Wildlife Management Advisory Council
North Slope

Yukon North Slope
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Companion Report 5: Caribou / Tuktu

Publication Information

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Companion Report to the Yukon North Slope Wildlife Conservation and Management Plan Number 5: Caribou / Tuktu

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About the Companion Report

This report is a companion document to the *Yukon North Slope Wildlife Conservation and Management Plan* (WMAC (NS), 2022). The *Yukon North Slope Wildlife Conservation and Management Plan* (the Plan) is grounded in traditional knowledge and Western science. It addresses traditional use and wildlife conservation and management issues affecting the Yukon North Slope. Strategies in the Plan align with actions underway or planned by a range of agencies and organizations with jurisdiction on the Yukon North Slope.

This companion report summarizes the information that was used to support the objectives and strategies in the Plan, and provides references for the studies used in its development. The companion report draws from authoritative works, reports that synthesize knowledge and issues, and presentations of recent research findings. Sources include traditional knowledge and traditional use, scientific reports and journal articles, and management and conservation reports.

Companion Report Table of Contents

Each chapter is available for download at https://wmacns.ca/what-we-do/conservation-plan/companion.

There are fourteen companion reports, addressing four selected topics of key interest as well as ten wildlife species featured in the Plan. The featured species were selected by participants at a workshop held in Aklavik. The wildlife species in the companion reports:

- Have high cultural or economic value or are important as food for Inuvialuit;
- Have similar habitat needs to other wildlife species, so that conserving their habitat is key to conserving habitat for other species; and/or
- Are important for healthy ecosystems, including species that are main food items for top predators.

The Plan identifies key conservation requirements on the Yukon North Slope for each featured wildlife species. The Plan's objectives and strategies are designed to meet these conservation requirements. This companion report summarizes the information that guides the objectives, strategies and conservation requirements in the *Yukon North Slope Wildlife Conservation and Management Plan*.

Companion Report: Caribou / Tuktu

This companion report provides information on the conservation requirements for caribou as identified in the *Yukon North Slope Wildlife Conservation and Management Plan*. It summarizes the information that guides the objectives, strategies and conservation requirements in the Plan. It includes information on traditional use, population status and trends, important habitat types and locations, threats to caribou, programs and measures for conservation and management, and selected studies and research relevant to the Yukon North Slope.

Conservation requirements for caribou on the Yukon North Slope

1. Protection of the entire caribou calving and post-calving grounds and summer habitat on the Yukon North Slope.
2. Protection of core summer habitats and migratory routes frequently used by the herd and conservation of those which are currently used less frequently but may become important in the future.
3. Conservation of caribou habitats across the Porcupine caribou herd's range, especially of calving grounds in the Alaska National Wildlife Refuge, through collaboration among jurisdictions and parties, and by actively supporting research, monitoring, management, and mitigation of development impacts to meet the ecological requirements of the herd.
4. Research and monitoring of habitat condition and quality with an emphasis on the calving and mid- to late-summer periods.

From the *Yukon North Slope Wildlife Conservation and Management Plan* (WMAC (NS), 2022)

Caribou on the Yukon North Slope

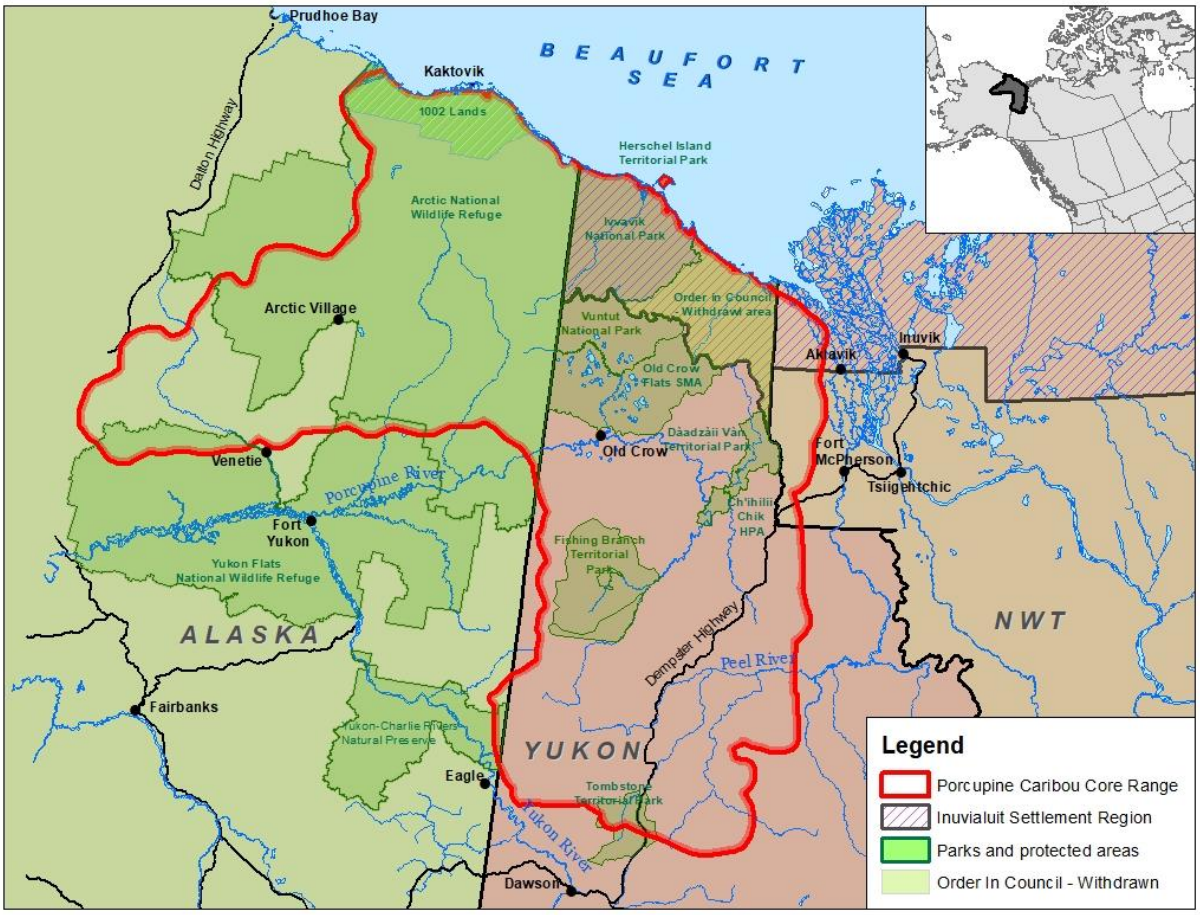
"…If you treat them good, they'll last you a lifetime. You look after the caribou. "

Jerry Arey, *Aklavik Local and Traditional Knowledge about Porcupine Caribou* (WMAC (NS) & Aklavik HTC, 2009, p. 71)

The Yukon North Slope is the northeast sector of the core range of the Porcupine caribou herd (Map 5- 1), a population of barren-ground caribou (Tuktu, *Rangifer tarandus granti*). Caribou migrate through and occupy diverse Yukon North Slope landscapes, from the coastal plain to mountain slopes. Large areas of the Yukon North Slope are especially important for caribou as late spring to mid-summer habitat for calving, nutrient acquisition, and insect relief.

The Porcupine caribou herd is separated from other barren-ground caribou herds to the east by the barrier of the Mackenzie River and Delta. The Porcupine herd's range overlaps at its western edge with the Alaskan Central Arctic herd. Caribou from these two herds may mix in areas of overlap in July and again during fall and winter (McFarland, Caikoski, Lenart, & Taras, 2017).

Map 5- 1. Porcupine caribou herd core range and protected areas



Map produced by Government of Yukon, 2021.

Much of the herd's range along the coastal plain, where the caribou congregate annually for calving, is protected as part of Ivvavik National Park or the Arctic National Wildlife Refuge, as shown on Map 5-1. However, critical areas of the coastal plains are vulnerable to potential human industrial impacts. The eastern portion of the Yukon coastal plain—Aullaviat/Aunguniarvik—is withdrawn from development by an Order in Council, and the Plan features a strategy to enhance this conservation framework (WMAC (NS), 2021, Strategy A1). The United States Congress 2017 decision to grant oil and gas leases in the 1002 Lands, the main calving location for the herd, weakens protection for Porcupine caribou and highlights the vulnerability of these critical calving, post-calving and early summer habitats (IGC, WMAC (NS), WMAC (NWT), & FJMC, 2018; PCMB, 2020b; D. E. Russell & Gunn, 2019). The 1002 Lands are approximately 600,000 hectares within Alaska's Arctic National Wildlife Refuge that are excluded from the Wilderness designation that applies to the rest of the refuge (USGS & USFWS, 2015).

The Porcupine caribou herd, at last estimate (2017), was made up of about 218,000 caribou (Porcupine Caribou Technical Committee, 2019a). Herd characteristics, such as birth rate and calf survival, indicate that the Porcupine herd is doing well, unlike other barren-ground caribou

herds across North America, many of which are declining. The Porcupine herd, like other caribou herds, is vulnerable to impacts from climate change and industrial development (D. E. Russell & Gunn, 2019; D. Russell & Gunn, 2017).

Due to their abundance, caribou are the key ecosystem driver of the Yukon North Slope. They modify and shape landforms and vegetation and are an important source of nourishment to a wide variety of terrestrial and aquatic life, and, through their droppings, to vegetation (COSEWIC, 2016; Gunn, Russell, & Eamer, 2011). Caribou support Yukon North Slope populations of wolves and grizzly bears and provide food for other predators and scavengers, including wolverine and golden eagles (Hayes, Baer, & Clarkson, 2016; WMAC (NS) & Aklavik HTC, 2009).

Caribou are the most important of the Yukon North Slope's wildlife species for Inuvialuit harvest. They have a central place in Inuvialuit culture, traditions, and way of life (Inuvialuit Harvest Study, 2003; WMAC (NS) & Aklavik HTC, 2009, 2018b).

> Protection of our caribou; that's one thing that really stands out to me, because that's their main route, for their migration [across the Yukon North Slope]….We've been depending on the caribou herd ever since I was a boy.
>
> *Yukon North Slope Inuvialuit Traditional Use Study* (WMAC (NS) & Aklavik HTC, 2018b, p. 100-107)

The Porcupine caribou herd is central to the economies and cultures of other Indigenous peoples in its range. It is highly valued by other northern residents for recreational hunting, wildlife viewing and tourism.

Traditional Use

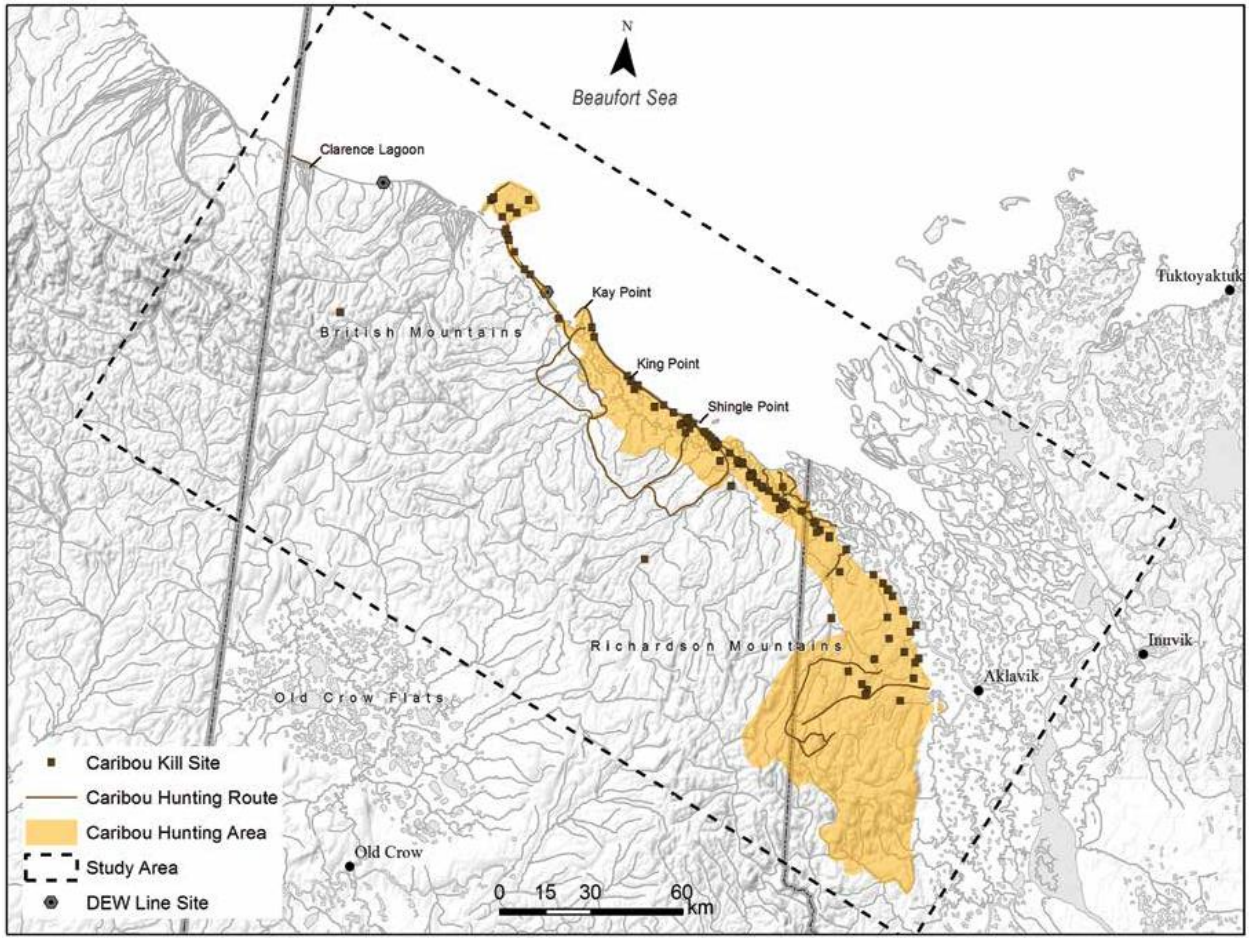
> "That's our food. Right now I'm cooking caribou meat, because the last few days I've been eating another kind of food, and I don't feel like I'm getting anything at all. So I told my kids today I'm going to cook caribou meat today, because we have to have caribou meat."
>
> Annie B. Gordon in *Aklavik Local and Traditional Knowledge about Porcupine Caribou* (WMAC (NS) & Aklavik HTC, 2009, p. 75)
>
> "I use caribou every day just about … For my grandson and my boy."
>
> Jacob Archie in *Aklavik Local and Traditional Knowledge about Porcupine Caribou* (WMAC (NS) & Aklavik HTC, 2009, p. 75)

The importance of caribou to Inuvialuit, particularly Aklavik residents, cannot be overstated. For this reason, the *Yukon North Slope Wildlife Conservation and Management Plan* (2021) puts considerable emphasis on the herd and its protection. In the Aklavik Community Conservation Plan (Aklavik HTC, Aklavik Community Corporation, WMAC (NWT), FJMC, & Joint Secretariat, 2016), Tuktu is described as a "highly valued food resource, historically also for clothing and

tools." Inuvialuit harvest accounts for approximately 20% of the total annual harvest of the Porcupine caribou herd throughout its range (PCMB, 2010a). Areas where Aklavik Inuvialuit hunt caribou and routes taken by hunters are shown in Map 5- 2. In recent times, caribou harvesting opportunities have been largely facilitated by boat access along the coast. This map, representing use patterns from living memory, is based on traditional use interviews conducted to provide information for the Plan. Current harvest areas on the Yukon North Slope are along the coastal plain and in the Richardson Mountains. However, the geographic relationship between caribou and Inuvialuit on the Yukon North Slope has shifted over time, reflecting changes in seasonal and year-round use areas, as well as a changing socioeconomic context. For example, caribou-related traditional use was centred more to the west early in the 20th century when Inuvialuit lived permanently at Qikiqtaruk. Expression of traditional use is strongly influenced by access and availability.

> "Get enough for what you need. Never harvest a whole bunch. Not unless you got a big family and feeding someone else, too. If you don't share with other people, don't get a whole bunch. But if you got a big family, one or two hunters, it doesn't matter how much they get, as long as they share with their families. That's what I think … You gotta have respect for any animal, not only caribou. Try not to kill too many… Like fish, for instance. You don't get a whole lot. You think you got enough, you just quit. "
>
> Participant in *Aklavik Local and Traditional Knowledge about Porcupine Caribou* (WMAC (NS) & Aklavik HTC, 2009, p. 73)

Map 5- 2. Caribou harvest areas and routes taken by hunters identified in Inuvialuit traditional use interviews



The interviewers asked Inuvialuit land users to identify hunting routes and areas used within living memory. Data from this map were used to develop the composite traditional use map in the Plan. Source: WMAC (NS) and Aklavik HTC (2018b), Map 6.

On average, 643 caribou were harvested annually by Aklavik Inuvialuit over the ten-year period from 1988 to 1997, as reported through the Inuvialuit Harvest Study (Inuvialuit Harvest Study, 2003, Table 21). The reported harvest of Porcupine caribou by Inuvialuit from 2016 to 2018 was considerably lower—an average of 208 caribou were harvested annually over this three-year period (IRC, 2019). Reported harvest across years is influenced by a range of factors, including socioeconomic conditions, changes in study methodology or participation rates, and ecological changes. In a 2009 study of Aklavik local and traditional knowledge of Porcupine Caribou, interviewees noted that for multiple, complex reasons, at the time of the study many people were not able to access caribou to meet their families' needs (WMAC (NS) & Aklavik HTC, 2009). In the same study, some interviewees suggested that the herd's migration patterns had changed; some stated that the herd uses a variety of different migration routes and their use of those routes at different times depends on a variety of factors (WMAC (NS) & Aklavik HTC,

2009). More recently, people in Porcupine caribou herd user communities have reported that, in years when the harvest is low, it is because the caribou are too far from the community (ABEKS, 2019). Harvester perception of caribou availability can be influenced by environmental conditions that affect caribou distribution; temperature and snow cover both play a role (Gagnon et al., 2020). Most people who do not hunt caribou report that the reason is that they do not have enough time (Chapter 1: Traditional Use provides additional context on changing patterns of traditional use of the Yukon North Slope).

> "I don't think the caribou follow the same route, never. They always go a different route 'cause that stuff they eat, it grows real slow. That's what we found out—they grow slow those plants, the lichen. "
>
> Jerry Arey in *Aklavik Local and Traditional Knowledge about Porcupine Caribou* (WMAC (NS) & Aklavik HTC, 2009, p. 22)

A 1991 dietary survey concluded that caribou is of prime importance in the diet of Aklavik Inuvialuit (Wein & Freeman, 1992). Caribou was the most frequently consumed food item in the 36 households surveyed, eaten on average 145 times during the previous year. Caribou was eaten in all but one of the households. Caribou meat and dry meat, tongue and heart were in the list of top ten preferred foods. A health survey of 36 Inuit communities across the Canadian Arctic concluded that caribou is the top source of protein for Inuit, and the primary source of several essential vitamins and minerals (Kenny, Fillion, Simpkin, Wesche, & Chan, 2018).

Traditional uses of caribou

Anything, everything [is used], guts, even the bag inside … well, even that is used. They can have it hanging and if it dries, they just cut pieces off it and they just throw it in when you're boiling meat, just to give that meat a flavour.

– Annie B. Gordon

We never waste meat. We don't use the bone—long ago they used the bone, chop it up and boil it and make some fat out of it for making bread. But we like the marrow, really, that's a delicacy.

– Anonymous

Nowadays we just eat the meat. When I was growing up, we had caribou-skin shoes, caribou-skin pants, caribou skin for outerwear, it's windproof. You don't see that now. Long ago when I was growing up everybody had that. [It changed] when school started … in the 50s, '54, '55.

– George Selamio

Source: *Aklavik Local and Traditional Knowledge about Porcupine Caribou* (WMAC (NS) & Aklavik HTC, 2009), p.80 and p.86

Habitat for Caribou

Overview

Currently one of the world's largest migratory barren ground caribou herds, the Porcupine herd ranges over 250,000 square kilometres of land straddling northeastern Alaska, northern Yukon, and the northwestern edge of the Northwest Territories. Sources of information about the Porcupine caribou herd's seasonal movements and favoured habitats include traditional knowledge about caribou and many years of studies, surveys, and tracking of the movements of individual caribou equipped with collars.

Porcupine Caribou Satellite Collar Location Program

This cooperative Canada/US program, which started in 1985, maintains satellite radio collars on caribou to document migration routes and habitat use over the seasons. Caribou collars have a GPS unit that records the location of the caribou at intervals over the day. The location data are sent from the collar to the satellite, which then transfers the data to a secure webserver back on Earth, where it is downloaded by caribou biologists.

(PCMB, 2020b; WMAC (NS), 2005)

I think the whole thing is important for the caribou. There's no spots where they stay, they're always travelling.

Dennis Arey in *Aklavik Local and Traditional Knowledge about Porcupine Caribou* (WMAC (NS) & Aklavik HTC, 2009, p. 24)

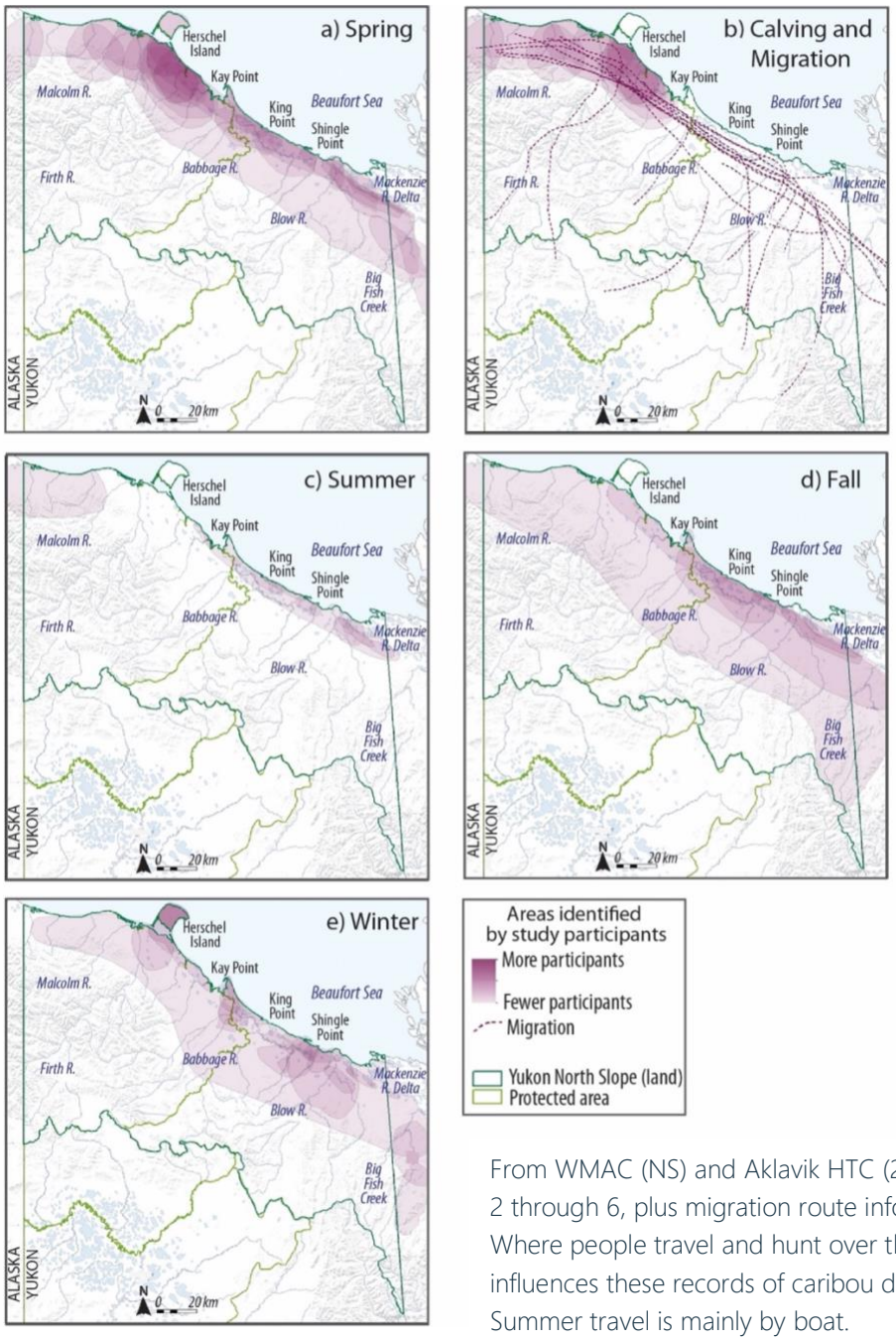
Based on the stories that interviewees shared about caribou migrations, Porcupine caribou rely on the availability of a variety of migration routes to adapt to change. The routes caribou take seem to depend on the following factors: food availability; weather conditions associated with rain, snowfall, and wind; air, boat, and land-based traffic; seismic activities and oil development; and hunting practices.

From *Aklavik Local and Traditional Knowledge about Porcupine Caribou* (WMAC (NS) & Aklavik HTC, 2009, p. 24)

Caribou Seasonal Movements and Habitat Use

Thirty-six years of caribou collar data echoes Inuvialuit knowledge: the entire Yukon North Slope, excluding the edge of the Mackenzie Delta, is used by caribou, though their routes through the landscape vary over the years.

Map 5- 3. Traditional knowledge about caribou distribution on the Yukon North Slope over the seasons



From WMAC (NS) and Aklavik HTC (2018a), maps 2 through 6, plus migration route information. Where people travel and hunt over the seasons influences these records of caribou distribution. Summer travel is mainly by boat.

Spring

In spring, caribou migrate from the taiga wintering grounds to the coast. Spring migration normally begins by early April, but timing and progress is largely dependent on snow conditions along the route. Although they prefer to travel along forested valley bottoms, in deep snow years the herd uses snow blown ridgetops when available. By late May pregnant cows are on the coastal plain and foothills of the western Yukon North Slope. Depending on snowmelt patterns, when they reach the coast they can spread along the foothills into Alaska or remain to calve in Yukon. Typically, this migration averages 245 kilometres, although the actual route is not a straight line. This travel takes place over an average of 33 days (Gurarie et al., 2019).

> Well, in the springtime, the cows like to be in the flats… most of the time the bulls always come last… [They] follow the cows.
>
> (WMAC (NS) & Aklavik HTC, 2018a, p. 14)

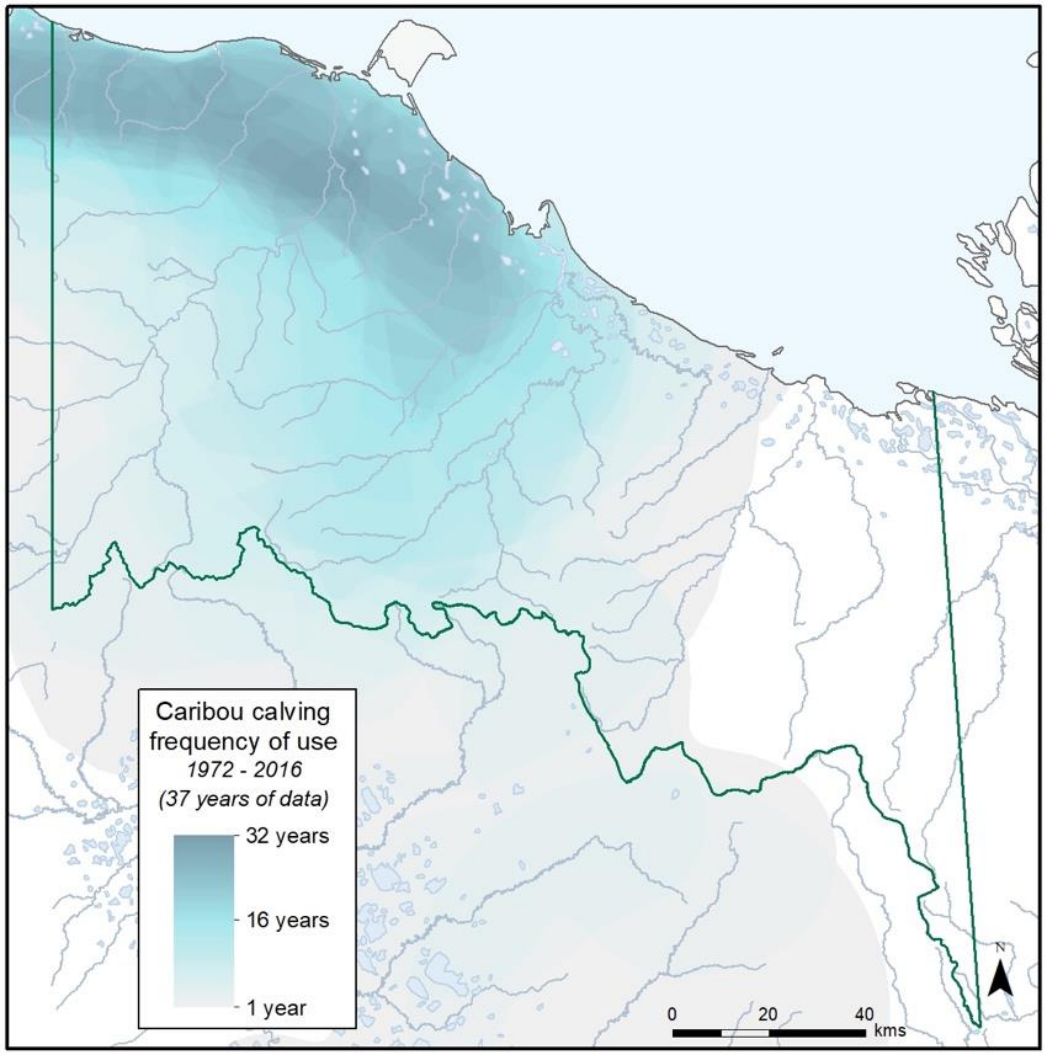
Calving and Post-Calving

Calving habitat is flat, open country close to the coast, where caribou can reduce exposure to predators and find relief from insects. They feed on fresh green plants, high in much-needed nitrogen. Calves are born on the coastal plain of Alaska and Yukon (Map 5- 4), with a long-term emphasis on the Alaskan 1002 Lands and areas directly south and east of them. Calving locations vary from year to year in response to snow conditions and pattern of snowmelt.

> [The calving grounds are] flat, rolling hills… you could see for miles… You [can] see out to the ocean, you can see all the way to Stokes Point, all the way to King Point.
>
> It's all [tundra], you know, there's a lot of good eating there, I guess… they're away from the mosquitoes [when they're] along the coast there.
>
> (WMAC (NS) & Aklavik HTC, 2018a, p. 18)

Some people have observed changes in calving locations, with calving further east or further inland, especially within the past 10 years (WMAC (NS) & Aklavik HTC, 2018a). This observation is consistent with climate data that shows that, over the last ten years, May 15 snow depth in the 1002 lands has been increasing, while snow depth to the east has decreased.

Map 5- 4. Caribou calving locations on the Yukon North Slope, based on 37 years of data on calving locations of collared caribou



This map is from the Plan (WMAC (NS), 2022, Appendix 1). Based on 37 years of data spanning 1972 to 2016, this map shows how frequently caribou calve in different areas of the Yukon North Slope. If an area has dark shading, caribou were located there in most years, while if it has very light shading, caribou were only located in that area during one or two years. Calving was mapped using collared caribou locations between May 26 and June 10 each year and the calving period seasonal range was estimated using a 95% kernel estimator. From this, overlapping polygons were enumerated to describe the relative frequency of use. Only data from calving females were used in this analysis. (Data source: Environment Yukon, in preparation)

Although calving generally takes place along the Alaska North Slope, east of the Canning River and west of Herschel Island, there is considerable annual variation. If snow conditions permit, pregnant females typically move west along the foothills of the Brooks Range and then north out onto the coastal plain, following the snowmelt pattern. However, if snowmelt is late, they may calve in the foothills and if really late, they may remain in Canada to calve. Although there is a low amount of new plant growth, what's there has the valuable nitrogen required to produce

milk and replenish weight lost over the winter. Normally the first plants to emerge are the flower heads of cottongrass, followed by other flowering plants and finally willows and other shrubs. Regardless of where they calve, as snow disappears, the cows with their newborns move into the Alaska National Wildlife Refuge, tracking fresh plant growth.

Summer and Early Fall

Soon after calving, as temperatures warm, insect harassment intensifies. Cows form larger and larger groups and are soon joined by bulls, juveniles, and cows without calves. How long these groups stay together depends on insect harassment. In the Porcupine herd, groups of many as 100,000 caribou may move an average of 25km a day, dispersing into smaller groups as they move into the mountains. As insect season ends, usually in early August, groups split up and concentrate on undisturbed feeding.

This period is critical for cows because they must gain mass before the fall rut in order to become pregnant. The late summer and early fall period is one of the few periods of the year where cow caribou have the capability of building up their body reserves. They feed on shrubs, grasses and sedges, and mushrooms, making up for foraging time lost to avoiding insects earlier in the year (D. E. Russell, Martell, & Nixon, 1993).

Aullaviat/Aunguniarvik and Caribou

The summer season is a crucial one for caribou, particularly for cows, as it is a time to put on critical body mass. Over time, the effects of insufficient weight gain include reduced parturition rates and reduced survival. Together, these have a negative effect on herd population numbers.

For the Porcupine caribou herd, the summer months are regularly spent in Aullaviat/Aunguniarvik (the Eastern Yukon North Slope) (see Map 5- 5). The herd has returned to the nutrient-rich landscape of Aullaviat/Aunguniarvik nearly every year for the past two decades. The importance of this place is captured in its Inuvialuktun name, which means: *where the people and animals travel/where the people hunt*.

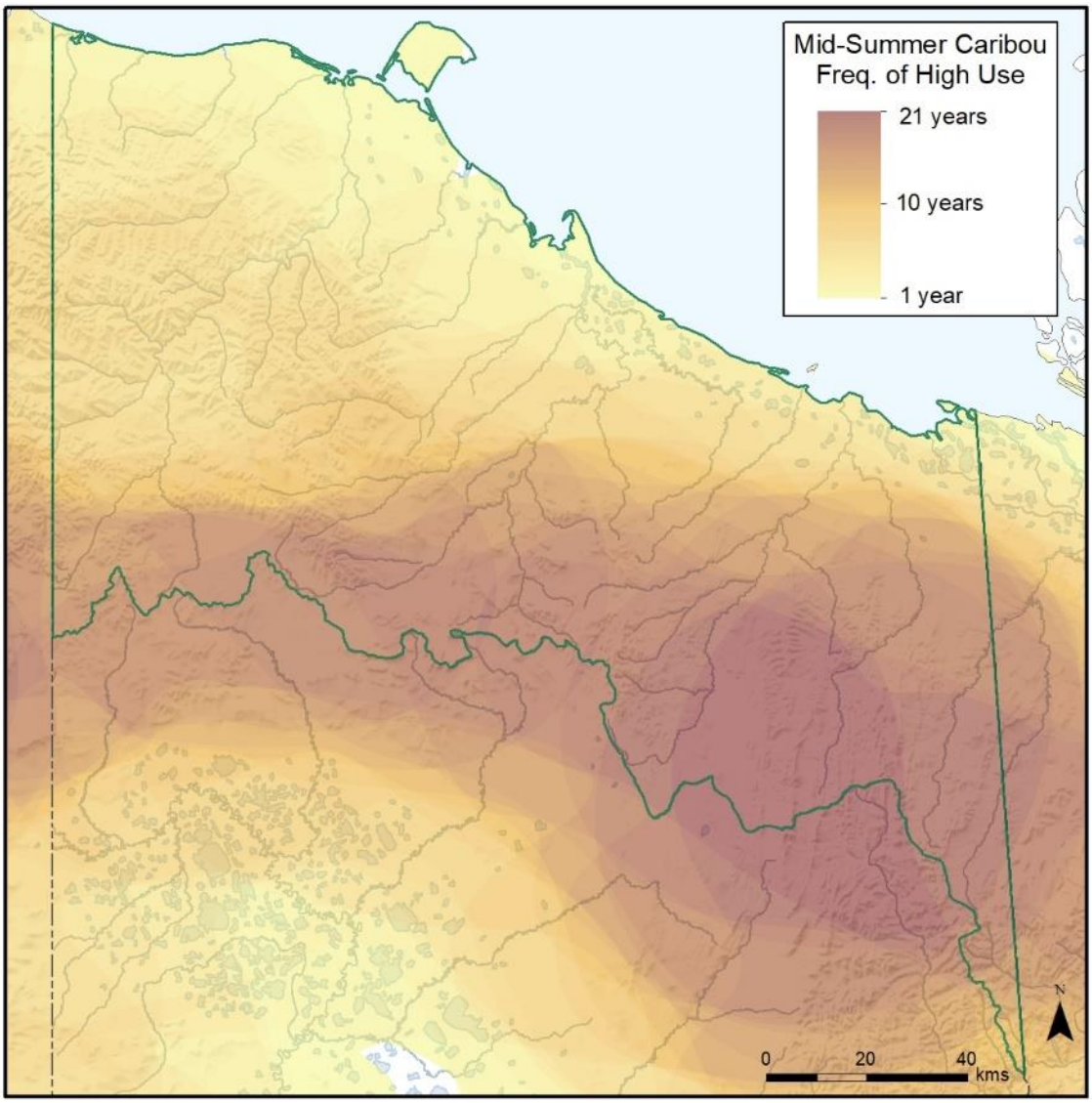
For more information on Aullaviat/Aunguniarvik, please refer to Companion Report 4: Aullaviat/Aunguniarvik.

(Environment Yukon, in preparation)

Although movement paths during this period vary, caribou generally migrate eastward from habitats in Alaska into Yukon's North Slope, normally arriving at the Blow River and Big Fish River area by mid to late July. Some caribou may also move northeast along the coast, selecting open tundra and flatlands with a good supply of green vegetation and sea breezes that provide insect relief. People also observe caribou in summer on hillsides or in the mountains, seeking relief from insects and predators. Collar data collected for the herd supports these observations, showing that most of the herd is typically found in the interior of the eastern Yukon North Slope from mid-July through late August or into September.

> Sometimes they come early, sometimes they come late—in August, all the time though, in August. Summertime only in August we expect caribou to come, but not the same time. Some time in the middle of August, end of August, sometime—last part of August. When they travel … they start showing in August, last part of August, like the 15th. That's why those old people always try to go to mountain August 15th or 10th, so they could look for caribou.
>
> (Alice Husky, WMAC (NS) & Aklavik HTC, 2009, p. 20)

Map 5- 5. Caribou mid-summer locations, based on 20 years of collared caribou data



This map is from the Plan (WMAC (NS), 2022, Appendix 1). It is based on overlaying the annual seasonal ranges of caribou from July 16 to August 7, using 20 years of collar data spanning the period 1990 to 2016 (ranges are based on 95% kernel density estimation). The map shows how often caribou use an area during the mid-summer season. If an area has dark shading, caribou were located there in most years, while if it has very light shading, caribou were only located in that area during one or two years. This map highlights areas that are very important for caribou in all or most years, but also that there is variability from year to year in use, which indicates that caribou need flexibility in habitat availability. Caribou cows with their calves arrive on the eastern North Slope every year around July 16 and will remain in the area until early September in most years. Data from all collared caribou were included in this analysis, i.e. males and parturient and non-parturient females. (Data source: Environment Yukon, in preparation)

People observe caribou in summer along the coast, on hillsides, or in the mountains, seeking relief from insects and predators. Snow patches provide important refuge from heat and insects.

> …they [caribou] hang out there [on snow patches] 'cause it's hot and, you know, it's warming up, June, July, and the mosquitoes are coming out… they go to the snow… 'cause it's cool and the mosquitoes won't bother [them] as much.
>
> (WMAC (NS) & Aklavik HTC, 2018a, p. 20)

Fall Migration, Breeding, and Winter

The main part of the Porcupine caribou herd will remain north of the Porcupine River if September and October are mild. Early, heavy snowfall often acts as a trigger for the herds to move south of the Porcupine River at the onset of fall migration. If fall storms end they may do a loop around Old Crow and cross the Porcupine River again. In the second to third week of October the Porcupine herd is in their breeding season, the rut. Usually, open landscapes are used during the rut, although the location varies, depending on how far south they are on their migration.

Small groups of caribou can remain on or near Qikiqtaruk over winter. Caribou select areas where wind blows the snow off vegetation. In winter, they eat lichens, sedges, and dried leaves.

> …they're eating along where they can easily access [vegetation], like a little high on the mountain and the sides [of hills].
>
> …Sometimes there will be west wind and they'll be on the west side, and sometimes it will be east wind and they'll be on the east side…. The wind always blows the snow off the top of the tundra … and they'll always be around… feeding around that area.
>
> (WMAC (NS) & Aklavik HTC, 2018a, p. 24)

Caribou Population

Species Conservation Status

The decision by COSEWIC to assess barren-ground caribou in Canada as Threatened in 2016 was based on the dramatic decline of most herds with no sign of recovery, and the presence of unprecedented cumulative threats related to climate change, industrial exploration and development on caribou ranges. Only 2 of 15 herds were determined to be increasing, one of which was the Porcupine caribou herd (Canada, n.d.; COSEWIC, 2016).

Table 5- 1. Barren-ground caribou conservation status

Status assigned by	Applies to	Status	References
Species at Risk Act (SARA)	Canada	Under consideration for addition to Schedule 1	(Canada, n.d.)
Committee on the Status of Endangered Wildlife in Canada (COSEWIC)	Canada	Threatened; last assessed 2016.	(COSEWIC, 2016)

Yukon	Yukon	S3S4: Vulnerable to Apparently Secure*	(Yukon, 2020)
International Union for Conservation of Nature (IUCN)	Global (*Rangifer tarandus*- all caribou)	On Red List of threatened species: status Vulnerable, population trend Decreasing; last assessed 2016	(Gunn, 2016; IUCN, 2020)

*Following the ranking system developed by NatureServe, an international network of conservation data centres (NatureServe, n.d.). S=Subnational

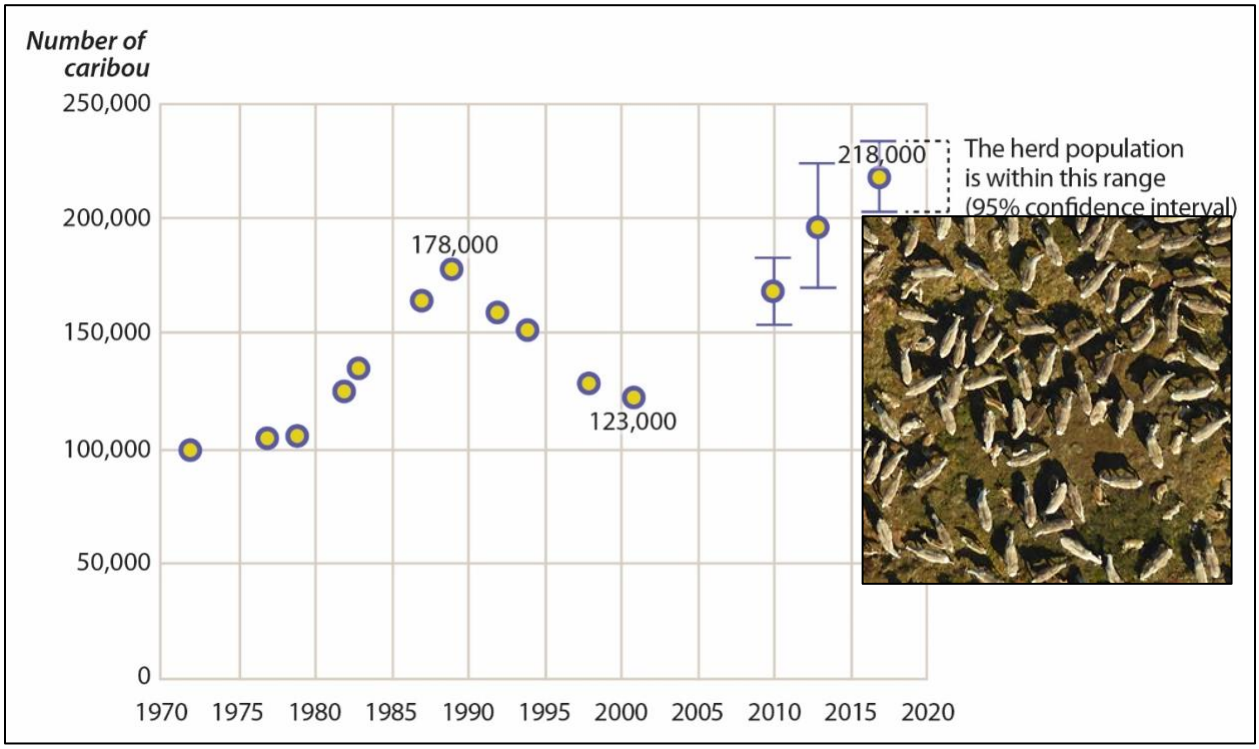
In 2016, the Porcupine caribou herd made up approximately one quarter of the total population of barren-ground caribou in Canada (COSEWIC, 2016). Understanding the complex factors that allow this herd to be increasing at a time when most herds are facing steep declines can help us plan for caribou recovery elsewhere. The highly collaborative, proactive management model in place for Porcupine caribou is a valuable example for other jurisdictions where caribou are not faring so well.

Porcupine Caribou Herd Status and Trends

Population counts have been conducted periodically since 1972, using aerial photographs of post-calving aggregations of caribou on or near the coastal plain (Figure 5- 1). In some years aggregations are as far east as the northern Richardson Mountains. Counts are scheduled for every 2 to 3 years but have to be postponed if weather conditions make visibility too poor, or if the herd is too spread out. These factors account for a period of uncertainty about the herd's status between counts in 2001 and 2010 (COSEWIC, 2016). Other population measures, such as proportion of calves to cows, number of bulls, and calf survivorship, are either taken from the population count or through additional surveys (Porcupine Caribou Technical Committee, 2019a, 2019b).

Population estimates since 2010 have confidence intervals—a range within which the true population is expected to fall. The estimates are based on the minimum count from the aerial survey and also make assumptions about groups without radio-collars as well as known radio-collars not detected in the aerial survey (Rivest, Couturier, & Crepeau, 1998). The most recent population estimate (2017) for the herd was 218,000, with a range between about 202,000 and 235,000 caribou.

Figure 5- 1. Porcupine caribou herd population size, 1972 to 2017



Population levels are minimum counts from 1972 to 2001, while estimates starting in 2010 are derived from minimum counts and modelling (based on Porcupine Caribou Technical Committee, 2019a, Figure 2). The photo is a segment of an aerial photo from the 2017 population count (photo: Alaska Department of Fish and Game).

What Influences the Abundance of Porcupine Caribou?

Participants in the study *Aklavik Local and Traditional Knowledge about Porcupine Caribou* (WMAC (NS) & Aklavik HTC, 2009) described influences on the health of the Porcupine caribou herd: predation, overharvesting, and, especially, weather.

> The wolves would take an awful lot, they take a lot of caribou. And overharvesting is another one. Hard winter, tough winter, like [cold and windy] this kind of weather is not good for the land because the snow is getting hard on top. If it rains it's going to freeze and the caribou can't break through that ice barrier to get down to where they want, you know, under the snow where the lichens and grass they eat are.
> Anonymous, p.44

> It's all important, wherever they can find food. They got to follow the food. If it rains in the fall time it's real bad—freeze-up. Under that snow it turns to ice. That's when the caribou starve. If it's good fall, not much rain or not too warm weather, they'll stay healthy.
> Anonymous, p.29

> Some years [herd health] is good and some years it's bad. Never the same all the time. Depends on the food that's growing up and the freezing rain, freezing snow and everything like that. It's not good for the caribou.
> Donald Aviugana, p.89

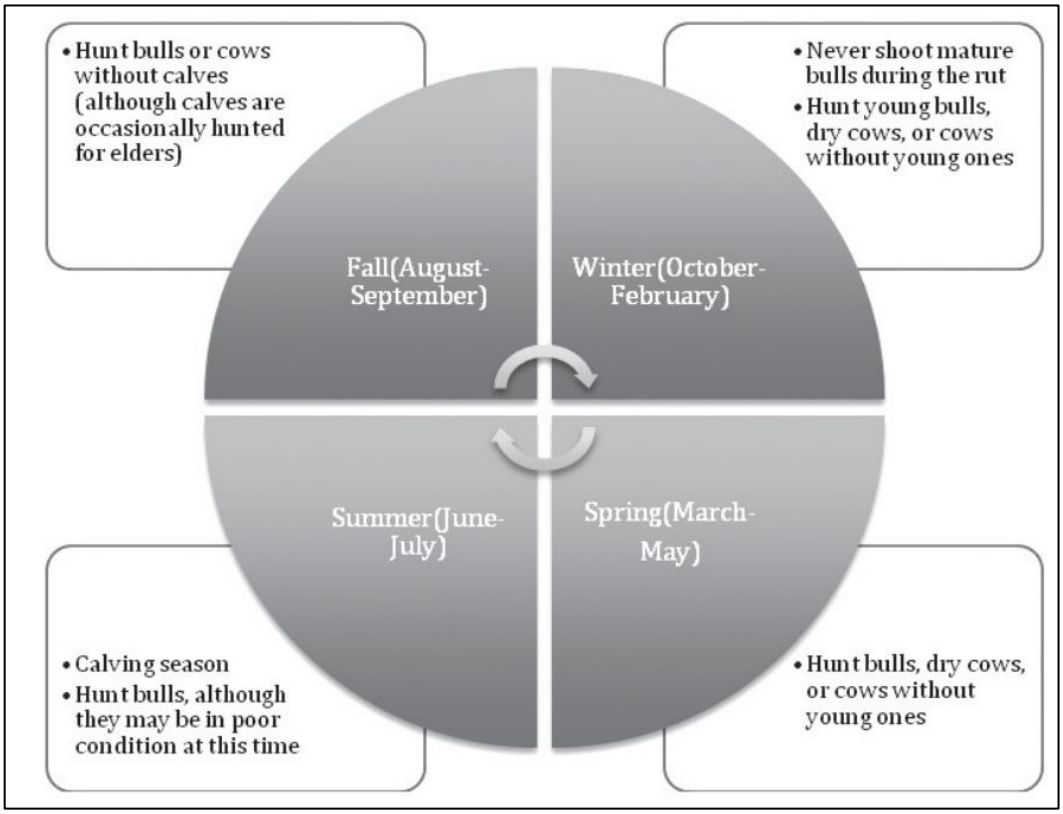
> When there's lots of rain it's good—not lots of rain, but rain once in a while [during the growing season]. Everything grows better … When it's too hot everything don't grow.
> Jacob Archie, p.30

Traditional knowledge and Western science-based studies suggest that barren-ground caribou go through natural fluctuations or cycles in abundance. These long-term shifts in populations are likely driven by large-scale decadal patterns in climate, interacting with changes in forage, predators, and pathogens (Gunn et al., 2011). Caribou face various challenges at critical times over the seasons and over their lifetimes, including from adverse weather, predation, or insects. The calving and post-calving periods are critical for the herd (International Porcupine Caribou Board, 1993). In the first month of life, an average of 25% of caribou calves die. In 2000 and 2001, over 40% of the calves died in the first month. Those years had deep snow which melted very late and many calves were born during migration, some south of the Porcupine River. If calves are born on the Alaskan coastal plain, the average survival rate increases with increasing plant growth. If they calve on the Yukon North Slope, calf survival declines with increasing March snow depth (Griffith et al., 2002; Russell & Gunn, 2019).

Harvest Management

Inuvialuit traditional hunting and meat preparation is described in *Aklavik Local and Traditional Knowledge about Porcupine Caribou* (WMAC (NS) & Aklavik HTC, 2009). Respectful harvest of caribou is based on many traditions, including letting the leaders pass, not wasting food, and adjusting harvest to the season.

Figure 5- 2. Summary of Aklavik Inuvialuit seasonal hunting of Porcupine caribou



(WMAC (NS) & Aklavik HTC, 2009, Figure 9)

On the Yukon North Slope, Inuvialuit have the exclusive right to harvest caribou in Ivvavik National Park and Herschel Island-Qikiqtaruk Territorial Park, and the preferential right to harvest caribou on the Eastern Yukon North Slope (Canada, 1984). A limited bull-only harvest by Yukon residents is permitted on the Eastern Yukon North Slope, subject to the herd status.

Harvest management in Canada is coordinated through the Porcupine Caribou Management Board (PCMB, 2020b), which was created through the *Porcupine Caribou Management Agreement* (Government of Canada et al., 1985). Management measures may include hunter education, recommendations on bull-only harvesting, and recommendations on restrictions on harvest.

Recommendations on harvest management measures in Canada are issued following each annual harvest meeting (PCMB, 2020a). In times when caribou abundance is low, all caribou user groups face tough decisions about harvest restrictions. The Porcupine Caribou Harvest Management Plan (PCMB, 2010a) provides guidance (see section on Links to Plans and Programs). The *Porcupine Caribou Herd Native User Agreement* (2019) includes provisions for coordinating harvest management efforts and reaching decisions on allocation of the harvest during times when the herd numbers are low (Vuntut Gwitchin Government, Tr'ondek Hwechin'in, First Nation of Na-Cho Nyak Dun, Inuvialuit Game Council, & Gwich'in Tribal Council, 2019).

No commercial harvest is permitted, but the *Porcupine Caribou Management Agreement* permits the sale and barter of meat among Canadian Indigenous user groups. Guidelines for these transactions have been established by the Porcupine Caribou Management Board (PCMB, 2011).

Transboundary Considerations

The range of the Porcupine caribou herd includes many jurisdictions: national and territorial regimes, land claim settlement areas, protected areas, and land use planning regions. Agreements, boards and committees, and some of the plans in place for these jurisdictions are described in the section on Links to Plans and Programs.

Observations, Concerns, and Threats

Cumulative Effects

The health and productivity of the Porcupine caribou herd is affected by a number of complex factors that interact in compounding ways (PCMB, 2012). Taking a cumulative effects approach to assessing the impacts from human-caused changes on the herd's range means taking a holistic view and considering potential impacts in relation to other pressures on caribou across their extensive range throughout the year. Stressors for caribou generally fall into two categories: naturally occurring pressures such as insect harassment, disease and parasites, forage quality, quantity and availability, predation, and weather; and human-caused pressures including climate change, seismic disturbance, range displacement, auditory, visual and mechanized displacement, contaminants, habitat loss and modification, harvesting, human harassment, and migratory disruption. The human-caused pressures can compound or amplify naturally occurring pressures. The resulting cumulative effects can manifest as habitat loss, displacement to marginal habitat, reduced high quality forage intake, decline in health, increased predation, and distribution shifts.

In line with environmental assessment legislation in the United States and Canada, new development proposals in Porcupine caribou herd range must assess the potential impacts of the proposed development on caribou. This includes transboundary impacts. Moreover, the requirement is not only to assess the isolated impact of the new development but rather the cumulative impact of the new development on top of impacts associated with other existing and future developments to the herd. Thus, if someone proposes a road into the winter range of a caribou herd, there is not only a need to assess the direct impact on wintering caribou, but also, how that adds to the existing impacts of other development and future climate trends within the entire range of the herd.

While the Porcupine herd's range is to date relatively undisturbed by development and has land management regimes that include several protected areas (Map 5- 1), potential development activities, including exploration and construction of infrastructure on the range, is a concern.

Climate change, the other principal human-related influence on the Porcupine caribou herd, presents a complicated suite of primary and secondary effects, some known and many that are subtle and not well understood (COSEWIC, 2016). While it is now well-established that the planet will continue to warm into the coming decades as a result of human activity (IPCC, 2021), the effects of climate change on Porcupine caribou are expected to be mixed, at least in the near-term. For example, more frequent freezing-rain events and increased snow pack depth are expected to have a negative effect on the herd, reflected in metrics like calf survival (Russell & Gunn, 2019). However, warmer temperatures in the fall and an increase in overall growing degree days may be beneficial for caribou (Russell & Gunn, 2019).

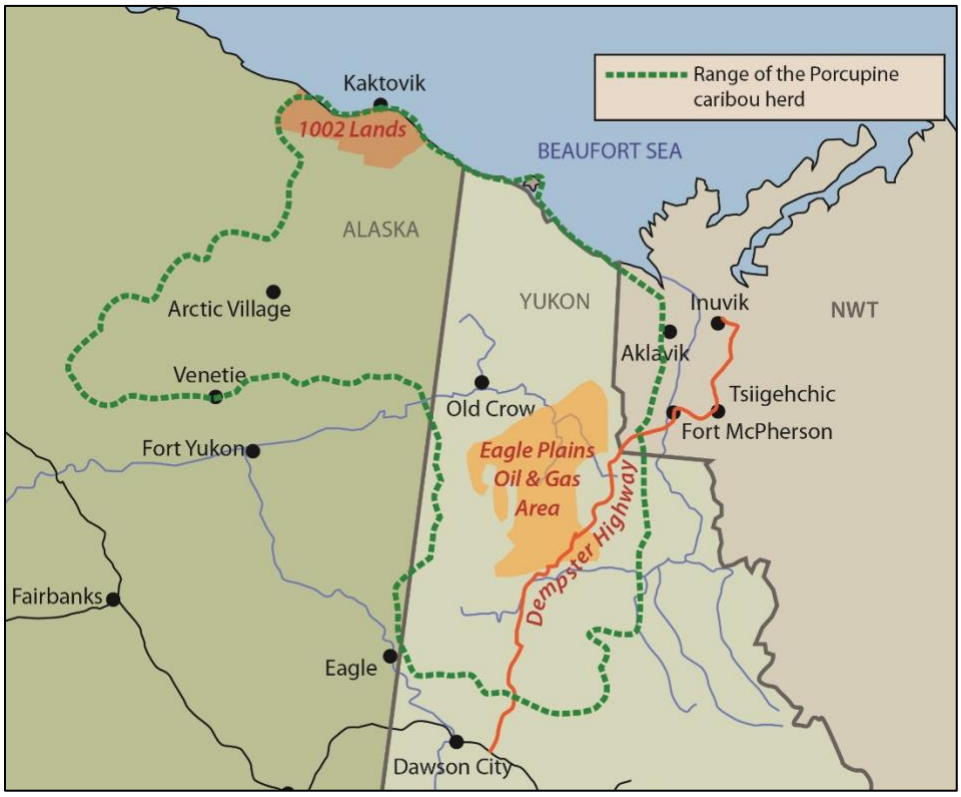
The uncertainty that comes with climate change raises the possibility for a plethora of complex, interacting effects that may influence caribou ecology. The Porcupine herd's range is immense – there are numerous local systems across that range that may shift as the climate warms. Maintaining connectivity for caribou across this massive landscape as the climate changes is crucial. Buffering against cumulative effects related to climate change is possible though. Decades of collecting movement data from collared caribou shows that while the herd may not use the same seasonal areas every year, those lesser used areas are necessary in years when conditions in high-use areas are not favourable, or the areas themselves are not accessible. Conserving large, healthy areas that support caribou and the migration routes that connect them is key to buffering for change.

Development on the Herd's Range

Main areas of current and proposed development and infrastructure within the herd's range are shown on Map 5- 6:

- 1002 Lands, Alaska, critical calving and post-calving habitat for the herd
  Section 1002 of the act that established the Arctic National Wildlife Refuge in 1980 deferred a decision about whether or not to allow oil and gas exploration and development in an area of the coastal plain that is now referred to as the "1002 Lands". In 2017, a provision requiring over half of the 1002 Lands to be opened to oil and gas leasing was signed into U.S. law. (For a cumulative effects assessment of this project, see Russell & Gunn, 2019.)
- Eagle Plains, Yukon, in the herd's winter range
  Oil and gas exploration in the Eagle Plains basin dates back to the 1950s. Renewed interest in exploiting these resources over the past decade led to a 2017 Yukon Government moratorium on exploration activities to provide time for consultations and development of agreements with First Nations governments.
- Dempster Highway, Yukon and NWT, crossing the herd's winter range
  The Dempster Highway connects Inuvik to Dawson City. The road provides an access corridor for harvesters. Road traffic can accidentally kill caribou and disturb migration (see Johnson & Russell, 2014).

Map 5- 6. Range of the Porcupine caribou herd showing the Dempster Highway and areas with approved or proposed opening to oil and gas development



Adapted from maps on the PCMB website (PCMB, 2020b)

The effects of development on migratory caribou have been studied in Canada and Alaska and are summarized in COSEWIC (2016). These effects include direct and indirect habitat loss, altered movement and migration patterns, and changes in behaviour.

Studies at Prudhoe Bay, on the Central Arctic caribou herd, found calving areas shifted away from areas with industrial development, even when the new areas had poorer forage conditions for nursing cows (Wolfe, 2000). A recent analysis, after 40 years of development within the Central Arctic herd's range, indicates that calving caribou are still avoiding roads and traffic (H. E. Johnson, Golden, Adams, Gustine, & Lenart, 2020).

The Porcupine caribou herd's avoidance response to development on and adjacent to the Dempster Highway was examined by analyzing 27 years of data on caribou locations in relation to the changing footprint of development features over the herd's range (C. J. Johnson & Russell, 2014). Caribou demonstrated the strongest avoidance response to settlements, followed by main roads and minor disturbance features, such as wells and seismic lines.

Effects of Climate Change

Inuvialuit land users who participated in the study *Inuvialuit Traditional Knowledge of Wildlife Habitat, Yukon North Slope* noted changes in calving locations, with a move to further east or further inland, especially within the previous 10 years. Interviewees suggested possible reasons, including earlier springs with earlier green-up, increased river flows disrupting migration routes, and human disturbance:

> …a lot of the times, these past 10, 15 years, it's been a hell of a lot warmer, earlier, you know? More land, more grasses and that exposed…"
>
> …springtime, you know, they [caribou] used to come down here [Alaska and western calving grounds] and calve, but… it's earlier springs and… then they're calving right from Barge Lake area… all the way… down the coast now.
>
> You know, it's just a matter of the timing of… things… you know, with everything being early… or later spring… depends on how far they make it before they start [to calve]…"
>
> (WMAC (NS) & Aklavik HTC, 2018a, pp.18-19)

Aklavik Inuvialuit have observed changes in migration patterns in spring and fall, with caribou spending less time along the coast, particularly in the fall, and changes in timing, depending on the weather. Migrations are becoming less predictable:

> They [caribou] don't hang around very long; they're just beelining straight up towards Old Crow and Alaska.
>
> …well, about 15–20 years ago, there used to be tons [of caribou] all over the North Slope… and then lately, now it's just more scattered bunches… like around 40 to 50…. Sometimes you'll get a couple hundred.
>
> (WMAC (NS) & Aklavik HTC, 2018a, p. 24)

Many participants in the study *Aklavik Local and Traditional Knowledge about Porcupine Caribou* (WMAC (NS) & Aklavik HTC, 2009) said they see more mosquitoes now than in the past. People attributed the increase to rising temperatures, and rain and flood events that create good breeding conditions for mosquitoes. People also observed that access to the land has changed:

> All the land where we travel long ago, easy to travel, it's not like that anymore. It's too much changes now, the creeks are drying out, the lakes is getting shallow. You'd be lucky to get into some places where we used to just go in with boats. It's not like that anymore.
>
> Annie B. Gordon, p. 63

Research and monitoring supports Inuvialuit land users' observations of changes to the seasons and their effects on caribou and on traditional use. Overviews of climate change effects on barren-ground caribou subpopulations are in COSEWIC (2016), Gunn et al. (2011) and Mallory and Boyce (2017). Climate change effects include changes to timing and quality of forage,

increased frequency of extreme weather events restricting access to food, changes in seasonal migration patterns, and large-scale changes to ranges, such as alteration of winter habitat by fires.

Actual impacts will be herd-specific. For example, the Porcupine caribou range in summer is a permafrost-dominated landscape. Summer warming will result in an increased active layer, making more moisture available for plants. On the Canadian Shield, herds like the Bathurst caribou herd summer on bedrock-dominated substrates. Summer warming results in less available moisture with increasing drought conditions.

This broad and complex subject is covered in more depth in Chapter 2 of this report, Climate Change Effects.

Additional Threats

Contaminants

Mercury and cadmium, though they do build up in Porcupine caribou organs, are at safe levels and have not increased in recent years (Gamberg Consulting, 2017; Gamberg, Poulain, Zdanowicz, & Zheng, 2015). Other contaminants, including radioactivity and persistent organic pollutants, are low in Porcupine caribou (Macdonald, Elkin, & Tracy, 2007; Stocki et al., 2016). Results of ongoing monitoring of caribou for contaminants are regularly presented at Porcupine Caribou Management Board meetings. Studies on contaminants in caribou are discussed in more depth in Chapter 3 of this report, Contaminants.

Parasites and Disease

As climates and ecosystems change, ungulate diseases and parasites can extend their ranges or become more prevalent in Arctic wildlife (COSEWIC, 2016; Kutz et al., 2012; Verocai et al., 2012). Warble and bot flies, common caribou parasites, can have a significant effect on caribou populations. The larvae directly affect caribou health. The adult flies can leave caribou with inadequate time to forage due to time spent avoiding the flies. The infection levels of these parasites depend on temperature and wind speed. An example of a parasite that may be expanding its range is a nematode legworm (*Onchocerca cervipedis*). This parasite infects moose and caribou and appears to have recently extended its range northward to subarctic moose populations in northwestern North America (Verocai et al., 2012).

Links to Plans and Programs

This section lists plans and programs that link to the objectives and strategies of the *Yukon North Slope Wildlife Conservation and Management Plan*. These plans and programs informed the development of the Yukon North Slope Plan and are an integral part of its implementation.

Conservation and Management

Agreements

The framework for conservation and management of the Porcupine Caribou Herd is set out in three agreements that provide goals, strategic directions, and mechanisms for ongoing cooperation among the many jurisdictions over the range of the herd (**Error! Reference source not found.**).

Table 5- 2. Agreements on Porcupine caribou herd conservation and management

Agreement	Geographic scope	Parties to the Agreement	Boards/ commission established
Agreement Between the Government of Canada and the Government of The United States of America on the Conservation of the Porcupine Caribou Herd (1987)	Range of the herd in Canada and the United States	· Canada · United States	International Porcupine Caribou Board
Porcupine Caribou Management Agreement (1985) This agreement is part of the *Inuvialuit Final Agreement* (Canada, 1984, Annex L)	Range of the herd in Canada	· Government of Canada · Government of Yukon · Government of the Northwest Territories · Council for Yukon Indians · Inuvialuit Game Council · Dene Nation and Metis Association of the Northwest Territories	Porcupine Caribou Management Board
Porcupine Caribou Herd Canada Range-Wide Native User Agreement (2019)	Range of the herd in Canada	· Vuntut Gwitchin Government · Tr'ondek Hwechin'in · First Nation of Na-Cho Nyak Dun · Inuvialuit Game Council · Gwich'in Tribal Council	Porcupine Caribou Native User Commission

Boards and Committees

- International Porcupine Caribou Board (Government of Canada, 2020)

  The board is made up of four members appointed by the US and four members appointed by Canada. The board meets annually.

- The Porcupine Caribou Management Board (PCMB, 2020b)
  The Canadian PCMB was established "to communicate information about the herd and provide recommendations to agencies responsible for managing the herd." The Board has representation from the five native user groups (**Error! Reference source not found.**) and the federal and territorial governments.
- Porcupine Caribou Native User Commission (Vuntut Gwitchin Government et al., 2019)
  This commission is tasked with coordinating harvest allocation and harvest management among the native user communities in Canada, based on the recommendations of the PCMB.
- The Porcupine Caribou Technical Committee (Government of Canada, 2020; PCMB, 2010a)
  This committee was recommended in the international agreement on Porcupine caribou. The PCTC, which predated the 1987 agreement by a decade, is made up of Alaskan and Canadian agency biologists and other researchers with expertise on Porcupine caribou biology, ecology, and management. The committee's work includes developing research and monitoring priorities, coordinating monitoring and other initiatives, and reporting on results. The PCTC also provides technical information and advice to various governments and boards.

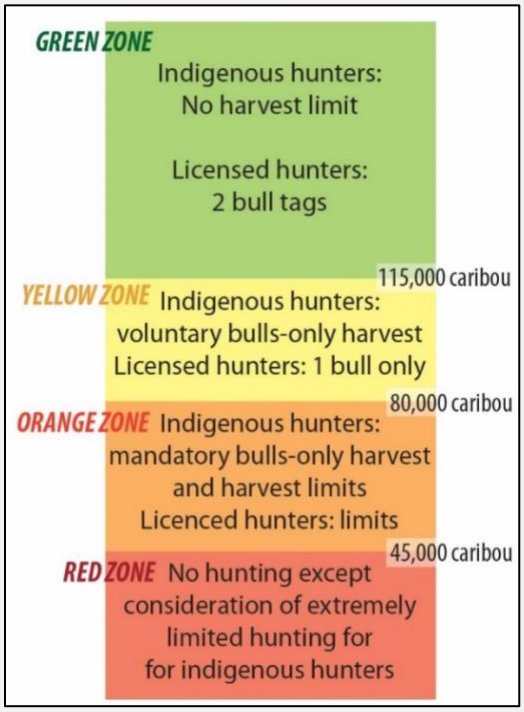
Plans

- *Harvest Management Plan for the Porcupine Caribou Herd in Canada* (PCMB, 2010a, 2010b) and the accompanying Implementation Plan (PCMB, 2016)

  The management goal is "to try to conserve the Porcupine Caribou Herd by adjusting the number and sex of caribou we harvest based on the changes in the herd size and population trend" (PCMB, 2010a, p. 6). Education and communication at the community level is a priority. Harvest management actions are based on current herd status, using a colour system (**Error! Reference source not found.**-3).

  The implementation plan, revised in 2016, outlines roles, responsibilities and tasks for harvest management, monitoring, evaluation, and adaptive management.

Figure 5- 3. Porcupine caribou harvest management colour chart



The colour zones represent the herd status and associated harvest management measures. Caribou numbers are herd size estimates, which is the main indicator for determining the herd status. All hunters must report their harvest in all colour zones. (PCMB, 2010a, 2016)

- *Aklavik Inuvialuit Community Conservation Plan* (Aklavik HTC, Aklavik Community Corporation, WMAC (NWT), FJMC, & Joint Secretariat, 2016)

  The plan identifies values for Special Designated Lands. Porcupine caribou, including calving and caribou hunting, is an identified value for the Eastern North Slope (Site 725DE). The Big Fish River watershed (Site 720DE) is identified as important caribou habitat; Ivvavik National Park (Site 727E) is identified as important for migration route and calving for Porcupine caribou; Herschel Island-Qikiqtaruk Territorial Park (Site 730E) is identified as year-round habitat for caribou.

Some caribou conservation measures in the Aklavik Inuvialuit Community Conservation Plan (p. 99):

- Identify and protect important habitats from disruptive land uses.
- Avoid shooting mature bulls during the rut.
- Do not harvest more than is needed.
- Convey and promote traditional means of using all of each animal harvested; discourage waste of meat.

- *Ivvavik National Park of Canada Management Plan* (Parks Canada, 2018)
  The main purpose of the park is to conserve wildlife, wildlife habitat, and traditional Inuvialuit use. Calving grounds within the park are part of Zone II–Wilderness, the highest level of protection. The plan recognizes that "The Porcupine caribou herd plays a critical role in sustaining Inuvialuit cultural traditions and life on the land", and that "maintaining its health is a key focus of conservation efforts (Parks Canada, 2018, p. 8).

> Ivvavik, meaning "a place for giving birth, a nursery," recognizes the park's significant role as the calving ground for the Porcupine caribou herd - the traditional subsistence wildlife resource for the Inuvialuit and other Indigenous peoples for thousands of years.
>
> *Ivvavik National Park of Canada Management Plan*

- *Herschel Island-Qikqtaruk Territorial Park Management Plan* (Herschel Island-Qikiqtaruk Management Plan Review Committee, 2018)
  Conservation of caribou is encompassed by the goals and actions to maintain ecological integrity (Goal #1) and to maintain traditional use and cultural connection (Goal #4).

- As the Porcupine caribou's range crosses land claim, territorial, and national boundaries, management and land use plans for jurisdictions beyond the Yukon North Slope are important in conserving the herd and its habitat:

  Vuntut National Park of Canada Management Plan (Parks Canada, 2010)

  Vuntut National Park (**Error! Reference source not found.**) establishes legal protection of portions of the Porcupine caribou herd's spring and fall migration range. The plan recognizes the critical importance of the herd to the Vuntut Gwitchin, and sets out commitments to continued cooperative management, education, research, and monitoring. The condition and trend of the herd is a key indicator of ecological integrity for the park.

  Arctic National Wildlife Refuge Comprehensive Conservation Plan (USGS & USFWS, 2015)

  The first purpose of the Arctic National Wildlife Refuge (**Error! Reference source not found.**) is "to conserve fish and wildlife populations and habitats in their natural diversity" (p. S-15). Caribou, the most abundant large mammal in the refuge, is recognized as an important subsistence species for Iñupiat and Athabascan (Gwich'in) hunters. The plan includes goals and objectives for conservation of ecological processes; preservation of wilderness areas; research and monitoring; incorporation of traditional knowledge in decision-making; and addressing concerns about proposals that may affect subsistence use.

  North Yukon Regional Land Use Plan (Vuntut Gwitchin Government & Yukon Government, 2009)

  The Porcupine caribou herd is considered the most significant wildlife resource in the planning area and holds a special place in the plan. A key issue addressed is oil and gas

development in Eagle Plains. The plan includes best management practices to protect caribou from disturbance, especially at critical times of the year.

Map 5- 7. Yukon land use planning regions and Gwich'in Settlement Area

(Vuntut Gwitchin Government & Yukon Government, 2009, Figure 1.1)

Peel Watershed Regional Land Use Plan (Peel Watershed Planning Commission, 2019)

Porcupine caribou may winter throughout the planning region (**Error! Reference source not found.**), though they are mainly down the Richardson Mountains into the Hart, Blackstone, and Ogilvie drainages. The plan contains provisions for avoiding or reducing activities that would disturb caribou during this time window. There is oil and gas potential within the planning region.

Working for the Land: Gwich'in Land Use Plan (Gwich'in Land Use Planning Board, 2003)

This land use plan is for the Gwich'in Settlement Area, shown in Map 5– 7. The Porcupine caribou herd is a principal resource requiring protection in three of the plan's special management zones:

1. Porcupine Caribou (Vàdzaih): in the Richardson Mountains, an area used during spring migration)
2. Stoney Creek (Gwatoh Taii Tshik): in the foothills of the Richardson Mountains, also part of the caribou's spring migration corridor
3. Dempster Highway Yukon/NWT Border to Peel River

These three special management zones have conditions designed to protect caribou .

Research and Monitoring Programs

- Indicators and monitoring through the Porcupine Caribou Management Board and Porcupine Caribou Technical Committee (Porcupine Caribou Technical Committee, 2018, 2019b, 2019a)

  A set of population, body condition, and habitat indicators is monitored and reported on annually to aid in decision making.

Table 5- 3. Porcupine caribou indicators

Population size and trend		Body condition	Habitat
• Population size • Population trend • Adult cow survival • Calf birth rate • Calf survival	• Calf:cow ratio late June • Calf:cow ratio March • Bull ratio • Peak of calving date	• Average back fat • Hunter assessment • Condition of caribou	• Snow conditions • Wildland fires • Linear disturbance and human development

Porcupine Caribou Technical Committee (2019a)

- Inuvialuit Harvest Study (IHS) 2016-2019 (IRC, 2017, 2018, 2019)

  From 2016-2019, annual harvest monitoring in the ISR was led by the Inuvialuit Game Council and the Inuvialuit Regional Corporation. This included caribou harvest monitoring. Inuvialuit Community Resource Technicians collected harvest information, including harvest locations, through monthly interviews with active harvesters. Inuvialuit caribou harvest was reported by the Inuvialuit Game Council at the Porcupine Caribou Management Board's annual harvest meetings (IGC, 2018, 2019).

- Arctic Caribou Contaminant Monitoring Program (Gamberg, 2015, 2017, 2018)

  This ongoing monitoring of the Porcupine and Qamanirjuaq caribou herds is part of the Northern Contaminants Program (Government of Canada, 2018). Monitoring goals are to determine if contaminants are affecting Canadian Arctic caribou populations or the safety of caribou as food, and to see if contaminant levels are changing over time.

- Arctic Borderlands Ecological Knowledge Society (ABEKS, 2020)(ABEKS, 2018)

  The Aklavik Hunters and Trappers Committee is a partner in this community-based monitoring program that includes several Porcupine caribou user communities. The program has been in operation since 1996. Monitoring consists of structured interviews with active hunters, conducted annually, and features questions about caribou, such as about body condition and about how successful harvesters were at meeting their needs for caribou each year. Results are presented at the Porcupine Caribou Management Board annual harvest meeting (ABEKS, 2019).

- Reports and presentations presented at the Annual Harvest meeting or collected by the Porcupine Caribou Management Board

  These include reports by the Inuvialuit Game Council and the Arctic Borderlands Ecological Knowledge Society (ABEKS, 2019; for example, IGC, 2018, 2019). The reports and presentations summarize results of meetings and interviews, including hunters' observations and Inuvialuit knowledge about Porcupine caribou, and inform decision making at these annual meetings.

Selected Studies and Research Relevant to the Yukon North Slope

There is a solid base of both traditional and scientific knowledge about the Porcupine caribou herd throughout its range. Inuvialuit traditional knowledge about caribou has been recorded through several studies and is documented on an ongoing basis through community-based monitoring and harvest management initiatives. Ongoing research and monitoring by government agencies and researchers includes habitat and migration studies, periodic estimates of the herd size, and monitoring of body condition, herd composition, and survival rates. Studies provide information on natural and human-influenced sources of mortality and threats to caribou health or productivity, including predation, insect harassment, unfavourable snow and ice conditions, contaminants, parasites, and disease. Research on caribou energetics has improved knowledge about caribou needs over the seasons and over their life cycles, and their vulnerability to impacts from industrial development and climate change.

This section is an annotated listing of selected reports, scientific papers, and other resources that provide support to the *Yukon North Slope Wildlife Conservation and Management Plan* and highlight issues and research directions that will be important to consider during its implementation.

Traditional Knowledge Studies

- *Aklavik Local and Traditional Knowledge about Porcupine Caribou* (WMAC (NS) & Aklavik HTC, 2009)

  This study is based on interviews with 14 local experts. Spatial information was recorded on maps. The results are referenced throughout this chapter.

- *Yukon North Slope Inuvialuit Traditional Use Study* (WMAC (NS) & Aklavik HTC, 2018b) and *Inuvialuit Traditional Knowledge of Wildlife Habitat, Yukon North Slope* (WMAC (NS) & Aklavik HTC, 2018a)

  These two studies were undertaken by the WMAC (NS) and the Aklavik HTC to document traditional use patterns and knowledge about wildlife habitat on the Yukon North Slope.

Both studies were based on interviews with Aklavik Inuvialuit land users. The results were used in developing the Plan and are described and referenced throughout this chapter.

Assessments and Syntheses of Study Results

➢ Porcupine caribou studies from 1970 to 2001

Results from this body of research and monitoring are presented and synthesized in two publications:

- *Movements and Distribution of the Porcupine Caribou Herd, 1970-1990* (D. E. Russell, Whitten, Farnell, & van de Wetering, 1992) compiles results from surveys by industry and government across the international range of the herd.
- *Range Ecology of the Porcupine Caribou Herd in Canada* (D. E. Russell et al., 1993) presents results of work carried out by the Canadian Wildlife Service as a joint project with the Yukon Department of Renewable Resources from 1979 to 1987. The report includes studies on range conditions, habitat selection, diet, and activity over the annual life cycle of caribou, and findings on caribou energetics.
- A chapter on the Porcupine caribou herd in *Arctic Refuge Coastal Plain Terrestrial Wildlife Research Summaries* (Griffith et al., 2002) contains summaries of scientific investigations of the Porcupine caribou herd and its habitat, updating and building on the information from an earlier resource assessment of the Arctic National Wildlife Refuge (Clough, Patton, & Christensen, 1987). Although the focus is the 1002 Lands in Alaska, this report includes summaries of studies up to 2001 over the entire range of the herd in Alaska and Canada.

➢ *Sensitive Habitats of the Porcupine Caribou Herd* (International Porcupine Caribou Board, 1993)

This report provides a foundation for habitat conservation over the international range of the Porcupine caribou herd. It categorizes the periods in the caribou's annual cycle by their importance to the long-term survival of the herd and summarizes knowledge about habitat use and land status of sensitive habitats during each period. The report is based on the 1970 to 1990 data compiled in Russell et al. (1992).

> At different times of the year, caribou need special places in order to stay healthy and raise their young. As the seasons change, the caribou travel from one special place or "habitat" to the next according to their needs for food, safety, escape from flies or shallower snow depths.
> (International Porcupine Caribou Board, 1993, p. 3)

➢ *Summer Ecology of the Porcupine Caribou Herd* (D. E. Russell & McNeil, 2005)

This report consolidates science-based knowledge about the ecological factors that affect caribou during the critical calving and post-calving periods and knowledge about the known and potential effects of climate change and oil and gas development on caribou. The report is based primarily on research results reported in Griffith et al. (2002).

- *Vulnerability Analysis of the Porcupine Caribou Herd to Potential Development of the 1002 Lands in the Arctic National Wildlife Refuge, Alaska* (D. E. Russell & Gunn, 2019) and *A decision support tool for assessing cumulative effects on an Arctic migratory tundra caribou population* (D. Russell, Gunn, & White, 2021)

  The report and associated paper synthesize science-based information and provide projections of potential impacts of development of the 1002 lands using the Caribou Cumulative Effects Model. Some conclusions from this risk assessment are in the section on Cumulative Effects.

- *Assessment and Status Report on the Caribou* Rangifer tarandus *Barren-ground Population in Canada* (COSEWIC, 2016)

  This assessment report summarizes knowledge on Canadian barren-ground caribou and provides the rationale for its designation by COSEWIC as Threatened.

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