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Aerial surveys of Peary caribou and muskoxen on Bathurst Island, Northwest Territories, 1973 and 1974

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Abstract

The distributions and numbers of Peary caribou (*Rangifer tarandus pearyi*) and muskoxen (*Ovibos moschatus*) on Bathurst Island in 1973 and 1974 were determined by aerial surveys based on a standard strip method. Coverage was 25% for the late winter surveys of 1973 and 1974, but varied between strata in summer 1974.

Most caribou observed in both late winter surveys were on the southeast of the island. The summer survey showed that the caribou had moved to the northern part. No calves were seen in 1974. Caribou numbers decreased an estimated 73% between summer 1961 and 1973, and 62% between summer 1973 and March 1974.

There was no marked seasonal change in the distribution of muskoxen, which were found mainly on central and southern Bathurst. No calves and few yearlings were seen in 1974. Muskoxen decreased by an estimated 40% from summer 1961 until summer 1973, 22% from then until March 1974, and a further 66% from March until August 1974. The decline of both species between 1973 and 1974 is attributed to ice and excessive snow cover. There was no evidence on which to evaluate the effects of industrial exploratory activity on either species.

Résumé

La distribution et le nombre des caribous de Peary (*Rangifer tarandus pearyi*) et des boeufs musqués (*Ovibos moschatus*) dans l'île Bathurst en 1973 et 1974 ont été déterminés au moyen de dénombrements aériens, selon la méthode habituelle par virée. L'observation effective a été de 25% lors des relevés de fin d'hiver de 1973 et 1974, mais a varié d'une division à l'autre pendant l'été 1974.

La plupart des caribous dénombrés à la fin des deux hivers étaient regroupés dans la partie sud-est de l'île. D'après le relevé d'été, les caribous se sont déplacés vers le nord pendant cette saison. Aucun jeune n'a été vu en 1974. La population de caribous a diminué d'environ 73% entre l'été de 1961 et 1973, et de 62% entre l'été 1973 et mars 1974.

Aucune variation saisonnière marquée n'a été enregistrée dans la répartition de boeuf musqué, dont la plupart des spécimens habitaient le centre et le sud de l'île. En 1974, on n'a vu aucun jeune et seulement quelques petits d'un an. Le nombre des boeufs musqués a diminué d'environ 40% entre l'été de 1961 et celui de 1973, de 22% de cette dernière date jusqu'à mars 1974, et d'un autre 66% de mars 1974 au mois d'août de la même année. Le déclin des populations de ces

deux espèces entre 1973 et 1974 est attribué aux glaces et à l'enneigement excessif. Rien n'a permis d'évaluer les effets de l'exploration industrielle sur l'une ou l'autre de ces espèces.

Introduction

The CWS conducted aerial surveys from 1972 to 1974 to determine numbers and distributions of Peary caribou (*Rangifer tarandus pearyi*) and muskoxen (*Ovibos moschatus*) on the western Queen Elizabeth Islands. The work was undertaken for two reasons:

(1) The Government of the Northwest Territories requires data for making game management decisions.

(2) The construction of a natural gas pipeline from the Queen Elizabeth Islands is probable, and baseline data are needed for evaluating the possible detrimental impact of such a pipeline on wildlife.

In 1973 the Inuit of Resolute Bay voiced concern about the possible effects of seismic activities on caribou on Bathurst Island, the most easterly of the large islands we surveyed. In 1973-74 a sharp decrease in both caribou and muskoxen occurred on Bathurst. The surveys were not designed to determine the effects of seismic activities on the animals, as intensive observational research would be necessary to deal with that question. However, the survey results document the decreases, and some of the associated circumstances.

A report on the necropsies of caribou and muskoxen on Bathurst and other islands is in preparation, and a more detailed report of all the aerial survey data from the islands will follow. We are making available here the results of our three aerial surveys of Bathurst Island conducted in 1973 and 1974. The only previous extensive aerial survey of caribou and muskoxen on Bathurst Island was conducted by the CWS in the summer of 1961 (Tener, 1963).

Survey area

Bathurst Island lies between latitudes 74° and 77° North, and longitudes 97° and 103° West (Fig. 1). The geology and geography have been described by Taylor (1956), Dunbar and Greenaway (1956), and Fortier *et al.* (1963). The island has a distinctive pattern of inlets and intervening ridges and headlands which reflect the underlying geology. Most of the coast is sharply sloping and rugged, but with few cliffs. Because of the long inlets, 25% of the land surface is within 2.5 km of the coast.

The northern three-quarters of the island is dominated by east-northeast folds of bedrock, which form a ridged upland. Erosion has caused regular and continuous ridges with gentle to moderately steep slopes. The drainages either follow the main valleys or cut across ridges forming a trellis pattern. Most of the land (63%) is below 150 m in elevation; the greatest relief is on the northwest, where bluffs reach 412 m.

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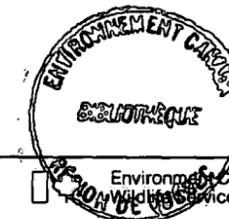
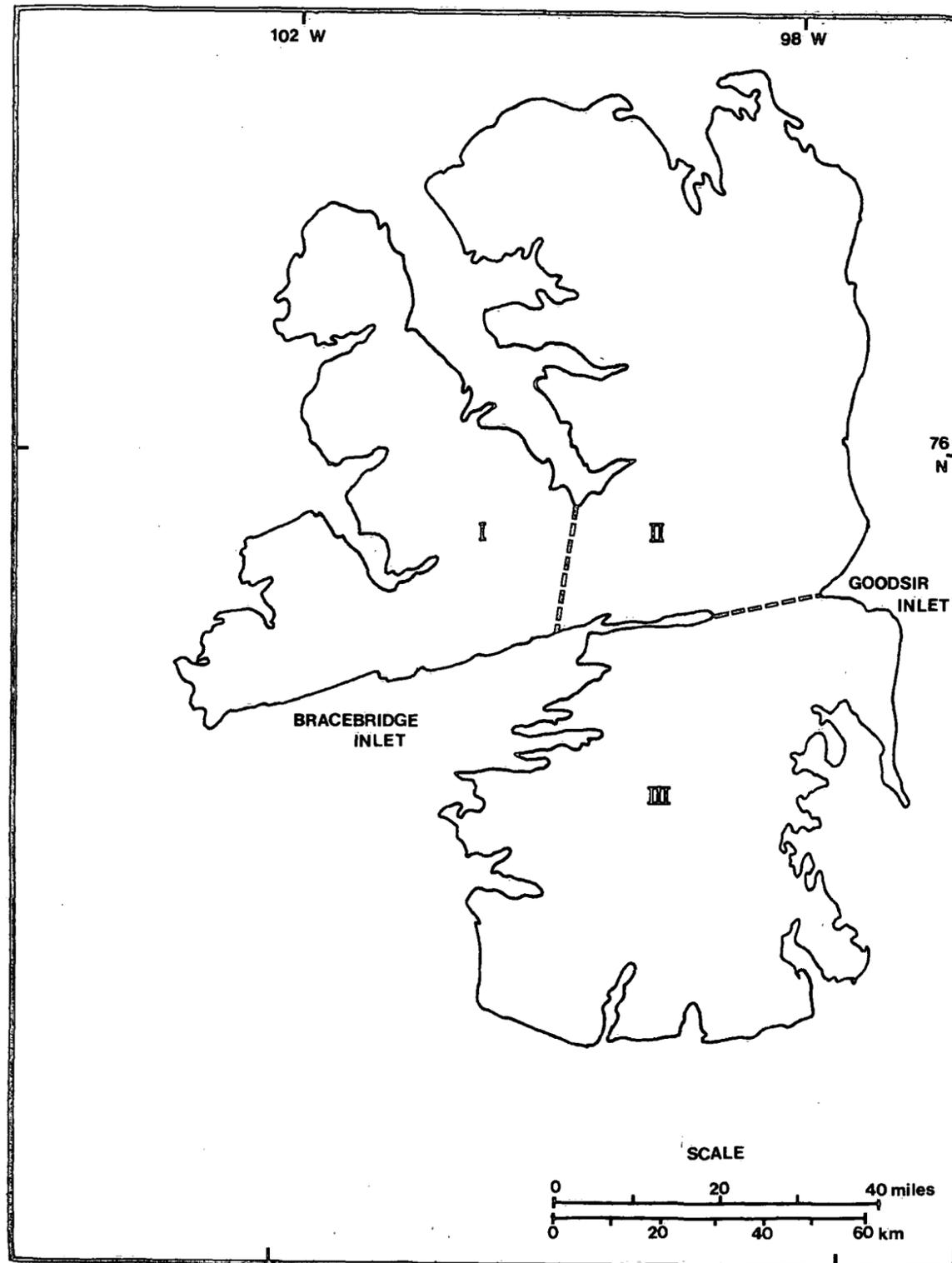


Figure 1
Stratification for aerial surveys of Bathurst Island, Queen Elizabeth Group, Northwest Territories, March–April 1973, March 1974, and August 1974



The southern quarter of the island is mainly a gently undulating plateau with few well-defined features. The land is less well-drained than the upland ridges to the north. To the southwest the plateau surface is broken by many small ponds.

The vegetation is probably typical of the western Queen Elizabeth Islands (Porsild, 1955). Studies of the vegetation to date have been restricted in scope and location, and do not permit evaluation of range conditions on the island.

Winter weather

Thompson (1971) compared meteorological data from Bathurst with those from Resolute Bay, Cornwallis Island (140 km southeast), and found that Bathurst Island has slightly colder winters. Topography had considerable effect on surface and local winds (Thompson, 1971), and therefore on the pattern of snow accumulations.

Snow cover was heavier in both 1971–72 and 1973–74 than in 1972–73. Snow cover remained later in 1972 than in 1973 and latest in 1974. In 1973 ice storms occurred in late September and early October, and were followed by severe snow storms in late October. Much low ground remained snow covered until July 1974.

Methods

Three surveys of the island were carried out by a standard strip method, using a Helio-Courier fixed wing aircraft. Observers were F.L. Miller and R.H. Russell, CWS.

Flight dates for the three surveys were March 29, April 1, 2, 3, 1973; March 25, 26, 28, 29, 31, 1974; and August 25, 26, 1974. Percentage coverage was 25% in March–April 1973 and March 1974. In August 1974 coverage varied between strata: Stratum III, 25%; Stratum II, 16%; and Stratum I, 12.5%. Stratification, size of strata and coverage of surveys are given in Table 1.

Bathurst was divided into three major land units (Fig. 1), which provided convenient strata for surveying. Parallel flight lines were drawn on 1:250,000 scale topographical maps. The flight lines were oriented east-west to provide maximum contact with the coast for accurate navigation. Flight paths were at 6.4 km intervals except in August 1974 on Stratum I and part of Stratum II where they were 12.8 km apart.

All survey flights were at about 150 m above ground level at speeds ranging from 110 to 190 kmph, depending on the number of animals encountered. Observations were located on the survey maps and recorded on tape.

Each strip surveyed was 1.6 km wide. Wires were strung from eye-bolts on the wing of the Helio-Courier to bolts on the fuselage in order to mark the boundaries of each strip. Lines marked on each observer's window were aligned with corresponding tabs on the wires. At an altitude of 150 m above ground, these tabs were checked against fuel drums located at 0.4 and 0.8 km intervals from a reference point on the ground. Allowance was made for the blind spot beneath the aircraft.

The number of animals on each stratum was estimated by extrapolation from the animals tallied on the survey strips on that unit. Group sizes were determined for animals both on and off survey strips.

Results

Observed and estimated numbers of caribou and muskoxen on Bathurst Island during March–April 1973, March 1974, and August 1974 are given in Tables 2 and 3. In the following text, numbers and percentages of caribou and muskoxen refer to estimates based on transect counts, unless otherwise stated.

Caribou distribution

In March–April 1973, 60% of the caribou were on the southeast of the island (Stratum III). The remaining caribou were nearly equally distributed between northeast (Stratum II, 18%) and northwest (Stratum I, 22%).

In March 1974 the distribution of caribou was similar to March–April 1973, but with a slightly larger proportion on Stratum III and a slightly smaller proportion on Stratum I: 74% of the caribou occurred on Stratum III, 21% on Stratum II, and 5% on Stratum I. However, actual numbers, both observed and estimated, were dissimilar between years (Table 2).

In August 1974 the distribution varied considerably from the 1973 and 1974 late winter surveys. No caribou were seen on transect in Stratum III, although 15% of the total caribou observed were off transect in that stratum. Of the total caribou observed on transect, 83% occurred on Stratum II and 17% on Stratum I.

The distribution of caribou in August 1974 was comparable to that observed in June–July 1961 (Tener, 1963), when Tener estimated that over 54% of the caribou were on Stratum II, and 45% and 0.4% on Stratum I and Stratum III respectively (Tener, 1963). This pattern was reversed in March–April 1973.

The results of both late-winter surveys (Table 2) indicate that the southeastern part of the island (Stratum III) is the major wintering area. The distribution of caribou in June–July 1961 and in August 1974 indicates that in summer most caribou on the island range over the northern part. These findings are in agreement with statements by Inuit residents of Resolute Bay (Bissett, 1968; Freeman, 1974) who believe that the caribou on Bathurst winter in the southeast, move to the northeast to calve, summer in the north, and return south in the autumn.

Caribou recruitment

We did not identify any short yearling caribou during either 1973 or 1974 late winter surveys. However, our ability to distinguish yearlings from the air is questionable. No caribou calves were observed during the August 1974 survey, and we conclude that few, if any, calves were born or reared successfully that year.

Caribou numbers

Tener (1963) estimated that there were 2,723 caribou on Bathurst in the summer of 1961. According to the results of our surveys, the number of caribou on the island decreased by about 90% between 1961 and 1974. The results also indicate that the number of caribou decreased by about 57% between March–April 1973 and March 1974, but little change occurred between March and August 1974.

In our 1973 surveys of Peary caribou on other islands, our counts in late winter were consistently exceeded by the subsequent summer counts exclusive of calves. We attribute the discrepancy to the white pelage of the caribou making them more difficult to see against snow. We have used our data from other islands (Melville, Prince Patrick, Byam Martin and Eglinton) to compensate for observational error intrinsic to late winter surveys. Furthermore, we have had to estimate the numbers of animals on Bathurst in summer 1973 because delays prevented a survey. We based this summer estimate on the previous late winter estimates for Bathurst, an assumed spring mortality, and the average percentage of calves seen on the four other islands in summer 1973.

The number of caribou estimated on Melville, Prince Patrick, Byam Martin and Eglinton in July–August 1973, excluding calves of the year, was 3,630. In March–April our survey estimate was only 3,148 caribou, although there must have been at least 3,630 present at that time. If we assume that natural mortality between the March–April and July–August surveys was 7.5%, the March–April estimate is increased to $100/100 - 7.5 \times 3,630 = 3,924$ caribou. Therefore our correction factor for March–April surveys is $3,924/3,148 = 1.246$. On that basis the estimate of 535 caribou on Bathurst in April 1973 is adjusted (535×1.246) to 667. Natural mortality at an assumed 7.5% in spring 1973 would have reduced the 667 caribou in April to 617 by June. However, we assume that calves were added to the Bathurst population in June 1973 in the same proportion as the ratio of calves to older caribou observed on the four other islands in summer 1973, namely 18.6%. There would then have been $617 \times 118.6/100 = 732$ caribou on Bathurst in July–August 1973.

Tener's (1963) estimate of 2,723 caribou in summer 1961 and ours of 732 in summer 1973 indicates a decline of 73% during the twelve-year period. The estimated percentage decline of caribou on Melville for the same period was the same, 12,799 to 3,433 or 73% and on Prince Patrick slightly less, 2,254 to 817 or 64%. On Bathurst between the summers of 1973 and 1974 there was a marked further decrease to approximately 278 or 62%.

If the 1973 adjustment is applied to the March 1974 estimate of caribou (231) on Bathurst ($231 \times 1.246 = 288$), the result is similar to the August 1974 estimate of 278, suggesting that losses after March were negligible. There is a possibility, however, that some mortality occurred between March and August and was offset by the return from Cornwallis of caribou that had moved there in winter.

Caribou harvest

The caribou on Bathurst Island are hunted by the Inuit of Resolute Bay. The kill statistics (Table 4) vary according to the source. However, data from the two sources agree in identifying a marked increase in the caribou killed on Cornwallis in the winter of 1973–74. Inuit hunters believe that caribou moved from Bathurst to Little Cornwallis and on to Cornwallis during the winter of 1973–74 (Freeman, 1974). The increased kill supports that supposition.

Muskox distribution

The distribution of muskoxen among the three strata of Bathurst varied less from one survey to another than was the case

for caribou, although numbers of muskoxen also declined. The greatest numbers of muskoxen were found on Stratum III during all three surveys: 48% in March–April 1973, 74% in March 1974, and 50% in August 1974. Stratum II contained 24% and 20% of the muskoxen in March–April 1973 and March 1974, respectively, but 50% in August 1974. Muskoxen on Stratum I decreased from 28% of the total in March–April 1973 to 6% in March 1974. No muskoxen were seen on transect on Stratum I in August 1974, but 8% of the total muskoxen seen on and off transect were on Stratum I.

Tener (1963) also estimated the greatest percentage of muskoxen (46%) were on Stratum III in June–July 1961, with 36% on Stratum I and 18% on Stratum II. Findings from 1961 (Tener, 1963) and 1973 and 1974 indicate that most muskoxen frequent central and southern Bathurst Island.

Muskox recruitment

As normally few muskoxen are born before the first week in April, it is not surprising that no calves were seen in either the March–April 1973 or March 1974 surveys. However, the failure to see any calves in August 1974 is evidence that, as in the case of caribou, few, if any, muskoxen were born or reared successfully on Bathurst in that year.

In March–April 1973, 33 (7.4%) of 446 muskoxen seen were short yearlings and in March 1974, 24 (9.2%) of 262 muskoxen observed were short yearlings. However, only 2 (1.9%) of 105 muskoxen seen in August 1974 were yearlings. Although we lack data on numbers of muskoxen born in 1973, we can conclude that few of them survived until their second summer.

Muskox numbers

Tener (1963) estimated that there were 1,136 muskoxen on Bathurst in the summer of 1961. According to our surveys the number had decreased by 40% to 678 by March–April 1973 (Table 3). The numbers of muskoxen further decreased by 22% from April 1973 to March 1974, and between March and August 1974 there was a sharp decrease of 66%. The decrease from March–April 1973 to August 1974 was 73%.

Bracebridge – Goodsir Inlet area

The valley between Bracebridge and Goodsir inlets is about 20 km wide and runs about 60 km from east to west across central Bathurst. It is of special interest because of the long-term biological studies being conducted there by personnel of the National Museums of Canada. Therefore, we have compiled separately the total numbers of caribou and muskoxen seen on the area during Tener's (1961) survey in 1961 and ours in 1973 and 1974. Percentages of total numbers of the species seen both on and off transect during the surveys are shown in parentheses.

In June–July 1961 only one of the caribou seen by Tener (1961) was on the area. During our surveys more caribou were seen on the area, even though total caribou numbers had decreased: March–April 1973, 18 (9%); March 1974, 2 (2%); and August 1974, 41 (49%).

In 1961, Tener (1961) saw 167 (69%) muskoxen on the Bracebridge–Goodsir lowland. During our surveys there were fewer muskoxen in the valley, both in absolute numbers and

as a percentage of the total: 109 (24%) in March–April 1973, 75 (26%) in March 1974, and 20 (19%) in August 1974.

Group sizes of caribou and muskoxen

Group sizes of both caribou and muskoxen were compared between surveys to determine how the species responded socially to decreases in density and to the difficult foraging conditions of the 1973–74 winter. Average group sizes observed by Tener (1963) in June–July 1961 and those recorded by us in August 1974 (Table 5) are similar for both species. This condition suggests that, even though overall numbers of caribou and muskoxen had decreased drastically, summer grouping dynamics remained consistent for each species.

The smaller average group size for caribou in March–April 1973 and March 1974 as compared to that observed in August 1974 reflects the greater wintertime dispersion that is normal in Peary caribou (Miller, Russell, and Urquhart, 1973; Miller and Russell, 1974). Many caribou that are judged to be solitary animals at that time may actually be members of loosely dispersed groups responding to forage scarcity on sparsely vegetated exposed sites.

The average group size of muskoxen seen in March–April 1973 (13.9) is expected for wintertime groups (Miller, Russell, and Urquhart, 1973; Miller and Russell, 1974). The smaller average group size of March 1974 (6.9) was probably caused by muskoxen having to leave their normally preferred feeding sites because of snow cover and to seek forage on wind-blown sparsely vegetated ridges and knolls, which could not support large groups for extended periods. Mortality and/or behavioural response to stress reduced the group sizes. The unusual occurrences of solitary muskox bulls in late winter suggests that intolerance brought on by stress may have led to fragmentation of groups in March 1974.

Intolerance between the smaller reformed groups might have caused displacement from restricted feeding sites and triggered extensive movements by some groups. Although part of the estimated 66% loss of muskoxen from Bathurst between April and August 1974 could have been the result of egress, we believe that most of that decrease can be attributed to mortality rather than to successful emigration. The condition of many of the muskoxen present in March had deteriorated to a level where they would have been incapable of lengthy travel.

Conclusions

Differences between 1961 (Tener, 1963) and 1973 survey results suggest that the numbers of caribou (Table 2) and muskoxen (Table 3) decreased by about 80% and 40%, respectively. The reduction in caribou numbers fits the overall pattern of decline of caribou on the western Queen Elizabeth Islands. The reduction in numbers of muskoxen, however, is in contrast to the observed increase on the other islands surveyed in 1972 (Miller, Russell, and Urquhart, 1973) and in 1973 (Miller and Russell, 1974). Gray (1973:35) suggests that more muskoxen than usual may have succumbed on Bathurst during the winter of 1967–68. Subsequent evidence indicates that there were no calves produced during 1968, 1969 or 1970 (Gray, 1973:45). We have documented in this report further marked reductions of both caribou and muskoxen between April 1973

and August 1974. Based on August 1974 estimates caribou have decreased by about 90%, and muskoxen by about 84% since 1961.

The compounded effects of increased mortality and absence or scarcity of calf production in some years have apparently been major causes of the observed declines of caribou and muskoxen on Bathurst Island between 1961 and 1974. Freeman (1974) describes the Inuit's belief that caribou moved off Bathurst during the winter of 1973–74, and the reported increased harvest of caribou on Cornwallis Island supports that supposition. It is possible that emigration has also contributed to the decrease in muskoxen on Bathurst.

We lack data from which to judge the effects of seismic or other industrial activities on the movements, reproduction, and survival of caribou and muskoxen over the short or long term. However, we believe that the main cause of the sharp decrease in both species in 1973–74 was starvation caused by ice and prolonged and excessive snow cover which reduced the availability of forage.

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Table 1
Stratification and coverage for three aerial surveys on Bathurst Island, Northwest Territories, 1973-74

Stratum		Distance flown (km)			Area surveyed (km ²)			Total area (km ²)
		Mar.-Apr. 1973	Mar. 1974	Aug. 1974	Mar.-Apr. 1973	Mar. 1974	Aug. 1974	
I	Northwest Bathurst	630	630	315	1,010	1,010	510	4,080
II	Northeast Bathurst	1,030	1,030	650	1,660	1,660	1,010	6,650
III	South Bathurst	840	840	840	1,350	1,350	1,350	5,360
I-III	Bathurst	2,500	2,500	1,805	4,020	4,020	2,910	16,090

Table 2
Estimates of Peary caribou obtained from three aerial surveys on Bathurst Island, Northwest Territories, March-April 1973, March 1974, and August 1974*

Stratum and date	Total caribou observed	1.6 km strip census			Estimated caribou
		Caribou on transect	Caribou/100 km ²		
March-April 1973					
I	43	29	2.9	117	
II	38	24	1.4	96	
III	122	81	6.0	322	
I-III	203	134	3.3	535	
March 1974					
I	4	3	0.3	12	
II	18	12	0.7	48	
III	59	43	3.2	171	
I-III	81	58	1.4	231	
August 1974					
I	8	6	1.2	48	
II	63	35	3.5	230	
III	13	0	0.0	0	
I-III	84	41	1.4	278	

*See text for adjusted values and extrapolation for July-August 1973.

Table 3
Estimates of muskoxen obtained from three aerial surveys on Bathurst Island, Northwest Territories, March-April 1973, March 1974, and August 1974

Stratum and date	Total muskoxen observed	1.6 km strip census			Estimated muskoxen
		Muskoxen on transect	Muskoxen/100 km ²		
March-April 1973					
I	109	48	4.8	194	
II	74	40	2.4	160	
III	263	82	6.1	326	
I-III	446	170	4.2	680	
March 1974					
I	13	8	0.8	32	
II	40	27	1.6	108	
III	232	99	7.3	393	
I-III	285	134	3.3	533	
August 1974					
I	8	0	0.0	0	
II	25	14	1.4	92	
III	72	23	1.7	91	
I-III	105	37	1.3	183	

Table 4
Reported harvest of Peary caribou on Bathurst and Cornwallis islands by Inuit hunters from Resolute Bay, Northwest Territories, winters 1971-74

Island by source	No. caribou killed		
	1971-72	1972-73	1973-74
Bathurst			
Freeman*	85	33	44
Martin†	26	75	20
Cornwallis			
Freeman	15	19	80
Martin	19	0	64
Totals			
Freeman	100	52	124
Martin	45	75	84
Differences by source	±55	±23	±40

*Freeman, 1974.

†Martin, 1974.

Table 5
A comparison of grouping statistics from aerial surveys in
June–July 1961, March–April 1973, March 1974, and
August 1974, Bathurst Island, Northwest Territories

Species and date	No. animals	No. groups including singles	No. singles	Group size incl. singles		Group size excl. singles	
				Mean	Range	Mean	Range
Caribou							
June–July 1961*	288	79	22	3.6	1–31	4.7	2–31
March–April 1973	203	69	10	2.9	1–6	3.3	2–6
March 1974	81	42	19	1.9	1–4	2.7	2–4
August 1974	84	16	1	5.3	1–11	5.5	2–11
Muskoxen							
June–July 1961†	108	22	4	4.9	1–32	5.8	2–32
March–April 1973	446	32	0	13.9	2–39	13.9	2–39
March 1974	285	48	8	5.9	1–17	6.9	2–17
August 1974	105	29	4	3.6	1–10	4.0	2–10

*Tener (1963).

†Tener (1961).