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Aerial Survey of Muskoxen (*Ovibos moschatus*) and Peary Caribou (*Rangifer tarandus pearyi*) on Northwest Victoria Island, May 2019

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ABSTRACT

An aerial caribou and muskox strip transect survey was conducted on northwest Victoria Island between May 8th and May 24th, 2019. Two Cessna 206 fixed-wing aircraft were used for the survey. The survey area was divided into four strata or blocks, named A, B, C and E. Strata A, B and C had been used in previous surveys of this area. There were 30 adult caribou observed on transect and 14 adult caribou observed off transect. The majority of caribou were observed in survey stratum C except for one group of 14 caribou observed in survey stratum A. The population estimate for adult caribou in survey stratum A was 78±136 (95% Confidence Interval (CI)). The population estimate for adult caribou in survey stratum C was 98±91 (95% CI). These estimates have a high variance so should be used with caution, and overall caribou numbers remain low. There were 962 adult and 100 calf muskoxen observed on transect and 1,482 muskoxen observed off transect lines. The population estimate for survey strata A, B and C combined was 5,550±1,672 (95% CI) adult muskox. This is lower than the 2015 estimate for these strata and indicates an annual decline of 16%. The population estimate for survey stratum E was 216±206 (95% CI) adult muskox.

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INTRODUCTION

Muskoxen (*Ovibos moschatus*) and Peary caribou (*Rangifer tarandus pearyi*) are important to Canadian High Arctic communities as a traditional food source and are among the iconic large mammal species in the region. Peary caribou were assessed by the Committee on the Status of Endangered Species of Wildlife in Canada (COSEWIC) as Endangered in Canada in May 2004 and legally listed as Endangered under the Federal *Species at Risk Act* in February 2011. Peary caribou were reassessed by COSEWIC as Threatened in 2015 however they are still legally listed at the federal level as Endangered. In 2012, Peary caribou were assessed as Threatened by the Northwest Territories (NWT) Species at Risk Committee and subsequently listed under the *Species at Risk (NWT) Act* as Threatened in 2013.

An aerial fixed-wing caribou and muskox strip transect survey was conducted on northwest Victoria Island in May 2019. The objective of the survey was to update the population estimates for muskoxen and Peary caribou, with the last complete survey for this region conducted in April/May 2015 (Davison and Williams 2019). In 2015 the survey timing was changed from previous summer surveys in this region so that Peary caribou could be counted separately from the Dolphin and Union herd (*R. t. groenlandicus x pearyi*). Peary caribou are found on northern Victoria Island year round while the Dolphin and Union herd migrates from its winter range on the mainland to summer on Victoria Island (Gunn et al. 1997). The survey area covers only a portion of the Dolphin and Union herd's summer range, so an overall estimate of that herd was not a goal of previous surveys of northwest Victoria Island. The change in season timing makes it difficult to compare caribou to previous surveys as caribou use different seasonal ranges (Gunn and Fournier 2000b). However, muskox summer home ranges are larger than their winter home ranges and they don't make long-distance seasonal migrations (Tener 1965, Gunn and Fournier 2000a). Therefore, we believe even with the change in survey timing we can compare trends of muskox abundance in the study area between surveys for muskox.

In 2018 this survey was attempted but aborted without completion due to aircraft issues. A survey stratum on the end of Prince Williams Sound was added to the study area in 2019 (Stratum E, Figure 1) upon recommendation of the Olokhaktomiut Hunter's and Trapper's Committee (OHTC) to cover an important hunting area. Stratum D (Figure 1), surveyed in 2015, was dropped from the 2019 survey due to fuel and time restrictions which resulted from the addition of Stratum E.

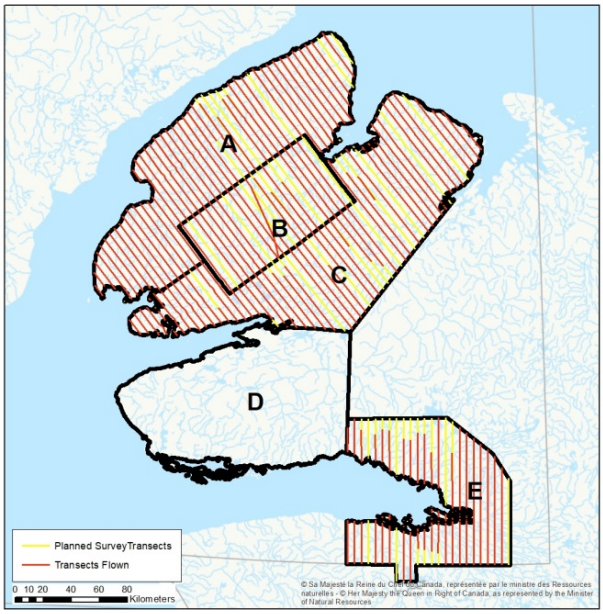

Figure 1. Survey strata and transects showing flown (red) and planned transects that were not flown (yellow).

METHODS

The survey area was broken into strata with strata A, B, C and E planned for this survey (Figure 1). Survey lines were spaced 5 km apart, for planned survey coverage of 20%. The survey was flown with two Cessna 206 fixed-wing aircraft based out of Ulukhaktok, NWT. Each survey crew consisted of a pilot, front right-seat recorder/navigator, and two community observers. Observers were seated in the back on either side of the aircraft. Peary caribou and muskoxen within a 500 m strip on each side of the aircraft were considered "on transect". The strip width was marked by flying at survey altitude over a measured 500 m distance on the ground and marking the aircraft windows. Observations beyond the 500 m markers were considered "off transect". The survey was flown at an average altitude of 120 m AGL and at an average speed of 160 km/hr.

Flight lines were saved as GPS track logs and all large mammal observations, on and off transect, were marked and saved to GPS by the recorder/navigator. Muskoxen observed were classified as adults or calves. Caribou observed were classified as mature bulls, cows/young bulls, or calves. Larger groups of muskoxen or Peary caribou on transect were circled and photos taken with a digital camera to be reviewed for an accurate count and classification.

Population estimates for adult Peary caribou and muskoxen were calculated using a ratio method for unequal-sized units sampled without replacement (Krebs 1999, Ecological Methodology, Version 7.0). Population estimates were only calculated for the adults because of the high variability of yearly productivity and higher mortality rate of animals in their first year. In addition, at the time of the survey the muskox calves were only about one month old and they were easily hidden from view by larger adults in tightly bunched muskox groups. The adults-only population estimation is consistent with previous population estimates, allowing trend determinations.

A two-tailed t-test was used to determine if the population estimates of adult muskoxen in survey strata A, B and C combined were significantly different than the 2015 estimates for the same area (Gasaway et al. 1986). Yearly growth rate (λ) was calculated as $\lambda=(Nt2/Nt1)1/T$ where Nt1=population at year one, Nt2=population at year two and T=number of years between population estimates. Growth rates were converted into percent change in population using the formula $(\lambda-1) \times 100$ (Mills 2012).

RESULTS

The survey was conducted between May 8th and May 24th, 2019. The survey was delayed intermittently by weather; survey lines were flown May 11-16, 20-22 and 24. Poor weather (fog and low cloud) limited flying on other days. The total flight time during the survey, including ferry flights, was 110.5 hours (46.4 hours on-transect). Survey strata and transect lines flown are indicated in Figure 1. The actual survey coverage over all strata was reduced from the planned 20% coverage to 16.5% due to weather and fuel considerations (**Table 1**Figure 1, Table 1). Some transect lines were randomly dropped using a random number generator to select transect numbers. Others transects were partially completed or not completed due to fog or low clouds.

Table 1. Summary of number of Muskox observed on transect during the Northwest Victoria Island survey 2019, and resulting population estimates by survey Stratum.

Block	Block Area Km^2	Area Sampled km^2	Percent Area Sampled	Number of Transects sampled	Number of Possible Transects	Time on Survey (hours)	Muskox Adults On transect	Muskox Calves On transect	**Population Estimate Muskox Adult**	SE of pop est	95% CI	Density km^2
A	13,868.5	2,494.8	18.0%	46	635	16.2	249	28	**1,384**	391.9	789	0.10
B	6,658.2	1,000.6	15.0%	18	110	6.2	174	17	**1,158**	319.4	674	0.17
C	15,778.2	2,581.2	16.4%	51	279	16.0	506	51	**3,093**	694.2	1395	0.20
ABC	36,304.9	6,076.6	16.7%	115	1024	38.4	929	96	**5,550**	846.11	1672	0.15
E	8,954.1	1,370.4	15.3%	21	116	8.5	33	4	**216**	100.2	206	0.02
TOTAL	45,259	7,446.982	16.5%	136	1140	46.9	962	100				

There were a total of 962 adult muskoxen and 196 calves seen on-transect in 80 groups of muskoxen, with herd size ranging from 1-46 muskoxen. The average group size on transect was 12 muskoxen.

There were 249 adult muskoxen and 28 calves seen in stratum A, giving an adult population estimate of 1,384±789 (95% CI) muskoxen. There were 174 adult muskoxen and 17 calves seen in stratum B, giving an adult population estimate of 1,158±674 muskoxen. There were 506 adult muskox and 51 calves seen in stratum C, giving an adult population estimate of 3,093±1,395 muskoxen. There were 929 adult muskoxen seen on transect in strata A, B and C combined, giving an estimate for this long-term survey area of 5,550±1672 (95% CI) and a density of 0.15 adults per km^2. The density of stratum E was 0.02 adults per km^2 with 33 adult muskoxen and four calves seen on transect, giving an adult population estimate of 216±206 muskoxen. Summaries of muskoxen observed by stratum are in Table 1. Locations of muskox observations are indicated in Figure 2.

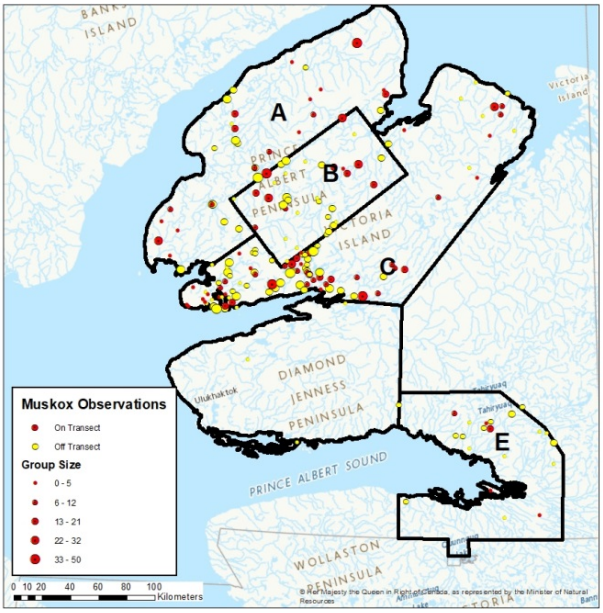

Figure 2. Locations of muskox groups observed on and off transect during the survey.

There was one group of 14 Peary caribou seen on transect in stratum A and four groups of caribou (group size 1-7 adults) seen on transect in stratum C and 14 caribou seen off-transect. The population estimate for adult caribou in stratum A was 78±136 (95% CI). The population estimate for adult caribou in stratum C was 98±91 (95% CI). Caribou observed by stratum are summarized in Table 2. Locations of caribou observations are indicated in Figure 3.

Table 2. Summary of number of Peary Caribou observed on transect during the Northwest Victoria Island survey 2019, and resulting population estimates by survey stratum.

Block	Block Area Km²	Area Sampled km²	Percent Area Sampled	Number of Transects sampled	Number of Possible Transects	Time on Survey (hours)	Caribou Adults On Transect	Caribou Adults Off Transect	**Population Estimate Caribou Adult**	SE of pop est	95% CI	Density
A	13,868.5	2,494.8	18.0%	46	246	16.2	14	0	**78**	67.4	136	0.0056
C	15,778.2	2,581.2	16.4%	51	279	16.0	16	14	**98**	45.2	91	0.0062
TOTAL	29,646.7	5,076.0	17.1%	97	525	32.2	30	14				

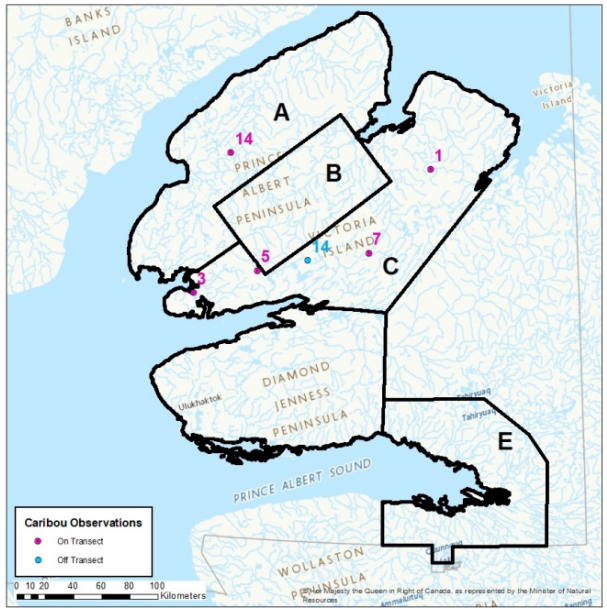

Figure 3. Locations and numbers of Peary caribou observed during the survey.

Four wolves were observed during the survey. Other wildlife observed included one grizzly bear, three polar bears, two beluga, Arctic hare, seals and various bird species. The locations of these wildlife observations are indicated in

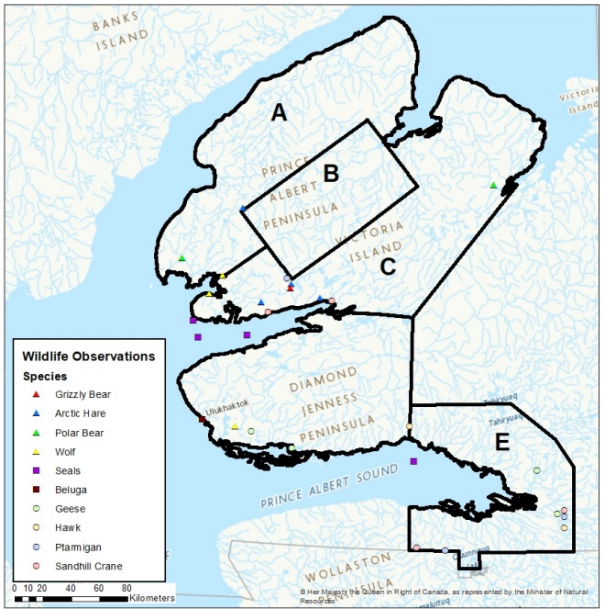

Figure **4**.

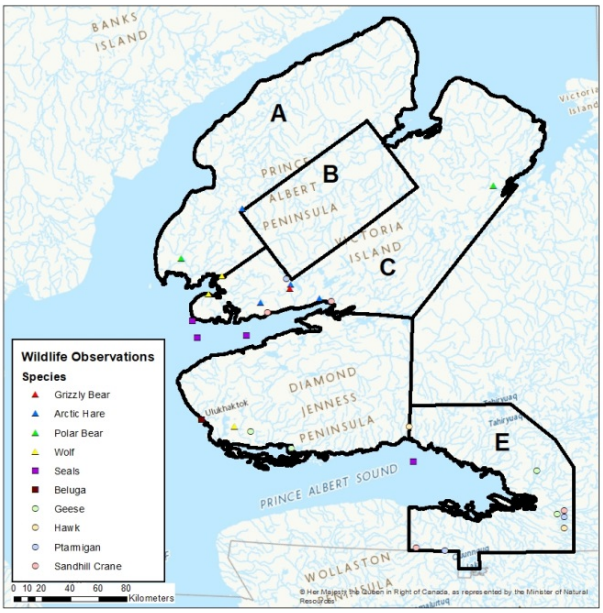

Figure 4. Locations of wolves and other animals observed during the survey.

DISCUSSION

The estimate of 5,550±1,672 (95% CI) adult muskoxen for Strata A, B and C combined is a significant decline (t=4.42, P>0.05, df=116) in the number of muskoxen since the 2015 estimate of 11,150±1,861 (95% CI) adult muskoxen (Davison and Williams 2019) (Figure 5). The annual rate of decline is about 16% over this four-year period. There is no trend information available for stratum E, as this is the first time this area has been surveyed in recent history.

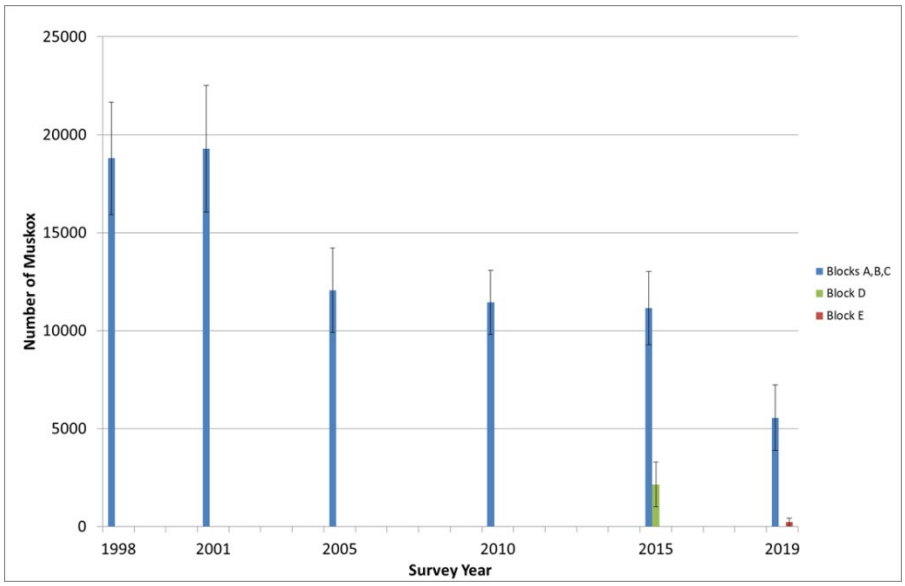

Figure 5. Population estimates for muskoxen on Northwest Victoria Island 1998-2019. Note 1998-2010 surveys occurred in summer and the 2015 and 2019 surveys occurred in spring. (From Nagy et al. 2009a, Nagy et al. 2009b, Nagy et al. 2009c, Davison and Williams 2013, Davison and Williams 2019)

The 2019 density estimates for muskox are some of the lowest recorded for the area with 0.15 adults per km^2 in strata A, B, and C combined, and 0.02 adult muskoxen per km^2 in Stratum E. In 2015, the density of strata A, B and C together was 0.31adult muskoxen per km^2. The density of stratum D, which was not included in this survey, was 0.24 adults per km^2 in 2015. Stratum E boundaries from this survey did not line up with past surveys but a survey in 1992 included the northern portion of our stratum E and had a density of 0.41 muskox/km^2 (Heard 1992). Additionally there were two other strata in the 1992 survey; one that included the southwest portions of our A, B and C strata and had a density of 0.24 muskox/km^2; and a high density survey stratum on the north side of Minto inlet, which would be in our stratum C, which had 1.01 muskox/km^2 (Heard 1992).

Surveys in 2013 and 2014 on the Nunavut side of Victoria Island indicate that the muskox population is lower than previous surveys in the 1980s and 1990s, with an overall

density of 0.07 muskox/km^2 and stratum densities that ranged from 0.06–0.13 muskox/km^2 (LeClerc 2015). Surveys previous to this have varied in scope. In 1999 a density of 0.50 muskoxen/km^2 was found on the south-eastern part of Victoria Island (Gunn and Patterson 2000, unpublished, reported in LeClerc, 2015). Therefore the densities found in this survey of 0.17-0.02 are on the low end of what has been observed on Victoria Island previously.

The rapid decline in muskox abundance on northwest Victoria Island 2015-2019 suggests that adverse health conditions and die-offs reported between 2009 and 2013 on Banks and Victoria Islands (Kutz et al. 2015) may have continued after 2015. Tomaselli et al. (2018) worked with community observers in Iqaluktutiaq (Cambridge Bay) on southeast Victoria Island and documented their observations of a steep decline in muskox abundance in southeast Victoria Island from about 1995-2014. The decline was accompanied by a decrease in proportions of juvenile muskoxen, a decline in body condition, an increase in observations of diseased muskoxen, and an increase in observations of acute muskox deaths (Tomaselli et al. 2018). Some of these adverse conditions may also have contributed to the muskox decline on northwest Victoria Island 2015-2019.

In 2015 there were only two Peary caribou observed during the survey and no estimate was calculated based on this low number. Although caribou seasonal movements and migrations make it more difficult to compare the surveys conducted in different seasons, the population estimate obtained in this 2019 survey, 78±136 (95% CI) for stratum A and 98±91 (95% CI) for stratum C, is similar to the estimate of Peary caribou from the summer 2010 survey (Davison and Williams 2013). The number of adult Peary caribou estimated in summer 2010 in strata A and B was 150±104 (95% CI) with an additional 430±214 (95% CI) adult caribou estimated in Stratum C; these were assumed to be Dolphin and Union caribou based on data from collared caribou (Davison and Williams 2013). The confidence intervals on our 2019 estimate are wide so results should be interpreted with caution. A population trend is not known due to the change in timing of the survey, though more caribou being observed in 2019 compared to the worrisome results of the 2015 survey is a good sign. The overall estimated number of caribou remains low, however.

Four wolves were observed during this survey and none of these were in the new stratum E. This is less than the 16 wolves observed during the 2015 survey in strata A, B and C combined (Davison and Williams 2019) and the summer 2010 survey where 18 adult wolves and one pup were seen in strata A, B, and C combined (Davison and Williams 2013). However, wolves are generally found at low densities and wolf sighting rates on aerial caribou surveys have a high variability and may be only a rough indicator of wolf abundance (Frame and Cluff 2011).

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