Photo: Eric Wald

DRAFT
PORCUPINE CARIBOU
ANNUAL SUMMARY REPORT
2012

Submitted to: Porcupine Caribou Management Board

Submitted by: Porcupine Caribou Technical Committee

November 2012

Harvest data from 2012 not received in time to be included in this report. The report will be updated when information becomes available.

Indicator Table

Annual Summary Report - November 2012

Prepared for the Porcupine Caribou Management Board

Indicator	Value	5 year average	Notes	Assessment
Population size and trend				
Population size	2012 = no photocensus	---	Declined by 55,000 caribou between 1989 and 2001. Recovered to 169,000 by 2010	
Estimated population	2012 = no data	---	Herd Estimator computer model in preliminary stages and waiting for 2012 indicators to be completed	
Population trend	---	---	Unknown current trend, recovered between 2001 and 2010	
Adult cow survival	2003 to 2006 study = 0.825	---	Similar to 2001 estimate (herd declining). Lower than when herd was increasing. Annual survival is quite variable.	
Calf birth rate	2012 = no data	0.83	24-year average = 0.81	
Calf survival to 9 months	2006 = 0.39	0.36 (13 years)	Exceeded survival target of 0.30. Missing 2005, 2007 to 2011 due to overlap with other herds.	
Peak of calving	2012 = no data	2 June	Average is within normal range	
Harvest				
Total harvest (2011/12)	---	---	Harvest data not received in time for this report	
% females in harvest	---	---	Harvest data not received in time for this report	
Hunters' needs met?	Increasing	---	Borderlands data available for 2010 and 2011	
Body condition				
Average backfat	F: no data M: 3.2 cm	F: 3.2 cm M: 1.5 cm	Fall 2011 males only. 5 yr. averages males only	

Indicator	Value	5 year average	Notes	Assessment
Hunter assessment	F: no data M: 2.9	F: 2.2 M: 3.1	Fall 2011 males only. 5 yr. average males only	
Condition of caribou	2010 = Good 2011 = Good	---	Category with the most number of respondents observing caribou body condition. Ratings vary from Excellent, Good, Fair, Mixed and Poor. Borderlands data available for all seasons in 2010 and 2011	
Health (abnormalities)	Increasing in all seasons except summer	---	Trend of physical abnormalities seen from 2010 to 2011 in each season. Borderlands data available for all seasons 2010 and 2011	
Habitat and other considerations				
Human footprint	ZOI Dempster Highway = 18.5 km ZOI Settlements = 34.5-38 km ZOI Low Use features (= 6 km	---	Strength of avoidance and ZOI reported for Dempster Highway, Settlements and Low Use human features from 1999-2012 (Johnson and Russell 2012), ZOI = Zone of Influence	
Snow conditions, Olgilvie and Yukon North Slope	Olgilvie 2012 = 69.7 cm North Slope 2012 = 42.0 cm	62.8 cm 38.8 cm		
Wildland fires	2012 data not yet available 2011 = 22 sq km	570 sq km	2011: much lower than average from previous 5 years. 2004 and 2005 largest burned area ever. Total of 15% of range affected by fires since 1960	
Unusual, extreme and rare weather events	Decreasing Icing = October Snow = December	---	Trend between 2010 and 2011. Month with highest number of icing and snow events in 2010 and 2011. Borderlands data available for all months 2010 and 2011	

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INTRODUCTION

This 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. 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 Procupine Caribou Technical Committee (PCTC) and the Arctic Borderlands Ecological Knowledge Co-op (ABEKC). ABEKC was formed to monitor and assess ecological change in the range of the Porcupine Caribou herd and adjacent Mackenzie Delta area in NWT, Yukon and Alaska using both science and local traditional knowledge. Community researchers conduct yearly interviews with local experts in each community on important indicators that can be used to track ecosystem change. Note that interviewees are selected by communities and the monitors with the intention of interviewing a select number of land users engaging with a suite of ecological indicators (ie. this should not be considered a random sample of caribou harvesters and should not be extrapolated to sampled communities). Information from yearly interviews are currently available from 1996-2011. In this report we utilized data from 2010 and 2011 available on the new ABEKC data portal. Interview information before 2010 is archived in an acces database. A prioirty of ABEKC over the next few years is to continue to analyze and process older data in order to improve access and use of all data via the new data portal.

Herd Background

The Porcupine Caribou Herd's (PCH) known range covers about 250,000 square kilometers (100,000 square miles) over areas in 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 native 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 which 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 informal Porcupine Caribou Technical Committee (PCTC) which consists of biologists from numerous agencies, co-management boards as well as occasional faculty members or students from various universities.

All aboriginal organizations within the Canadian range of the herd have land claim agreements. These agreements solidify the aboriginal right to hunt for food 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 native organizations signed the *Porcupine Caribou Management Agreement* (PCMA), creating the within-Canada Porcupine Caribou Management Board. In 1987, Canada and the United States signed an International Conservation Agreement, creating the International Porcupine Caribou Board (IPCB).

Research and monitoring is guided largely by the *Porcupine Caribou Management Plan* (drafted by the PCMB) and the *International Plan for the Conservation of Porcupine Caribou* (1987). The PCTC coordinates research and monitoring activities, optimizes funds and staff time, and provides 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.

These goals are taken from the *Porcupine Caribou Herd Management Plan, 2000/2001 to 2002/2003.*

Herd size

- To know whether the herd is increasing, stable, or declining; to know what factors are affecting population growth.
- To be able to predict how climate change may affect the herd.
- To be able to predict how different levels of development and human activity will affect the herd.
- To better understand cumulative impacts of events on the herd (weather, human activity, predation, new species, snow cover, etc.).

Range use

- To obtain full protection for the calving grounds and ensure that human activities on other seasonal ranges do not negatively impact those ranges or caribou.
- To understand how natural events may be affecting the seasonal ranges of the herd.
- To understand the affects, if any, that muskoxen have on the seasonal ranges of caribou.

Harvest

- To ensure that the harvest is known and is managed so that it is sustainable.
- To ensure that harvesting activities along the Dempster Highway do not interrupt the normal migration and range use of caribou.
- To ensure that the Dempster Highway regulations do not cause unnecessary hardships for harvesters.
- To ensure that the Porcupine caribou are not harvested for commercial purposes or wasted.
- To ensure that Alaskan hunters know where they can hunt.
- To support traditional knowledge.

Body condition

- To know the general condition of the herd over the long term will be known.

- To know the levels of disease and parasite will be known.
- To ensure that users and others are kept informed/involved in studies.

Co-management

- To have the user communities and local governments be an integral part of the PCH
- management.
- To increase communication with the users of the herd
- To ensure that the PCMB and the IPCB continue to operate
- To ensure that traditional knowledge is used in decision making
- To have the communities understand and support the role of the co-management groups such as the PCMB

Culture and education

- To produce non-technical information on the herd for the communities and general public use.
- To support user or traditional knowledge.
- To maintain the Johnny Charlie Sr. Scholarships.
- To promote good hunting practices and support hunting regulations on the Dempster Highway.

Tourism and industry

- To obtain protection for the sensitive ranges of the herd.
- To understand the cumulative impacts that tourism, development along with other variables may have on the herd.
- To help the public understand the importance of the herd and its range.

These goals are taken from the objectives listed in the *International Plan for the Conservation of Porcupine Caribou*.

- 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.

Alaska Department of Fish and Game list the following as management objectives (Lenart 2007):

- Maintain a minimum population of 135,000 caribou.
  - Conduct censuses every 2-3 years.
  - Estimate parturition rates and late June calf:cow ratios of radio-collared females.
  - Monitor herd movements by periodically relocating radio-collared caribou.
  - Monitor the harvest through field observations, hunter reports and contact with residents.

POPULATION

Population size – photo census

Objective
To estimate the size of the herd every 2 to 3 years (last completed 2010).

Methods
A technique called an Aerial Photo Direct Count Extrapolation has been used to estimate the herd size since 1972 (Urquhart 1983). 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. This technique is considered an accurate and reliable method to count large barren-ground caribou herds.

Results
Caribou aggregations were not sufficient to conduct a photocensus in 2012. The PCH was monitored from late June through mid-July for aggregations conducive for a photocensus. Multiple telemetry flights were conducted in Alaska by Alaska Department of Fish and Game **(**ADF&G) and one flight was conducted in Canada by Yukon Environment. Results of the telemetry flights accounted for the location of all radio-collared caribou in the PCH. The herd was split into three distinct geographic regions. Forty-two percent of the radio-collars were on the south side of the Brooks Range in Alaska, 53% were on the North Slope in Alaska, and 4% were in Canada near the Yukon and Northwest Territories border.

Discussion
When the herd was first counted with this technique in 1972, the herd was estimated at about 102,000 caribou (Figure 1). The herd size grew steadily at about 5% each year until it reached 178,000 caribou in 1989. The herd began to decline by 3 to 4% per year from 1989 to 1998, and by 1.5% per year from 1998 to 2001. The census in 2001 showed 123,000 caribou in the herd (Arthur 2001).

Working cooperatively, biologists from Canada and Alaska attempted to photo census the herd each year since 2003 but were unsuccessful. In 2007 photos were taken however they were not good quality. If the herd had continued to decline at the same rate, it was estimated that the herd could have numbered 100,000 or fewer caribou in 2010.

Finally in July 2010, conditions permitted photos to be taken. The ADF&G estimated 169,000 caribou in the herd from that census, the second highest count on record. The high number of caribou showed the herd had obviously recovered from the 12-year decline documented between 1989 and 2001. Because of the length of time between the estimates it is hard to know the current trend for the herd (e.g. still increasing).

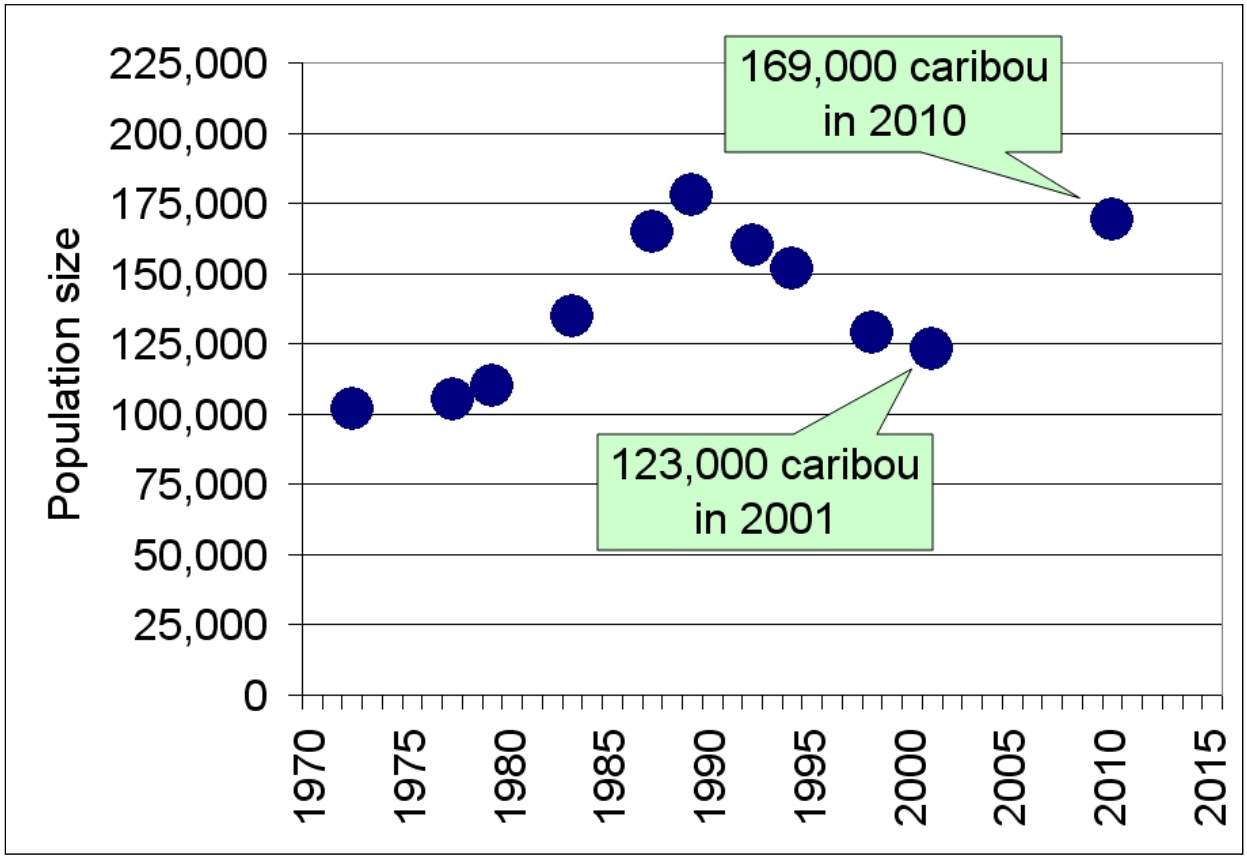


Figure 1. Estimated herd size of the Porcupine caribou herd size by photo census, 1972 to 2012. Blue dots indicate successful survey attempts.

Population size – computer modeling

Objective

To build a computer model (the "Herd Estimator") that incorporates available biological information to estimate the total herd size and a measure of uncertainty surrounding that estimate. This new model updates the previous Caribou Calculator which was initially developed in 2001 and was a significant contribution in the development of the HMP.

Methods

The new Herd Estimator will substantially reduce the number of input variables for estimating the herd's size. Variables included in the Herd Estimator are: previous photocensus estimates, adult sex ratio, harvest numbers, cow survival, and calf recruitment. In addition to using annual values for these variables, the variability of these values will also be included in the model to allow for herd size estimates to also have a measure of uncertainty (e.g., confidence interval) associated with it. The variability (i.e., uncertainty) in the model projection is obtained by running the model many times, each time using a different combination of input variable values. Decision-makers will be able to use this uncertainty, as a measure of confidence, when developing and implementing management actions, and when assessing alternative management scenarios. As with the Caribou Calculator, the Herd Estimator will be implemented as a Microsoft Excel based model.

Results

A preliminary version of the Herd Estimator has been provided to YG by the contractor. Additional "fine-tuning" of the parameter values, and the incorporation of results from the 2012 fall rut count are yet to be included in the final version. YG and the contractor were also hoping to include results from the planned 2012 photocensus of the herd, but this year's survey was called off due to poor aggregation of the herd. Figure 2 provides an illustration of the model's projections.

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, and accurate tool was desired to provide managers with information on the herd's size. In particular, information on the confidence of these estimates is critical information which managers can use when developing management actions. While the previous Caribou Calculator did provide projected estimates of the herd's size, there were no measures of uncertainty associated with them, which reduced the confidence managers had in them. To address the need for an updated model which would also provide measures of uncertainty in model projections, YG contracted the initial Caribou Calculator developer to develop the new Herd Estimator.

Key features of the new Herd Estimator are that it has substantially reduced the number of input variables to only those deemed key to the population projections. Furthermore, variability surrounding these input variables is also included in the model projections which results in a more biologically realistic model. It is these sources of variability that allow for the final model projections to have associated measures of uncertainty.

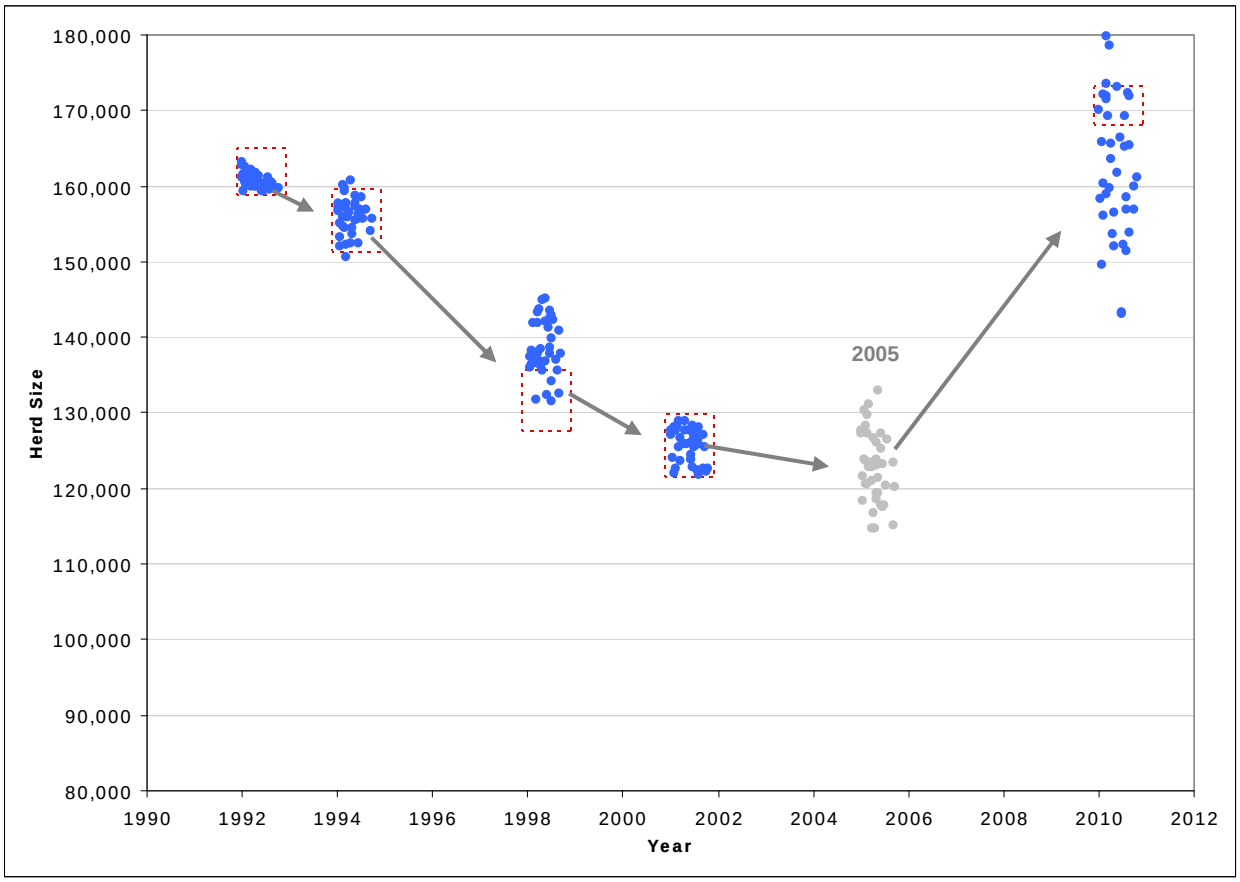


Figure 2. Projected PCH abundances from the newly developed Herd Estimator. Years in blue indicated years when a photocensus estimate was obtained. The points indicate the range of variability in abundance estimates and thus the spread of those points represents the uncertainty associated with the model's projections. The red dashed box indicates a generalized measure of uncertainty surrounding the photocensus estimate. These boxes are provided solely for descriptive purposes to illustrate how "close" the model's projections come to the photocensus estimates and do not identify true measures of uncertainty.

Adult female survival

Objective
To document the survival of adult females each year.

Methods
In response to the continued population decline, researchers started a project in 2003 to get an updated estimate of adult female survival (Wertz et al 2007). As with many populations, the survival of breeding females is very important to the potential growth of the herd. 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.

Researchers flew monthly over the winter to locate all the radio collared females and determine whether they were alive or not. Results showed that adult females survived at a similar rate as they did from 1989 to 1991 when the herd started to decline. Assuming that female survival was driving the decline, this suggested that the herd had continued its declining trend. Another interesting and unexpected result from the most recent study is that there appeared that more cows die during the spring and summer months than previously thought.

After the 3 year project was done, the number of flights was reduced but we continued to calculate an estimate of adult female survival for each winter. It should be noted that these calculations have low statistical power due to small sample size of collared caribou.

Results
Since 2003, we continue to see a pattern of lower survival as we go from summer to the next spring (Figure 3). More cows die during spring (March to June) than during. Estimates of annual survival continue to be lower than the survival rates estimated in the 1980's when the herd size was increasing and similar to estimates just after the decline started (Figure 4). The study was completed in 2009.

Discussion
Estimates of survival are quite variable from year to year (Figure 4). A sustained change of 2 or 3 percent in survival can make the difference between a herd increasing and decreasing. We would need up to 300 collars deployed on caribou in order to reliably detect such a small change. This is unfeasible.

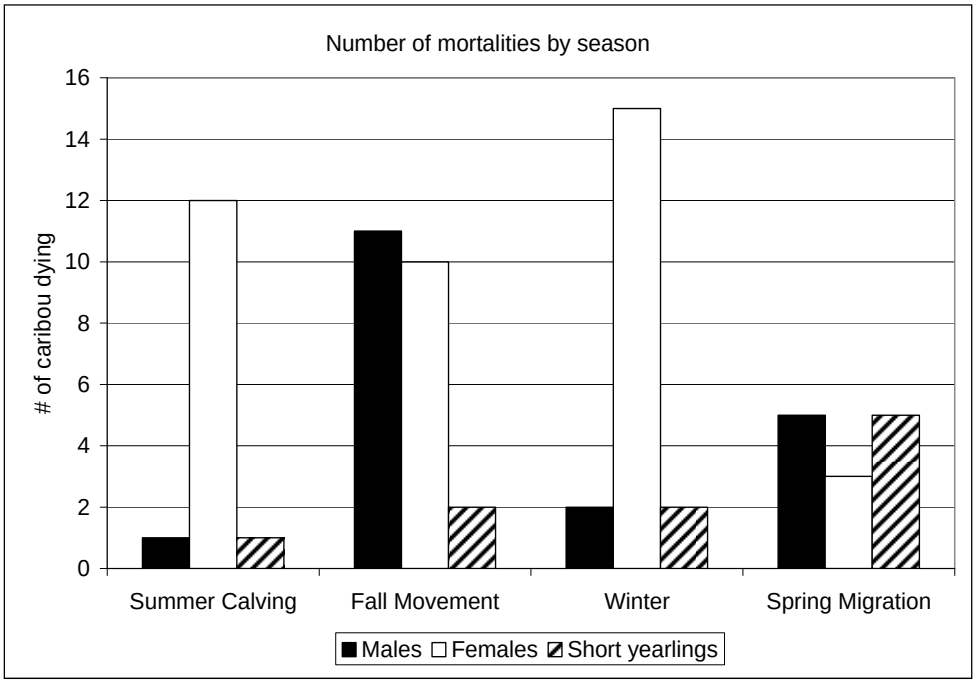


Figure 3. Timing of all mortalities of Porcupine caribou, by season from2003 to 2006.

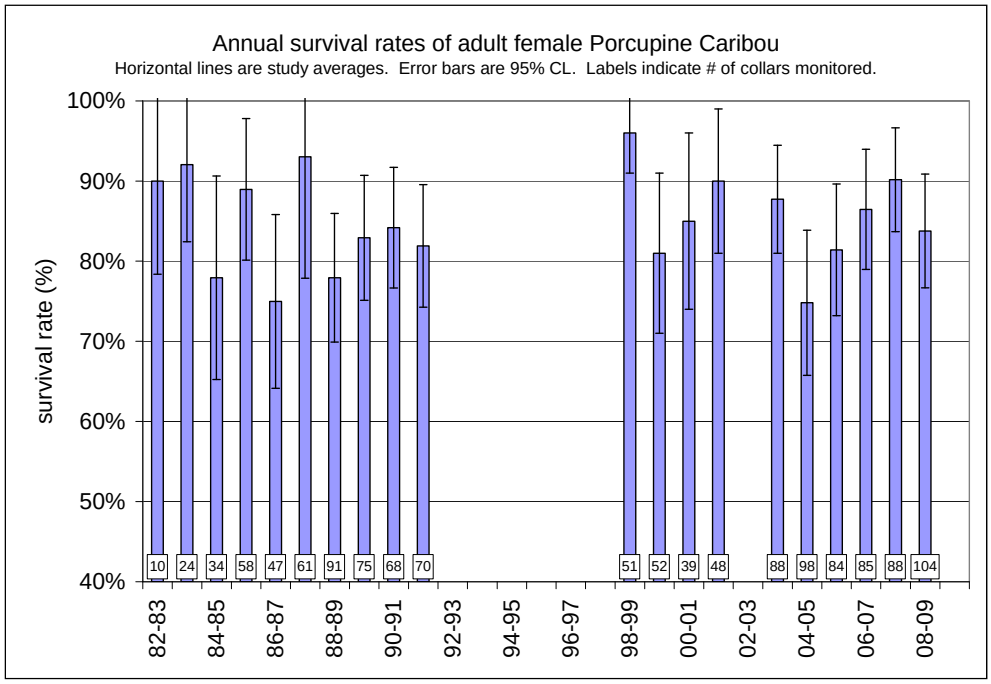


Figure 4. Annual survival estimates for adult female Porcupine Caribou, 1982 to 2009. Source: Fancy et al 1994; Arthur et al 2003; Wertz et al 2007 and unpublished data.

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 birth rate and early survival rate of calves. Collared females are located from a fixed-wing aircraft and are classified as barren, pregnant, or have given birth. They are re-located after about one month to determine whether the calves have survived. Calving success is presented as the percent of cows that had calves. The July calf ratio is based on the proportion of collared females still with calves in late June or early July.

Because the majority of calves will have weaned by March, we do not use the radio collared females in late winter but instead estimate the number of calves for every 100 adult cows, called a calf:cow ratio. In many of the recent years, overlap with other herds on winter range has prevented researchers from conducting the March composition count.

Results
For the first time since 1987, poor weather prevented adequate radio tracking to estimate calving rate and calving distribution. During 31 May – 2 June, 2012, three attempts were made to observe radio-collared cows to determine calving status. However, extensive fog on the coastal plain and adjacent mountain prevented low level flights across most of the PCH calving grounds. Although the calving status of 26 radio collared cows was determined, the sample size is not adequate to report a calving rate estimate. Since 1985, birth rates and the proportion of cows with a live calf in late June were similar during the population decline as during the population increase (Figure 5).

Radio tracking flights conducted during 20-21 June, 2012 to estimate post-calving survival of calves were unsuccessful. Post-calving groups consisted of tens of thousands of densely packed caribou making isolation and identification of individual caribou from an aircraft not possible. Some caribou groups were in brush which concealed calves.

Discussion
There is no apparent pattern in the estimates. Years of low survival in certain years are linked to deep snow years and / or a late spring melt. 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. If birth rates or calf survival rates are low for several years in a row, population growth is more vulnerable therefore we should keep monitoring calves to ensure that if a large change in productivity does occur, we are able to document it.

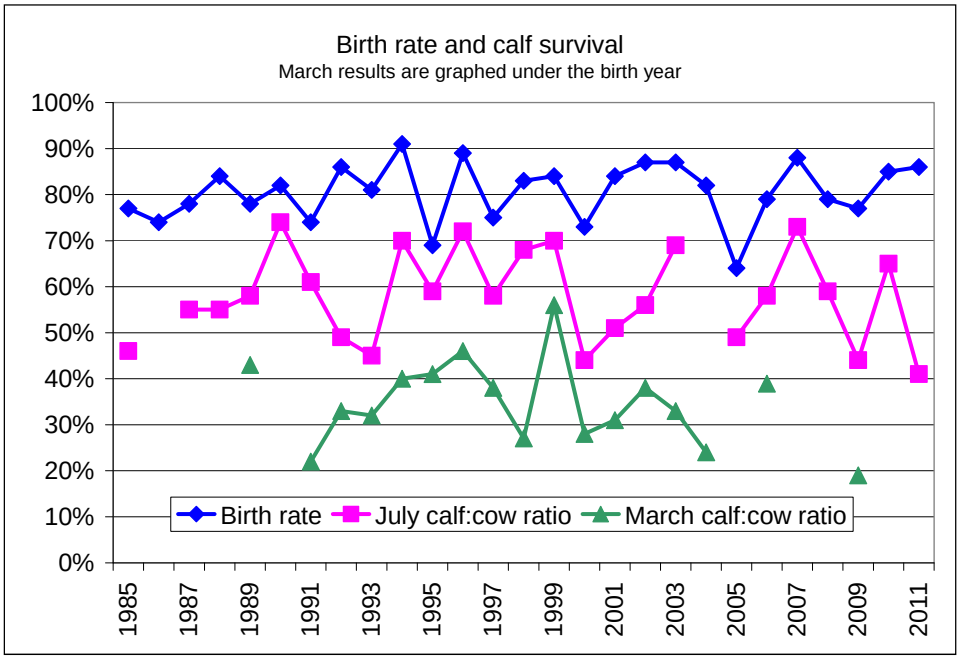


Figure 5. Estimated birth rate and calf survival indices for the Porcupine Caribou herd from 1985-2012. There is no data available for 2012 due to poor weather and poor dispersion of post-calving groups.

Peak of calving

Objective
To estimate the date when half of the collared adult female caribou have given birth each spring.

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 used for 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.

Results
For the first time since 1987, poor weather prevented adequate radio tracking to estimate peak of calving. During 31 May – 2 June, 2012 three attempts were made to observe radio-collared cows to determine calving status. However, extensive fog on the coastal plain and adjacent mountain prevented low level flights across most of the PCH calving grounds during 2012. Since 1999, the peak date of calving varies by a few days each year, but there is no indication that large numbers of cows are giving birth 'out of sync' (Table 1).

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. This means that most of the cows would have been bred within a very short time period therefore peak of calving can be used as an indicator of how the rut went the previous fall. If the calving period is extended, it might mean that the rut was disrupted and cows were bred in a

second estrus. This shows up as calves being born over an extended period of time. This is important because calves born late in the season are probably more likely to die from predators and they also may be too small to make the migration south for winter, reducing calf survival. We would start to worry if births were a week or more out of sync.

Table 1. 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	
Average	2 June	

Short yearling survival to 3 years of age

Objective
To document the survival of 9 month old calves to 3 years of age.

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 6). 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.

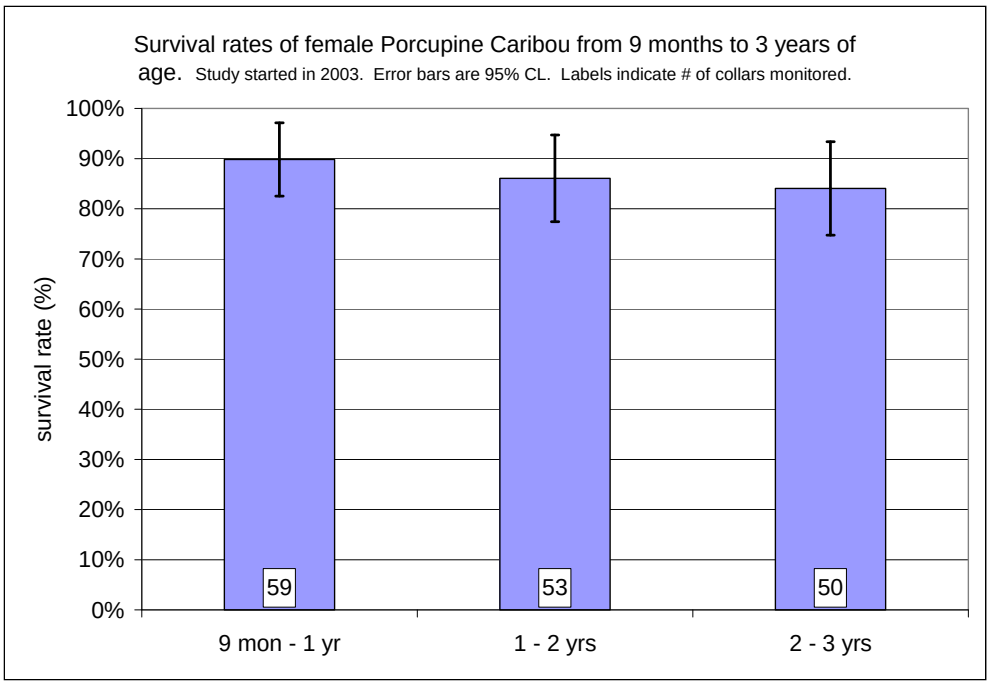


Figure 6. Survival of Porcupine Caribou females from 9 months to 3 years of age from 2003-2010.

Adult bull survival

Objective
To document the survival of adult bull caribou.

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 (see Figure 3). Bull mortality rate increases dramatically about 5 years after collaring. 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.

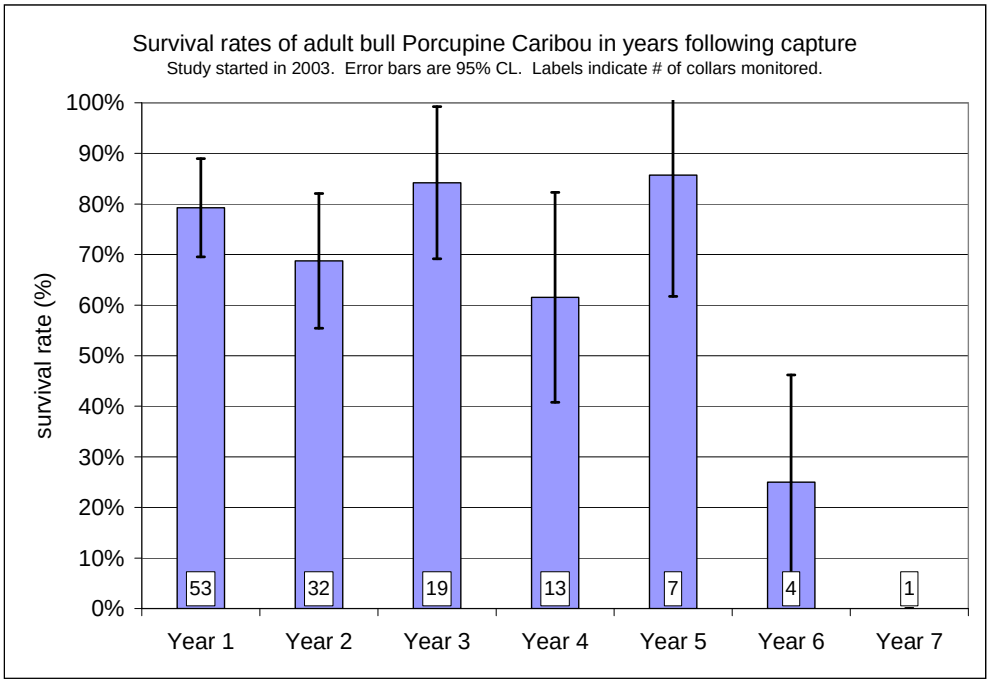


Figure 7. Survival of male Porcupine Caribou from 2003 to 2010.

Bull Ratio

Data from 2012 has not been fully analyzed and is therefore not available for this report.

Objective
To document the ratio of bulls to cows in the herd. The next photo census attempt, and accompanying rut count is scheduled for 2013.

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

Results
For the 2009 count, we counted caribou in the areas around 34 radio-collared caribou. Results showed about 40 bulls for every 100 cows, lower than was found in 1980 (60 bulls for every 100 cows). We have low confidence in this number due to low sample sizes.

In 2010, because ADF&G were able to get a photo census, we did another rut count. This time we were able to sample caribou in areas around 53 radio-collared caribou. The 2010 estimate was 57 bulls for every 100 cows, similar to the 1980 estimate. We have higher confidence in this result due to the larger number of radio-collared caribou sampled.

In 2012, even though we were not able to get a photo census, it was decided by the PCTC that a rut count would be useful in understanding the affect of a bull oriented harvest over the last several years. Staff from ADF&G and YG successfully completed the count in mid-October. Large aggregations of caribou occurred first near Arctic Village and then moved east into Yukon allowing for a high number of collars to be sampled by this survey. This should result in an estimate with high confidence. A report is anticipated in December 2012 or January 2013 that summarizes the findings.

Discussion
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 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. For some other barren ground herds, researchers have documented very low sex ratios (less than 20 or even 10:100 cows) but have not seen that the pregnancy rate has dropped.

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. Population modeling showed 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 in the harvest, therefore another composition count to get an updated bull ratio was completed in 2009 and 2010 (prior to an increase in bulls in the harvest under the HMP).

The PCTC plans to conduct a rut count in every year that a photo census is done in order to input the sex ratio into the population model (Herd Estimator). 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. The PCTC still needs to determine how many collars are needed to provide the precision needed to assess the effect of harvest on the herd sex ratio.

HARVEST

This section does not include updated information from 2012/13.

Hunt management

On an annual basis, caribou harvest is dependent on the distribution of the herd and whether the herd migrates close to communities. For example, if few caribou use the Alaskan winter ranges, harvest by hunters of the PCH in Arctic Village is nil.

Hunters from each user community access the herd in different seasons and in different regions of the herd's range. Kaktovik hunters hunt caribou along the north coast in summer once the sea ice melts and they are able to use boats to reach caribou. In summer, caribou can be available to Mackenzie Delta hunters along the coast or in the Richardson Mountains. Caribou can be hunted by Old Crow hunters as they cross the Porcupine River during the fall and spring migrations. In late fall, many hunters from different user groups can access caribou near Arctic Village, in the Richardson Mountains and along the Dempster Highway.

Over the years, we've seen that the Dempster Highway provides very convenient access to the herd from early fall to early spring and most of the reported harvest by Canadian hunters takes place along the highway.

In Alaska, there are laws regulating all users. In Yukon and NWT, non aboriginal hunters must abide by license, tag and season regulations. In the Yukon, non-resident Canadians must hunt with a Yukon Resident holding a Special Guide license and non-resident aliens must hunt with a registered outfitter. There is currently no non-resident hunting of Porcupine Caribou in the NWT.

In February 2011, the Porcupine Caribou Management Board hosted the first Annual Harvest Meeting under the HMP. From this meeting, the PCMB recommended that the Canadian Parties adopt the Green harvest management zone. Harvest management in this zone means that there is no restriction on aboriginal harvest and licensed hunters are limited to 2 bulls per year. Hunting regulations were changed and implemented for the fall 2011/12 season.

See Figures 8, 9 and 10 for regulations for all three jurisdictions for the 2011/12 season.

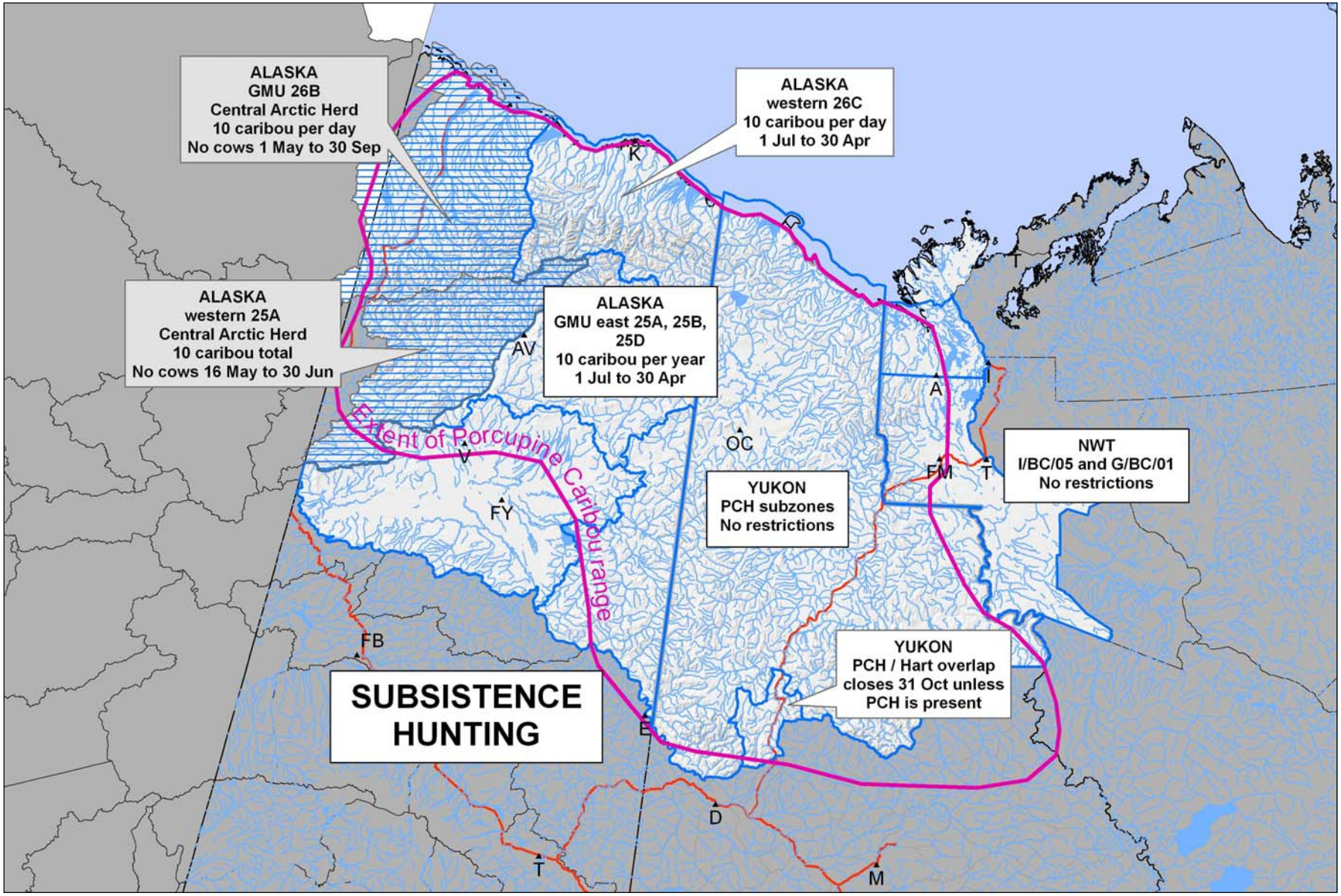


Figure 8. Hunting regulations for PCH subsistence hunters, 2012/13.

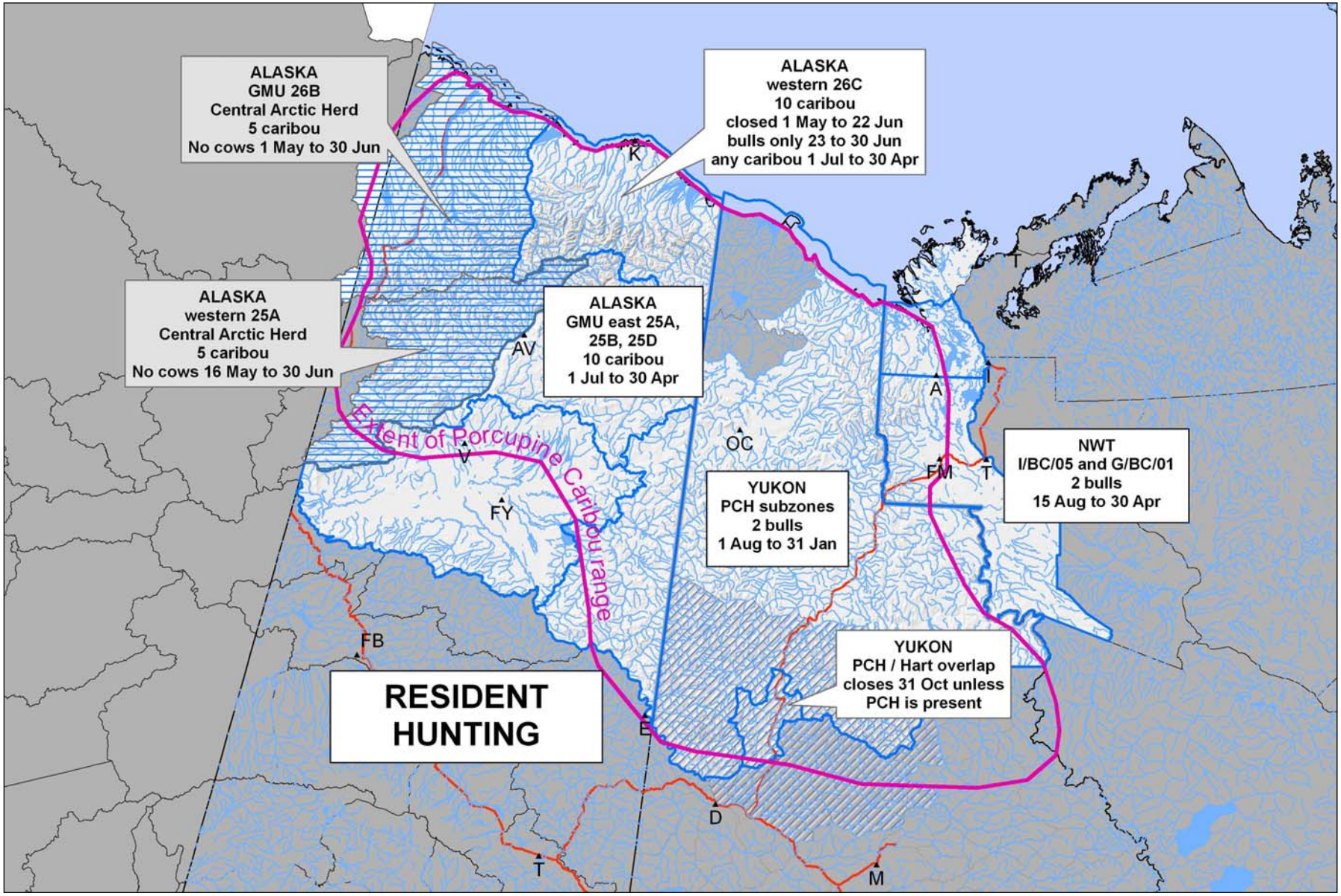


Figure 9. Hunting regulations for PCH resident hunters, 2012/13.

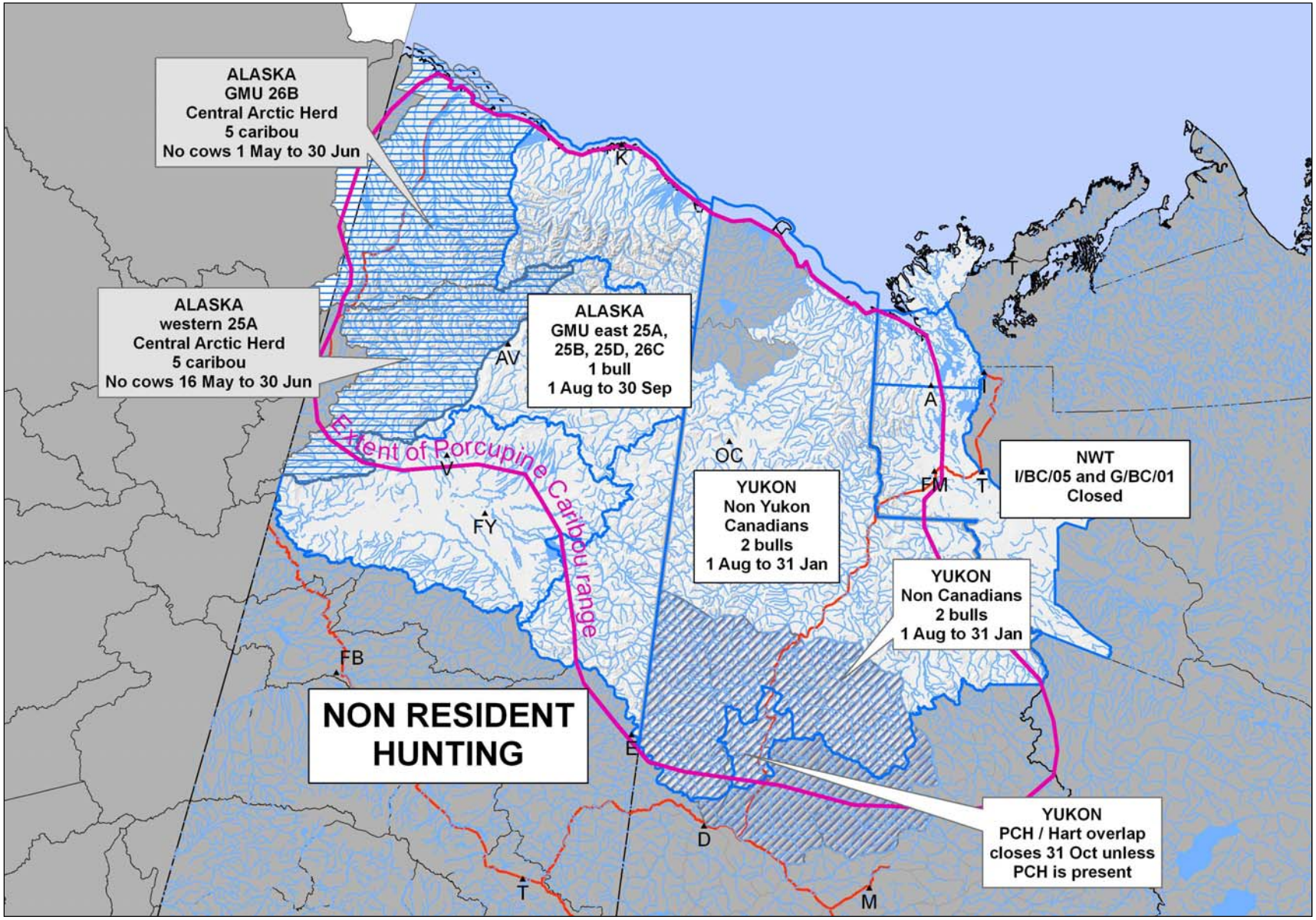


Figure 10. Hunting regulations for PCH non-resident hunters, 2012/13.

Estimated number of caribou harvested

This section does not include updated information from 2012/13.

Proportion of females in the harvest

This section does not include updated information from 2012/13.

Were hunters' needs met?

Objective
To determine if hunter's met their needs for caribou that year.

Methods
The ability of hunters to meet their needs for caribou is an important indicator tracked during yearly ABEKC interviews. Data summaries were provided for all seasons for 2010 and 2011 (ABEKC 2010 and 2011). Interviewees were asked whether they met their needs for caribou for that years' hunting period with answers of "yes" or "no". Note that interviewees are selected by communities and the monitors with the intention of interviewing a select number of land users engaging with a suite of ecological indicators (ie. this should not be considered a random sample of caribou harvesters and should not be extrapolated to sampled communities).

Results
The majority of respondents met their needs for caribou in both 2010 and 2011. There is a slight increasing trend as 9% more respondents met their needs in 2011 when compared to 2010. Interviews for 2012 will be completed from January to Feb 2013.

Discussion
An analysis of ABEKC data based on interviews from 2000-2007 was recently completed by Russell et al. (In Press). Researchers found that there was a general increasing trend in meeting needs in both spring and fall hunting periods over time (Russell et al. In Press). From 2005-2007, respondents met their needs on average 70% and 80% during fall and spring, respectively. There was a significant but weak relationship between meeting needs and caribou availability in both seasons during this time period.

The average percentage of respondents that met their needs for caribou from 2010 to 2011 was 14% lower than 2005-2007. If this indicator is correlated with how available caribou are on the landscape then it suggests that caribou availability in 2010-2011 was lower than 2005-2007.

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.

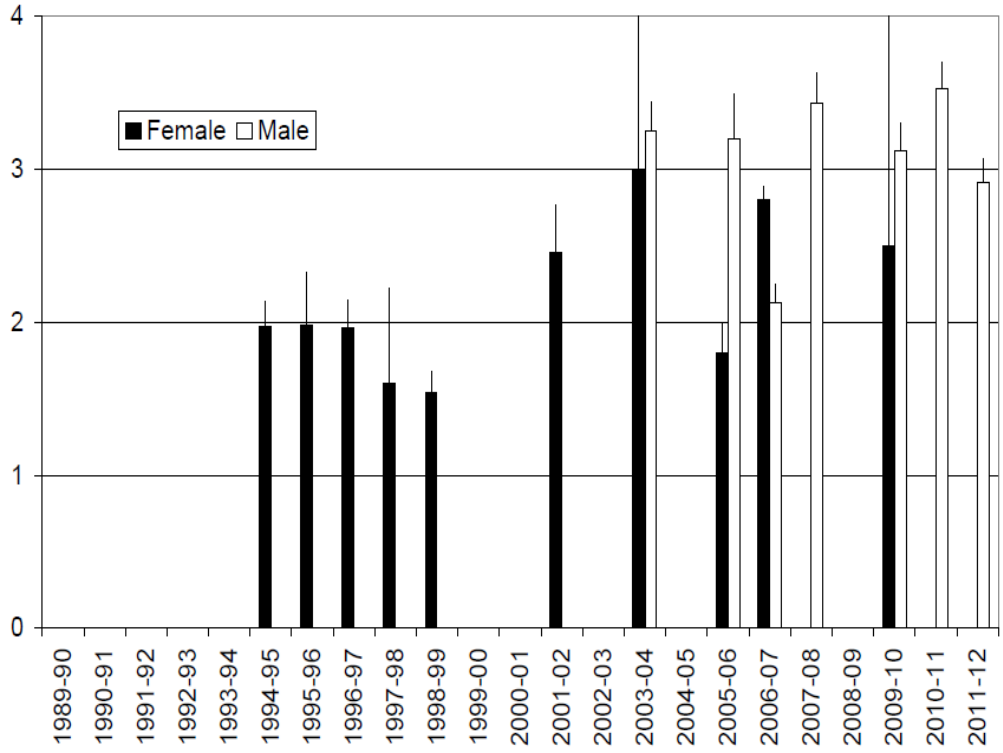
Methods
Starting in 1987, Anne Allaye-Chan (a PhD student from University of Alaska Fairbanks) developed equations to estimate the body weight, body fat and body protein for adult cow Porcupine Caribou (Allaye-Chan 1991). Government of Yukon (YTG) did collections from 1989 to 1991 to test these equations and in 1991, started regular monitoring with hunters from Old Crow (Porcupine River in September), Ft. McPherson, Dawson and Mayo (Yukon portion of the Dempster Highway in November and March).

In 2001, we formally modified the program so that hunters could submit samples from any caribou they harvest. This program is also called the Caribou Sampling Initiative (CSI) in the HMP and is also 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
Overall, average body condition of harvested male caribou is classified as good but declined slightly in 2011-12 (Figure 11). Data show increased variability since 2001. Average backfat depth of harvested males shows an increasing trend since 2009-10 (Figure 12). All animals reported for 2011-12 are from the fall of 2011. There is no data for the winter of 2011-12. The current year and 5 year running averages are for males only due to recent bull-only hunting restrictions.

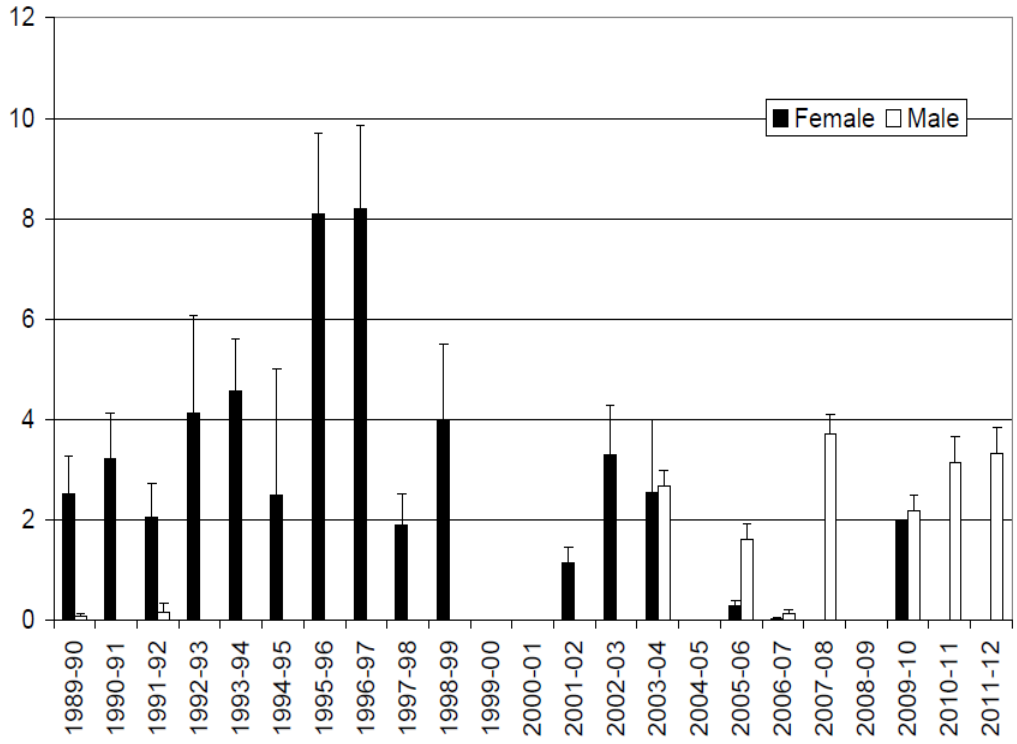
Discussion
Variability in body condition estimates since 2001 corresponds to when hunters began rating their harvested caribou compared to when they were working with the biologists on the collection. This could also be a seasonal effect; caribou collections in the early 1990's were done 3 times (Sept, Nov and March) whereas the current system allows hunters to submit samples all winter long. This improving condition was also seen in the Arctic Borderlands Ecological Knowledge Co-op data (Russell et al 2008; Russell 2011).

We should also keep in mind 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. With regulation changes that discourage or prohibit the harvest of cows, the program will document trends over time for bulls rather than using the equations to try and determine productivity of cows.



1=poor 2=fair 3=good 4=very good
Error bars are standard errors. Labels indicate # of caribou sampled.

Figure 11. Average condition of harvested Porcupine caribou recorded by hunters.



Error bars are standard errors. Labels indicate # of caribou sampled.

Figure 12. Average depth of backfat recorded in Body Condition Monitoring.

Observed Body Condition and Health of Caribou

Objective
To determine trends in body condition of Porcupine caribou between years and seasons.

Methods
Body condition and health of caribou are important indicators tracked during their yearly ABEKC interviews. Data summaries were provided for all seasons for 2010 and 2011 (ABEKC 2010 and 2011). Interviewees were asked to about the condition of caribou they observed each season over the past year. There are six possible responses to this question; Don't Know, Excellent, Good, Fair, Mixed and Poor. Respondents that stated "Don't Know" were not included in the analysis. Note that interviewees are selected by communities and the monitors with the intention of interviewing a select number of land users engaging with a suite of ecological indicators (ie. this should not be considered a random sample of caribou harvesters and should not be extrapolated to sampled communities).

Results
Respondents observed caribou most often in good condition in both 2010 and 2011. On average, there was no difference in the percent of respondents that observed caribou in excellent and good condition in 2011 compared to 2010 (Figure 13). Differences between seasons and years were variable, however, 11% more respondents observed caribou in excellent and good condition in spring 2010 compared to 2011. Interviews for 2012 will be completed from January to Feb 2013.

An average of 6% more respondents observed caribou in fair and poor condition in 2011 compared to 2010. This trend is similar across all seasons. Caribou in mixed condition were observed by respondents 5% more in 2010 than 2011 in all seasons with the exception of spring (Figure 13).

Discussion

The ABEKC data is useful because provides additional body condition information on the entire herd that might not be captured with the body condition monitoring of harvested caribou only (e.g. males only in some management regimes). Preliminary data from interviewees suggest that the overall body body condition of Porcupine caribou was good in both years. There is a slight increasing trend of caribou in fair and poor body from 2010 to 2011 but the number of these observations remain small.

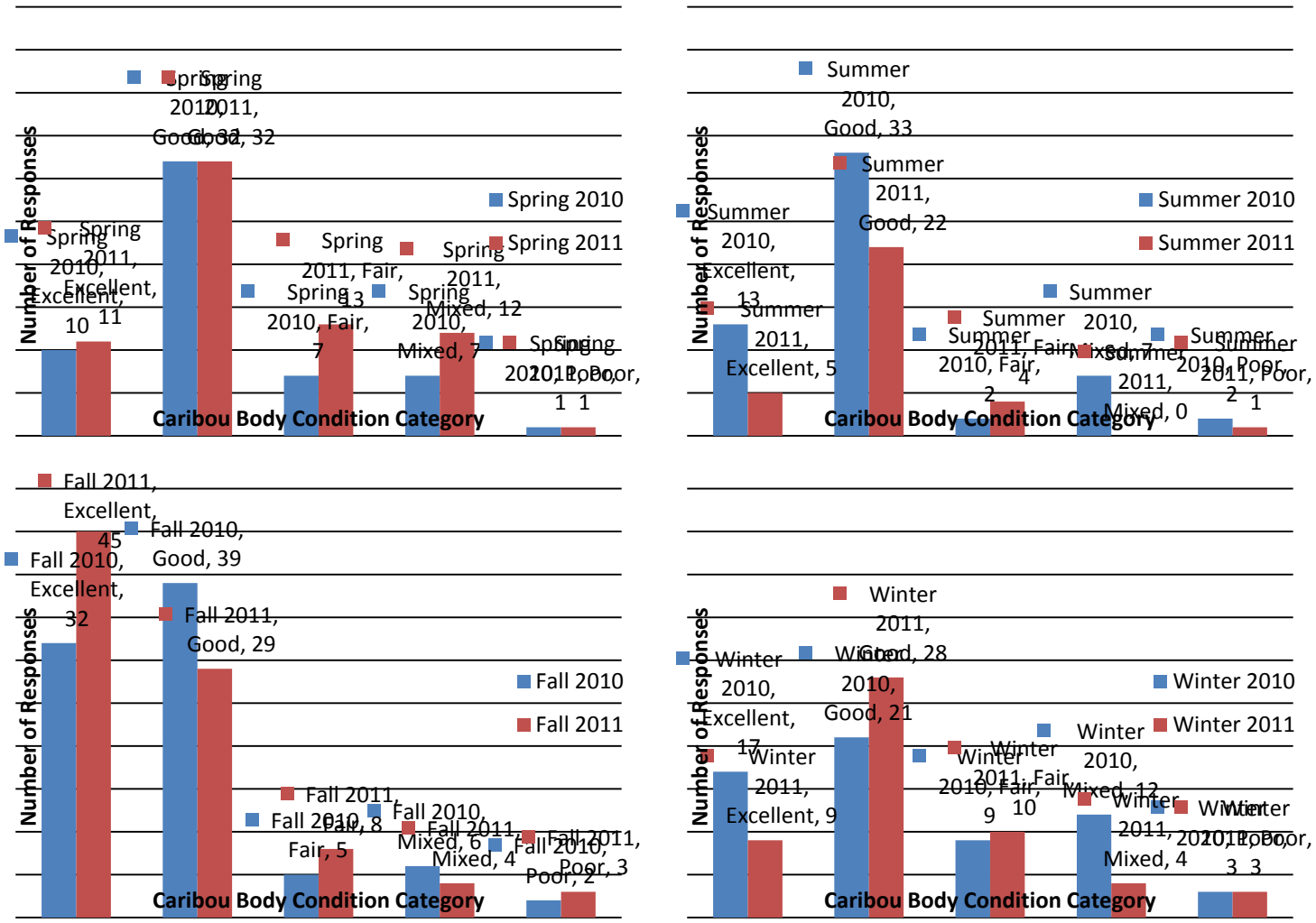


Figure 13. A summary of Arctic Borderlands Ecological Knowledge Coop interview results in 2010 and 2011. Respondents were asked about the overall condition of Porcupine caribou that they observed in each of the four seasons.

Abnormalities

Objective
To determine trends and types of abnormalities observed on Porcupine Caribou across all seasons.

Methods
Body condition and health of caribou are important indicators tracked during their yearly ABEKC interviews. Data summaries were provided for all seasons for 2010 and 2011 (ABEKC 2010 and 2011). Interviewees were asked to identify caribou physical abnormalities on the caribou that they observed in each season over the past year. Respondents could select one or a number of categories for this question; 1) Bad Liver 2) Cysts and white spots 3) Don't Know 4) None 5) Sores and pus 6) swollen joints, testes glands, or 7) wounded and limping. Not all fields were reported in all seasons. Interviewees that responded "Don't Know" to the questionairre were excluded from the analysis. Respondents that stated "Don't Know" were not included in the analysis. Note that interviewees are selected by communities and the monitors with the intention of interviewing a select number of land users engaging with a suite of ecological indicators (ie. this should not be considered a random sample of caribou harvesters and should not be extrapolated to sampled communities).

Results
The percentage of responses that indicated the presence of a physical abnormality in the caribou they observed in 2010 and 2011 was similar across all seasons except spring (Table 2). Spring had an approximately 50% lower incidence of physical abnormalities on observed caribou. The number of physical abnormalities reported by interviewees increased from 2010 to 2011 in all seasons except summer (Table 2). Interviews for 2012 will be completed from January to Feb 2013.

Table 2. Summary of physical abnormalities from Porcupine caribou during Arctic Borderlands Ecological Knowledge Coop interviews in 2010 and 2011.

Season	Total Number of Responses (2010 and 2011)	Total Physcial Abnormalities Observed (% of observations in 2010 and 2011)	Trend 2010 to 2011
Winter	53	28%	Increasing (1.5X)
Spring	68	32%	Increasing (2X)
Summer	44	16%	Stable (small sample size reported)
Fall	79	29%	Increasing (2.8X)

Discussion
This indicator may be useful to track overall health, parasite load, and the influence of disease on the herd. Increases in these trends could be used to initiate additional disease sampling programs.

HABITAT

Human Footprint

Objective
To determine how Porcupine caribou use habitat surrounding human features such as the Dempster Highway, seismic lines and other human “footprints” within their winter range.

Methods
Researchers used Resource Selection Functions (RSF’s) to statistically compare habitat use of known animal locations with a set of randomly selected locations that characterize the surrounding habitat (Johnson and Russell 2012). Avoidance or preference for certain habitats or human features can be determined if caribou select locations in a different proportion to what is available to them on the landscape.

Johnson and Russell (2012) used 3520 caribou locations (satellite collars) and 17600 random locations from 1985 - 2012 to quantify caribou habitat use on their winter range. They divided the analysis into two time periods (1985-1998 and 1999-2012) and into below average and above average snow years. The caribou and random locations were overlain on maps of landcover and human features (Dempster Highway, Settlements and low use human features; Figure 14). The Zone of Influence (ZOI) was also calculated for each human feature. This measurement represents the distance at which caribou no longer demonstrate a response to the human feature (e.g. avoidance).

Results
- Strongly selected for Sparse Mixed Forest, Wet grass/sedge Tundra and Alpine Tundra landcover classes
- Avoided Mixed Forest and Barren landcover classes
- Strong avoidance to both Settlements and the Dempster Highway (few locations Settlements)
- Weak avoidance of Low Use human features (seismic lines, well sites and winter road)
- ZOI was largest during the 1985-1998 for all disturbance types
- ZOI for Settlements was 34.5-38 km, however difficult to verify due to few caribou locations in vicinity of settlements and settlements located at the edge of the winter range
- ZOI for Dempster Highway was 30 km during 1985-1998 and 18.5 km during 1999-2012
- ZOI for wells, trails, winter roads and seismic lines was 11 km during 1984-1998 and 6 km during 1999-2012
- No influence of snow depth on distribution based on habitat or human features

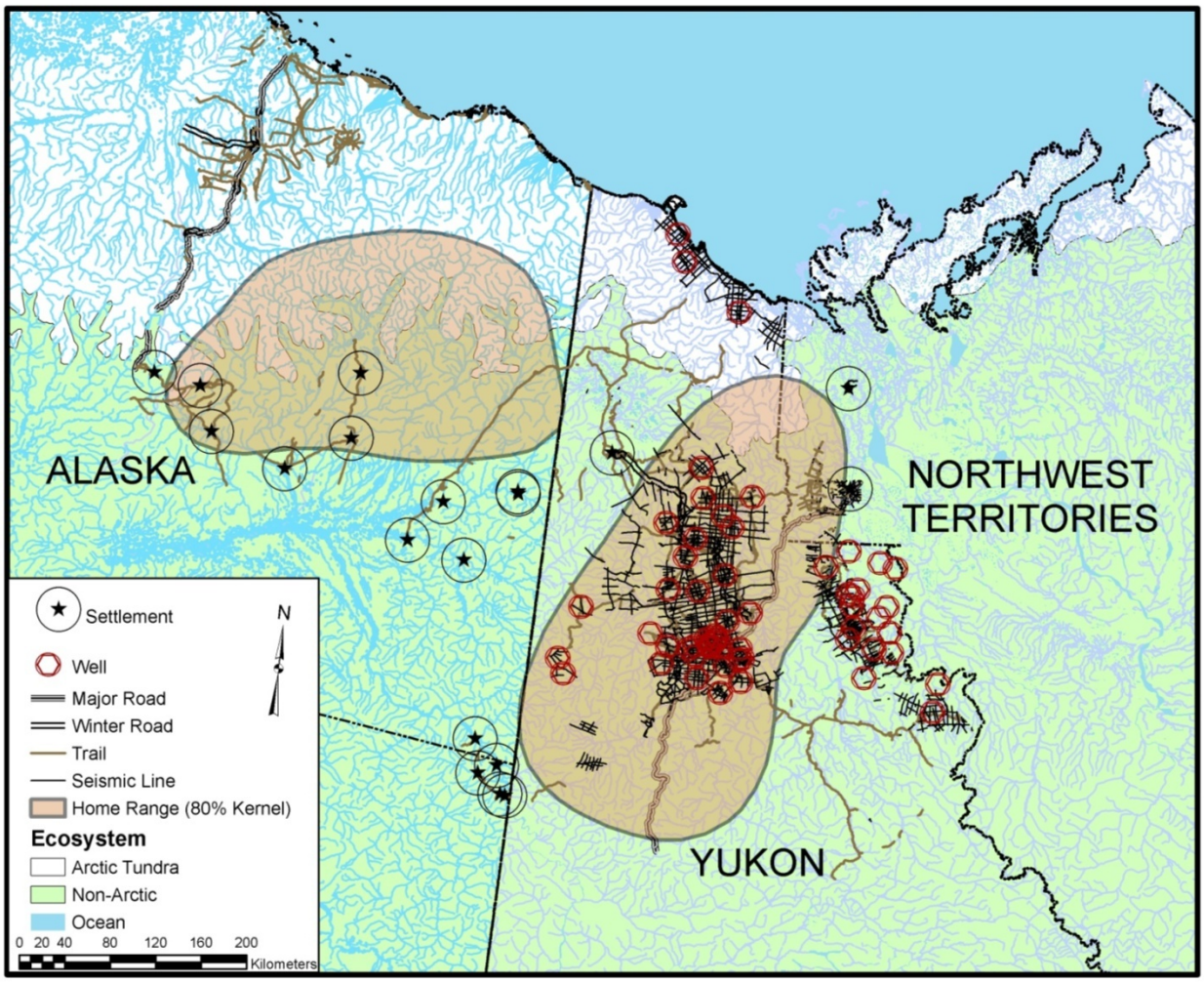


Figure 14. Location of human disturbance features and the winter range of the Porcupine caribou herd across the Yukon and Northwest Territories, Canada and Alaska, USA (source: Johnson and Russell 2012).

Discussion

The Porcupine Caribou herd showed larger zones of influence and stronger avoidance responses to human features than similar research completed on the Bathurst Caribou herd. Settlements have the largest zone of influence which may be based on true avoidance of settlements by caribou or the winter distribution may not include settlements. Stronger response to human features during 1985-1998 may be because the features were relatively new on the landscape (e.g. seismic lines). Therefore, caribou may change their response depending on the age or condition of the human feature or become habituated to the human feature over time.

We can use this information to assess what proportion of the population may be affected by future development. In the future, researchers could link information on avoidance of human features to the energy-protein model and the Caribou Estimator to estimate how development would affect the growth of the herd.

Wildland fires

2012 season fire map data is not yet publicly available from Yukon or NWT. This section of the report contains information current to 2011 (identical to previous Status Reports).

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 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 since 1965-2011 was summarized in this report.

Results
As of the 2011 season, the total area burned by fires since 1960 is 37,779 square kilometers or roughly 15% of the herd's total annual range (Figure 15). Fires in 2011 burned a total of about 22 square kilometers, much lower than the average area burned (570 sq km) in the previous 5 years and significantly less area than the largest fire years in the 2000's (e.g., area burned in 2004 was 10,213 km^2 and in 2005 was 5691 km^2). There were no fires in the NWT and only one in the Alaskan portion of the range in 2011. There were four in 2011 in the Yukon, the largest of which was ~ 14 km^2. The years 2004 and 2007 show the largest number of large fires recorded in recent years (Figure 16). Fires in 2004 and 2005 resulted in record large tracts of area burned (Figure 17).

Discussion
Fire perimeters are mapped by the fire management sections of the 3 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 therefore 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 finally some fires burn areas that were previously burned.

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 that they 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.

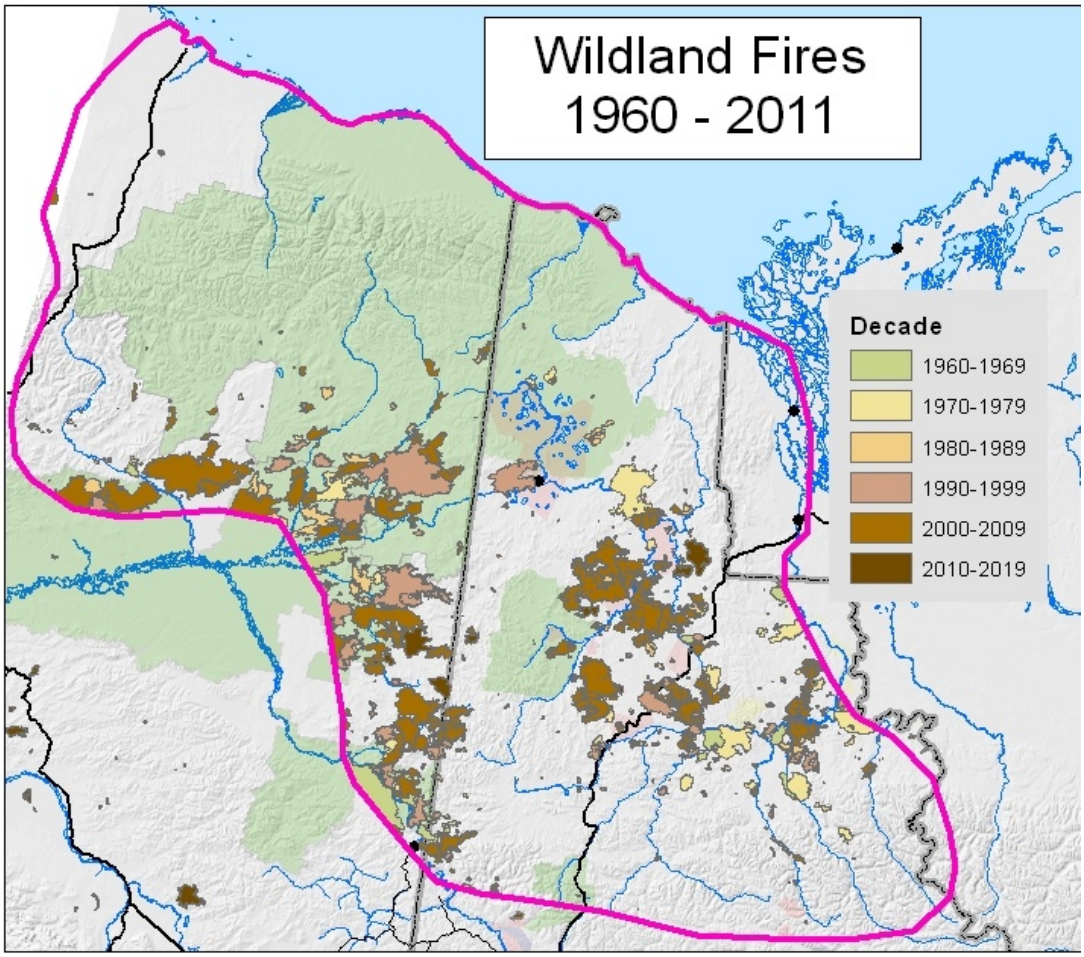
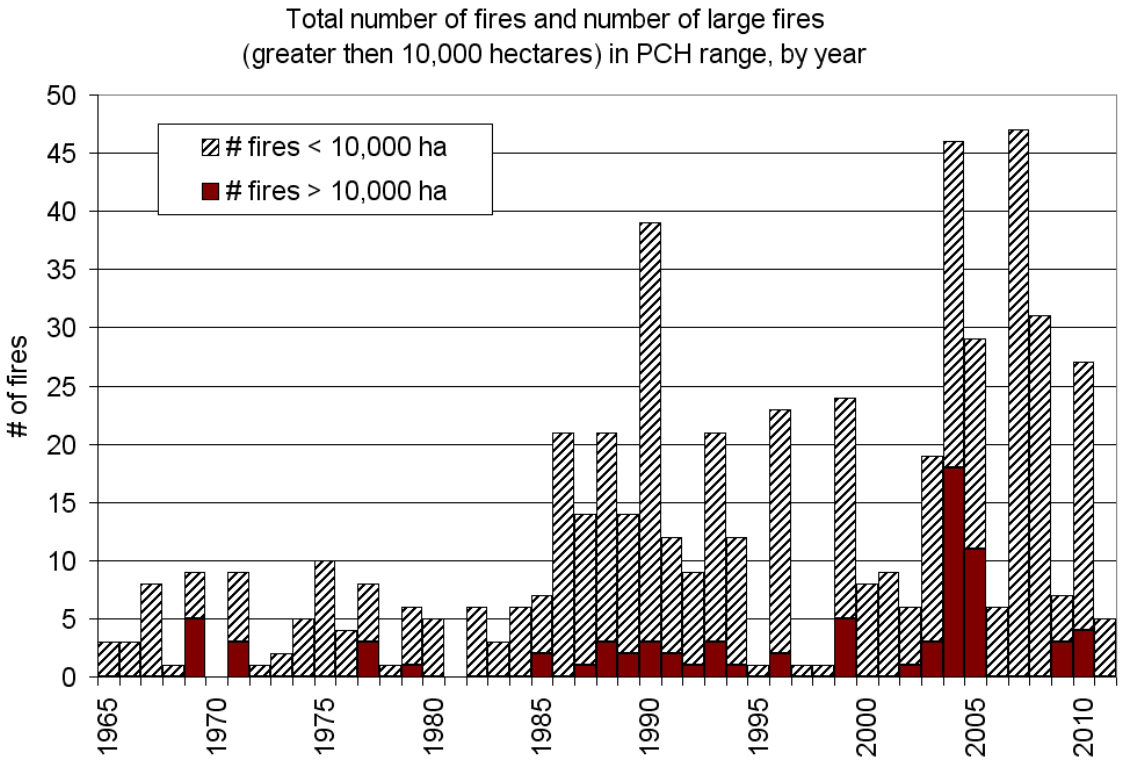


Figure 15. Areas burned within range of the Porcupine Caribou Herd in Alaska, Yukon and Northwest Territories from 1960 to 2011.



Includes NWT fire data (© 2002-11. Government of NWT with permission from Environment and Natural Resources, NWT), Alaska and Yukon fire data.

Figure 16. Total number of fires and number of large fires to 2011 within the within the range of the Porcupine Caribou Herd in Alaska, Yukon and Northwest Territories.

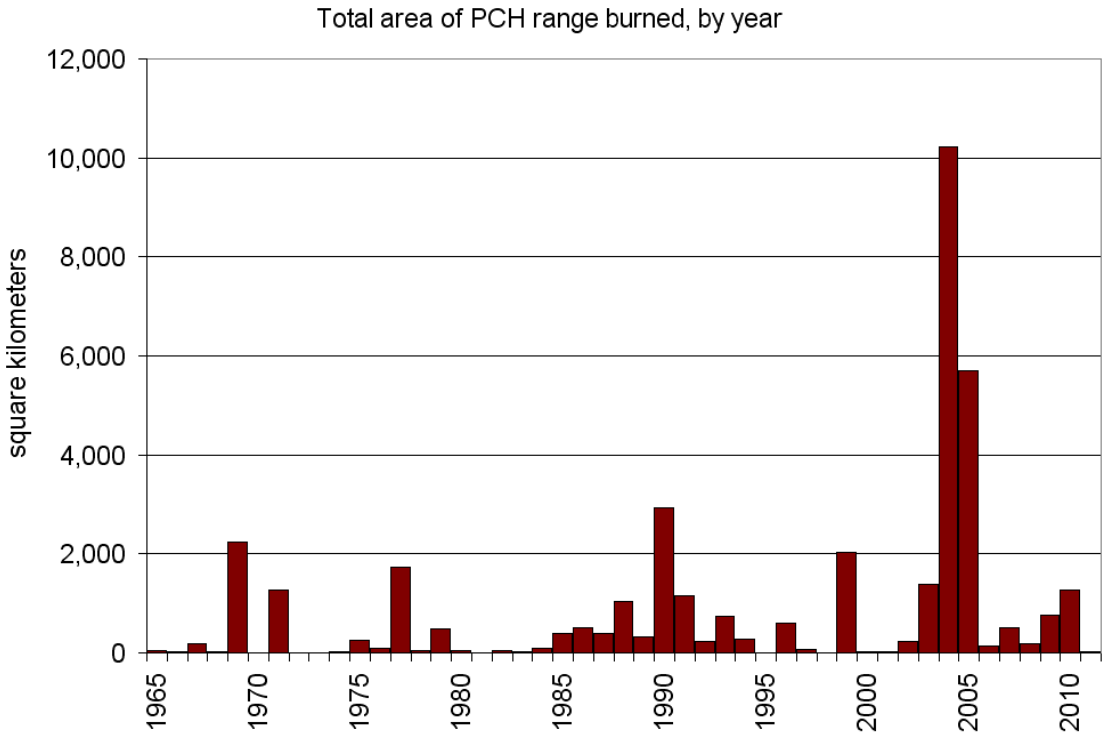


Figure 17. Total area burned by fire, by year to 2011 within the range of the Porcupine Caribou Herd in Alaska, Yukon and Northwest Territories.

Importance of Weather and Climate

Objective
Determine the role of weather and climate in the productivity of the Porcupine Caribou herd by comparing climate indicators from the 1970's until present day to find patterns that are consistent with an increasing or declining herd.

Methods
Russell (2012) used key indicators from CircumArctic Rangifer Monitoring and Assessment (CARMA) Network's climate database ranging from 1979 to 2010. He provided a graphical summary for all 32 years and then averaged the data for analysis into 3 phases that represented overall PCH population trends:

- 1980s increase (1979-1987)
- 1990s decline (1988-1999)
- 2000s increase (2000-2010)

Results
Overall, the 1990s represented the least favourable conditions for caribou, consistent with the declining trend during this period (Table 3; Russell 2012). The conditions were very similar between the 1980s and 2000s. The green colour indicates most favourable conditions to caribou, while yellow and red represent average and least favourable conditions, respectively (Table 3).

Table 3. The weather and climate patterns for the Porcupine Caribou Herd, averaged for three population trend phases from 1980's-2010. Green – most favourable to caribou; yellow – average condition, and; red - least favourable. Source: Russell 2012.

Season	Indicator	1980s	1990s	2000s	Figure(s)
Calving					
	Snow on ground May 20				2,3
	Early green-up (GDD>70 C)				5,6
	Growing degree days June 20				4,7,8,9
	Cotton grass index				12,13
Summer					
	Cumulative oestrid index				14,16
	Cumulative mosquitoe index				15,16
	Days of high oestrid harassment				17,19
	Days of high mosquitoe harassment				17,19
	Length of oestrid season				20,22
	Length of mosquitoe season				21,22
	Drought index				23,24
Fall					
	Mushroom index				25,26
	Amount of freezing rain				27,28
	Days of freezing rain				29,30
Winter					
	Beginning of winter snow				31,32
	Maximum snow depth				33,34,35
	Forest fire index (drought index)				36,37,38
Spring					
	# freeze-thaw events to April				39,40
	Snow melt in April				41,42
	Snow depth May 15				43,44

Discussion

Russell (2012) speculated that poor winter and spring conditions in the 1990s could have set up for cows entering the calving period in poor condition resulting in higher cow mortalities, higher early calf survival but poorer subsequent survival, smaller calves, smaller females, later average age of first reproduction and overall lower herd productivity. Russell (2012) suggests this as a possible mechanism for the decline of the herd in the 1990s. The next step is to integrate climate and population productivity to see how different climate scenarios affect the body condition of an adult female PCH cow.

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, a series of measurements are made, usually 10 repeated measures and depth and either snow density or snow water equivalent (SWE) is recorded. Where necessary, SWE is converted to density by dividing SWE by the depth of snow. Not all stations were measured in all years. Data presented in this report represents results from 17 stations from the Yukon since 2012. Data from other jurisdictions were not available in a compatible form for this report.

Results
Recent data don't show any trends or large deviations from long term averages
Figure 18). The red lines delineate snow regions, relevant to caribou (Russell et al 1993).

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.

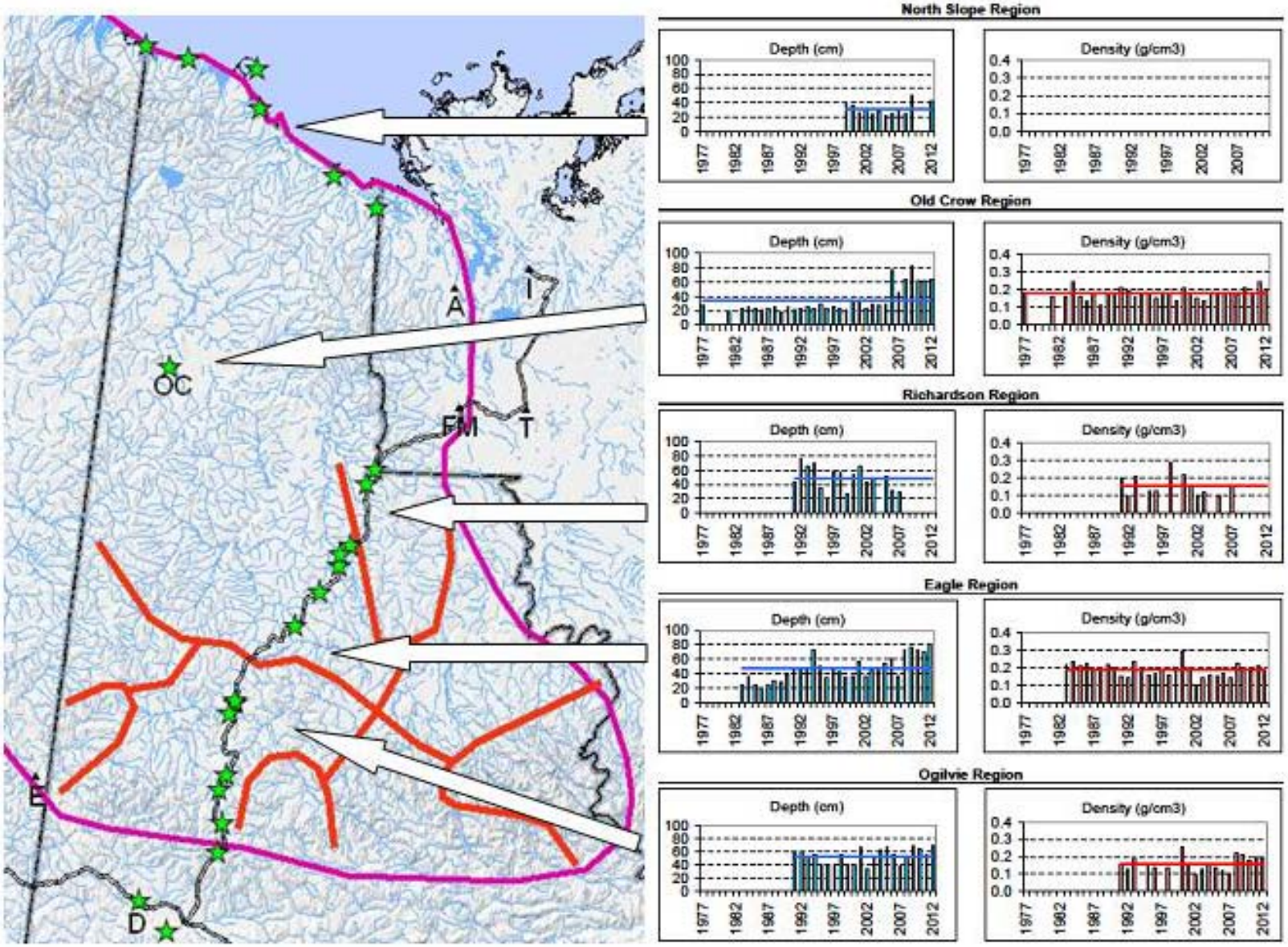


Figure 18. Summary of snow depth and density by snow region from permanent stations (indicated by green stars) for the Yukon portion of the Porcupine Caribou Herd range. Red lines on the map delineate snow regions relevant to caribou (Russell et al 1993).

Extreme weather events

Objective
To gather information on unusual and rare weather events (icing and snow) that may affect Porcupine caribou.

Methods
Unusual, extreme and rare weather related events are important indicators tracked during yearly ABEKC interviews. Data summaries were provided for all months for 2010 and 2011 (ABEKC 2010 and 2011). Interviewees were asked to identify the months when they observed any of the following usual, extreme or rare weather-related events; torrential rain, icing event, really frosty, drought – very dry conditions, other (specified) or none. Each month could have one or more options checked. All snow and icing events were tallied and summarized by month and year. Respondents that stated "Don't Know" were not included in the analysis. Note that interviewees are selected by communities and the monitors with the intention of interviewing a select number of land users engaging with a suite of ecological indicators (ie. this should not be considered a random sample of caribou harvesters and should not be extrapolated to sampled communities).

Results
2010 had 1.7 times more icing and 2.5 times more snow events when compared to 2011 (Figure 19 &
Figure **20**). In both years, October had the most icing events, while December experienced the largest number of snow events. January was the most different month between the years, with the number of icing and snow events being greatest in 2010 (Figure 19 &
Figure **20**). Interviews for 2012 will be completed from January to Feb 2013.

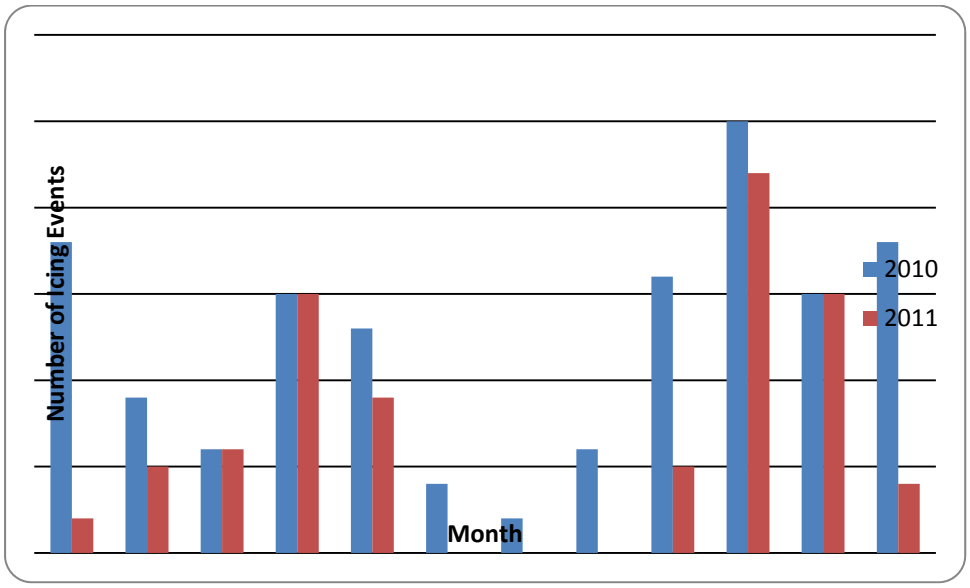


Figure 19. Number of icing events that respondents identified during Arctic Borderlands Ecological Knowledge Coop interviews in 2010 and 2011.

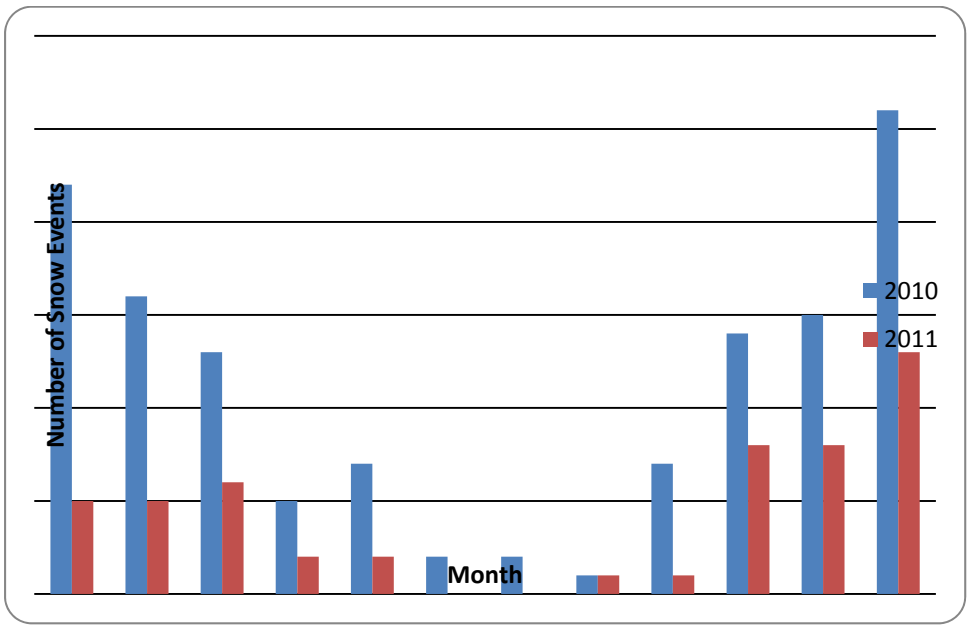


Figure 20. Number of snow events that respondents identified during Arctic Borderlands Ecological Knowledge Coop interviews in 2010 and 2011.

Discussion

Deep snow and periodic icing events on the winter range can restrict the ability of caribou to access their food. These weather events are often suggested to be the cause of mass starvation, catastrophic declines and extirpation of local populations in reindeer and caribou herds. However, a comprehensive review of the impact of climate, snow and ice in the declines of reindeer and caribou populations states that there is little evidence to suggest that this is true across the extent of caribou distribution (Tyler 2010). In some cases there was a lack of data on weather and ground conditions at the same time as changes in population size so it was difficult to determine the cause of the decline. Therefore, it is important to track snow and icing conditions in conjunction with other population indicators. Unusual, extreme and rare weather may become increasingly important with long-term changes in climate.

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Appendix A. Summary of biological parameters

Year	Cows Observed[b]	Parturition Rate	June Calf Survival[c]	Post-calving Survival[d]	July Calf:Cow[e]	March Calf:Cow[f]	Population Estimate	Peak of calving	Calving note
1985		0.77			0.46				
1986		0.74							
1987	51	0.78	0.71		0.55		165,000		
1988	91	0.84	0.65		0.55				
1989	74	0.78	0.74		0.58	0.43	178,000		
1990	74	0.82	0.90		0.74				
1991	77	0.74	0.82		0.61	0.22			
1992	78	0.86	0.57		0.49	0.33	160,000		
1993	63	0.81	0.56	0.83	0.45	0.32			
1994	98	0.91	0.77	0.93	0.70	0.40	152,000		
1995	95	0.69	0.85	0.92	0.59	0.41			
1996	74	0.89	0.81	0.91	0.72	0.46			
1997	48	0.75	0.77	0.90	0.58	0.38			
1998	58	0.83	0.82	0.94	0.68	0.27	129,000		
1999	39	0.84	0.83	0.86	0.70	0.56		3-Jun	1-5 June
2000	44	0.73	0.61	0.82	0.44	0.28		7-Jun	
2001	70	0.84	0.61	0.79	0.51	0.31	123,000	8-Jun	5-10 June
2002	68	0.87	0.65	0.85	0.56	0.38		5-Jun	
2003	70	0.87	0.79	0.85	0.69	0.33		1-Jun	
2004	74	0.82	g	g	g	0.24		3-Jun	3-4 June
2005	55	0.64	0.77	0.88	0.49	h		2-Jun	1 - 4 June
2006	66	0.79	0.73	0.86	0.58	0.39		2-Jun	
2007	67	0.88	0.83	0.90	0.73	h		30-May	
2008	63	0.79	0.73	0.92	0.59	h		30-May	29 or 30 May
2009	65	0.77	0.57	0.75	0.44	0.19		2-Jun	
2010	41	0.85	0.76	0.87	0.65	h	169,000	1-Jun	prior to 2 Jun

Year	Cows Observed[b]	Parturition Rate	June Calf Survival[c]	Post-calving Survival[d]	July Calf:Cow[e]	March Calf:Cow[f]	Population Estimate	Peak of calving	Calving note
2011	59	0.86	0.48	0.59	0.41	h		30-May	prior to 1 Jun
2012	g	g	g	g	g			30-May	prior to 1 Jun
Mean		0.81	0.72	0.85	0.58	0.35		2-Jun	
5 yr mean		0.83	0.67	0.81	0.56			30-May	

[a] 1987-2003 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.
[c] Estimated as (July calf:cow ratio)/(parturition rate).
[d] Includes only calves observed during early June whose mothers were observed in late June (i.e., does not include most perinatal mortality).
[e] Includes only radiocollared cows >3 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 or mixing of herds
[h] No data due to mixing of herds