# PORCUPINE CARIBOU
# ANNUAL SUMMARY REPORT
# 2021 – 2022

Firth River, July 2022
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Submitted to: Porcupine Caribou Management Board

Submitted by: Porcupine Caribou Technical Committee

November 15, 2022

# Indicator Table

## Annual Summary Report 2021 – 2022

| Indicator | Value | Average | Notes |
|---|---|---|---|
| **Population size and trend** | | | |
| Population size | 2022 = photocensus not attempted | -- | Herd did not aggregate sufficiently for photocensus. Successful photocensus in 2017 found 218,457 (95% CI = 202,106 - 234,808) caribou. |
| Population trend | 2022 = no data | $\Lambda$ = 1.037 (2010-2017) | Declined by 55,000 caribou between 1989 and 2001. Recovered to 169,000 by 2010 and continued to increase to 218,457 in 2017. Recent annual growth rate almost identical to growth phase from 1972-1989. |
| Population model | 2022 = model results not yet available | | Population model (2017-2021) indicates herd is likely stable or possibly increasing. |
| Adult cow survival | 2020= 94.7 %. 2022 model results not updated | 88.8 % (2012-2020) | Sampling interval is June 1 – May 30 |
| Adult bull survival | 2020= 68.1 %. 2022 model results not updated | 70.4 % (2015 – 2020) | Sampling interval is June 1 – May 30 |
| Yearling cow survival | 2020= 80.5 %. 2022 model results not updated | 85.4 % (2017 – 2020) | Sampling interval is June 1 – May 30 |
| Calf birth rate (Parturition rate) | ≥ 4 yr olds = 0.76 | 0.85 (5-yr average) | 18-year average (2005 – 2022) = 0.81 |
| | ≥ 3 yr olds = 0.70 | 0.82 (5-yr average) | 18-year average (2005 – 2022) = 0.79 |
| | 3 yr olds = 0.50 | -- | Small sample sizes for each year and limited consecutive years limit the ability to calculate meaningful averages or adequate time-series weighted averages. |
| Post-calving survival | 2022 = 0.93 | 0.88 (long-term average) | Includes ≥ 3 year old adult cows |
| Late June calf:cow ratio | 2022 = 0.68 | 0.58 (long-term average) | Includes ≥ 3 year old adult cows |
| March calf:cow ratio | 2022 = no data | -- | 17-year average = 0.35. Survey in March 2017 = 0.35 |
| Bull Ratio | 2022 = no data | -- | Survey rarely completed. |
| Peak of calving | 2022 = June 4 | June 2 | Peak of calving in 2022 was June 4, slightly later than average. |

# Indicator Table

## Annual Summary Report 2021 – 2022

| | | | |
|---|---|---|---|
| **Body condition** | | | |
| Average backfat | F: 0.3 cm; M: 0 cm | F: 2.5 cm; M: 1.9 cm | Caribou were not available for fall 2021 harvest, majority of samples collected November 2021 thru March 2022 when caribou are typically thin. Very small sample size |
| Hunter assessment | F: 2.0 M: 2.0 | F: 2.6 M: 2.7 | Caribou were not available for fall 2021 harvest, majority of samples collected November 2021 thru March 2022 when caribou are typically thin. Very small sample size |
| Overall condition of caribou | 2021-22 = generally good | Good | Caribou Body Condition generally remained good although sample collection was minimal 2021 – 2022. |
| **Habitat and other considerations** | | | |
| Snow conditions winter (2021-22) | <u>Snow Depth</u><br>Eagle = 97.7 cm<br>Ogilvie = 91.7 cm<br>Old Crow = 74.0 cm<br>North Slope = 25.7<br>Richardson = no data<br><br><u>Snow Density</u><br>Eagle = 0.22 g/cm$^3$<br>Ogilvie = 0.22 g/cm$^3$<br>Old Crow = 0.23 g/cm$^3$<br>Richardson = no data<br>North Slope = no data | <u>5 yr Av. Depth</u><br>80.5 cm<br>70.8 cm<br>69.2 cm<br>25.7 cm<br>no data<br><br><u>Density</u><br>0..21 g/cm$^3$<br>0.21 g/cm$^3$<br>0.18 g/cm$^3$<br>no data<br>no data | Eagle and Ogilvie Regions were well above the long term and the 5 year averages; Old Crow Region was slightly above the long term average and the 5 year averages. Snow density in Eagle, Ogilvie and Old Crow regions were near the 5 year average but above the long term average.<br><br>Eagle and Old Crow Regions appear to have an increasing trend in snowpack. |
| Wildland fires | 2022 = data not yet available<br><br>2021 = 590.6 km$^2$ | 5 year average 1666.6 km$^2$ | No significant burns in 2021. Although not formally reported on in this report, several moderate sized fires occurred in winter range within the Yukon and to a lesser degree, the NWT and Alaska during 2022. |
| Linear disturbance and human development | 2021-22 = No major increases | N/A | Oil and gas leases in the Arctic National Wildlife Refuge were suspended until review of the Coastal Plain Leasing Environmental Impact Statement is completed. Winter road to Old Crow was in use late winter 2022, and is expected to be operational in late winter 2023 if sufficient snowfall occurs. |

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# INTRODUCTION

## *Porcupine Caribou Annual Summary Report*

This report was prepared for the Porcupine Caribou Management Board (PCMB) to provide information to make an assessment on the status of the herd as part of the *Harvest Management Plan for the Porcupine Caribou Herd in Canada* (HMP). Information within this report was guided by the topics listed in the HMP. As noted in relevant sections, some information is not available or analyzed in all years. Under the HMP, Parties are requested to comment on this report and provide additional information to the PCMB at the Annual Harvest Meeting. Information for this summary report was provided by members of the Porcupine Caribou Technical Committee (PCTC) to inform that process.

## *Herd background*

The Porcupine Caribou Herd's (PCH) core home range is approximately 201,190 $km^2$ and extends into Alaska, Yukon, and the Northwest Territories. Within this range, there are currently 12 different areas where different agencies have jurisdiction over land and/or wildlife management. Management of the herd must take into consideration:

- 2 federal governments
- 3 state or territorial governments
- 8 Indigenous land claim agreements
- 5 national parks or preserves
- 1 territorial park
- 2 special management areas
- 2 specific ordinances
    - Dempster Highway Area Development Ordinance, and
    - a federal Order-in-Council Withdrawal (Yukon North Slope)

The PCH was the first international caribou herd with its own formal co-management agreements and boards. There are five main management agencies that work on the herd: Canadian Wildlife Service, U.S. Fish and Wildlife Service, Government of Yukon, Government of the Northwest Territories, and the Alaska Department of Fish and Game. Management and research is coordinated by the PCTC, which consists of biologists from numerous agencies, co-management boards as well as occasional faculty members or students from various universities.

All Indigenous organizations within the Canadian range of the herd have land claim agreements. These agreements solidify the Indigenous right to hunt for subsistence and ensure local participation in wildlife management through co-management boards. The agreements also created lands that are privately owned and managed by the First Nations or Inuvialuit. Self-governing agreements in Yukon also give the First Nation governments the ability to regulate their citizens and their land.

## *Management direction and goals*

To help coordinate management, two Porcupine Caribou agreements were set up, each creating a co-management board. In 1985, three governments and three Indigenous organizations signed the *Porcupine Caribou Management Agreement* (PCMA), creating the within-Canada Porcupine Caribou Management Board. In 1987, Canada and the United States signed the *International Porcupine Caribou Agreement* between the Government of Canada and the United States of America on the Conservation of the Porcupine Caribou Herd, creating the International Porcupine Caribou Board (IPCB).

The PCTC drafts work plans to coordinate research and monitoring activities, optimize funds and staff time, and provide technical information to co-management boards and agencies. Harvest management is co-operative among the Parties to the PCMA and is guided by the HMP and the accompanying Implementation Plan.

Goals that pertain to the PCTC taken from the *Porcupine Caribou Management Agreement* (1985) and reflected in subsequent documents prepared by the PCMB include:

> B. The Board shall review relevant scientific information [and traditional knowledge] on the conservation management of the herd and its habitat, and make recommendations to the Minister on policy, legislation and regulations regarding:
> - Management strategies
> - Further research where there appears to be a need, including recommendations on methods of data collection and presentation;
> - A herd management plan; and
> - A predator management plan.
>
> D. The Board may identify sensitive [caribou] habitat areas requiring special protection and recommend measures to protect such areas.

The *Plan for the International Conservation of the Porcupine Caribou Herd* outline a number of objectives pertinent to the PCTC.

- To conserve the Porcupine caribou herd and its habitat through international cooperation and coordination so that the risk of irreversible damage or long-term adverse effects as a result of use of caribou or their habitat is minimized.
- To ensure opportunities for customary and traditional uses of the Porcupine caribou herd.
- To enable users of Porcupine caribou to participate in the international coordination of the conservation of the Porcupine caribou herd and its habitat.
- To encourage cooperation and communication among governments, users of Porcupine caribou, and others to achieve the objectives of the Agreement.

# POPULATION

## *Population size – photocensus*

**Objective**
To estimate the size of the herd every 2 to 3 years.

**Methods**
A technique called an Aerial Photo Direct Count Extrapolation has been used to estimate the herd size since 1972 (Davis 1979, Valkenburg et al. 1985, Rivest et al. 1998). Once the insects come out during the warm weather in late June or early July, the caribou gather into very large, tight groups sometimes consisting of tens of thousands of caribou. These large groups are photographed and caribou in the photos are counted. Any caribou that are found outside of the large groups are added and the estimate is rounded to the nearest thousand caribou. Radio-collared caribou are used to help locate the caribou aggregations and correct the estimate for any missing caribou. This technique is considered an accurate and reliable method to count large barren-ground caribou herds and can also provide a measure of uncertainty (confidence interval) around the population estimate. A confidence interval is a range of values that describes the uncertainty surrounding the population estimate. For example, the photocensus in 2013 found that the population estimate of the PCH was 197,228 (95% CI = 168,667 – 225,789). That means

that we are 95% confident that the true population estimate is within the upper (225,789) and lower number (168,667).

**Results**

The herd was monitored using GPS collar locations with limited visual observations by Alaskan pilots throughout late June to see if the herd would form large aggregations that would allow for a photocensus. Thick smoke from wildfires in Alaska and a lack of sufficient aggregation amongst the herd prevented a photocensus in summer 2022. By early July the PCH were on the move, with the majority of the herd moving from the Alaska coastal plain to the Richardson Mountains (Figure 1).

The last photocensus (2017) resulted in a minimum count of 198,104 caribou and a population estimate of 218,457 (95% CI = 202,106 – 234,808) caribou (Caikoski 2017). The annual growth rate from 2010 to 2017 was estimated at λ = 1.037 (SE = 0.0082; Caikoski 2017).

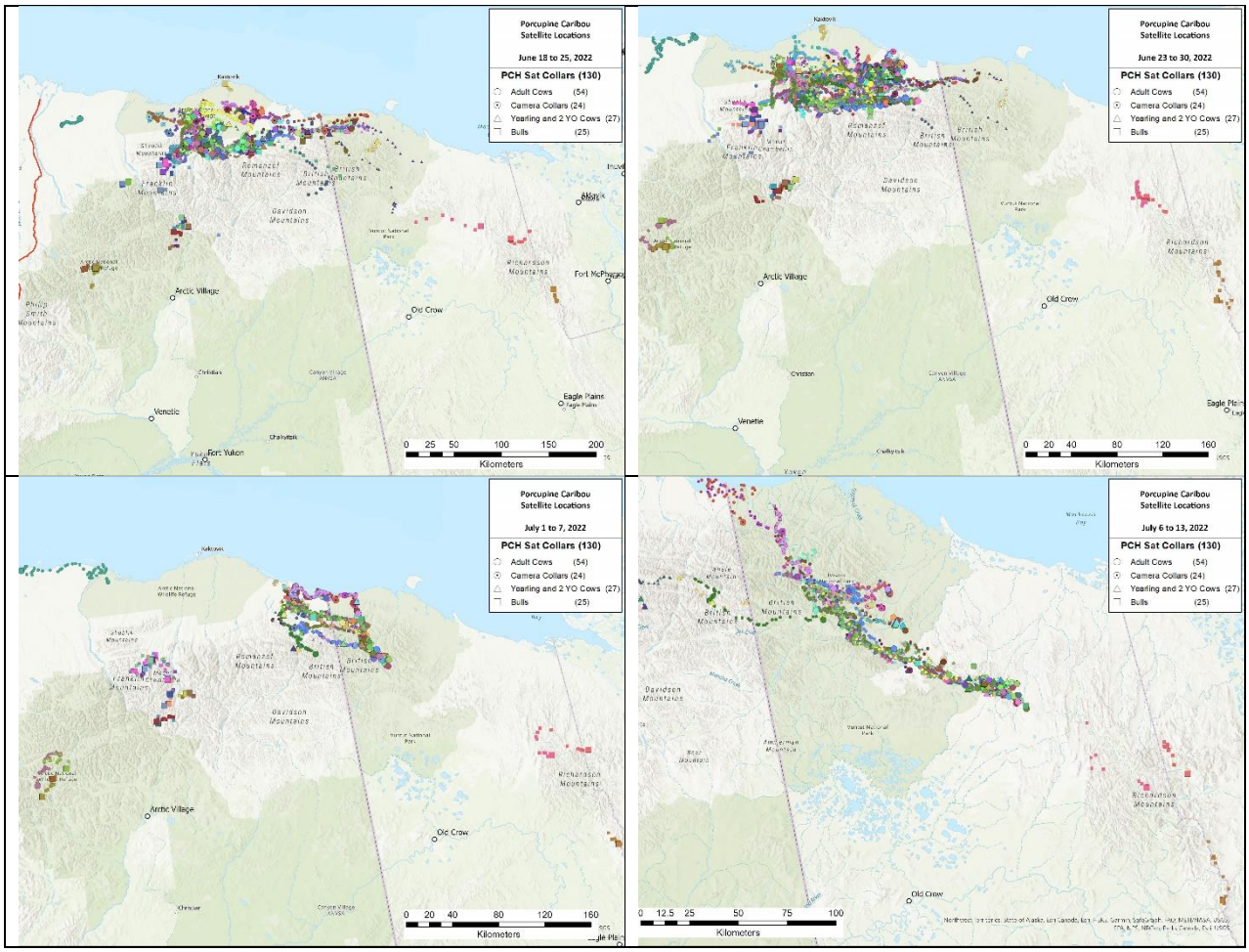


Figure 1. Maps of the Porcupine caribou herd movements from June18th to July 13th, 2022.

**Discussion**

The most recent photocensus in 2017 indicated that the Porcupine Caribou herd was at its highest number since surveys began in the 1970's (Figure 2). Analysis of how fast the herd is growing shows that the current growth rate (λ = 1.037: Caikoski 2017) is almost identical to the growth rate during the last growth phase of the herd from 1972 to 1989. If the growth rate (λ or

lambda) is larger than 1, then population is considered to be increasing. A population with a λ <1 may indicate a decreasing population. We will next attempt a photocensus the summer of 2023.

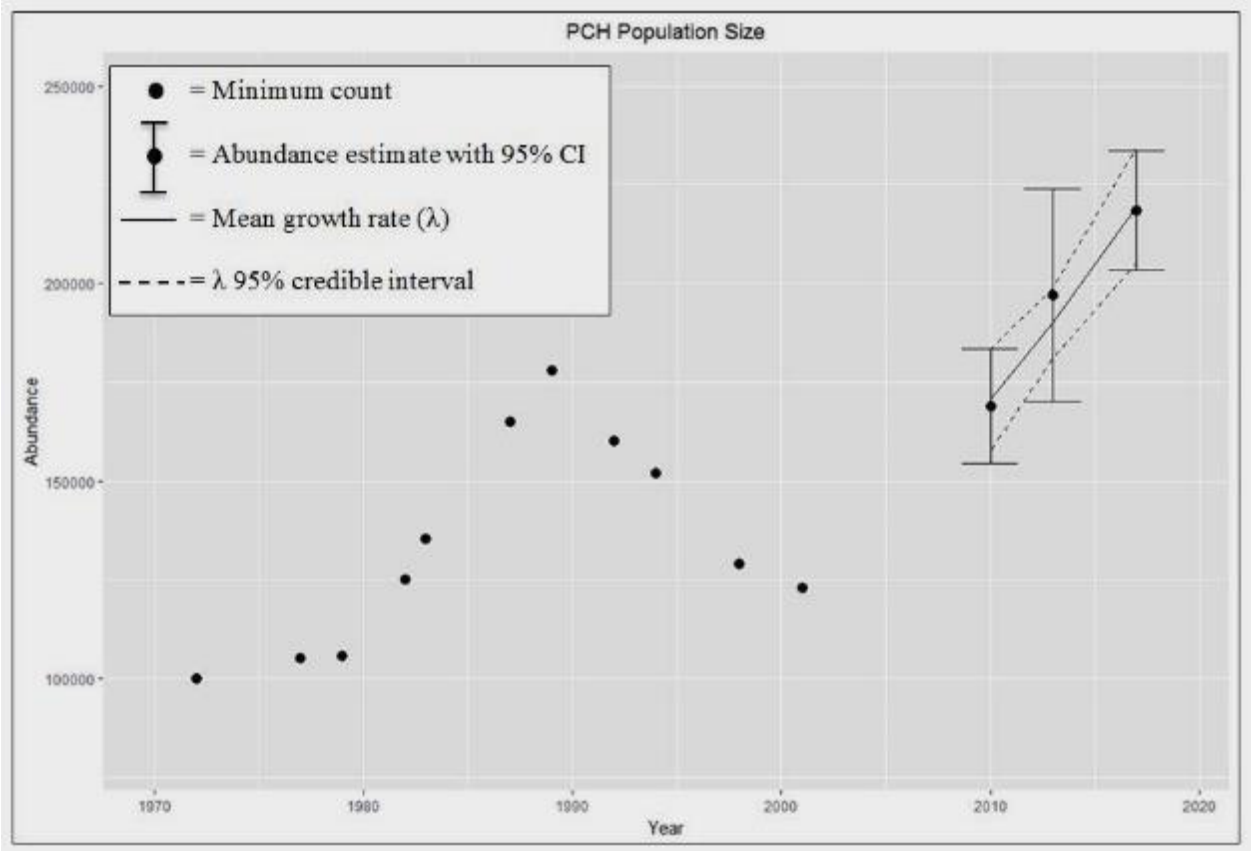


Figure 2. Population size of the PCH from 1972 to 2017. Data from 1972 to 2001 are photocensus minimum counts. Estimated abundance and associated 95% confidence intervals in 2010, 2013 and 2017 were derived from photocensus minimum counts and modeling to account for caribou not photographed (Rivest et al. 1998).

## *Population size – computer modeling*

**Objective**

To estimate the total herd size and the measure of uncertainty surrounding that estimate using a computer population model. The model is also useful for examining the influence of some of the different herd indicators (e.g., adult female survival or the number of calves) and the effect when you combine each of these indicators within a year. The model includes an estimate of how certain we are. Our uncertainty in our estimate will generally increase the further we are from a successful photocensus (e.g., 2017).

**Methods**

Data in the model includes previous photocensus estimates, the adult sex ratio, harvest numbers, annual estimates of cow and bull survival, and calf recruitment. With each of these values we also included a measure of how certain we are about each as we know values are not exact. This allows us to have a measure of uncertainty in our final herd size estimate(s) (i.e., confidence interval). We calculated the uncertainty in the final model projections by running the model many times, each time using a different combination of the model inputs identified above. We do this because we never know the precise number of calves or exactly how many cows die in a year, but we know approximately, what these numbers are from our monitoring. The uncertainty

provided around projections is useful, as it tells us how confident we are in the size and trend of the population estimate and the probability that we are in a specific management zone identified by the HMP.

To develop our current estimates, we used information from the indicators collected as described throughout this report, including data since the last successful photocensus (i.e., 2017). We modelled survival of different age and sex classes of the herd using available information where possible (e.g., yearling cows, adult males and females). When information was not available (yearling, 2-3 year old bulls), we estimated these rates based on the most similar age and sex cohorts and the expected relative survival of each age and sex class (e.g., yearling bull survival is lower than yearling cows but higher than adult bulls). Where variables were only partially available (e.g., total harvest each year) we used the best available information and approximated the actual harvest for the year to ensure each Party had at least some harvest accounted for. For calf recruitment, we did not have data available other than pregnancy rates on the calving grounds (i.e., parturition) and late June survival, however field staff do keep qualitative track of the number of calves observed during capture events. We used this information together with historic recruitment data and ran five different recruitment scenarios in our population projections to get a general sense of the population and trend. We chose to use a range of values (0.4 – 0.58) to represent calf mortality rate (i.e., recruitment) as it was the variable that we lack sufficient data for.

**Results**

We produced five different trend lines with confidence intervals surrounding each line for 2017-2021 (Figure 3). Some data (e.g., 2021-22 survival and harvest data) were not available in time to allow us to update the model in November 2022. All scenarios and their associated confidence intervals fell well within the threshold for the Green Zone as identified by the HMP (i.e., >115,000 caribou). Most scenarios indicate that the herd has remained either stable or possibly increased, although a proportion of runs where calf survival was extremely poor shows the herd may have declined slightly.

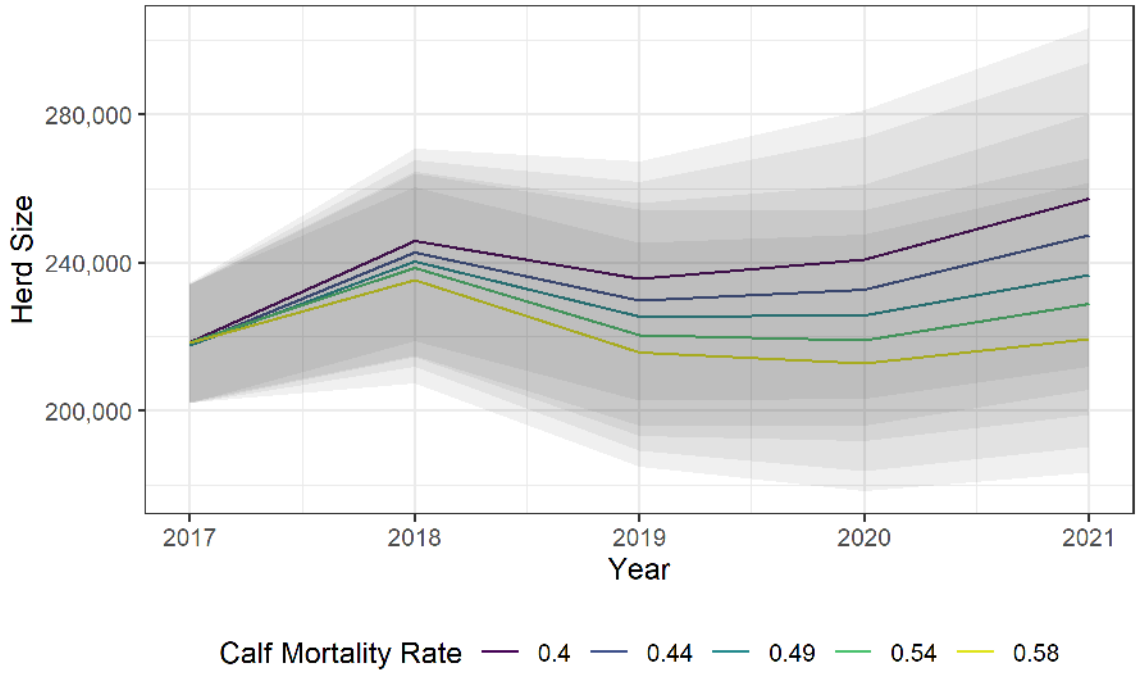


Figure 3. Projected population size of the Porcupine caribou herd under five different calf mortality scenarios (e.g., 0.4 represents 40% of calves dying or 60% surviving from birth to 1 year of age;

note this is the highest increase of the five scenarios presented while 0.58 or 58% mortality would equate to the lowest). The grey represents the uncertainty around the five different scenarios with darker shades of grey representing greater overlap and a more likely outcome.

**Discussion**
Given the difficulty with obtaining regular photocensus estimates of the herd's size, primarily due to poor weather or a lack of animal aggregation, this tool was designed to provide the Board and Parties with information on the herd's population size and trend. The population model incorporates uncertainty, which is critical information when managers are developing management actions.

Working from the 2017 population estimate of 218,457 (95% CI = 202,106 – 234,808) the models project that the herd is likely stable or possibly increasing, with a smaller chance of a decline. Based on these results it is extremely likely that the herd remains in the Green Zone.

To generate the models several assumptions were required. Harvest data was at least partially available for each year; however, precise estimates of total harvest and the sex ratio of harvest remain unknown. Having more precise harvest estimates wouldn't likely change the population estimate, but improved harvest data would result in a better estimate with less uncertainty. The addition of annual survival estimates for adult cows and bulls, and for yearling cows, completed by the PCTC, is a significant improvement on historic survival estimates that were limited based on sample size, duration of each study, and the required analytical framework used. The largest gaps in data at this time appear to be calf recruitment, the sex ratio of the herd, and survival of younger bull classes.

## *Survival Estimates*

**This section has not been updated with 2022 information and contains modelling results from 2012-2020.**

**Objective**
To obtain an annual estimate of survival for adult female, adult male, and yearling female Porcupine caribou.

**Methods**
Annual survival was estimated from GPS collared caribou using known-fate models (logistic regression; Caikoski 2021). Annual survival for adult females (years 2012–2020), adult males (years 2015–2020), and yearling females (years 2017–2020) were conducted separately and were reported with 95% confidence intervals. A year was defined as June 1 through May 31, which represents the time period from birth to consecutive birth dates.

**Results**
The sampling period was from June 1, 2020 through May 31, 2021. For this time period, adult cow survival was almost 6 % above average, while bull and yearling survival were slightly below average. (Table 1; Figure 4).

Overall patterns of annual survival show a decline in 2018 across all caribou sampled (adult females, adult males and yearling females; Table 1). Adult female survival showed a 10% decrease in 2015 since estimates are available for a longer time period compared to adult males and yearling females (Table 1; Figure 4). However, confidence intervals around these annual survival estimates overlap with each other so the difference between these years may not be statistically significant.

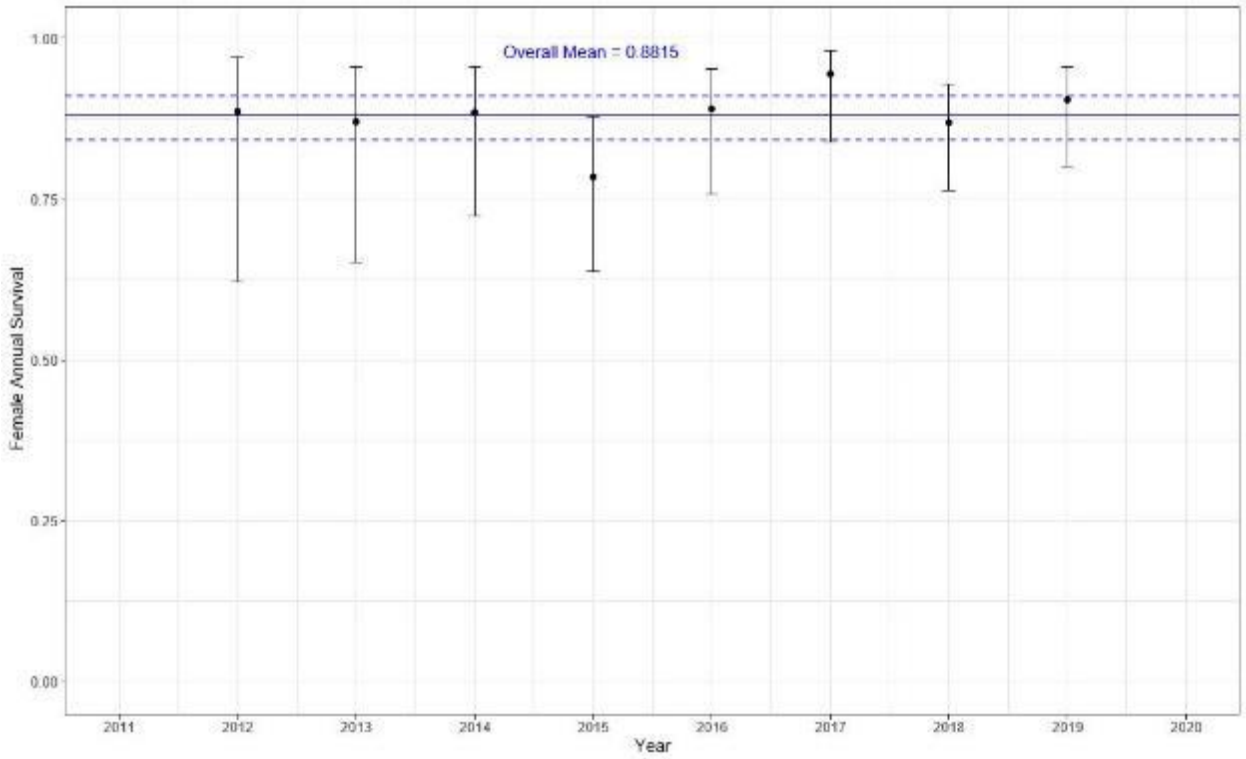

Figure 4. Year specific survival estimates for GPS collared adult female Porcupine caribou (black circles) compared to the grand mean (solid horizontal bar), 2012–2019 *(*Caikoski 2021). All confidence intervals are 95%. A year is defined as the period from caribou birth (June 1) to one year later (May 31). For example, year 2012 occurs from June 1, 2012–May 31, 2013.

**Discussion**

Prior to the deployment of significant numbers of GPS collars on the herd, previous studies estimated survival rates of adult females using periodic radiotracking flights of VHF collars throughout the year and staggered entry product-limit methods (Kaplan and Meier 1958, Pollock et al. 1989). Fancy et al. (1994) reported an average annual survival rate of 84% during 1982–1991, Arthur et al. (2003) reported an average annual survival rate of 81% during 1997–2001, and Wertz et al. (2007b) reported an average annual survival rate of 82% during 2003–2006. Our estimate of 88% for the average annual survival of adult females during 2012–2019, is higher than those previous studies and is consistent with our observed population growth during the same time period.

Population models based on PCH demographics suggest that relatively small but persistent reductions in adult female survival result in a population decline (Walsh et al. 1995, Griffith et al. 2002, Arthur et al. 2003). However, a suite of varying demographic responses can confound the effect of adult survival on abundance, either masking the effects of high adult survival or mitigating against poor adult survival. Furthermore, precision associated with estimates of survival to date are insufficient to detect statistical differences when small changes in vital rates occur. However, empirical evidence from vital rates reported here and three other studies compared to population abundance over the same time periods suggests a minimum long term average of 84% in annual survival for adult females may be necessary to prevent population decline.

Future estimates of yearling female survival will likely improve our understanding of recruitment to the 2-year-old age class, particularly during stable, growing, or declining phases in herd abundance.

Table 1. Estimates of annual survival for Porcupine Caribou Herd adult females (2012–2020), adult males (2015–2020), and yearling females (2017–2020; Caikoski 2020b). A year is defined as June 1-May 31 (e.g. year 2012 = June 1 2012–May 31 2013).

| Age/Sex | Year | Annual Survival | 95% LCL | 95% UCL |
|---|---|---|---|---|
| Adult Females | 2012 | 0.836 | 0.575 | 0.944 |
| | 2013 | 0.871 | 0.653 | 0.957 |
| | 2014 | 0.885 | 0.724 | 0.955 |
| | 2015 | 0.767 | 0.619 | 0.863 |
| | 2016 | 0.889 | 0.755 | 0.952 |
| | 2017 | 0.942 | 0.830 | 0.981 |
| | 2018 | 0.870 | 0.765 | 0.930 |
| | 2019 | 0.921 | 0.820 | 0.966 |
| | 2020 | 0.947 | 0.846 | 0.983 |
| | Grand Mean | 0.888 | 0.853 | 0.915 |
| Adult Males | 2015 | 0.778 | 0.463 | 0.923 |
| | 2016 | 0.693 | 0.444 | 0.848 |
| | 2017 | 0.716 | 0.451 | 0.871 |
| | 2018 | 0.587 | 0.198 | 0.843 |
| | 2019 | 0.734 | 0.441 | 0.891 |
| | 2020 | 0.681 | 0.466 | 0.826 |
| | Grand Mean | 0.704 | 0.604 | 0.784 |
| Yearling Females | 2017 | 0.944 | 0.666 | 0.992 |
| | 2018 | 0.808 | 0.519 | 0.934 |
| | 2019 | 0.863 | 0.558 | 0.964 |
| | 2020 | 0.805 | 0.563 | 0.922 |
| | Grand Mean | 0.854 | 0.746 | 0.919 |

## *Calf birth rate and calf survival*

**Objective**
To document the annual calf birth rate and survival rate.

**Methods**
Calving surveys are conducted each year to estimate the number of pregnant cows on the calving grounds (i.e., parturition) and the early survival rate of calves. Radio collared females ≥ 3-years old are located from a fixed-wing aircraft and are classified as barren, pregnant, or already given birth. Female caribou pregnancy is assumed if cows are observed with calves, have hard antlers or distended udders (Whitten 1995). Parturition is described as the percent of cows that had calves. Starting in 2018, we began summarizing parturition rates for 3-year olds, ≥3 year olds, and ≥4 year old cows. .

Female caribou that were determined parturient during the calving survey are re-located after about three weeks to determine whether the calves have survived. The late June calf ratio is based on the proportion of collared females with calves in late June, while calf survival is the proportion of cows that still have their calf divided by the number that were parturient on the calving grounds.

In some years a March composition count is completed to estimate the number of calves per 100 adult cows being recruited into the population. We do not use the same approach as summer calf surveys (i.e., using individual collared cows to estimate our calf:cow ratio), because most calves will have weaned before March. As a result, calves may or may not be located with their mothers during the March survey making a more generalized approach necessary. Instead, we classify caribou as either bull, cows or calves and then calculate the calf:cow ratio.

**Results**

Parturition rate

The 2022 survey to estimate parturition rate and calving locations was conducted from June 1-3rd in Alaska and May 31st to June 1st in the Yukon. Surveys in Alaska were conducted by ADF&G while Yukon Government completed surveys in Yukon (Figure 5; Caikoski 2022).

The parturition rate for adult cows ≥ 4-years of age was 76% (*n*=34) and 70% for adult cows ≥ 3-years of age (*n*=46; Figure 6). Parturition rate for 3-year old cows was 50% (*n*=12). Parturition rates for all three age categories were below the long-term means, but within the range of values observed since 2005.

Post-calving survey

The post calving survey to estimate 3-week calf survival and the calf:cow ratio was conducted June 21 and 22, 2022. Post calving survival estimated from cows observed with calves in early June that were subsequently observed in late June (excludes most perinatal mortality) was 93% for calves of adult cows ≥ 3-years of age (*n*=15). The late June calf:cow ratio was 68 calves per 100 cows ≥ 3-years of age (*n*=44). Despite below average productivity, early calf survival was high and late June calf:cow ratios were above the long-term mean. During the survey, most post-calving caribou occurred on the edge of the foothills and coastal plain between the Okpilak River and the Aichilik River in Alaska (Figure 7).

March composition count

No composition count was conducted in March 2022. The last composition count (2017) reported a calf:cow ratio close to the long term average for the herd (35.8 calves per 100 cows; Figure 6). Late winter composition counts are planned for 2023 – 2025.

**Discussion**

Population dynamics are most affected by survival of adult females over the medium and long term but can withstand fairly large annual fluctuations in calf birth rate or calf survival over the short term. Figure 6 shows large fluctuations in these rates, but if birth rates or calf survival rates are low for several years in a row, population growth is more vulnerable and susceptible to decline.

Since 2017, we have documented declines in birth rate for all age classes and similar declines in late June calf:cow ratio. Although these measures have declined, birth rates (with the exception of ≥ 3-year olds) and late-June survival are similar to long-term averages.

Three-year-old parturition rate is used as a long-term index that may reflect the impact of weather or range conditions on nutritional status. Based on past herd case studies, Boertje et al. (2012) suggest that managers can use this index to predict impending declines in herd numbers. We will

continue to collect this information and compare to the threshold suggested by Boertje et al. (2012).

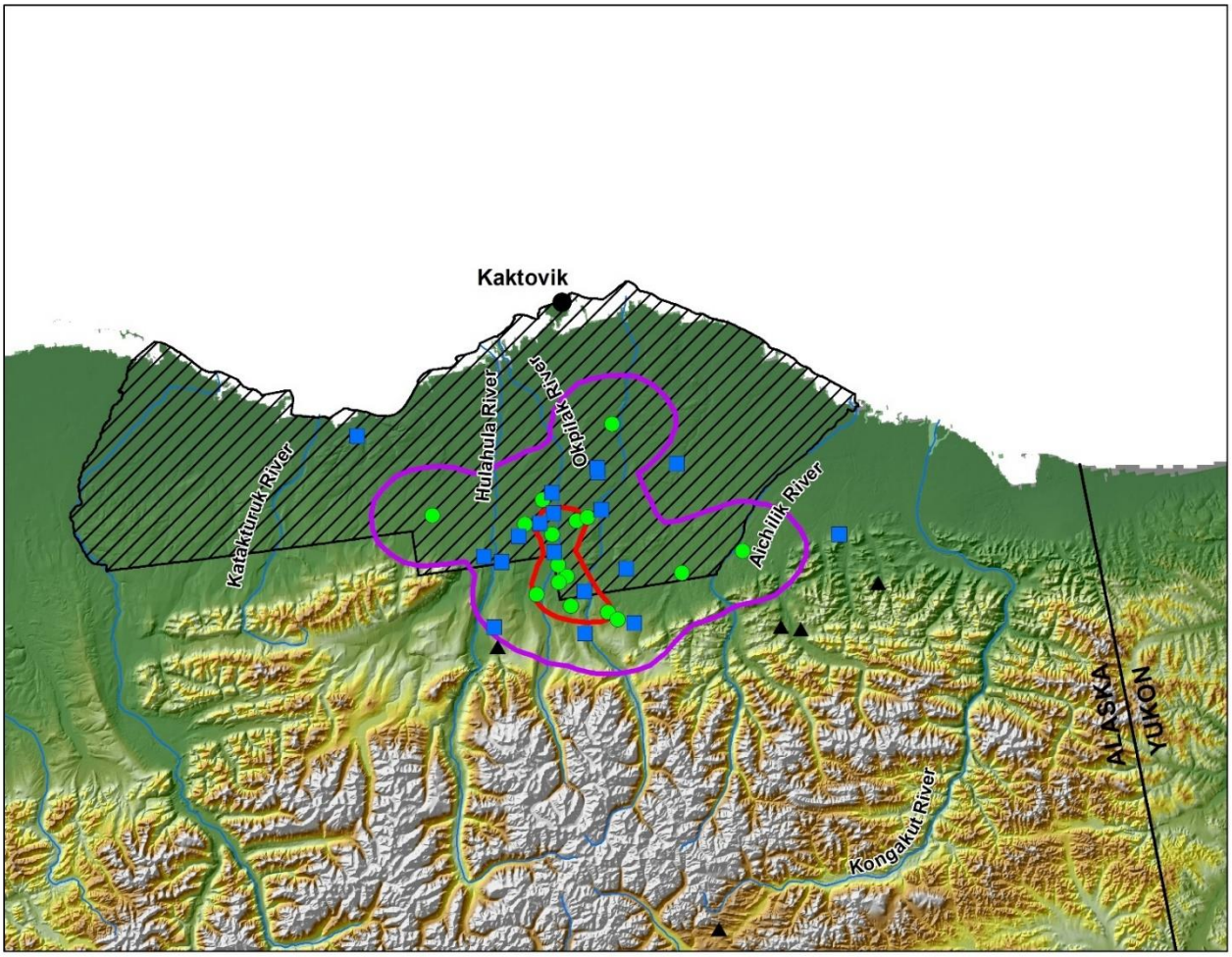


Figure 5. Locations of collared Porcupine caribou cows observed with a newborn calf (green circles), those judged to be parturient but had not yet given birth (blue squares), and those judged to be barren (black triangles), 1 June –3 June 2022. The extent of the calving grounds were estimated by the isopleth encompassing 99% of the fixed kernel utilization distribution of locations of cows observed with a calf (purple polygon). The concentrated calving area is the area with greater than average density of caribou cows with calves (red polygon; Caikoski 2022). Non-parturient cows observed in Yukon are not mapped here.

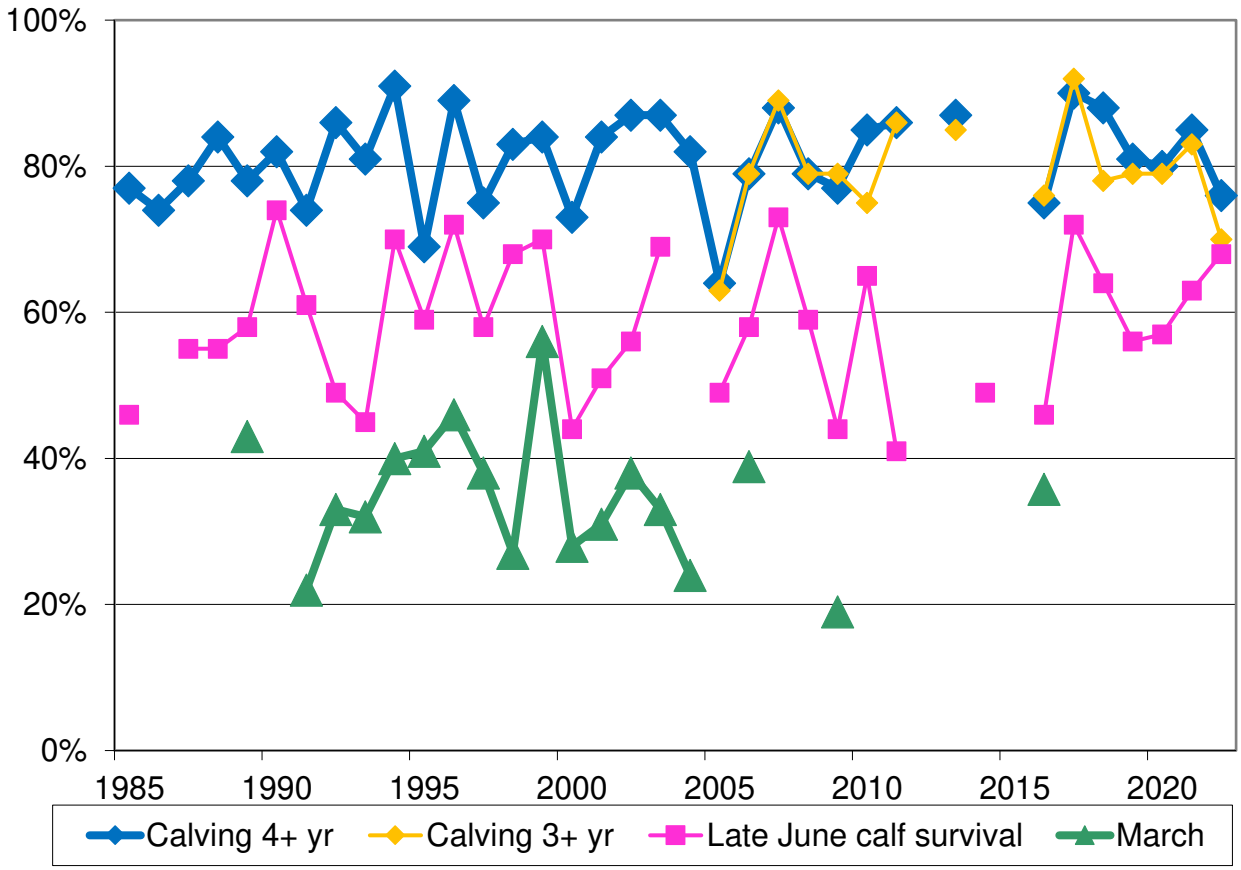


Figure 6. Estimated birth rate, calf survival indices and March composition count for the Porcupine Caribou herd from 1985-2022.

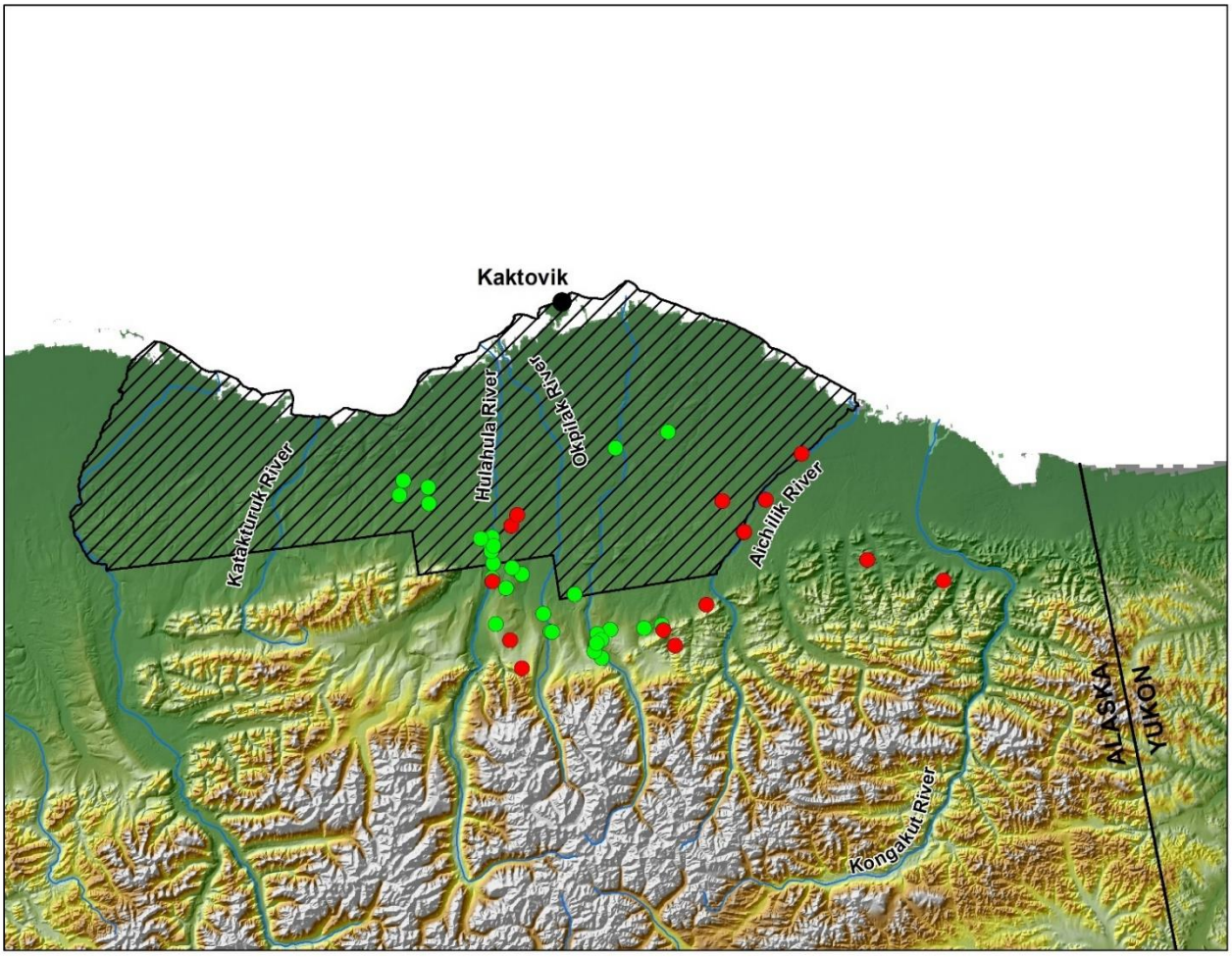

Figure 7. Locations of GPS collared Porcupine caribou cows observed in Alaska with a calf (green circles) and without a calf (red circles) during 21–22 June 2022 (Caikoski 2022). Non-parturient cows observed in Yukon are not included on this map.

## *Peak and Extent of calving grounds*

**Objective**
To estimate the date when greater than half of the collared adult female caribou have given birth each spring and the extent of the calving grounds.

**Methods**
During the calving surveys to document the birth rate (see previous), researchers record the date of their flights and how many of the collared cows have given birth. Only adult female caribou aged 3 years or older are included in this indicator. In some cases, the birth date is estimated based on the estimated age of the calf. The researchers then estimate the date when half of the collared adult female caribou have given birth. Peak of calving was approximated as the date at which greater than half of parturient cows were observed with a calf at heel.

**Results**
Of the cows ≥ 3-years of age that were judged to be parturient, 17 of 35 were observed with a calf at heel by 3 June, indicating peak of calving likely occurred on 4 June, slightly later than the average (June 2; Table 2; Caikoski 2022). Most calving occurred in or adjacent to the foothills between the Aichilik and Hulahula rivers and along the coastal plain in Alaska (Figure 5). Concentrated calving occurred in foothills and on the coastal plain within the Okpilak River

drainage, Alaska. Six cows were observed in Yukon, none of which were judged to be parturient (not depicted in Figure 5).

**Discussion**
Caribou typically give birth *en masse* with many of the cows giving birth within days of each other. This is thought to be a strategy to reduce the risk of predation on any individual calf.

Since 1999, the peak date of calving has varied by a few days each year. In 2022, peak of calving likely occurred on June 4, 2 days later than the average (June 2nd). We will continue to monitor this indicator to see if this is an emerging trend.

Table *2*. Peak dates of calving for the Porcupine Caribou herd.

| Year | Peak of calving | Note |
|---|---|---|
| 1999 | 3-Jun | 1 to 5 June |
| 2000 | 7-Jun | |
| 2001 | 8-Jun | 5 to 10 June |
| 2002 | 5-Jun | |
| 2003 | 1-Jun | |
| 2004 | 3-Jun | 3 or 4 June |
| 2005 | 2-Jun | 1 to 4 June |
| 2006 | 2-Jun | |
| 2007 | 30-May | |
| 2008 | 30-May | 29 or 30 May |
| 2009 | 2-Jun | Before 2 Jun |
| 2010 | 2-Jun | |
| 2011 | 2-Jun | |
| 2012 | No data | |
| 2013 | 4-Jun | 3rd or 4th June |
| 2014 | No data | |
| 2015 | No data | |
| 2016 | 1-Jun | |
| 2017 | 3-Jun | |
| 2018 | 6-Jun | Could be bias late due to poor weather early in surveys |
| 2019 | 4-Jun | |
| 2020 | 1-Jun | |
| 2021 | 30-May | |
| 2022 | 4-Jun | |
| Long-Term Average | 2Jun | |
| 5-Year Average | 2-Jun | |

## *Bull Ratio*

**This section has not been updated with 2022 information and contains discussion of results from 1980 - 2010.**

**Objective**
To document the ratio of bulls to cows in the herd.

**Methods**
We fly by helicopter during mid-October and classify as many as 200 caribou around each radio-collared caribou (bulls, cows, short yearlings). Caribou are classified into cow, calf, or either small, medium, or large bull. Then the number of bulls relative to the number of cows is calculated by dividing the total number of bulls by the total number of cows.

**Results**
Surveys are planned to coincide with years where photocensus surveys are completed, therefore surveys were not completed for 2022. The last survey was attempted by ADF&G in October 2017 but was unsuccessful due to poor weather.

The ratio of bulls to cows was estimated first in 1980 (Porcupine Caribou Management Plan 1989). That study estimated that there were about 60 bulls for every 100 cows which indicated a healthy herd. Bull survival and the bull ratio were not regularly monitored in following years because as long as the pregnancy rate remained high, there was no reason to believe that there are too few bulls to breed the cows. Subsequent surveys occurred in 2009 and 2010. Results from the 2010 survey are the most reliable and indicated a ratio of 57:100. In 2013, due to the poor result achieved in 2012 and the successful completion of a photo count on the herd, a rut survey was planned. Unfortunately leading up to the survey a large proportion of the herd moved to the western edge of the herd's range, eventually mixing with members of the Central Arctic Herd (CAH). Monitoring during the rut showed most caribou remained mixed with the CAH which resulted in the cancellation of the rut count.

**Discussion**
In the Harvest Management Plan for the Porcupine Caribou Herd in Canada (HMP; Porcupine Caribou Management Board 2010), there is a provision for bull only harvest to be implemented for different user groups if the herd drops below a certain population size. In addition, the PCMB continues to promote harvesting of bulls, regardless of population size. Population modeling has shown that if the proportion of bulls in the harvest rose from 30% to 80%, we could see a sex ratio in the herd of about 40 bulls per 100 cows. We don't really know what might happen to the herd sex ratio when we take more bulls during harvesting activities; as a result, we completed composition counts to get an updated bull ratio in 2009 and 2010 prior to the projected increase in harvested bulls resulting from the HMP.

Due to the logistical difficulty and high expense of acquiring this data, the PCTC rarely attempts this survey. Accurate harvest data from all Parties, including the sex ratio of the harvest, is important to assess the effect of a bull-dominated harvest on the herd sex ratio.

# CARIBOU BODY CONDITION

## *Hunter assessments and condition indicators*

**Objective**
This long term project uses specific samples from hunter killed caribou to track the fatness of Porcupine caribou.

**Methods**
Equations to estimate the body weight, body fat and body protein for adult cow Porcupine caribou were initiated in 1987 (Allaye-Chan 1991). Government of Yukon (YG) completed collections from 1989 to 1991 to test these equations and in 1991, started regular monitoring with hunters from

Old Crow (Porcupine River in September), Fort McPherson, Dawson and Mayo (Yukon portion of the Dempster Highway in November and March).

In 2001, the PCTC formally modified the program so hunters could submit samples from any Porcupine Caribou harvested. This program is also called the Caribou Sampling Initiative (CSI) in the HMP and is similar to the Circum-Arctic Rangifer Monitoring and Assessment Network Level 1 monitoring (Gunn and Nixon 2007). Hunters record a number of variables and rate the condition of their caribou.

**Results**

During the fall of 2021-22, caribou were generally not available to hunters. Small groups of caribou were available on the Dempster Highway and the coastal plain in early August, but by mid to late August the majority had moved into Alaska. Caribou were fairly concentrated west of Arctic Village until mid-October when they started spreading out over the Alaskan portion of their range, with small groups returning to the Yukon by early November. Caribou became available to hunters near Old Crow for a period of time before moving further from the community. Groups of PCH ended up in the Whitefish Lakes area where they were available to hunters from Old Crow and Fort McPherson in late winter 2022. Yukon hunters collected all PCH Body Condition samples from the end of October 2021 thru March 2022.

Samples were collected in late fall and winter from 19 PCH in 2021-22, although only 11 of these were assessed by hunters for body condition and back fat depth. Samples were all completed post-rut which likely explains the lower scores for both measures than average. Although no samples were obtained from the core of wintering caribou in Alaska, during late winter capture efforts caribou there appeared to have slightly higher body condition scores than those in the Yukon.

**Discussion**

Average body condition data seems to be more variable after 2001 when hunters began rating their harvested caribou compared to when they were working with biologists on the collection (Figure 8 and Figure 9). This could also be a seasonal effect; caribou collections in the early 1990's were completed three times during the year (Sept, Nov and March) whereas the current system allows hunters to submit samples all winter long. Bulls harvested in September tend to have the highest body condition and back fat values, while bulls and cows harvested in October and November tend to be significantly lower – as observed during this sampling period.

It is worth noting that hunters can be very selective when harvesting. This indicator gives an index of harvested caribou, not an index of the entire herd. Also, data are pooled over each winter but sample sizes remain small.

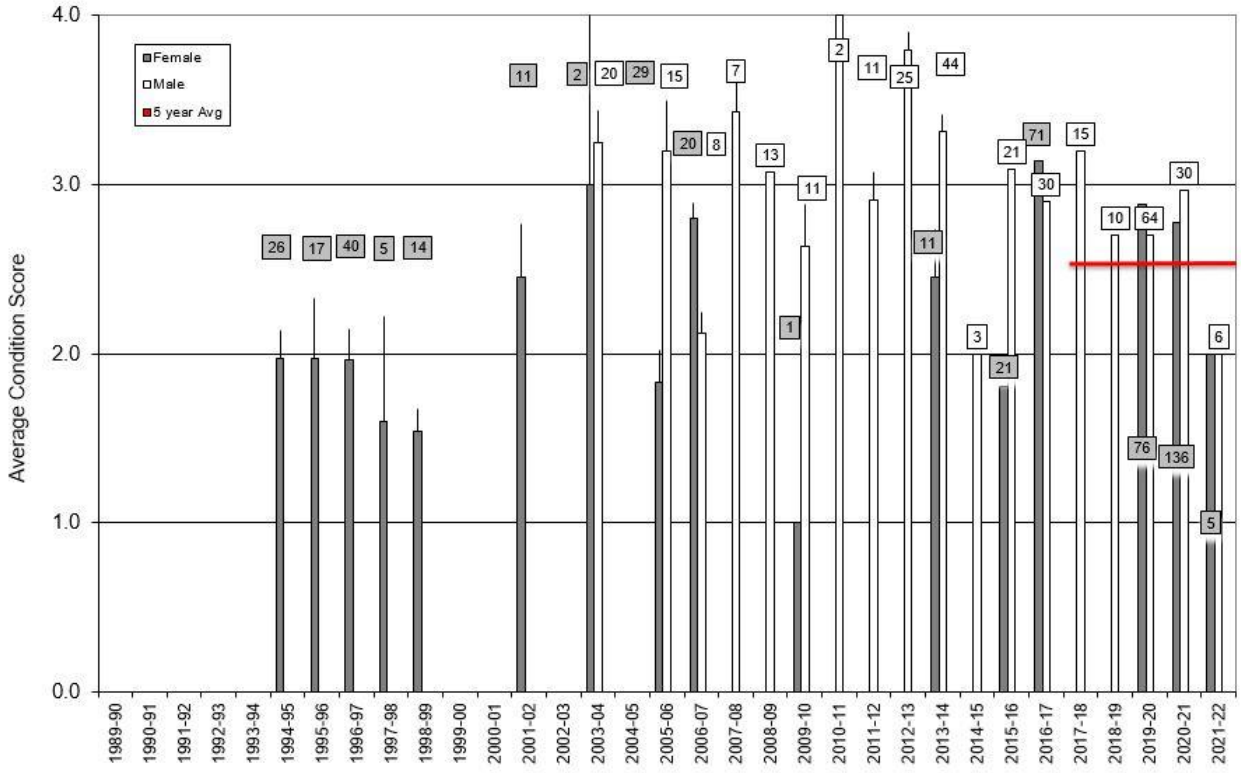


Figure 8. Average condition of harvested Porcupine caribou recorded by hunters. 1=poor 2=fair 3=good 4=very good. Error bars are standard errors. Labels indicate # of caribou sampled.

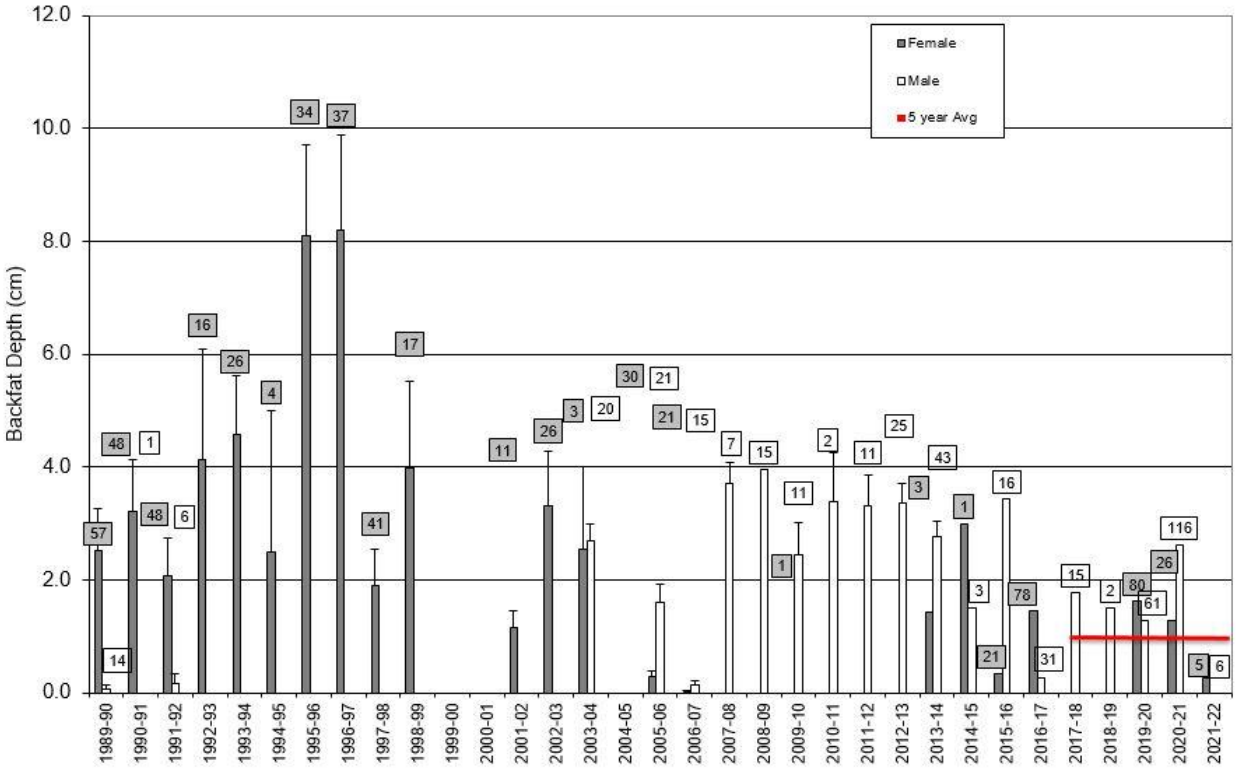


Figure 9. Average depth of backfat (cm) recorded in Body Condition Monitoring. Error bars are standard errors. Labels indicate # of caribou sampled.

# HABITAT

## *Wildland fires*

**2022 season fire map data is not yet publicly available from Yukon or NWT. This section of the report contains information current to 2021 for Yukon, Alaska and NWT.**

**Objective**
To monitor the amount of Porcupine Caribou range burned as an index of range condition.

**Methods**
Historical fire perimeter data was downloaded from the respective agencies websites. Some judgments were made to delete what we thought were duplicate fires and merge incompletely mapped fires along the borders between jurisdictions. Fire polygons were clipped to the extent of historic PCH range and total area burned was summed for each year. The Alaskan fire perimeter data starts in 1945, Yukon in 1945 and NWT in 1965, therefore only fire information between1960-2020 was summarized in this report.

**Results**
As of the 2021 season, the total area burned by fires since 1960 is 47,368.9 $km^2$ or roughly 18% of the Porcupine Caribou herd's total annual range (Figure 10. **Burn perimeter within the range of the Porcupine Caribou Herd in Yukon, NWT and Alaska from 1960 to 2021.**. Yukon fires in 2021 burned a total of about 591 $km^2$, well below the 5-year average of 1667 $km^2$. In 2021, there were seven fires in the Alaskan portion of the PCH range, six in the Yukon and seven in the NWT (Figure 11). Only one fire in 2021 was considered large (i.e., >10,000 hectares), burning approximately 37,000 hectares southeast of Old Crow, Yukon.

**Discussion**
Fire perimeters are mapped by the fire management sections of the three jurisdictions. Although there are many similarities in methods, there are five cautionary notes when considering the data presented here. Firstly, the technology for remotely detecting wildland fires improved only in the 1960's and any data prior to that should be viewed with caution. Secondly, past fires are continually being digitized from satellite or other remote sensing methods so the dataset will change as new data on old fires is added. Thirdly, maps show perimeters of fires only and do not reflect any unburned patches or varying fire severity within burned area. Fourthly, some fires are too small to map and are not included in the map files. And, lastly, many fires may occur in areas previously burned, thus over-representing the amount of potential lichen loss using this approach.

There is much variability in how fires affect caribou; however, research completed on the Beverly Caribou Herd found that forests burned by wildfire produced enough lichen forage as early as 40 or 50 years after the fire. These areas once again become important to caribou (Thomas and Kiliaan 1998). Caribou also tended to avoid burns larger than 10,000 hectares (100 $km^2$). The rate of re-growth of caribou forage can be quite variable and caribou use of burns is generally unknown, therefore wildland fire information presented here should be considered as an index of changes to winter habitat.

Note that we are currently analyzing lichen cover data for inclusion within the annual status report. Although not formally reported on in this report, several moderate sized fires occurred in winter range within the Yukon and to a lesser degree, the NWT and Alaska during 2022.

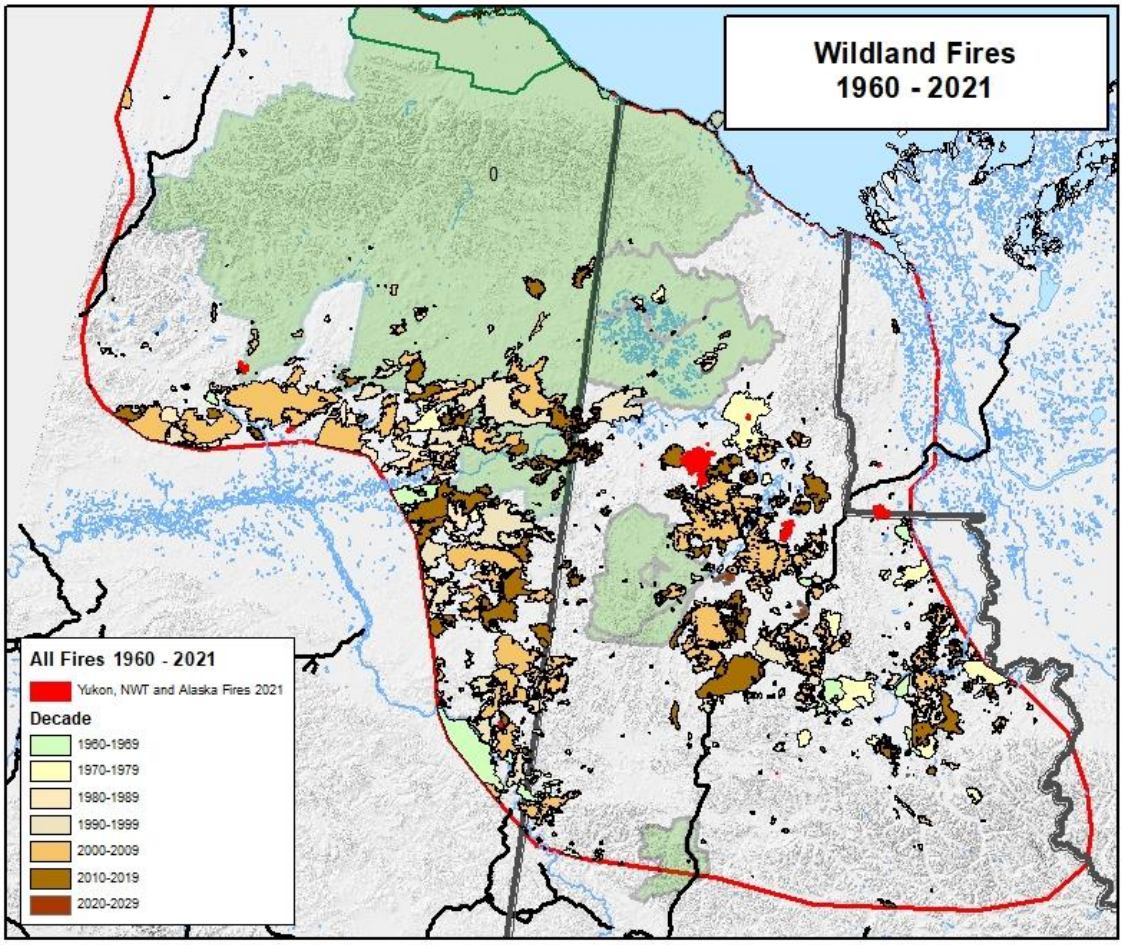


Figure 10. Burn perimeter within the range of the Porcupine Caribou Herd in Yukon, NWT and Alaska from 1960 to 2021.

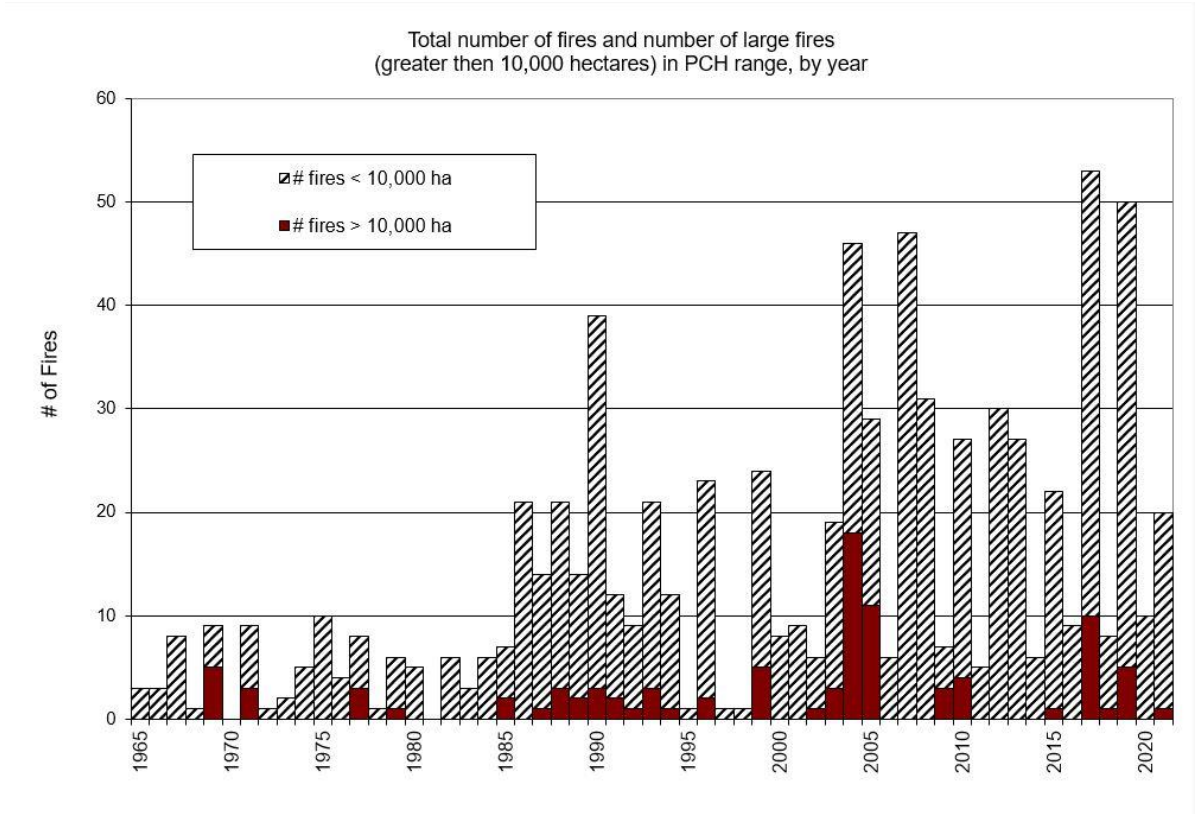


Figure 11. Total number of fires and number of large fires to 2021 within the range of the Porcupine Caribou Herd in Yukon, NWT and Alaska.

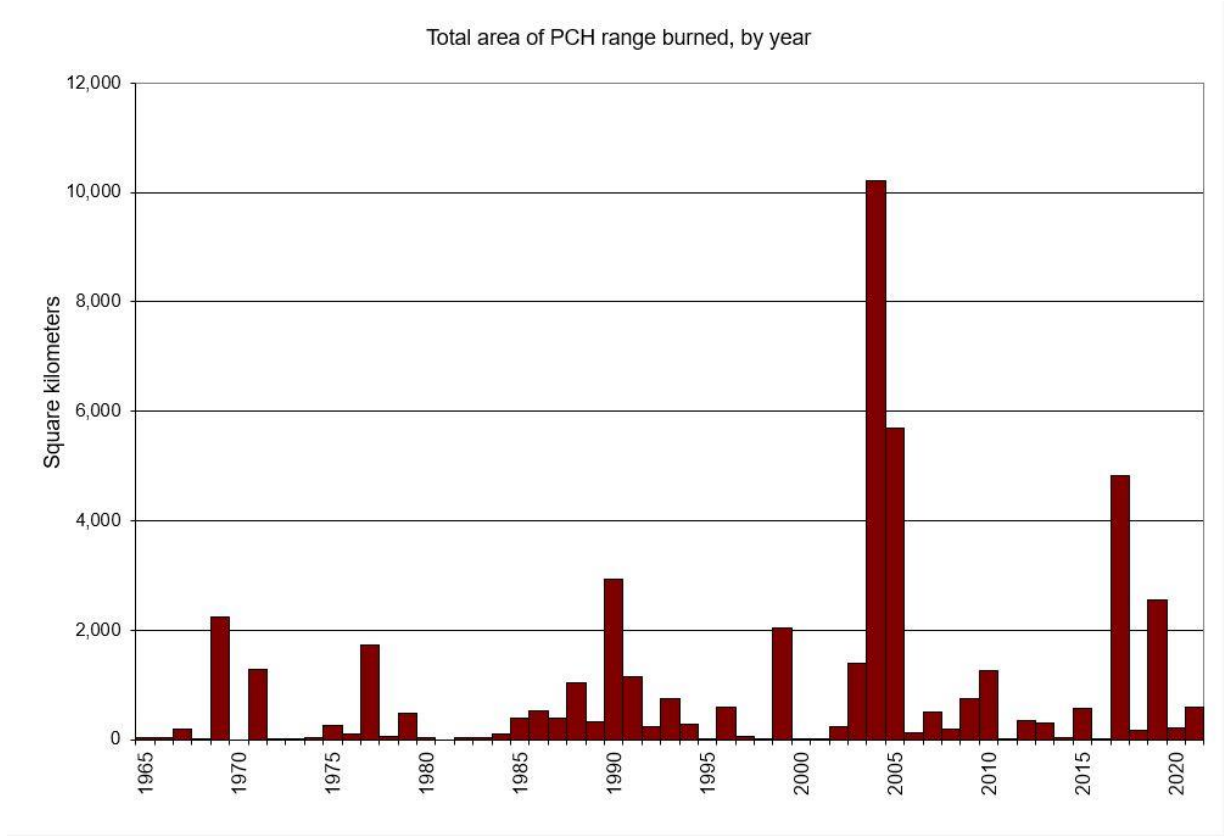


Figure 12. Total area burned by fire, by year to 2021 within the range of the Porcupine Caribou Herd in Yukon, NWT and Alaska.

## *Linear disturbance and human development footprint*

**Objective**
To monitor the amount of linear disturbance and development footprint present on the herd's range.

**Methods**
Data is acquired from a number of sources in NWT, Yukon, and Alaska. Much of the historical data was acquired during a cumulative effects assessment completed for the PCMB in 2008-2012. Newer data was acquired for specific activities known to have been carried out within the range of the herd. Data quality varies for historical data but is thought to be more accurate for recent disturbances. Smaller developments (e.g., individual gravel quarries) may not be accounted for. In the case of historical disturbances (e.g., seismic lines cut in the 1960's), it is unknown whether features have adequately recovered or not to be removed from datasets, and in most cases a wide range of vegetation recovery can be expected even on the same feature.

Data is mapped at a range scale and areas with significant new development are provided with a map of the specific area that has been disturbed. Where appropriate the total linear footprint has been summarized for different disturbance types and a total area of the footprint provided where possible.

**Results**
It is believed that no detectable changes occurred in linear disturbance and human footprint, although a review of disturbance layers is planned for 2023. Alaska Bureau of Land Management (BLM) conducted oil and gas lease sales in the 1002 area of the Arctic National Wildlife Refuge (ANWR) in early 2021. However, leases were suspended shortly afterwards, and all proposed winter seismic work has been paused pending the review of the Coastal Plain Leasing Environmental Impact Statement. The lease area overlaps with PCH calving, post-calving and summer ranges. Winter seismic operations and clean up activities overlap with the timing of calving and post-calving of caribou on the coastal plain of ANWR. In addition, winter seismic activities, if not conducted within specific environmental conditions, could have long-term impacts on caribou forage in this area.

Most development in the range of the Porcupine Caribou herd occurred prior to the 1980's so we know relatively little about the disturbances except when they are still active (Figure 13). In 2013-2014, a major 3D seismic project occurred in the Eagle Plains area of Yukon. Based on data provided by Yukon Oil and Gas Branch and the company responsible for conducting the work, a total of 2,124 km of seismic line varying in width from 1.75-5 meters was cut, totaling approximately 5.35 $km^2$ of footprint. Access roads in the area totaled 228 km and varied in width between 3-5 meters (Figure 14).

Bisecting the Yukon portion of the PCH winter range, the Old Crow winter road is an approximately 5 meter wide, 260 km seasonal road that follows historic routes from Eagle Plains on the Dempster Highway, although the actual construction in any given year can occur within an approved 300m corridor right-of-way. The winter road was opened in late winter 2022, the first time since 2014 that Old Crow was accessible by wheeled vehicles; several previous winters insufficient snowfall did not allow for construction of a proper winter road. In 2020 and 2021 freight was hauled to Old Crow along the winter access route with snowcats pulling tracked trailers over top of the snow,
Construction of the Old Crow winter road is expected to occur in 2022-23.

**Discussion**

Linear disturbances and human footprint can affect caribou in multiple ways. Increased access can provide hunters with increased success and in some cases may facilitate predator movements resulting in higher predation levels or increased stress levels for caribou. Footprint can also impact habitat and habitat use by either directly impacting the habitat or by creating behavioural responses where caribou do not use high quality habitat as they may perceive it to be too risky. Large patches of intact habitat are known to be critical to caribou herds.

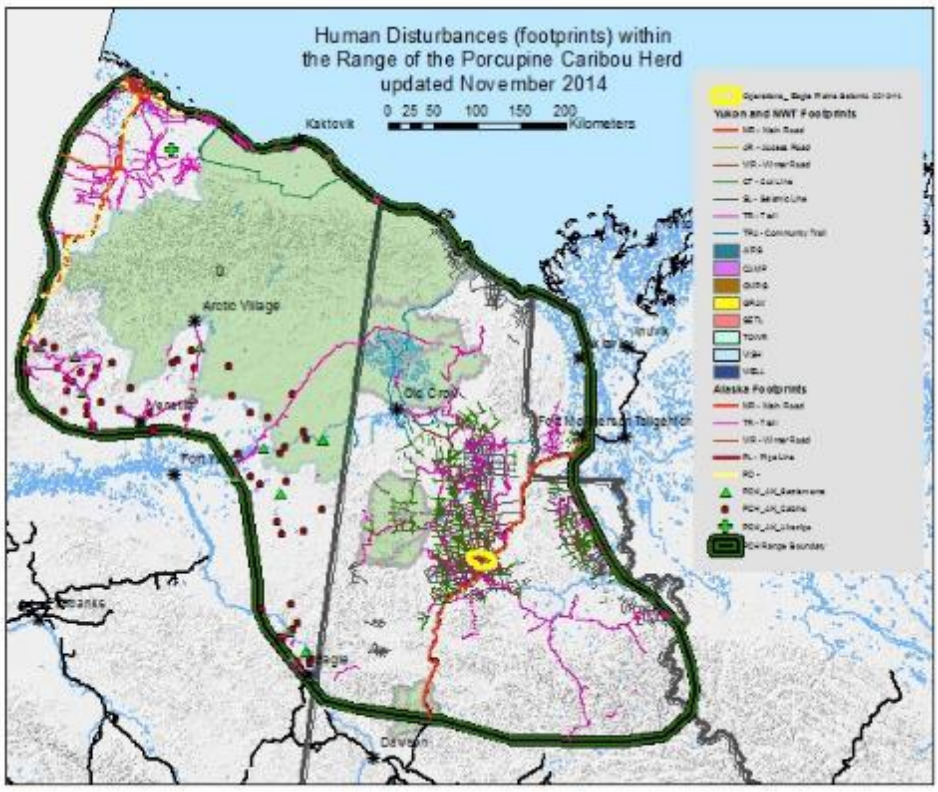


Figure 13. Human disturbance within the range of the Porcupine Caribou herd (updated Nov. 14, 2014 – November 23, 2017) in Alaska, Northwest Territories, and Yukon.

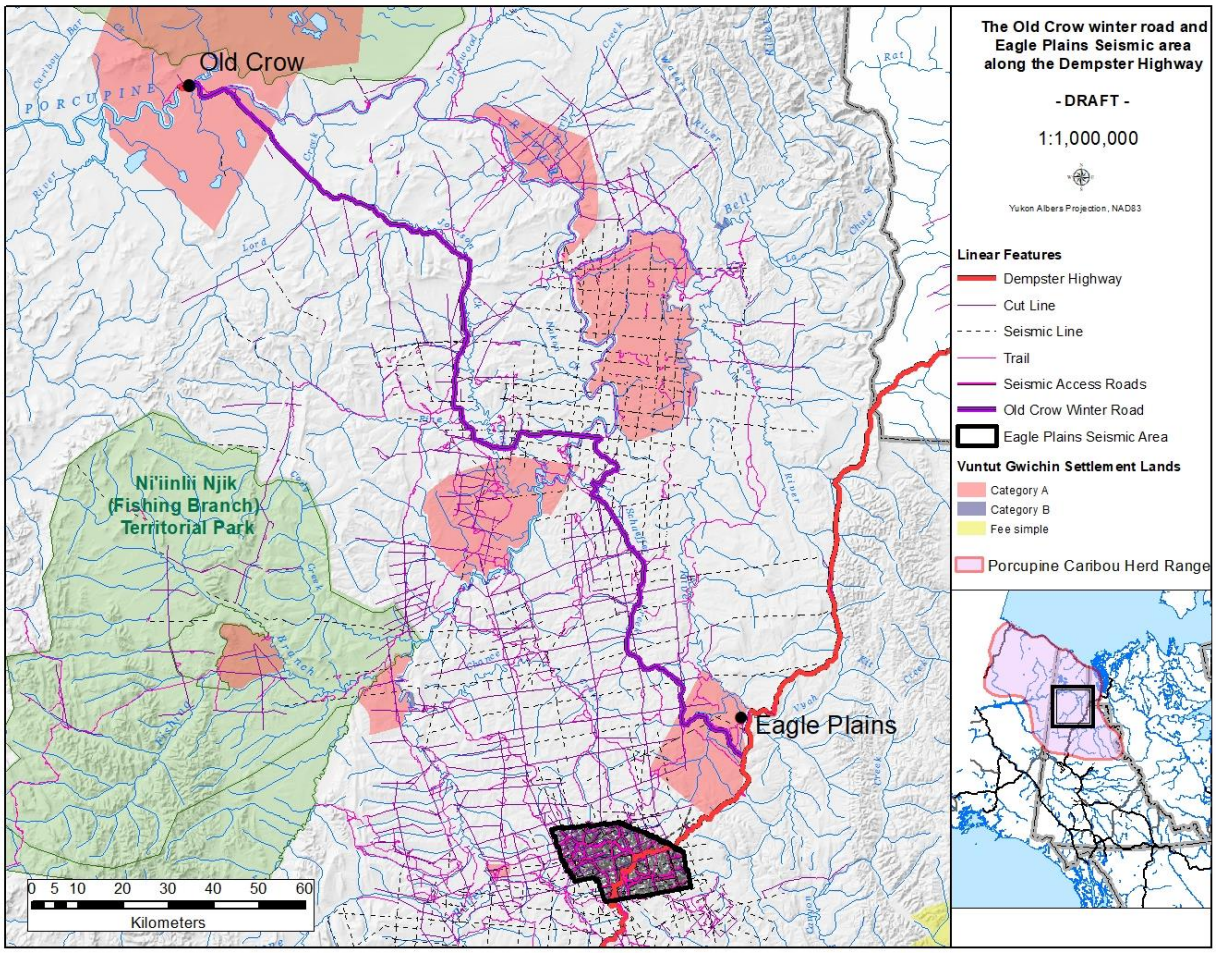


Figure 14. The Old Crow Winter Road, historical cut lines and trails, and 3D seismic lines, trails and roads associated with Eagle Plains Seismic exploration within the range of the Porcupine Caribou Herd in Yukon

## *Snow condition*

**Objective**
To gather an index of snow depth and hardness.

**Methods**
Water Resources (when under Environment Canada and now under Yukon Government) recorded late winter snow depth and snow water equivalent back to the 1970's. The Yukon Fish and Wildlife Branch also did late winter snow measurements along the Dempster Highway and Yukon north coast since the 1990's.

At specified permanent locations, ~10 repeated measures of depth and either snow density or snow water equivalent (SWE) are recorded. Where necessary, SWE is converted to density by dividing SWE by the depth of snow. Not all stations are measured in all years pending availability of staff. Data presented in this report represents results from 17 stations from the Yukon since 2013. Data from other jurisdictions were are available in a compatible format for this report. For example the GNWT records SWE however does not record depth, so snow density measurements cannot be calculated and do not appear on Figure 16.

**Results**

The Porcupine Caribou Herd mainly wintered in Alaska during winter 2021 – 2022 stretching from the Dalton Highway to the Alaska Yukon border (**Error! Reference source not found.**). Caribou occurred in widely scattered groups in the Yukon, notably along the upper Bluefish River and the Whitefish Lakes area. Small groups were also located in the upper reaches of the Bell, Driftwood and Firth Rivers.

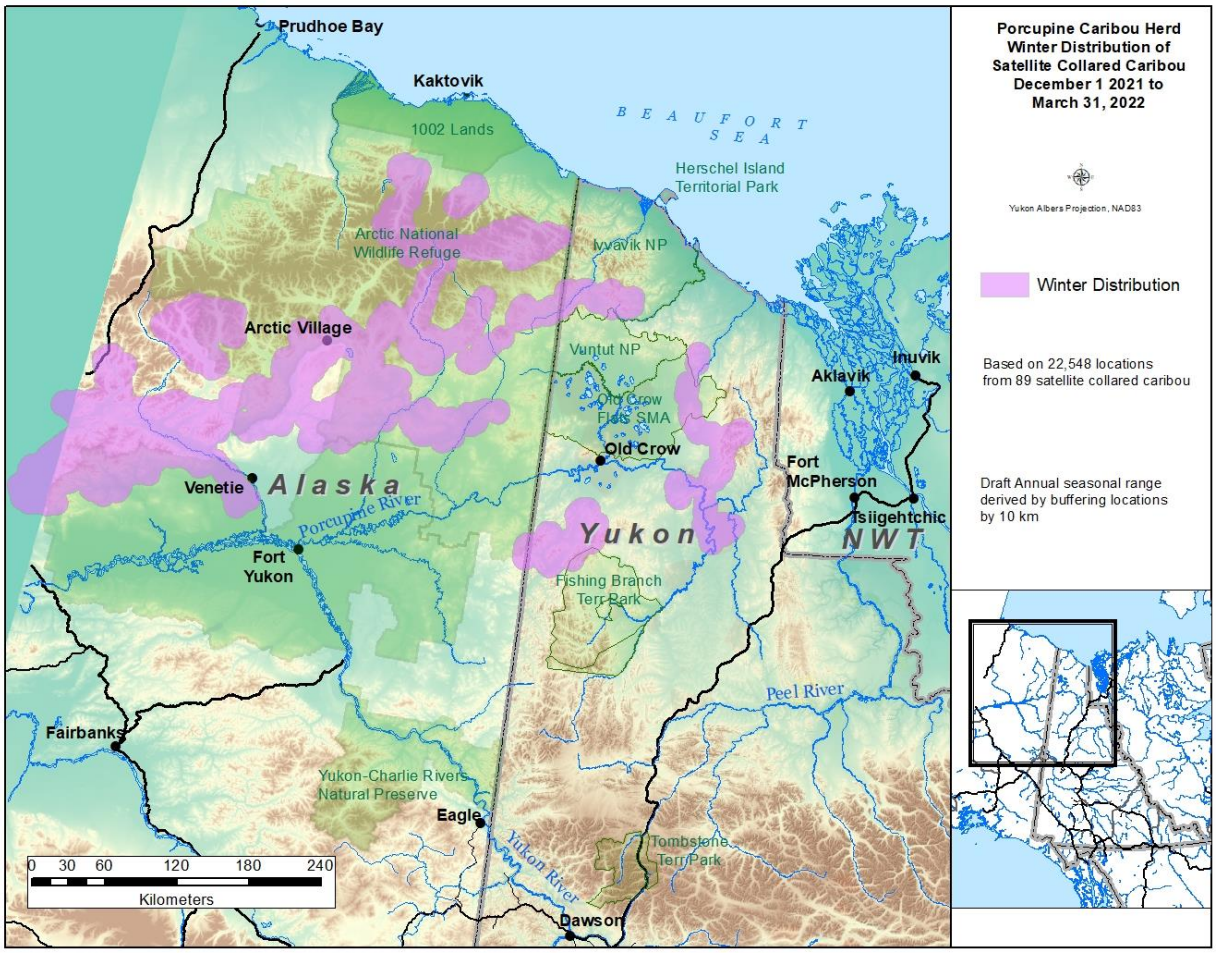


Figure 15. Winter distribution of Porcupine Caribou from Dec. 1, 2021 to March 31, 2022.

Eagle and Ogilvie Regions were well above the long-term and the 5-year averages for snow depth, while the Old Crow Region was slightly above the long-term average and the 5-year averages (Figure 16). The North Slope Region was slightly below the long-term average for snow depth.

Snow density in Eagle, Ogilvie and Old Crow regions were near the 5-year average but above the long-term average (Figure 16). Eagle and Old Crow Regions appear to have an increasing trend in snowpack. The long-term trend for snow pack in the Eagle and Old Crow Regions appears to be increasing slightly, particularly over the last 10 years (Figure 16). Snow density may also be increasing in the Ogilvie and Old Crow Regions.

Snow measurements were not collected in the Richardson region in 2022.

During late winter fieldwork in the Yukon and Alaska, we observed snow conditions that corresponded to the above data. Snow conditions generally seemed above average in the Yukon range, but, relatively shallower in the Alaskan portion of the range which is where most caribou wintered.

**Discussion**

When snow is deep or hardened by wind, caribou expend more energy digging through the snow which can potentially affect their body condition, and reproductive capability. Caribou are not always in the areas where we measure snow but this information can be used as an index of winter conditions affecting caribou.

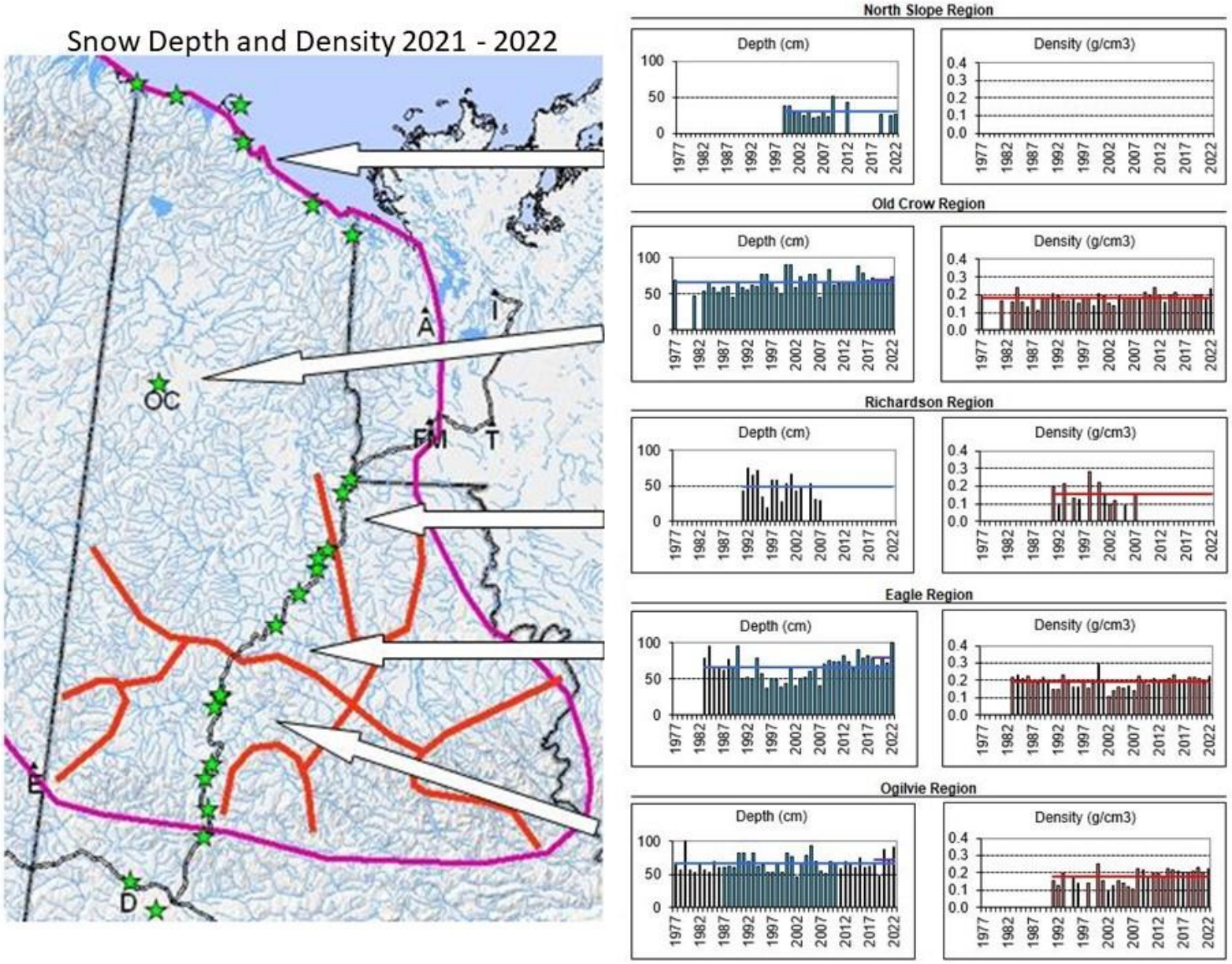
Snow Depth and Density 2021 - 2022
A
I
OC
FM
T
E
D
North Slope Region
Depth (cm)
Density (g/cm3)
Old Crow Region
Depth (cm)
Density (g/cm3)
Richardson Region
Depth (cm)
Density (g/cm3)
Eagle Region
Depth (cm)
Density (g/cm3)
Ogilvie Region
Depth (cm)
Density (g/cm3)

Figure 16. Summary of snow depth and density by snow region from permanent stations (indicated by green stars) for the Yukon portion of the Porcupine Caribou Herd range. Red lines on the map delineate snow regions relevant to caribou (Russell et al 1993).

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# Appendix A. Summary of biological parameters

| Year | Parturition Rate ≥ 4 yrs (sample size) | Parturition Rate ≥ 3 yrs (sample size) | Parturition Rate 3 yrs (sample size) | June Calf Survival[c] | Post-calving Survival[d] | Late June Calf:Cow[e] | March Calf:Cow[f] | Population Estimate | Peak of calving | Calving note |
|---|---|---|---|---|---|---|---|---|---|---|
| 1985 | 0.77 | | | | | 0.46 | | | | |
| 1986 | 0.74 | | | | | | | | | |
| 1987 | 0.78 (51) | | | 0.71 | | 0.55 | | 165,000 | | |
| 1988 | 0.84 (91) | | | 0.65 | | 0.55 | | | | |
| 1989 | 0.78 (74) | | | 0.74 | | 0.58 | 0.43 | 178,000 | | |
| 1990 | 0.82 (74) | | | 0.90 | | 0.74 | | | | |
| 1991 | 0.74 (77) | | | 0.82 | | 0.61 | 0.22 | | | |
| 1992 | 0.86 (78) | | | 0.57 | | 0.49 | 0.33 | 160,000 | | |
| 1993 | 0.81 (63) | | | 0.56 | 0.83 | 0.45 | 0.32 | | | |
| 1994 | 0.91 (98) | | | 0.77 | 0.93 | 0.70 | 0.40 | 152,000 | | |
| 1995 | 0.69 (95) | | | 0.85 | 0.92 | 0.59 | 0.41 | | | |
| 1996 | 0.89 (74) | | | 0.81 | 0.91 | 0.72 | 0.46 | | | |
| 1997 | 0.75 (48) | | | 0.77 | 0.90 | 0.58 | 0.38 | | | |
| 1998 | 0.83 (58) | | | 0.82 | 0.94 | 0.68 | 0.27 | 129,000 | | |
| 1999 | 0.84 (39) | | | 0.83 | 0.86 | 0.70 | 0.56 | | 3-Jun | 1-5 June |
| 2000 | 0.73 (44) | | | 0.61 | 0.82 | 0.44 | 0.28 | | 7-Jun | |
| 2001 | 0.84 (70) | | | 0.61 | 0.79 | 0.51 | 0.31 | 123,000 | 8-Jun | 5-10 June |
| 2002 | 0.87 (68) | | | 0.65 | 0.85 | 0.56 | 0.38 | | 5-Jun | |
| 2003 | 0.87 (70) | | | 0.79 | 0.85 | 0.69 | 0.33 | | 1-Jun | |
| 2004 | 0.82 (74) | | | g | g | g | 0.24 | | 3-Jun | 3-4 June |
| 2005 | 0.64 (55) | 0.63 (65) | 0.60 (10) | 0.77 | 0.88 | 0.49 | h | | 2-Jun | 1 - 4 June |
| 2006 | 0.79 (66) | 0.79 (67) | 1.00 (1) | 0.73 | 0.86 | 0.58 | 0.39 | | 2-Jun | |
| 2007 | 0.88 (67) | 0.89 (71) | 1.00 (4) | 0.83 | 0.90 | 0.73 | h | | 30-May | |
| 2008 | 0.79 (63) | 0.79 (69) | 0.83 (6) | 0.73 | 0.92 | 0.59 | h | | 30-May | 29 or 30 May |
| 2009 | 0.77 (65) | 0.79 (72) | 1.00 (7) | 0.57 | 0.75 | 0.44 | 0.19 | | 2-Jun | |

| Year | Parturition Rate ≥ 4 yrs (sample size) | Parturition Rate ≥ 3 yrs (sample size) | Parturition Rate 3 yrs (sample size) | June Calf Survival[c] | Post-calving Survival[d] | Late June Calf:Cow[e] | March Calf:Cow[f] | Population Estimate | Peak of calving | Calving note |
|---|---|---|---|---|---|---|---|---|---|---|
| 2010 | 0.85 (41) | 0.75 (48) | 0.14 (7) | 0.76 | 0.87 | 0.65 | h | 169,000 | 1-Jun | prior to 2 Jun |
| 2011 | 0.86 (59) | 0.86 (59) | | 0.48 | 0.59 | 0.41 | h | | 30-May | prior to 1 Jun |
| 2012 | g | g | g | g | g | g | g | | 30-May | prior to 1 Jun |
| 2013 | 0.86 (42) | 0.85 (45) | 0.67 (3) | i | I | i | | 197,000 | 4-Jun | 3-4 June |
| 2014 | g | g | g | g | g | 0.49 | | | no data | |
| 2015 | g | g | g | g | I | i | | | no data | |
| 2016 | 0.75 (28) | 0.76 (37) | 0.78 (9) | 0.61 | 1.00 | 0.46 | 0.36 | | 3-Jun | |
| 2017 | 0.90 (42) | 0.92 (54) | 1.00 (12) | 0.81 | 0.90 | 0.72 | | 218,000 | 3-Jun | |
| 2018 | 0.88 (41) | 0.78 (50) | 0.33 (9) | 0.73[j] | 0.88[j] | 0.64[j] | | | 6-Jun | |
| 2019 | 0.81 (42) | 0.72 (57) | 0.47 (15) | | 0.94[j] | 0.56[j] | | | 4-Jun | |
| 2020 | 0.80 (35) | 0.79 (42) | 0.71 (7) | | 0.93[j] | 0.57j | | | 1-Jun | |
| 2021 | 0.85 (39) | 0.83 (46) | 0.71 (7) | | 0.90[j] | 0.63[j] | | | 30-May | |
| 2022 | 0.76 (34) | 0.70 (46) | 0.50 (12) | | 0.93[j] | 0.68 | | | 4-Jun | |
| Mean | 0.81 | 0.79 | 0.70 | 0.72 | 0.88 | 0.58 | 0.35 | | 2-Jun | |
| 5 yr mean | 0.85 | 0.81 | 0.54 | N/A | 0.91 | 0.58 | N/A | | 2-Jun | |

[a] Data are from Fancy et al. (1994, Can. J. Zool. 72:840–846), Alaska Department of Fish and Game, and Yukon Department of Environment.

[b] Number of radiocollared adult cows for which parturition status was determined in early June, excluding those known to be <4 years old. Includes caribou of unknown age, but most likely > or equal to 4 years olds. Prior to 2003, all caribou were of unknown age.

[c] Estimated as (July calf:cow ratio)/(parturition rate).

[d] Includes only calves observed during early June that were subsequently observed in late June (i.e., does not include most perinatal mortality).

[e] Excludes radiocollared cows known to be < 4 years old.

[f] As of March of the year following birth of each cohort; includes all cows >1 year old.

[g] No data due to adverse weather conditions.

[h] No data due to mixing of herds on winter range.

[i] No data due to dense caribou groups making identification of cow:calf pairs not possible.

[J] Starting in 2018, all females ≥3 years old are included in the summary. Past status reports only reported adult cows ≥4 years of age unless otherwise stated in the footnotes. Parturition status remains for radiocollared adults ≥4 yrs old.

# Appendix B. Previous research findings

## *Adult female survival*

**Objective**
To obtain an annual estimate of survival for adult female Porcupine caribou.

**Methods**
There have been a number of issues with past methods to determine female survival estimates. However, with increases in the number of GPS collars deployed on the herd, the PCTC can calculate survival estimates using the known fate (i.e. alive, dead) of GPS collared females. Analyses will include how survival varies by age, sex and season.

**Results**
Researchers started a project in 2003 to get an updated estimate of adult female survival in response to the continued population decline (Wertz et al 2007a). Survival estimates ranged between 0.065 to 0.097 but showed a general trend of increased survival from 2003 to 2011. (**Figure 17. Annual survival estimates for adult female Porcupine Caribou, May 2003 – June 2012. Source: USFWS unpublished data.**).

**Discussion**
As with many populations, the survival of breeding females is very important to the potential growth of the herd. A sustained change of 2 or 3 percent in survival can make the difference between a herd increasing and decreasing. Adult female survival has been estimated twice before; once when the herd was increasing and again when the herd began to decline (Fancy et al 1994, Walsh et al 1995). Information gathered from these earlier studies indicated that most cows died in winter, the harshest season of the year.

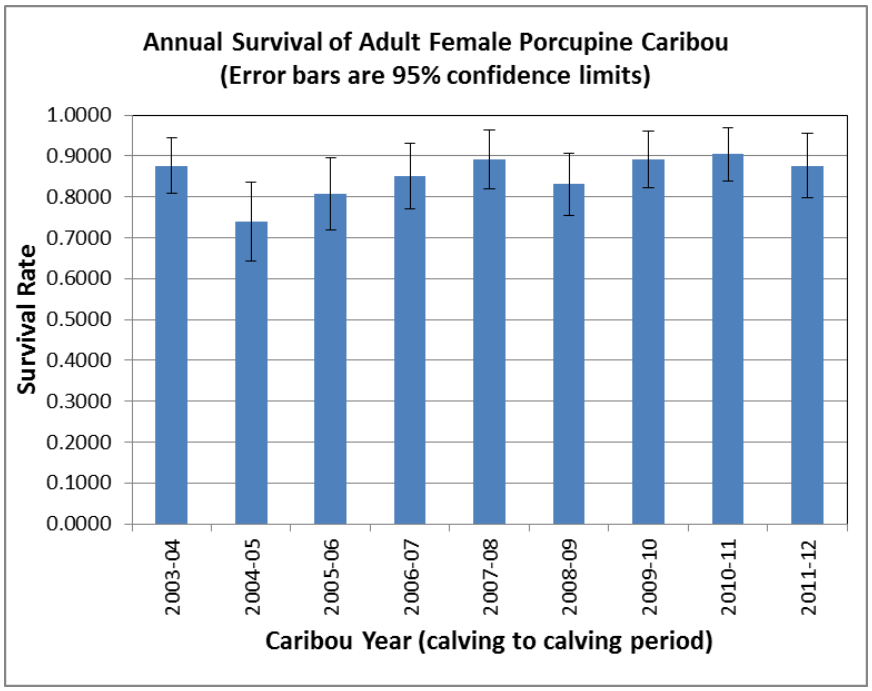

Figure 17. Annual survival estimates for adult female Porcupine Caribou, May 2003 – June 2012. Source: USFWS unpublished data.

## *Short yearling survival to 3 years of age*

**Objective**
To document the survival of 9 month old calves to 3 years of age (2003-2010 only).

**Methods**
Starting in 2003, we captured about 10 female caribou in March that were born the previous spring (9 months old) and put conventional radio collars on them. The data from all years of captures were pooled to estimate how many calves survived to breeding age. Because we know exactly how old these caribou were, we recapture them after 3 years or sooner and replaced their collars to maintain a collared sample.

**Results**
The average survival rate of female Porcupine caribou appears to decline as caribou age from 9 months to 3 years but because of the error bars overlap on the estimates we cannot say for certain that there is any change in survival rate as caribou survive to breeding age (**Figure 18. Survival of Porcupine Caribou females from 9 months to 3 years of age from 2003-2010.**). The average survival rates of female caribou 9 mo. – 3 yrs of age are similar (87%) to adult female survival rates taken from the same time period (84%). The last year of this seven year study was completed in 2010.

**Discussion**
In 2003, we started a 7-year study to estimate how well calves survive to 3 years of age when they should enter the breeding portion of the population. This has been estimated only once before in 1983-88 (Fancy et al 1994). We have been assuming that once calves reach one year of age, they survive at the same rate as adults. We are testing this assumption because, as with the survival of adult females, the survival of young females is important to population dynamics. Computer population modeling shows that it would take a decrease of only 6% in adult female survival or a decrease of 50% of calves to cause a decline like we have documented for the Porcupine Caribou Herd between 1989 and 2001 (Arthur et al 2003). Other work has shown that survival of calves in their first year of life is very low. Survival of these young, non-breeding animals is similar to adult females.

Small sample sizes are an issue for this analysis. The estimates are based on data pooled over multiple years of collaring efforts, however the sample size at step one of the analysis is 59 animals. In order to be able to detect small changes in short yearling survival with confidence, we would have to maintain collars on many more young caribou. There are constraints to doing that in terms of funding, availability of free radio frequencies, logistics of flying, and community concerns. Despite these constraints, we decided to continue small numbers collaring short yearling females each year to continue recording survival estimates (low statistical power given the small sample size) but also to ensure the collared sample of caribou is not biased toward older animals.

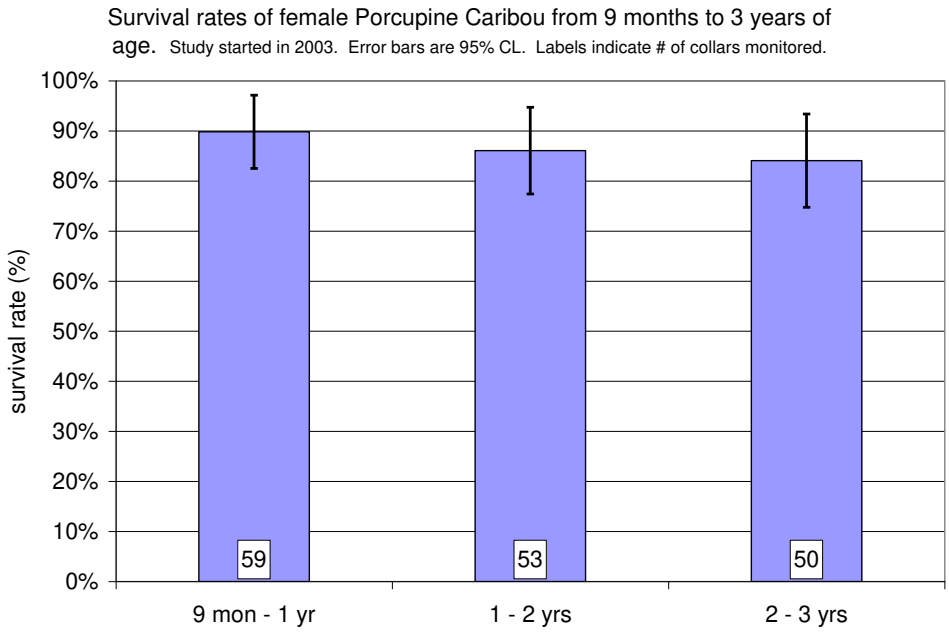


Figure 18. Survival of Porcupine Caribou females from 9 months to 3 years of age from 2003-2010.

## *Adult bull survival*

**Objective**
To document the survival of adult bull caribou (2003-2010 only).

**Methods**
Each year before a census attempt, we deploy a number of collars on adult bull caribou so we can locate the bull groups during the census field work. Because we've been preparing for a census each year for 8 years running, we have an unprecedented number of bulls collared. We are able to do an analysis similar to the short yearling analysis. All collared bulls were pooled and we calculated their survival rate in years following capture.

**Results**
Between 2003 and 2006, more bulls died during the fall than any other season. Bull mortality rate increases dramatically about 5 years after collaring (**Figure 19. Survival of male Porcupine Caribou from 2003 to 2010.**). Assuming bulls were at least 3 years old at the time of capture, bulls start dying at an increased rate at 8 or more years of age. The study on adult bull survival extended from 2003 – 2010. No further collaring of bulls is planned.

**Discussion**
As expected, we see that bulls seems to survive at a lower rate than adult cows. Bulls are probably more stressed during the rut which contributes to a lower survival rate.

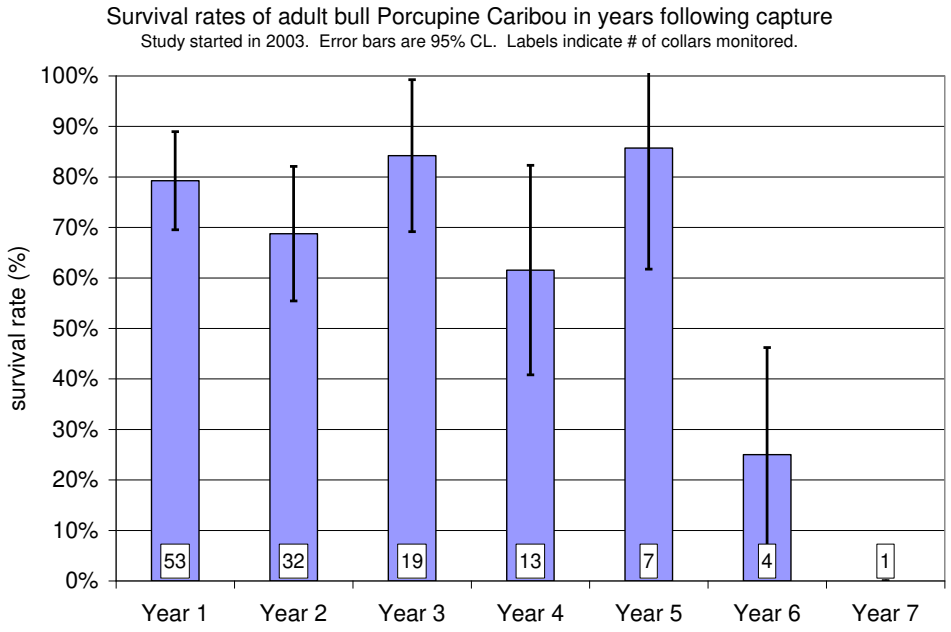


Figure 19. Survival of male Porcupine Caribou from 2003 to 2010.