



Peary Caribou and Muskox Survey of the Melville-Prince Patrick Complex, Northwest Territories and Nunavut, Summer 2012

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ABSTRACT

In July 2012, an aerial fixed-wing transect survey of Peary caribou species and muskoxen species was conducted on the Melville-Prince Patrick Island complex, Northwest Territories and Nunavut. This area had not been surveyed for these species since 1997. A Helio Courier was used for the survey with observers on each side and a recorder/navigator in the front. Survey lines were generally spaced at 5 km intervals and ground coverage was about 20%. We estimated the population of Peary caribou on the Melville-Prince Patrick complex to be over 5,500 adult caribou, where in 1997 the population estimate was below 1,000. We estimated the population of muskoxen on the Melville-Prince Patrick complex to be over 3,500 adult caribou, where in 1997 the population estimate was below 2,400. In 1997 there were no living caribou found on the smaller islands of the complex (Eglinton, Emerald and Byam Martin islands), however in this survey caribou were found on all three islands. In 1997 and in this survey there were no living muskoxen on Emerald or Byam Martin Island. Results showed an increase in overall numbers of caribou and muskoxen since 1997; however the trend between the 1997 and 2012 surveys is unknown because of the extended time between surveys. We assessed weather patterns from 1979-2012 in the area using the MERRA database; this suggested that winter icing events were relatively rare over this period and snow cover generally was consistent.

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INTRODUCTION

Peary caribou (*Rangifer tarandus pearyi*) are a subspecies of caribou characterized by their adaptation to living in the high Arctic. They are endemic to northern Canada and found in the Arctic Archipelago on several islands, including the Queen Elizabeth Islands. Peary caribou were assessed as Endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in large part due to overall population declines of 72% since 1961 (COSEWIC 2004), and assessed as threatened in the Northwest Territories by the Species at Risk Committee (SARC) in 2012 (SARC 2012). Peary caribou are a species of high cultural and economic importance to Inuvialuit and Inuit people. The Ulukhaktok community conservation plan (Ulukhaktok 2008) identifies areas of Melville Island as important for Peary caribou.

The planned 2012 survey area was to include eight western Queen Elizabeth Islands: the Melville-Prince Patrick complex which includes Melville, Prince Patrick, Eglinton, Byam Martin and Emerald Islands, and a group of islands collectively called the Prime Minister Group (Brock, Mackenzie King and Borden Islands; Figures 1, 2).

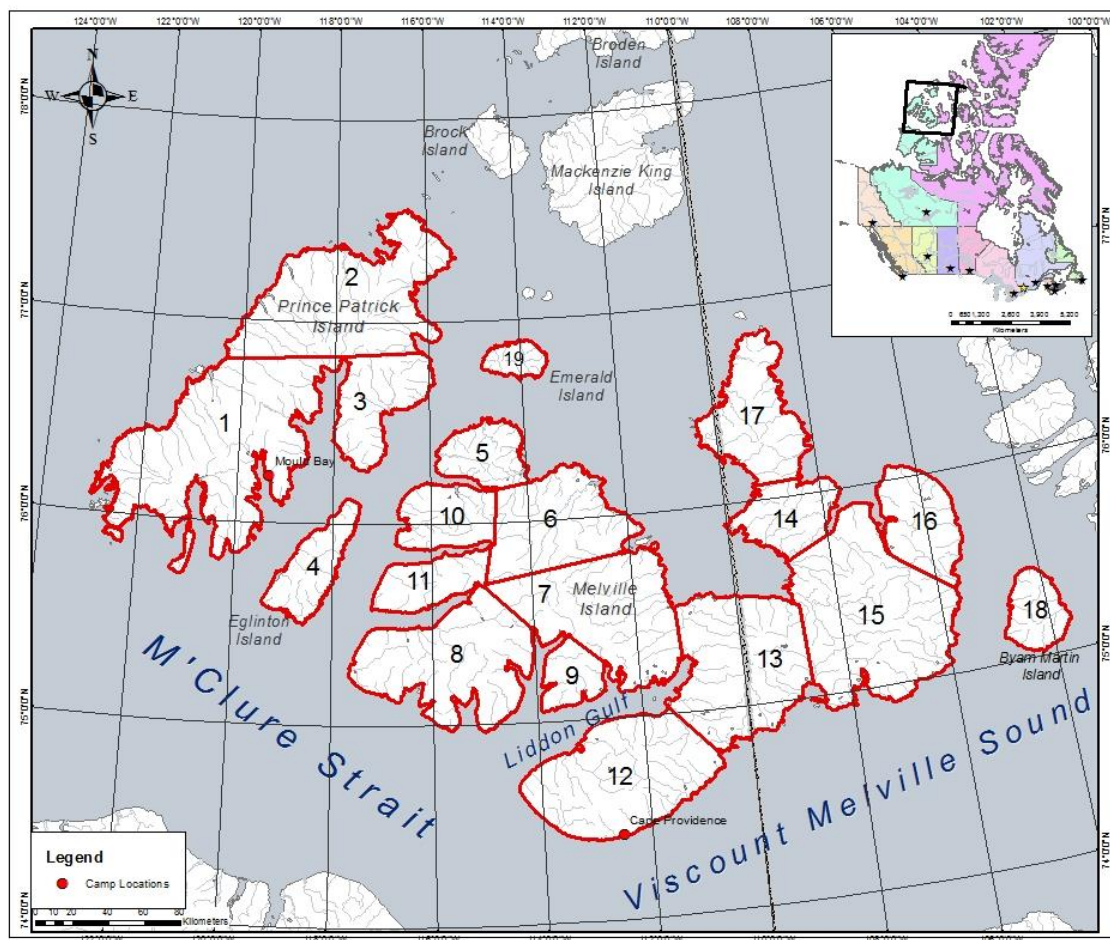


Figure 1. Survey area in 2012 divided by strata.

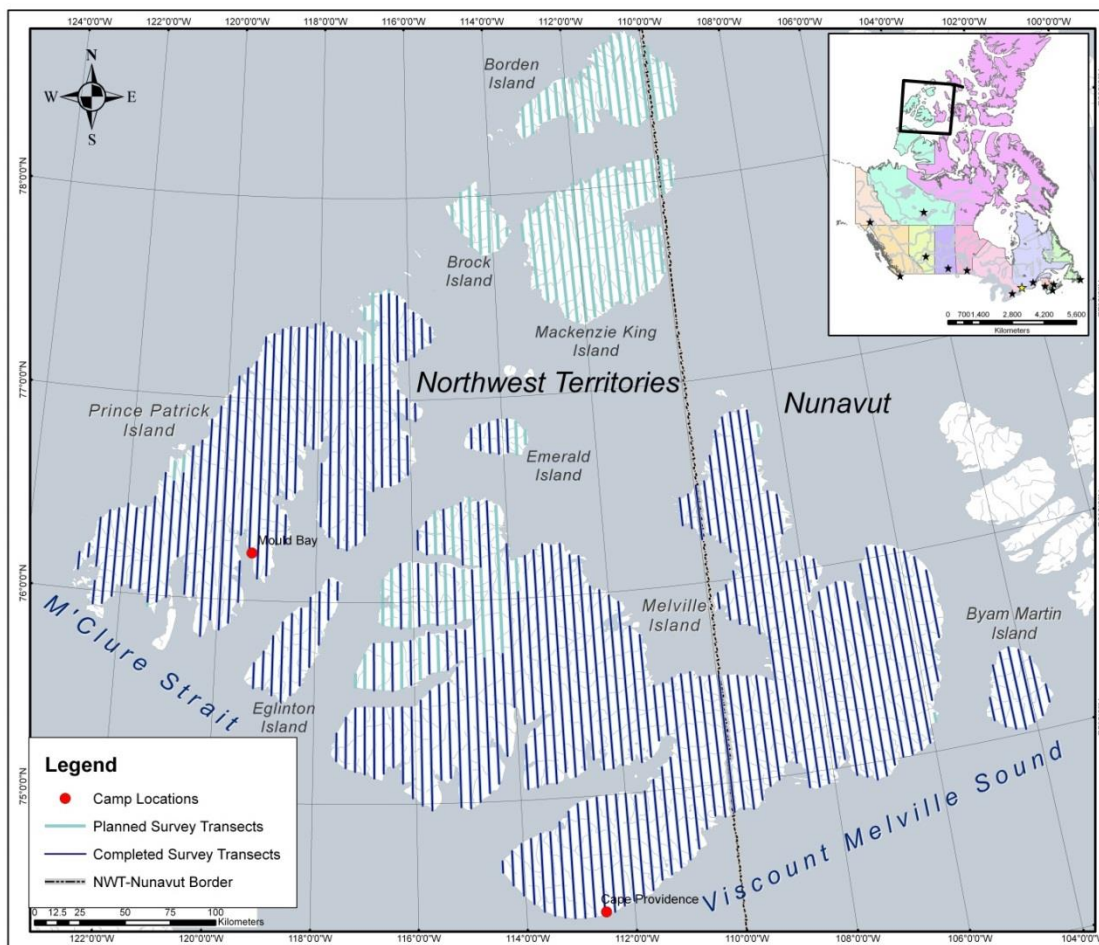


Figure 2. Survey area showing transect lines planned and flown. The bases for flying at Cape Providence and Mould Bay are shown in red.

In 1961, nearly 60% of Peary caribou on the Queen Elizabeth Islands were found on these groups of islands (Tener 1963). However Peary caribou populations declined considerably since that time. In 1997, the population estimate for adult Peary caribou on Melville Island was 787 ± 97 (SE), 84 ± 34 (SE) on Prince Patrick and 36 ± 22 (SE) on Mackenzie King Island (Gunn and Dragon, 2002). There were no caribou found on Eglinton, Byam Martin, Emerald, and Brock Islands in 1997, despite presence of caribou on these islands in previous surveys in 1961 and in the 1970s. Borden Island was not surveyed in 1997. The Melville-Prince Patrick complex and the Prime Minister Group had not been surveyed since 1997.

The Government of Nunavut conducted a strip-transect distance sampling method survey for caribou and muskoxen of the following islands or groups of islands: Bathurst Island Complex in

2001, Prince of Wales and Somerset in 2004, Ellesmere in 2005-2006, Axel Heiberg, Ellef Ringnes, Amund Ringnes, Loughheed, Cornwall, Meighen, and King Christian in 2007, and Devon Island in 2008 (Jenkins et al 2011). The results from the Bathurst Island Complex, which is west of our study area, indicated that the Peary caribou population had increased from the 1997 survey, however the numbers were not as high as historical population estimates (Tener 1963).

The Government of the Northwest Territories surveyed the neighbouring areas of Banks Island and Northwest Victoria Island in 2010 (Davison et al. 2013, Davison and Williams 2013). Results indicated that the populations of Peary caribou in these areas are reduced from historic numbers but have been stable (no further decline) for the last decade (Davison and Williams 2013, Davison et al. 2013). The Banks Island sub-population of Peary caribou has been surveyed at regular intervals of about five years since 1982. The Northwest Victoria Island study area has been surveyed at regular intervals of no more than five years since 1998. The Melville-Prince Patrick Islands complex has not undergone regular surveys due to the remoteness of the study area and low harvest pressure. This survey was conducted to fill the gap in knowledge of the current Peary caribou and muskox populations on these islands.

METHODS

A strip transect aerial survey was flown using a fixed-over-winged, single engine Helio Courier aircraft on tundra tires between July 31th and August 26th, 2012. Melville and Prince Patrick Islands were divided into the same strata as in the 1997 survey (Figure 1). Survey lines were spaced five km apart for the target survey coverage of 20%. Observers were seated on each side, in the rear of the aircraft, with the recorder in the front seat beside the pilot. Transects were flown at an altitude of 120 m and average speed of 160 km/hr. A 500 m strip was marked on the aircraft window. Observations within the 500 m strip on each side of the aircraft were considered “on-transect”. Observations beyond 500 m, or under the aircraft, were considered “off-transect”.

Observations were recorded by the recorder and locations marked using a hand-held GPS. Caribou were classified as adult bulls, adults (cows/young bulls), or calves based on body size and antlers. Muskoxen were classified as adults or calves based on body size. All caribou and muskoxen that were not calves were considered adults in this survey. All other wildlife sightings of large mammals were recorded. Population estimates for each species were calculated using adult observations only utilizing the program Ecological Methodology, version 7.0 using aerial survey method two (Krebs 1999).

The survey was based at the Department of Environment and Natural Resources (ENR) polar bear project’s cabin on southwest Melville Island and from a tent and trailer located on the airstrip near Environment Canada’s now closed weather station at Mould Bay, Prince Patrick Island (Figure 2).

RESULTS

The survey was flown in 159 hours (including ferry flights) between July 31th and August 26th, 2012. Melville, Prince Patrick, Byam Martin, Eglinton, and Emerald Islands were surveyed. Mackenzie King, Brock and Borden Islands (Figure 1) could not be reached because sea ice between the islands was not solid and the required ceilings to cross open water in a single engine survey aircraft were not achieved. There was incomplete coverage on the north end of Melville Island due to weather constraints. Two lines were dropped on Emerald Island and a few lines were cut short on the north end of Prince Patrick Island due to fog. Planned and completed transects are shown in Figure 1. Percentage coverage of each island was 19.5, 21.0, 19.3, 19.8, and 19.2 for Melville, Prince Patrick, Byam Martin Emerald, and Eglinton Islands respectively (Table 1).

Table 1. Summary of Peary caribou results by island.

Island	Area km ²	Number of Possible Transects	% of Area Surveyed	Number Transects Flown	Number Adult Caribou Counted	No. Calf Caribou Counted	Density 100 km ² (Adults)	Population Estimate (Adults)	95% CI
Melville	42,583.2	864	19.54	187	529	70	6.44	2,712	487
Prince Patrick	16,090.1	276	21.03	73	556	119	16.4	2,635	861
Byam Martin	1,157.9	38	19.26	7	23	8	10.3	119	73.0
Emerald	570.1	37	19.75	7	9	2	8.3	46	78.0
Eglinton	1,573.4	51	19.17	10	35	0	11.6	183	134.0

The largest Peary caribou group, including calves, was 28 caribou, with average group size of four caribou. Peary caribou observations are summarized in Table 1, and locations are indicated in Figure 2. The largest muskoxen group, including calves, was 35 with average group size of seven muskoxen. Muskox observations are summarized in Table 2, and locations are indicated in Figure 3.

Table 2. Summary of muskox results by island.

Island	Area km ²	Number of Possible Transects	% of Area Surveyed	No. Transects Flown	Number Adult Muskox Counted	Number Calf Muskox Counted	Density 100 km ² (Adults)	Population Estimate (Adults)	95% CI
Melville	42,583.2	864	19.54	187	586	19	7.0	2,998	770
Prince Patrick	16,090.1	276	21.03	73	106	4	3.1	504	319
Byam Martin	1,157.9	38	19.26	7	0	-	-	-	-
Emerald	570.1	37	19.75	7	0	-	-	-	-
Eglinton	1,573.4	51	19.17	10	41	1	13.6	214	198.0

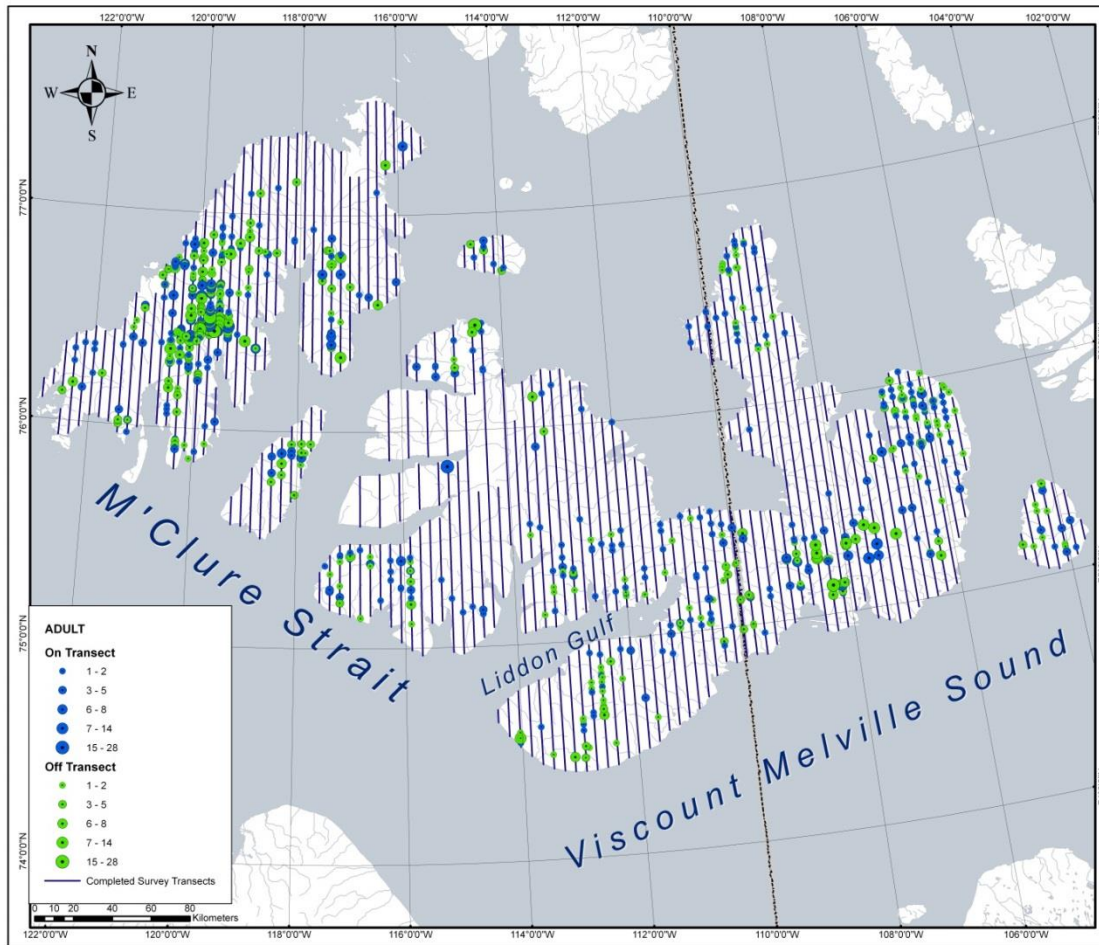


Figure 3. Transect lines flown and locations of Peary caribou groups, 2012.

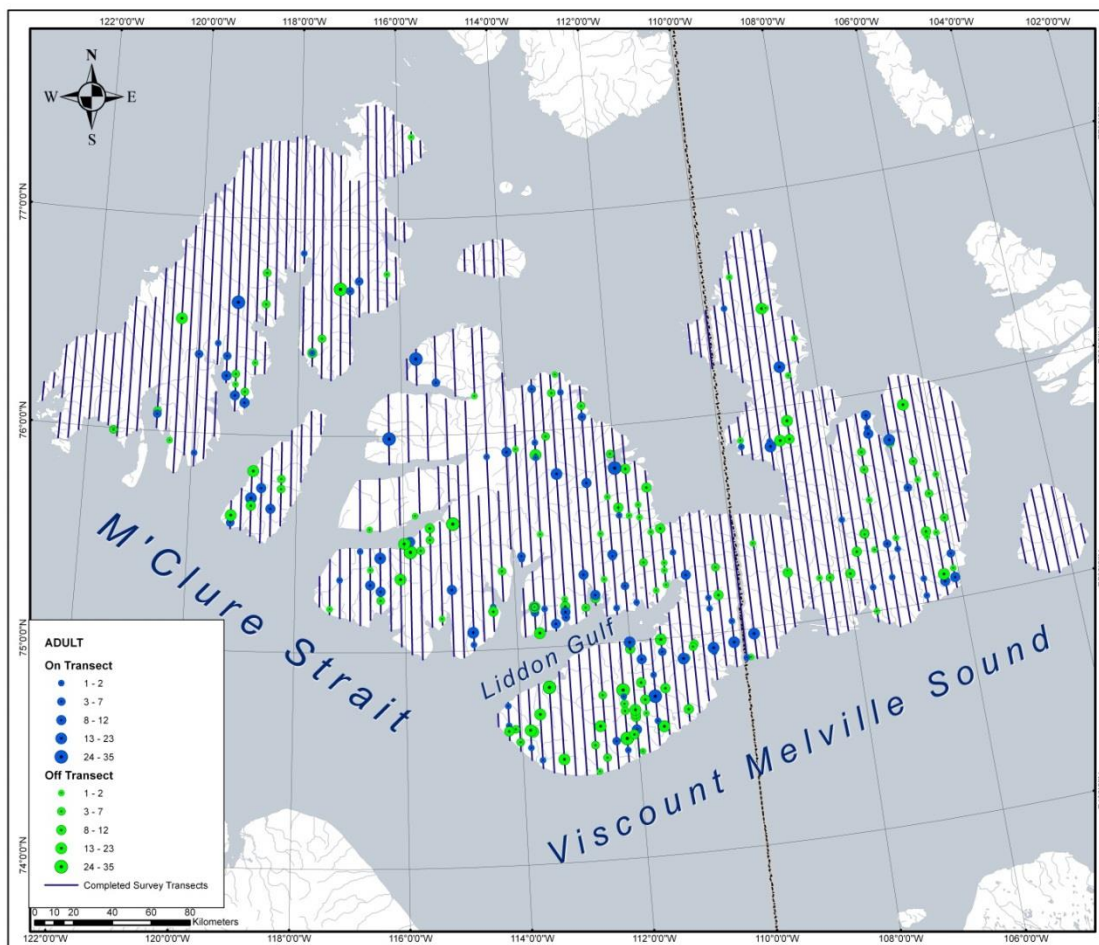


Figure 4. Flight lines and locations of muskox groups, 2012.

There were few muskox calves observed. However, observations of muskox calves were likely biased low because they were often hidden when adults in the herd formed a protective circle.

Five polar bears and 17 wolves were observed during the survey. The locations of these sightings are indicated in Figure 5.

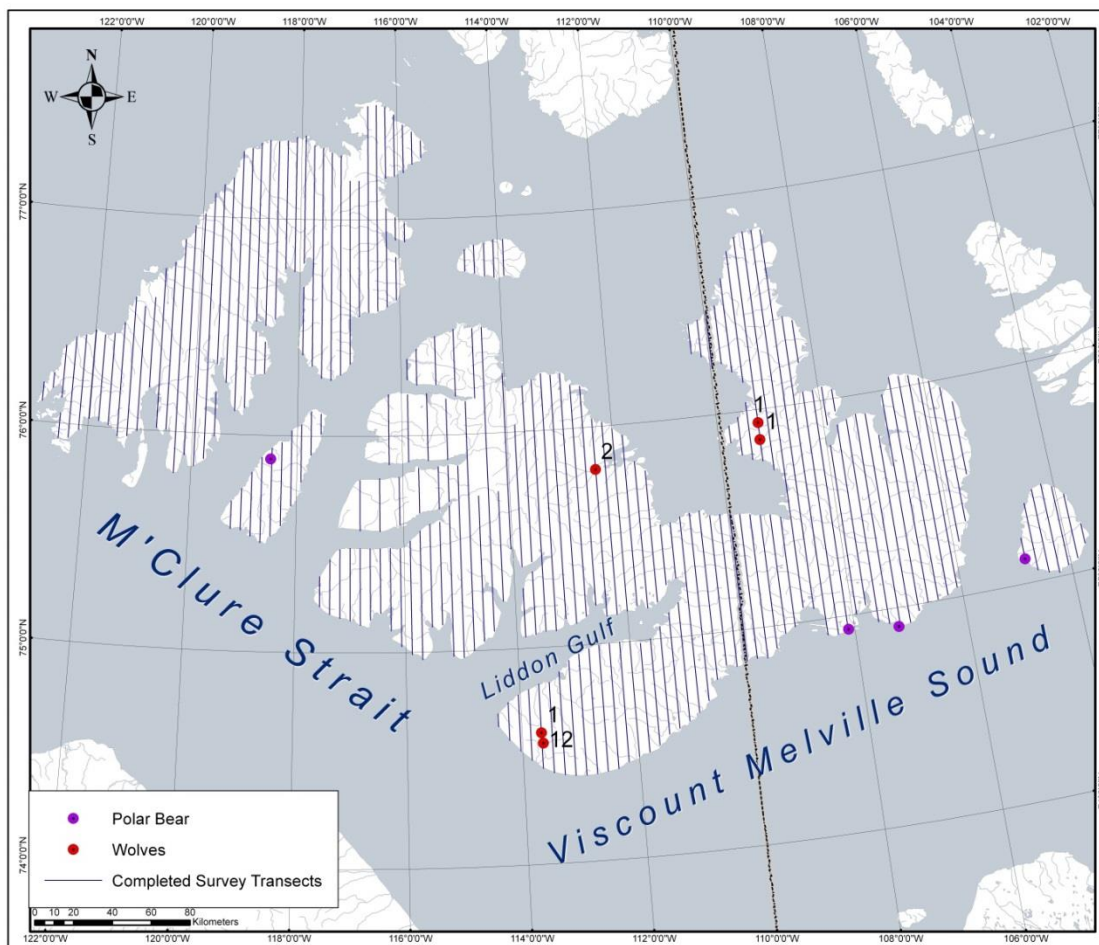


Figure 5. Locations of polar bears and wolves observed during the survey, 2012.

Melville Island

There were 529 adult caribou and 70 calves seen on transect, giving a population estimate of $2,712 \pm 487$ (95% Confidence Interval, CI) non-calf caribou on Melville Island. There were a total of 586 adult muskoxen and 19 calves observed on transect yielding a population estimate of $2,998 \pm 852$ (95% CI) adult muskoxen on Melville Island. The estimates are higher than the 1997 estimates of 787 ± 97 (Standard Error, SE) Peary caribou and $2,258 \pm 268$ (SE) muskoxen. Density and population estimates were also calculated for each of the 13 strata and are presented in Tables 3 and 4.

Table 3. Melville Island Peary caribou results by strata.

Strata	Strata Area km ²	Number of Possible Transects	% of Area Surveyed	Number Transects Flown	Number Adult Caribou Counted	Density 100 km ²	Population Estimate (Adults)	95% CI
5	1,402.5	49	20.9	11	18	6.1	86	79
6	3,514.9	84	19.4	17	10	1.5	52	34
7	4,848.8	99	19.3	20	27	2.9	140	56
8	4,776.7	100	19.3	19	65	7.0	336	192
9	1,016.2	36	20.0	7	12	5.9	60	67
10	1,711	54	20.9	11	5	1.4	24	49
11	1,456.7	58	19.6	13	17	6.0	87	148
12	5,143.1	110	18.4	21	27	2.9	146	67
13	5,051.8	26	18.6	16	96	10.2	515	57
14	1,766.1	59	20.1	12	1	0.3	5	10
15	6,814.5	90	19.5	19	138	10.4	709	254
16	2,138.2	41	19.7	8	86	20.4	437	223
17	2,942.7	58	20.6	13	27	4.5	131	83

Table 4. Melville Island muskox results by strata.

Strata	Strata Area km ²	Number of Possible Transects	% of Area Surveyed	Number Transects Flown	Number Adult Muskox Counted	Density 100 km ²	Population Estimate (Adults)	95% CI
5	1,402.5	49	20.9	11	65	22.2	311	367
6	3,514.9	84	19.4	17	29	4.3	149	144
7	4,848.8	99	19.3	20	79	8.4	409	307
8	4,776.7	100	19.3	19	94	10.2	486	380
9	1,016.2	36	20.0	7	37	18.2	185	184
10	1,711	54	20.9	11	0	-	-	-
11	1,456.7	58	19.6	13	0	-	-	-
12	5,143.1	110	18.4	21	107	11.3	580	415
13	5,051.8	26	18.6	16	67	7.1	360	60
14	1,766.1	59	20.1	12	17	4.8	85	150
15	6,814.5	90	19.5	19	60	4.5	308	274
16	2,138.2	41	19.7	8	13	3.1	66	147
17	2,942.7	58	20.6	13	18	3.0	87	137

Prince Patrick Island

There were 556 adult caribou and 119 calves seen on transect giving a population estimate of $2,635 \pm 861$ (95% CI) adult caribou on Prince Patrick Island. There were a total of 106 adult muskoxen and four calves observed on transect yielding a population estimate of 504 ± 319 (95% CI) adult muskoxen on Prince Patrick Island. These estimates are much higher than the 1997 estimates of 84 ± 34 (SE) Peary caribou and 96 ± 42 (SE) muskoxen. Density and population estimates were also calculated for each of the four strata and are presented in Tables 5 and 6.

Table 5. Prince Patrick Island Peary caribou results by strata.

Strata	Strata Area km ²	Number of Possible Transects	% of Area Surveyed	Number Transects Flown	Number Adult Caribou Counted	Density 100 km ²	Population Estimate (Adults)	95% CI
1	7,951.8	115	20.3	32	442	27.9	2,178	700
2	5,954.7	108	21.0	30	53	4.2	252	106
3	2,183.6	53	21.9	11	61	12.7	278	271

Table 6. Prince Patrick Island muskox results by strata.

Strata	Strata Area km ²	Number of Possible Transects	% of Area Surveyed	Number Transects Flown	Number Adult Muskox Counted	Density 100 km ²	Population Estimate (Adults)	95% CI
1	7,951.8	115	20.3	32	90	5.6	444	297
2	5,954.7	108	21.0	30	1	0.1	5	6
3	2,183.6	53	21.9	11	15	3.1	68	68

Byam Martin Island

There were 23 adult caribou and eight calves seen on transect giving a population estimate of 119 ± 73 (95% CI) non-calf caribou on Byam Martin Island. There were no muskoxen observed on Byam Martin Island. In 1997 there were no living caribou or muskoxen observed on Byam Martin Island.

Emerald Island

There were nine adult caribou and two calves seen on transect giving a population estimate of 46 ± 78 (95% CI) non-calf caribou on Emerald Island. There were no muskoxen observed on Emerald Island. In 1997 there were no living caribou or muskoxen observed on Emerald Island.

Eglinton Island

There were 35 adult caribou and no calves seen on transect, giving a population estimate of 183 ± 134 (95% CI) non-calf caribou on Eglinton Island. There were a total of 41 adult muskoxen and one calf observed on transects yielding a population estimate of 214 ± 198 (95% CI) adult muskoxen on Eglinton Island. The estimates are much higher than the 1997 estimates of 37 ± 21 (SE) muskoxen. In 1997 there were no caribou observed on Eglinton Island.

DISCUSSION

Peary caribou and muskox populations on the Melville-Prince Patrick complex have increased significantly since the last survey conducted in 1997; however long intervals between surveys makes it difficult to determine the current trend in the population. How and when the recovery occurred within the last 15 years remains a gap in our understanding of these populations.

Caribou and Muskox Populations on Neighbouring Islands

To the south, populations of Peary caribou on Banks and Northwest Victoria Island have not shown the same marked increase as on Melville-Prince Patrick complex. Populations on Banks Island stabilized at a depressed number from numbers recorded the 1980s (Davison and Williams 2013, Davison et al. 2013). The 2014 population survey of caribou on Banks Island has shown that this population is beginning to increase (Davison et al. In Prep.). Muskoxen increased in numbers from the early 1980s, peaking on Banks Island at almost 70,000 animals in 1994 and again in 2001. Between 2005 and 2014 muskox numbers on Banks Island have been decreasing (Davison et al. 2013, Davison et al. In Prep.). Muskox populations on Victoria Island also peaked in 2001 and have decreased in 2005 and 2010 (Davison and Williams 2013).

To the east of the Melville-Prince Patrick complex, Peary caribou and muskoxen on the Bathurst Island complex have also recovered from low numbers (Anderson 2014). Muskoxen and caribou on the Bathurst Island complex underwent a similar large die-off in 1996-1997 leading to a population estimate of 74 ± 25 (SE) 1+ year old caribou and 124 ± 45 (SE) 1+ year old muskoxen on Bathurst Island during the 1997 survey (Gunn and Dragon 2002). In May 2013, 1483 ± 387 (95% CI) caribou (including calves which in May would be +11 months old) were estimated on the Bathurst Island complex. During the same survey, muskoxen were estimated at 1888 ± 979 (95% CI) adults on Bathurst Island (Anderson 2014).

Weather

There is a gap in our knowledge of Peary caribou population dynamics on the Melville-Prince Patrick complex but weather data may provide some insight. It is generally thought that Peary caribou populations are driven by factors such as weather events which limit forage availability and not by factors such as degradation of habitat by overgrazing (Miller and Barry 2009). Crashes of populations in the past have been attributed to severe winter weather conditions (Gunn and Dragon 2002).

There are several weather events that can restrict a caribou's access to vegetation: deep/dense snow cover, freezing rain, freeze-thaws and other such icing events. When widespread, these conditions will cause die-offs (Miller and Barry 2009). Kohler and Aanes (2004) found that ground-ice thickness is the best parameter to explain population growth rate variability of Svalbard reindeer. Miller and Gunn (2003) linked high snow falls recorded at Resolute to the decline of caribou in the Bathurst Island Complex in 1973/74, 1994/95, 1995/96 and 1996/1997. There was an 83% decline observed between the 1996 and 1997 population estimates on the Bathurst Island Complex, with a similar decline occurring on the Melville-Prince Patrick Island Complex (Gunn and Dragon 2002, Miller and Barry 2008). The primary predictor of how well a Peary caribou population is doing is the absence of severe winter weather conditions (Miller and Barry 2009). The effects of climate change are a large concern and whether they could help or hinder the abundance of Peary caribou (Gunn and Dragon 2002). Attempts to model climate change scenarios on Peary caribou showed a variety of net effects from strongly positive to strongly negative. The most important factor seem to be frequency of severe events; however there are many uncertainties (Tews et al. 2007).

Availability of weather data in the Arctic is limited because weather recording stations are few in number and spread over a large geographic area. However, the CircumArctic Rangifer Monitoring and Assessment Network (CARMA) have developed a weather database for caribou, utilizing the NASA's Modern Era Retrospective Analysis for Research and Application (MERRA) data set (Russell et al 2013). This database was used to estimate the amount of freezing rain and snow density from 1979-2011 in the study area (Figures 6, 7). A spike in the amount of freezing rain and snow density in 1997 corresponded to a known die-off (Gunn and Dragon 2002). There was also a spike in freezing rain in 1985. Long survey intervals make it difficult to pinpoint die-offs, but caribou populations on Melville Island did fall from 1,679 in 1974 to 843 in 1987 (Miller et al. 1977, Miller 1988). On Prince Patrick Island populations went from 621 in 1974 to 151 in 1986 (Miller et al. 1977, Miller 1987). Based on the amount of freezing rain, it seems unlikely there were conditions for a large die-off between the survey in 1997 and 2012.

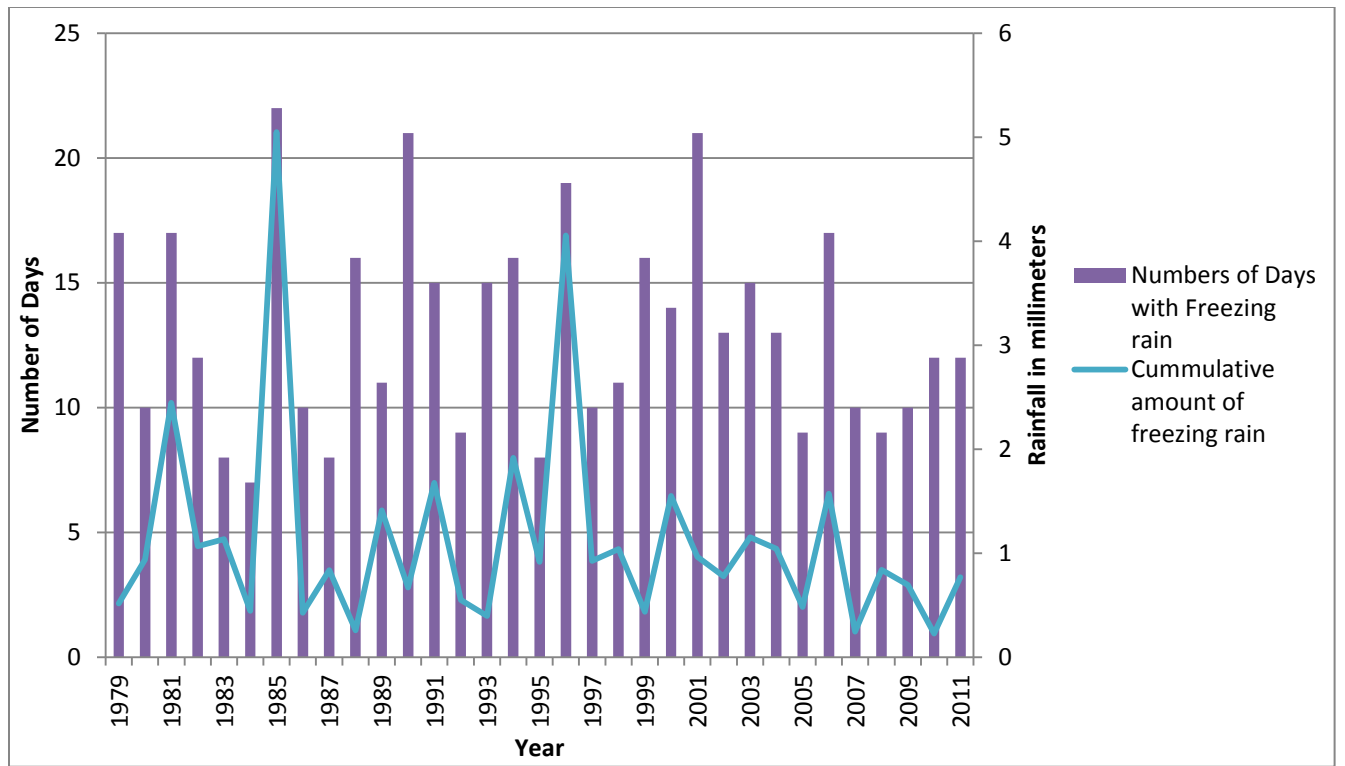


Figure 6. Number of days with freezing rain and cumulative amount of freezing rain in millimeters over the study area (Russell et al 2013).

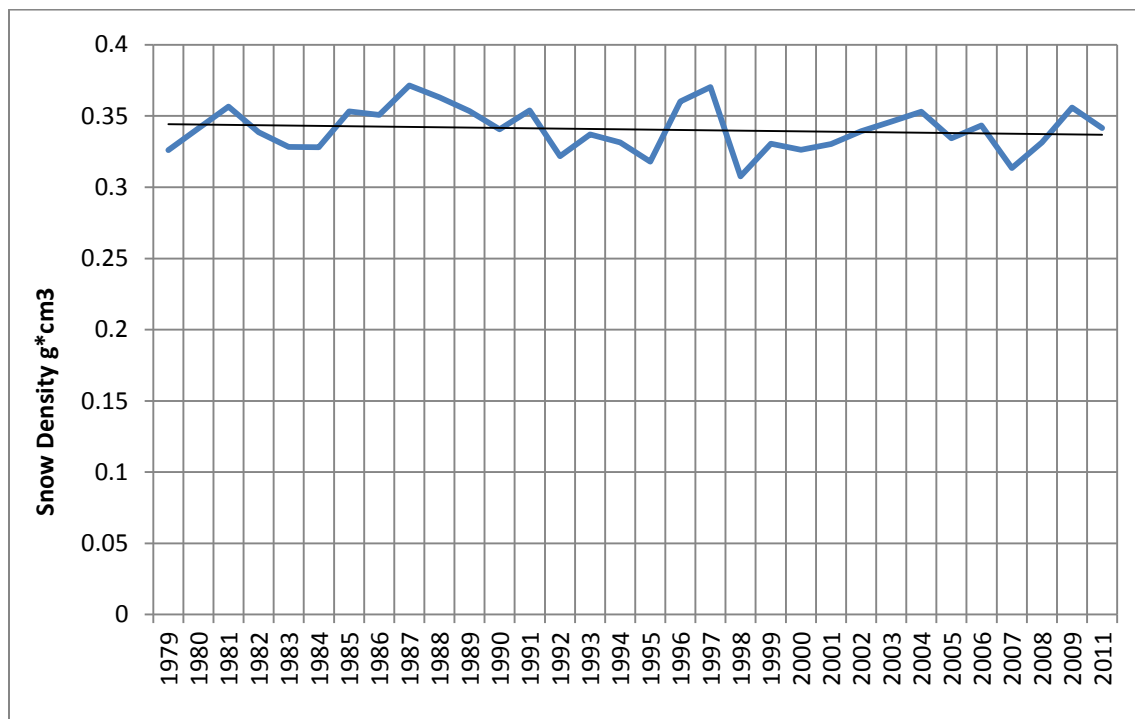


Figure 7. Winter snow density with trend line over the study area (Russell et al 2013).

Snow cover has been linked previously to Peary caribou die-offs. Miller and Gunn (2003) showed that the decline in the population of Peary caribou on Bathurst Island occurred during winters with the highest snow-fall. They used snowfall recorded at the community of Resolute. The MERRA data (Russell et al 2013) provides us with better data over a larger area instead of relying on a single weather station some distance from the actual caribou. The general trend of snow density over time has been relatively constant, with a very slight decrease in density from 1979-2011 (Figure 7).

Summer foraging conditions may have been improving. The length of the growing season increased by up to two days in some areas of Melville and Prince Patrick Islands between 2000 and 2010 (Zeng et al 2011). This could mean an increased availability of vascular plant forage for Peary caribou.

The combination of longer summers and less extreme winter conditions over time could have contributed to higher survival and productivity in muskoxen and caribou. This would then lead to the increase in the population of Peary caribou and muskoxen we recorded in 2012. However, due to the remote nature of the area, the weather data provides only a partial understanding of on-the-ground conditions experienced by Peary caribou and muskoxen.

Conclusions

Overall, the number and distribution of both Peary caribou and muskoxen were greater on the islands we surveyed than the last time the area was surveyed in 1997. Since 1997, caribou have re-populated Byam Martin, Emerald, and Eglinton islands, where there were none seen in 1997 (Gunn and Dragon 2002). Muskoxen were also not observed on Emerald and Byam Martin islands in 1997. Not much is known about seasonal changes in distribution of either species in this region but seasonal movements of Peary caribou between Prince Patrick, Eglinton and Melville islands have been recorded (Miller et al. 1977). Muskoxen have a relatively smaller home range size, usually don't cross ice unless forced by weather events and therefore may be slower to recolonize islands (Dumond 2006, Gunn and Fournier 2000, Taylor 2005).

The challenge with monitoring populations on these islands is their remoteness and resulting high cost of conducting the surveys. With the large time between surveys, we do not know the current trend or the possible changes that may have occurred between 1997 and 2012 in Peary

caribou and muskox numbers and distribution. There is very little to no harvest pressure in the study area and minimal human activity (such as mineral exploration or other development) on the landscape. Because of this the area is considered a lower priority for monitoring than other areas of the muskox and Peary caribou range. Despite this, and the challenges with surveying this area due to its remoteness, we recommend that surveys occur more frequently. The effects that a warming climate may bring to Peary caribou and muskoxen in the high Arctic are unknown, and more frequent surveys are necessary to monitor any effects.

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