf on peninsula. Foraging alone, looks to be separated from its mother.
29-Jul	1 caribou feeding
	250 caribou feeding. Cow to calf ratio is low. Travelling quickly north. Cow leaders of group.
31-Jul	100 caribou, 30 calves in herd. Running away from bugs heading southeast.
	2 caribou cow and calf. 0.5 km away from herd.
01-Aug	6 caribou; close to camp
02-Aug	2 caribou; too far away to see details Moving into wind
	7 caribou; too far to see, in the rocky area. 3 of them are bulls
	4 caribou: 4 miles away, walking into wind
06-Aug	1 caribou cow: feeding walking north into wind
	300 caribou: spotted far away
	200 caribou
	600 caribou: on the flat lands. By Concession lake.
07-Aug	2500 caribou spotted far away by concession lake
	1000 caribou 6 km away. By Concession lake.
08-Aug	8 caribou on skyline
09-Aug	4 caribou cows
	1 caribou cow

Appendix 2: Observations of Injured Animals from July 5th to August 14th, 2017.

July 14th	**1 injured Bull:** front right leg injured. The bull is left behind as large herd, 2500 animals, walked in fast pace southwest. He is standing in rocky area with large boulders around. The bull is in skinny condition. He starts to walk west after the herd but is in pain and walks very slow. A second bull follows the injured bull. He is not injured. This bull walks alongside the injured bull and follow/lead the injured bull back to the larger herd. The bulls are scared off us as we came upon them and walk at first slowly ahead of us. The bull is severely limping. Then they start to walk in fast pace to catch up with the larger herd. As the herd rest on the flat sloping ground, they catch up and lie down to rest on a shelf overlooking the valley.
	1 cow: injured front right leg. She is limping. She is walking in the back end of herd.
	1 calf: injured back left leg.
	1 cow: injured back right leg.
July 20th	**1 calf:** injured back leg. Calf, and it mother, walks north along shoreline to nǫɔokè on Fry Inlet.
	1 cow: injured front leg. Two cows walking on hill top above larger herd.
	1 cow: injured front foot. Cow is part of 250 animal herd.
July 21	**1 cow**: injured front leg. Still walking fast; she walks with one calf.
	1 cow injured back leg. Cow is part of 400+ caribou herd.
July 23rd	**1 cow:** injured. The injured cow was part of 300+ herd. She kept up with the fast pace of the herd, as no animals were observed lagging behind
Aug 09	**1 Cow**: injured back leg. The cow is in healthy body conditions.

Appendix 3: Observations of Cows and Calves from July 5th to August 14th, 2017.

July 6th	**1 cow**: brown hide. Healthy body conditions.
	1 calf: 1-year old yearling – light brown hide. healthy body condition
July 7th	**1 Yearling** (1-year-old) – came walking right up to us. Looking for its mother. Mother has abandoned it or its separated from its mother. Healthy body conditions. White winter coat, can see chunks of hair falling off. White tail. Dark colour hair on all legs. Small short antlers. Dark colour hair around eyes, as characteristic of calves/ yearlings.
July 9th	**1 cow**: 3-year-old. No calf. Walking by itself.
	White winter coat. Healthy body conditions, no injuries.
July 11th	**1 young cow**. Healthy condition. Lost its winter fur. Running with her head up, and eyes fixed staring at us, as she runs by us at 50 metres distance.
	1500+ Caribou herd. Herd compositions: mainly cows and calves. Approximately 45% calves: "the amount of calves is normal in the herd." Calves are in good and healthy conditions. Some calves lying down resting. High number of yearlings; white color winter coat. Most animals in herds still has winter coat on. The overall herd seems white from a distance.

	1 cow and 1 calf: the cow is young. Probably same as we saw earlier in the day, at the same location. The cow and calf are in healthy conditions. No injuries. The two animals walking by themselves, no other animals around. walked towards us from the small peninsula, as we stand on higher ground, to avoid mosquitoes. They noticed us, turned around immediately, and walked fast pace back out on the peninsula, where they came from.
July 14th	**2500+ caribou herd:** grazing and walking slowly on north side of the long wide valley east - of Carrot Lake, north of Contwoyto Lake
	3 cows: walking on rocky hill above us. One cow is standing on top of hillside 100 metre from us looking down at us. The cows are "dry cows" - they have no calves this year. They are in skinny condition. The dry cows *"are the last to get fat."*
	2 cows and 2 calves: walking after the herd, trying to catch up with the larger herd, that moves in faster pace ahead. The cows stop and the calves are weaning from their mothers. The calves are all in healthy conditions. The cows/mothers are in good conditions.
	1 calf: left behind as herd walked fast. The calf starts to run after the herd. The mother notices her calf is gone, then stop and waited, and walked towards the calf. They reunite. Calf appear to be healthy.
	1 calf: the calf is left behind. The calf is walking around and looks for its mother. The calf finds her mother, and they reunite. They stop and the calf weans from its mother. Calf and cow in healthy condition.
	1 cow: walking 500 metres behind herd. Cow is walking around and looking for its calf. We cannot see the calf. Cow walked out of our sight. We can not see if she reconnects with calf.
July 20th	**250 caribou:** Cow with calf is leader of herd. 70% cows – mostly cows in herd – few bulls. 1:1 ratio calf to cow. The cows have healthy body condition. Not fat, but normal condition for this time of year. Calves: in healthy condition. "lots of calves in the herd."
	1 cow, running back looking for its calf.
	1 cow: a dry cow – she has no calf.
	1 cow: walking around and eating. She is picking up and eating mushrooms. She walks close up to us, 20 metres.
	4 dry cows: 2 cows with 2 yearlings: no calves from this year; 2 cows: with no calves.
	3 dry cows, walking north catching up with large herd.
	1 cow with collar observed.
	1 cow – injured front foot.
	Calves: in healthy condition. "lots of calves in the herd." Numerous calves are 'talking'. We hear many of the calves grunting loud.
July 21	Caribou swimming across rocky nǫɔokè: centre of Fry Inlet:
	1 cow; 1 calf; 1 yearling.
	1 calf; and 1 cow. Cow has injured front leg. Still walking fast pace.
	1 cow: no calf
	400+ caribou herd. 1:1 ratio - cow to calf. Every cow has a calf - "lots of calves in herd." 40% bulls: more bulls in this herd than on July 20th. The caribou are in healthy body conditions. No signs of skinny in any animal. No animals lagging behind the main herd. All animals walk fast in a single tight herd, no one falling behind. Body conditions: all animals are in good healthy conditions. "Really healthy caribou"
	1 cow injured back leg
	Calves are in healthy conditions: running around. Calves are nursing/feeding milk from their mothers (Photo below). Bulls start to accumulate fat reserves now. They look healthy and strong. Some have large, black antlers.
	1 cow injured

	Calves: Every cow has a calf - "lots of calves in herd."
	Calves are in healthy conditions: running around. Calves are nursing/feeding milk from their mothers (Photo below). Bulls start to accumulate fat reserves now. They look healthy and strong. Some have large, black antlers.
28 July	**1 calf**. Foraging alone, looks to be separated from its mother. The calf is in healthy conditions.
31 July	**1 cow and 1 calf:** 0.5 km away from 100 caribou herd.

Appendix 4: Field Notes on Wolves

Pop estimate Lupin mine area	Wolves: estimate around 50 wolves in the area around Johns camp - Lupin mine – 3 dens
	"wolves are scared of eagles"
Puppies	Wolves can have up to 11-14 puppies in one litter. 4 puppies in a litter is average.
	Wolf family can have up to 14 pups. John counted 14 pups in one family, in November 1987.
	Wolves hunt mainly cows or injured bulls.
Wolf Island:	Wolf Island: smaller island southwest of Old weather station island. The name comes from a pack of wolf that stayed on the island for a whole summer. Herds of caribou used to swim out to the island continuously all summer, so the wolves had secure food supply and didn't need to go anywhere.
	Wolves: some wolves eat each other. Can use wolf meat as wolf bate.
Wolf Dens	Den in esker by Jericho mine airstrip
	Den, possibly several dens, by esker east of Carrot lake
	Den by Lupin mine
	Den north of Kuniks bay
	Dens around concession lake
Health conditions	Wolves observed around Contwoyto Lake are in healthy conditions.
	The body size is large. All wolves appear fat
	When no food for the wolves, they would be skinny, no observations of skinny wolves.
	The pups are all in healthy and good conditions.
	"Seeing a wolf is a 'good sign', must be caribou around"
Muskox – wolves	wolves don't hunt much for muskox calves. The young bull muskox will chase them away. It is too dangerous for wolves to hunt muskox.
	wolves will take the same paths/trails as caribou travel on the land.
caribou outswim wolves	"caribou outswim wolves easily"
	"We see more wolves in late September-October when the pups are larger and follow their parents. The wolves take lots of caribou".
	Unless they are hunting, the wolves stay in den, underground. During summer, they hunt in evening and at night. Its is too hot during day, so they stay in cold underground den to stay cool.

Mining infrastructure	Mining infrastructure block caribou movement. Wolves use this to their advantage to hunt caribou when the herds vulnerable.
Inuit and Dene wolf hunters	Before, families, Inuit and Dene families, used to live all over the land, all the way down to the treeline, and hunted around 500 wolves a year. Now, John is the only one left. 'There are lots of wolves on the land".
habitat	rocky/hilly area is known as wolf country. Caribou will not usually walk around rocky area.
sight	"Wolves can see very far, even across the lake they can still see you"
Wolf hunting:	"if we hunt 100 wolves, we could save 1000 caribou"
	hunts wolves around his camp – caribou come and stay around his camp during winter.
	"I hunt wolves, because it's a connection"
	Hunted 30 wolves this year. Normally hunt 50 wolves a year.
	Wolf population is high. People are not harvesting wolf anymore.
	"People keep wolf population in balance – and the caribou population in balance"
	Indigenous people – as harvesters - are an inherit part of a balanced ecosystem.
	"too much wolves"
	"Should be open season all year round and bounty on wolves"
	"caribou is their main prey"
	"they have lots of puppies to feed"
	"A pack of wolves can kill 30 caribou a day. Wolves kill caribou, eat, sleep then kill caribou again. All day they keep doing this. They kill a lot of caribou."
Tłı̨chǫ words for Wolf	Den – e?oo
	Wolf – Diga
	Female – Digats'e
	Wolf son/children: Diga woza
	Diga woza – wolf pup/son/children
	Diga nade – wolf family
	Diga ts'e – female wolf
	E?oo – den
	Diga e?oo – wolf den
Inuit name for wolf	Amagok – wolf
	Amagauk – wolf pup
"wolf if raven's brother in-law"	"wolf if raven's brother in-law"
	"raven is wolf brother in-law"
	After raven hide all caribou they told him: he won't kill anything after doing that. Now he will only eat scraps off the street.
Ravens	2 ravens flying around – an indication that a wolf kill might be close by.
wolf fur	"if you touch the wolf fur, it can make a person sick".

Appendix 5: Field notes on Climate Changes

Disappearing Snow patches	in early July, usually there are numerous snow patches scattered over the land, mainly in crevasses, sun shades and slopes were the wind packs the snow during winter, and overflow-ice build up along rivers. This year there are hardly any. Caribou usually stay on these cool areas to avoid insects, now the herd needs to run to avoid insects.
	one snow patch is visible further north. “no snow patches on the ground anymore”.
	“During summer, they’re body gets too hot, like to drink overflow water”.
	“Used to be snow patches on the land until mid-august and September. Now, these years, the snow patches are melting by late June”. the snow melts earlier, there are no source of water to feed the vegetation during warm periods of summer. Especially the low lying, flat muskeg areas.
	“Caribou used to stay and spend time resting on the snow patches, now people don’t know where herds are during summer months”.
	Snow patches – the summer ice and snow areas are all melted – no place to cool down for caribou.
	Numerous animals standing in water. “feet are hot, so they stand in water. same as dogs do, to cool off feet.”
Observations of new species on post calving range	Ladybug: new species at Contwoyto Lake.
	Bald eagle: “never used to see then before. Started seeing them in 2005”. “Eagles follow jackfish”.
	Grasshopper
	Red squirrel/chipmunks
	scooter ducks
	Mallard ducks: “started seeing them last year (2016). Mallards was never in arctic before”.
Ice	some summer the ice stays on the lake until mid-august, or late July. “Now, these years, the ice is mostly melted by end of June”.
warm weather	"Usually hot weather is in July not August" -
Wind	Wind: not normal with this strong wind in July. Last year, 2016, was very windy. Usually not so windy in July. “Nowadays its hard to predict when storm is coming. Before, we could tell long before a storm was coming”
	Wind: “never used to get this windy in July. Usually we have not much wind in July. But last two years, its been really windy in July”
	Wind: not normal with this strong wind in July. Last year, 2016, was very windy. Usually not so windy in July.
	“It is usually not so windy in July. June and September are usually windy.
	Usually it its much warmer in July, this year is cold summer. “fall time will come fast.”
	“Nowadays its hard to predict when storm is coming. Before, we could tell long before a storm was coming”
Warm water	Warm water: these days the water is much warmer. “your hands don’t get cold, when in water”

Appendix 6: Field Notes on Caribou Behaviour and Migration

Caribou Behaviour	Population Decline:	Used to see herds for three months straight running down eastern shore of Contwoyto Lake, and crossing at Nadloks, nǫɔokè, where family had camp. "These last years you don't see herds like that."
		"8-9 years after Ekati mine started – the herds started to decline".
		"Caribou herd started to decline and scatter after mines opened".
	Bulls travel late from forest	Saw one barren-ground bull caribou in June in Gametì while checking his fish net. He shot it. Thick fat. Some bulls stay around in forest hanging around with woodland caribou, then travel north to post-calving grounds late in spring, or into summer.
	wind	caribou travel into the wind to get away from bugs
	Sand ridges:	caribou follow sand ridges, eskers or sand bars through the landscape. We can see their tracks and trails in the sand following the sand bars that moves through the landscape. And trails in the vegetation between sand bars. Caribou walk to these open sandy area and hills to be in wind, away from bugs – they walk, eat, walk.
	antlers	Antlers: "Bulls of last year" don't have antler.
	Bulls antler in July	bull's antlers are really black and thick of velvet in July.
	Bulls antler in August	In August: herds go to treeline to peel off velvet on antlers.
	Bulls antler in September	In late September, the velvet has pealed off antlers, and become "hard horns" Drop antlers end of October to end of November. In September, the bulls have white mane.
	October Migration	Late September and early October: the herds come back north to east/south side of Contwoyto Lake in late September and early October for the rut. "Stay in area until freeze up. The best place to be is Naloks".
	Black Antlers	Black antlers indicate that the animal is healthy and fat. The black color is the velvet. Bulls usually have less winter fur off.
	Cow antler	Cows shed antlers in May.
	Antlers as Viagra	The tip of caribou antlers, the soft part with velvet on is considered to work as Viagra. Some elders request it from hunters. The Chinese market request velvet antler for the Viagra properties.
	Collars	"Caribou carrying collars, often the fur around their neck where the collars are worn off, and skin is sore". He shot caribou with collar. The collar was all iced up all around neck. It could hardly move its neck due to the iced-up collar. "Caribou with collars look miserable." People are afraid the meat is contaminated from collars and won't eat it.
	Mushrooms	Caribou will sometimes eat mushrooms when they have been travelling long distance - there is water in the mushroom.
	Mosquitos	Once large herds of caribou come by camp then all mosquitos follow the caribou herd – less insects in camp.
		On hot days, caribou run to avoid mosquitos. Run fast sprints or go to high ground where its windy.

	Cows can leave there calf behind in muskeg	The calf gets tired from walking on hot days, cow can leave it in muskeg to rest. The calf will sit quiet in muskeg. Wolves only attack the calf if they see it by chance.
	"Bulls of last year"	Bull that was born last year. Two-year-old bull are smaller and don't have antlers yet. Bulls older than two-three years old have antlers.
	Islands on Contwoyto Lake	Bulls and some dry cows stay on islands on the lake all winter long.
	Cow leader	The cow leader needs to be fat and healthy and in good shape. Some cow leaders don't have calf – no one to look after and can eat lots and become fat.
	October Rut:	"Bulls are fighting, sometimes see bulls with only one antler, the other side of broken off. One can walk right up to herd. Hunters stop shooting caribou when the rut starts, as the meat is "too strong" tasting. The dominate bulls impregnate the cows.
	Dry Cows	the dry cows have small straight antlers with a small 'horn' sticking out. The antlers are same size as yearlings.
		"During winter, if its not good feeding, the pregnant cows cannot support the fetus, even if it was pregnant in the fall"
		"its normal that not all cows have calf"
		Cows with a calf – have little pointed antlers
	cool off feet	Numerous animals standing in water. "feet are hot, so they stand in water. same as dogs do, to cool off feet" Joe Zoe.
	Caribou communication	Caribou communicate by body language, head shakes and speak: grunts, and vocal sounds. They leave "tracks" with scent glands on the hoofs for others to follow.
	Calving grounds	"caribou calving grounds are everywhere." "We see caribou calve right on the ice on Contwoyto Lake, they calve everywhere"
	security guards	Herds has "security guards" some animals standing/walking on outskirt of herd – they will notify herd leader of any dangers, and herd will move on from area with danger.
Caribou Migration	Movement of large herds/ collars	The large group of female collars moved slow. They stayed a long time in certain areas – from Katewhachaga to Carrot lake to east of Shallow bay.
		July 23-24 all other herds around Contwoyto Lake travelled in fast pace to those key females (leaders). The other collars/herds travelled around south end of Contwoyto Lake and Fry Inlet, some crossed at rocky nǫɔokè and other at sandy nǫɔokè over Fry Inlet, then travelled northwest direction to join up with the key females.
		"The area where key females and large herds are now, area between Contwoyto Lake and Rockinghorse lake, is a lush and green area consisting of rolling hills, with good feeding grounds. A good place to congregate. Further south, towards Yamba lake is much rockier and hilly, so where the herds are now being perfect for them,"
		The cool and windy weather makes caribou stay in flat terrain and rolling hills with green lush vegetation, as they do not have to avoid any mosquitos and insects.

		The many herds follow the scent trail from other herds. They follow the same scent trail to join up at a certain location.
	smaller herds "are lost" - waiting for leaders	Some animals who walk alone or in smaller herds "are lost." They are waiting for the bigger herds to come along that they can go with. When the big herds come, they might go fast. Herds can travel far in one da
		Smaller herd – no leader: smaller herds wait around. They go back and forth until the larger herds come. "there is not boss ahead" so they go back and forth until cow leader come.
		"These herds are just walking back and forth on this peninsula without really moving anywhere. These herds are waiting for the larger herds with the cow leaders before they start moving fast further south"
	Water crossing and winter fur	Water crossing and winter fur: there are not many large water crossings between calving grounds and Contwoyto Lake, that's why winter fur is still on for most of the animals.
		The animals lose their winter fur when swimming across the water crossing,
	Caribou migration in October – before freeze up	The caribou herds come back up north to south part of Contwoyto Lake. They stay in the area for 2-3 weeks, to feed, until ice on the lakes is strong, then they migrate southwest/west.
		Some caribou stay all winter around Contwoyto Lake. Some caribou stay all winter around islands on Contwoyto Lake. Islands on Contwoyto Lake: bulls and some dry cows stay on islands on the lake all winter long.
		Late September and early October: the herds come back north to east/south side of Contwoyto Lake in late September and early October for the rut. Stay in area until freeze up. "The best place to be is Naloks".
		herds go to treeline in august to peel off velvet on antlers.
	caribou migration to people	"caribou and people are happy to see each other"
		"when people are on their hunting grounds, more caribou come"
		"when there are no people on the hunting grounds, the caribou herds pass right through"
		Caribou funnel through the nǫɔokè /Naloks during July-August-September, on east shore of Contwoyto Lake. The numerous large herds would cover the hills and surrounding lands. Caribou swim across the nǫɔokè and walk right though the camp. Once the herds had passed through, they would return and walk back right through the camp again.
		"you shoot one caribou; the others will come walking right by you".
		"Some people are really connected. If they are good or bad persons, animals know and will come to them".
		"When a person passes on, the animals know and will come to that area".
		"Absence of people at camps around Contwoyto Lake – then the herds just pass right by. They are not hanging around. When people were hunting at Nalok, caribou would pass by and then came back again. Not just pass by but come back to people".
		"if more people were on the land, we would have way more caribou"
		"now families are gone, no more caribou"

		"It's the same with fish. Now no one fish. The fish seems to disperse, when fishing spots are not used anymore"
		"Persons are 'fixed' (connected) to caribou or other animals. When they pass on, the animals know and come to the area. It is the same for fish, or weather. Some persons are so connected to the land and animals"

Appendix 7: Field Notes on Weather, Wind and Caribou Behaviour

Weather and Caribou behaviour		
	Weather follow caribou/caribou follow weather. They follow each other	"Weather follows caribou, when caribou come, the weather gets funny. They like the cold and wind – no insects"
		"when caribou first come, we get rain for days," "when caribou come, rain comes for days"
		Caribou and Weather - "when caribou come – the weather always gets funny" People could manipulate the weather, and make the wind go away, or get cold weather. His great grandmother was powerful.
	Wind	Windy: easy to spook the animals. Their senses are heightened when its windy. When its wind they get scared fast and run away.
		when it is windy, caribou are unbothered by insects and can graze peacefully
		Wind: "the wind is what keeps them alive in winter,". They can smell the wolves; the wind carries the scent. The caribou will know by detecting the smell and thus stay alive. The wind decides where caribou go in the summer, to stay away from mosquitos.
	Rain	Rain: "the rain is fixing the caribou." The rain will make the winter fur come off.
		"caribou get fat from rain" It will eat lots of good quality vegetation
		"rain is good for caribou"
	Caribou movement and Rain and cold weather:	on days with rain and cold weather, there are no mosquitos on the caribou face. The animals don't have to walk into the wind.
		Caribou will follow the weather when its cold and windy, don't need to go into wind as a means to escape mosquitos, on cold and windy days.

Appendix 8: Field Notes on Impacts of Mining

Mining Impacts	Mines and Population Decline:	"Used to see herds for three months straight running down eastern shore of Contwoyto Lake, and crossing at Naloks, nǫɔokè, where families had camp". "These last years you don't see herds like that."
		"Few years after Ekati mine started – the herds started to decline".
		"4-5 years after Ekati mine was established, then caribou disappeared". "A main migration routes were from Ekati, to Gordon lake, to Yellowknife was a main migration route. Now the mine and winter road has taken over the caribou migration areas".

	Smell and sound of blasting from mine	Blasting from mine: “can hear blasting or 40 miles/64 kilometres from Ekati mine to Pellet lake” – 40 miles/ 64 kilometres. “Can smell sulphur kilometres downwind during blasting”.
		“after Ekati established, one can smell sulphur 15 km downwind after explosions”.
		“Yellow smoke can be seen for long ways after explosions/ blasting”.
	Jericho mining infrastructure on caribou migration route	“Before Jericho mine, the caribou migration would migrate from Carrot lake to Sunbay”.
		For over a week in July the herds are staying relatively stable north and east of Carrot lake. They do not walk passed the mining infrastructure. They try to walk passed the mine, but each time the wolves attack the herds and they are prevented from moving south. Eventually the herds push on and move passed the mine, but at high cost. Two caribou killed while the herd are trying to walk through the narrow valley passed Jericho mine.
		“Jericho mining infrastructure is right on the migration route. The roads and traffic to the tailings facilities prevent the caribou from migrating southwest of Carrot lake”. The airstrip and infrastructure prevent caribou herds from crossing southeast of carrot lake. The caribou need to walk along a narrow route between the mining infrastructure on the west side and the rocky Wellingham hills on the east side. Then wolves hunt them as they are vulnerable crossing through the valley.
		In their current location the herd is prevented in the movement by mining infrastructure and esker on west side and the steep rocky hills on the east side. The whole herd is grouped together in one tight unit in front of esker.
		1 wolf – white fur, runs behind the herd, coming in from the north, from wide valley, follows the side of the esker. Runs in front of the herd, and hides. When herd tries to walk past the narrowest point, the wolf attacks from the side. Tries to attack a small herd of 10+ animals but fails as the caribou outrun the wolf.
		Wolf attacks the herd from various sides. The herd regroups, stops, then slowly attempts to enter the end of funnel, and try to continue walking south into narrow valley. Wolf chases smaller herd in small crevasse. Wolf catches one caribou.
		The herd contracts and start to walk east back into wide valley. Then the herd stop. 10 min later – herd start walking southwest again into narrow valley. Another attempt. One cow leads the rest of the herd. The cow walks first passed the esker in southwest direction passed the mine. As herd walk past the esker, the white wolf comes and attach a second time. The herd reacts, runs, then scatters and fans out over the wide slope, runs back north into valley and regroups into a tight unit.
		The herd is blocked in by mining infrastructure to the west and rocky hill to east. The only route south, and to southwest side of Contwoyto Lake, is through the valley and passed the mine site. As they funnel into the narrow valley, the wolf continuously attacks the herd. After third attempt of going into narrow valley passed airstrip, then the herd contracts again into a tight unit and start to walk slowly back north into wide valley.

		Wolves use natural and industrial landscape to their advantage to hunt caribou when the herds vulnerable and blocked by mining infrastructure.
	Lupin: impacts on fish	when Lupin mine opened, in 1979, "we could not catch any fish in a 5-mile radius around mine site." After the mine closed operations, 2007, the fish started to come back, and it was possible to catch fish in area again.
	Rayrock and access to money: caribou hunting	"after Rayrock opened, we stopped hunting for yearling" – Before any mines was operating, people had no access to money, they travel to barrenland to hunt yearlings for the soft hide used for beddings and clothing. After the Rayrock mine opened, people started to have camps around the mine areas, and some men started to have access to money. At the same time the Weaver and Devore store opened in Yellowknife. There they could buy new materials, with the money they earned, and people started to use canvas for clothing and material.
		After this socio-economic change, people started to hunt mainly bulls on the barrenlands in fall time. They make drymeat from the bulls hunted. And stopped hunting for yearlings.
	1990s Diamond rush and caribou	in the 90s the barrenlands experienced the diamond rush by introduction of large amount of exploration activity, helicopter activity, and sampling. "all the industrial activity disrupted the caribou movement. There was too much helicopter activity all over the summer and fall range of the herd". There was a large fuel cache stored at Lupin mine, the helicopters would stop to refuel at Lupin, and daily there was much helicopter activity. "This noise activity disrupted the caribou movement in the area. Consequently, the Bathurst caribou herd moved".
	Smell from mining activity	"caribou got good nose, good smell, they smell it [oil from gravel roads, metal constructions, and mines] and they go away." "The caribou get scared really easy – there was too much exploration around mainland between Lupin and Bathurst Inlet"
	Oil content in gravel roads	Caribou stay away from mine site due to smell – the scent. In particular, the gravel roads have oil content – that smell far. The gravel roads all around Lupin mine have oil content in the grave mix, the smell from the oil deter the large herds of caribou.

Appendix 9: Field Notes on Relations between People, Caribou and the Land

Relations between People, Caribou and the Land	"they (people) know where they (caribou)were going to go. Have to wait for them (caribou)"
	"f you take care of my body, I will be back next year."
	If you don't, and one bone is missing, I [caribou] won't be back next year"
	"They [caribou] know who the bad guy and the good guy is"
	"you have to look after them good, and don't hit them with a stick – use everything, every bone"
	"women cannot step over blood"
	"if you go somewhere new on the land, you have to watch your language"
	"if you follow me, I am not the only one – the caribou tells the hunters".
	"Animals make people happy."

	"Absence of people at camps around Contwoyto Lake – then the herds just pass right by. They are not hanging around. When people were hunting at Nalok, caribou would pass by and then came back again. Not just pass by but come back to the people".
	"if more people were on the land, "we would have way more caribou"
	"now families are gone, no more caribou"
	"It's the same with fish. Now no one fish. The fish seems to disperse, when fishing spots are not used anymore"
	"Persons are 'fixed' (connected) to caribou or other animals. When they pass on, the animals know and come to the area. It is the same for fish, or weather. Some persons are so connected to the land and animals"
	"Elders like to eat caribou fetus because it is soft. But it is not for young people who can become sick if they eat it".
	"His grandpa was connected/ 'fixed' with loon. The loon came around camp all summer long – sit in calm back bay and sleep"
	"I hunt because it's a connection"
	"If there were more people on the land hunting, there would be more caribou"
	"Some people are really connected. If they are good or bad persons, animals know and will come to them".
	"When a person passes on, the animals know and will come to that area".
	"Some times weather will be good or bad after a person pass on".
	"People are 'fixed' to animals: like ptarmigan, wolves, beaver, caribou".
	"if you hunt for caribou, don't look for them. Just go to a hill to look, they will come to you"
	"Hunter go with big parka to top of hill. Sit there all day, and look/watch for caribou. Then caribou will come"
	Hunting wolves around Lupin mine area – caribou come and stay around the camp during winter.
	"caribou and people are happy to see each other"
	"when people are on their hunting grounds, more caribou come"
	"when there are no people on the hunting grounds, the caribou herds pass right through"
	"Wolf population is high. People are not harvesting wolf anymore".
	"People keep wolf population in balance – and the caribou population in balance"
	"you shoot one caribou; the others will come walking right by you"
	Indigenous people – as harvesters - are an inherit part of a balanced ecosystem.
	"caribou know people – they know how you treat them. If you swear at them or don't treat them good – they know"
	"I never go search for caribou, just go to a hill to look – caribou will come. I never sneak up on them. Just stand there, and they walk right up to me. I just take my time, once I see one I want, I shot"
	"If you rush, and don't act right – they know, and won't come"
	"when caribou come – the weather always gets funny" – People could manipulate the weather, and make the wind go away, or get cold weather. His great grandmother was powerful.
	"Long ago, they had many beliefs, they were powerful"

	“Weather follows caribou” when caribou come, the weather gets funny. They like the cold and wind – no insects”
	“You don't say 'bear' in the tundra, he will hear you and come to you. Instead you say big animal”.
	“Sometimes I talk to the raven in Tłı̨chǫ, I ask him where the caribou are, he will drop a rock or point to where the caribou are with his beak or wings”.

Tłı̨chǫ Government
Culture and Lands Protection

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