

Status of Peary Caribou and Muskox Populations on Bathurst Island, N.W.T., August 1981

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ABSTRACT. An aerial survey of Bathurst Island, Northwest Territories, Canada, was conducted 10-13 August 1981 to determine if Peary caribou (*Rangifer tarandus pearyi*) and muskoxen (*Ovibos moschatus*) had recovered since die-offs in the early 1970s. Sampling intensity was 26%, except for 74% over Polar Bear Pass on central Bathurst Island. Populations of 289 Peary caribou and 208 muskoxen were estimated. The proportion of calves among classified animals was 19% for caribou and 16% for muskoxen. Caribou were concentrated on northern Bathurst, preferring elevations 151-300 m above sea level (asl). Muskoxen were concentrated in southern and central Bathurst Island, preferring elevations below 150 m asl. Spatial separation of the two species during the survey suggested little or no range overlap during late summer. Calf production and/or summer survival in 1981 was significantly greater than in 1974. The 1981 caribou and muskox estimates were only slightly greater than in August 1974. Thus the populations estimated in 1981 showed no marked overall recovery since 1974. Prohibition of harvesting of both species should continue on Bathurst Island. An "extensive-then-intensive" survey design is recommended for future work, based on statistical problems associated with the 1981 and previous surveys.

Key words: Northwest Territories, Peary caribou, muskoxen, population status, distribution, management

RÉSUMÉ. Du 10 au 13 août 1981, on a effectué un relevé aérien de l'île de Bathurst, dans les Territoires du Nord-Ouest au Canada pour déterminer si la population du caribou de Peary (*Rangifer tarandus pearyi*) et celle du boeuf musqué (*Ovibos moschatus*) s'étaient remises de la dévastation du début des années 1970. L'intensité de l'échantillonnage était de 26%, sauf dans le Polar Bear Pass au centre de l'île de Bathurst où elle était de 74%. On a évalué les populations à 289 caribous de Peary et à 208 boeufs musqués. La proportion de veaux parmi les animaux qui ont été classifiés était de 19% pour les caribous et de 16% pour les boeufs musqués. Les caribous étaient concentrés au nord de l'île de Bathurst, montrant ainsi une préférence pour des altitudes comprises entre 151 m et 300 m au-dessus du niveau de la mer. Les boeufs musqués, qui préféraient des altitudes inférieures à 150 m au-dessus du niveau de la mer, étaient concentrés au centre et au sud de l'île de Bathurst. La séparation géographique des deux espèces durant le relevé semble indiquer qu'il n'y a eu que peu ou pas de chevauchement de leurs territoires à la fin de l'été. La production des veaux et/ou la survivance durant l'été étaient nettement plus grandes en 1981 qu'en 1974. L'estimation du nombre de caribous et de boeufs musqués en 1981 n'était que légèrement supérieure à celle d'août 1974. Les populations estimées en 1981 ne montraient donc dans leur ensemble aucune amélioration notable depuis 1974, et il devrait être encore interdit de chasser ces deux espèces dans l'île de Bathurst. En raison de problèmes statistiques associés aux relevés de 1981 et aux précédents, on recommande de planifier un relevé couvrant d'abord une plus grande surface, puis plus détaillé, en vue d'un travail futur.

Mots clés: Territoires du Nord-Ouest, caribou de Peary, boeuf musqué, état de la population, répartition, gestion

INTRODUCTION

Bathurst Island, Northwest Territories (N.W.T.), has a land area of about 16 000 km² and lies among the south-central Queen Elizabeth Islands in the Canadian arctic archipelago (Fig. 1). The island and its vegetation have been described by Fortier *et al.* (1963), Edlund (1983) and others.

In summer 1961, Tener (1963) estimated 2723 Peary caribou and 1136 muskoxen during the first systematic aerial survey of the island. From an aerial survey in summer 1974, Miller *et al.* (1977) estimated that the number of Peary caribou had declined by 92% to 231 and muskoxen had declined by 86% to 164 on Bathurst Island since 1961. Between 1961 and 1974, caribou populations had declined throughout all the western Queen Elizabeth Islands because of low productivity and high mortality. Miller *et al.* (1975) attributed these die-offs to early snowfalls, deep and prolonged snow cover and ground-fast ice, which critically reduced forage availability.

From 1960 to 1974, Inuit hunters from Resolute Bay, Cornwallis Island, harvested Peary caribou primarily on Bathurst Island (Riewe, 1976). Inuit were concerned that oil and gas exploration on Bathurst Island may have been responsible for, or contributed to, the caribou decline. In 1981, the Department of Renewable Resources, Government of the Northwest Territories (G.N.W.T.), wanted to determine if the populations had recovered since 1974. Therefore, I conducted an aerial survey of Bathurst Island in August 1981 to determine the numbers and distributions of Peary caribou and muskoxen and to evaluate the

proportion of calves in the populations. As well, the Department of Renewable Resources, G.N.W.T., had a special interest in wildlife in Polar Bear Pass (Fig. 2), because that area was being considered as a National Wildlife Area.

METHODS

Peary caribou and muskoxen on Bathurst Island were counted using a standard aerial strip-transect method (*cf.* Miller *et al.*, 1977). Tape markers were used on the wing struts of a Cessna 337 to delineate a 0.8 km strip on each side of the aircraft. Transects were flown at 122 m above ground at 190-210 km·h⁻¹. The 0.8 km strips fell beyond the blind zone directly below the aircraft. Four survey strata were established on Bathurst Island: stratum 1, 4070 km²; stratum 2, 6501 km²; stratum 3, 5094 km²; and stratum 4, 404 km². Survey strata 1, 2 and 3 were largely similar to those of Tener (1963) and Miller *et al.* (1977). However, stratum 4 over Polar Bear Pass lies between my strata 2 and 3 (Fig. 2). In each of strata 1, 2 and 3, the parallel north-south transects were 6.4 km apart to give a coverage of about 26%. In stratum 4, transects were oriented roughly east-west and were 1.6 km apart for about 74% coverage (26% of the stratum was under the aircraft and was not surveyed). The pilot plotted observations on 1:250 000 topographical maps, while the two rear observers counted and recorded animals as being calves or older animals and inside or outside the strip-transect. When all animals in a group could not be counted from the transect, the group was circled to obtain an accurate count.

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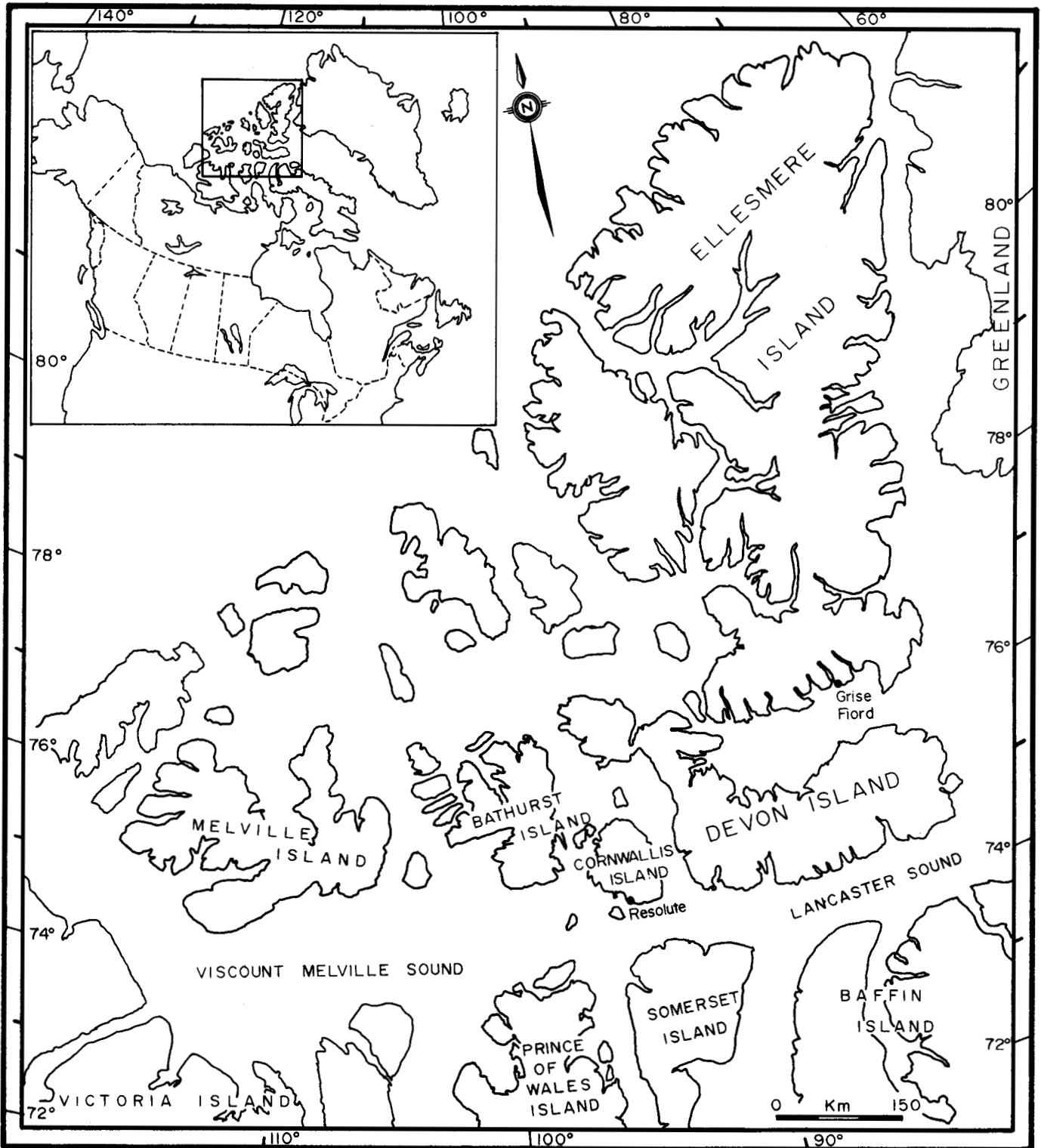


FIG. 1. Queen Elizabeth Islands (north of 74°N), N.W.T., Canada.

All flights originated from Resolute Bay, resulting in extensive ferrying over stratum 3.

Only animals counted within strip transects (including calves) were used to estimate numbers and standard errors, which were calculated with ratio-estimator formulas (Miller *et al.*, 1977). The land area in each of the four strata and in each of four "elevation zones" and five "distance from seacoast zones"

(Miller *et al.*, 1977) was determined from 1:250 000 topographical maps. To determine Peary caribou and muskox preferences for certain strata or zones, the numbers of animals in different strata or zones were compared, based on the proportions of land area, using χ^2 tests. Preference was assumed wherever the number of observed animals was statistically greater than would be expected if they occurred in proportion to the available land

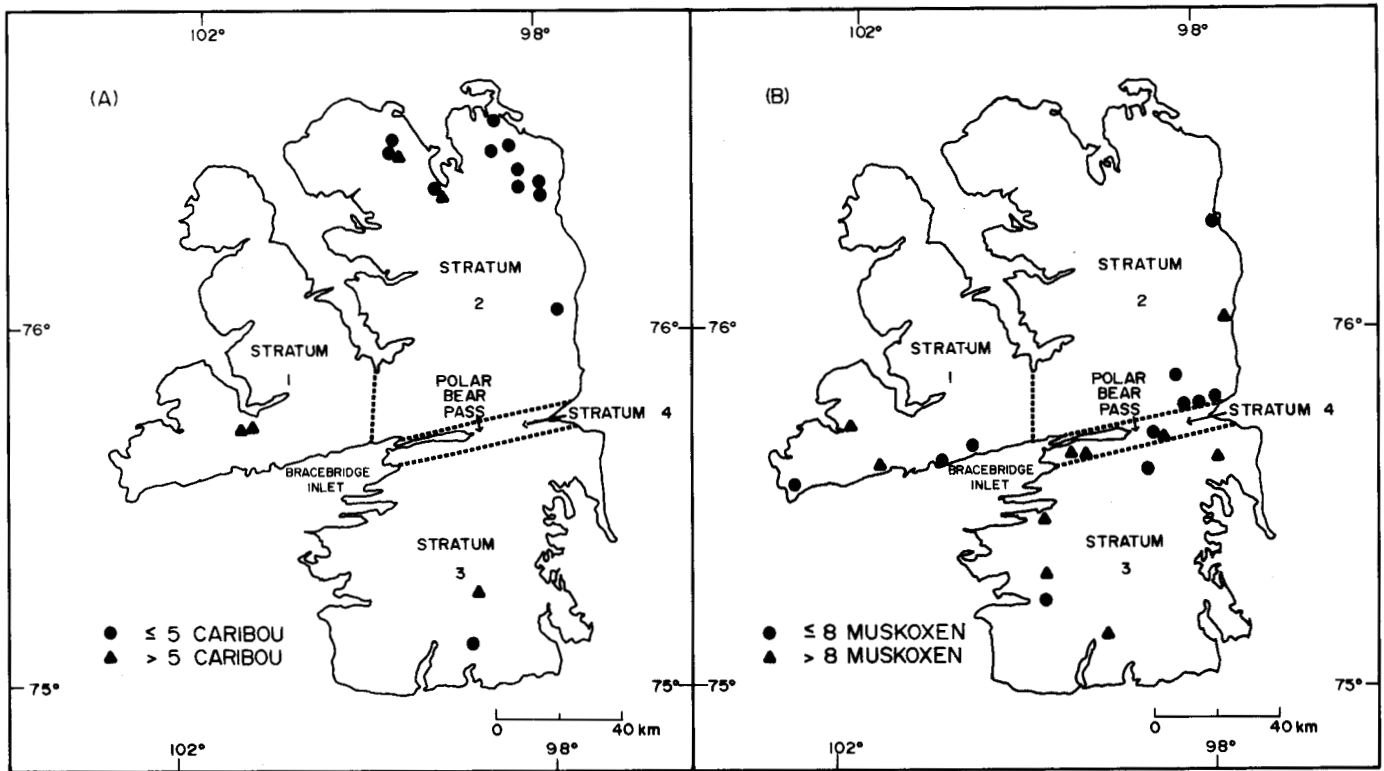


FIG. 2. Distribution of Peary caribou (A) and muskoxen (B) during an aerial survey on Bathurst Island, N.W.T., 10-13 August 1981.

area. Animals observed within and outside strip transects during the survey were used in these comparisons.

RESULTS

An overall aerial coverage of 26.8% of Bathurst Island — 25.5% on strata 1 and 3, 25.6% on stratum 2 and 74.3% on stratum 4 — was obtained during the period 10-13 August (Fig. 2). Sample sizes were 13 transects in stratum 1, 15 each in strata 2 and 3, and 5 in stratum 4. During the survey, snow had already accumulated in strata 1 and 2, north of Polar Bear Pass (stratum 4), at elevations over 100 m above sea level (asl). Survey conditions were generally good. However, low cloud and falling snow caused a few transects to be resurveyed in stratum 2.

Peary Caribou

I estimated a population of 289 Peary Caribou on Bathurst Island in August 1981 (Table 1). The number of caribou one year or older was estimated at 234. No confidence interval was calculated because the data were not normally distributed and

untransformable because of the clumped distribution of the small number of caribou (74) observed on transect.

About 19% of the observed caribou were calves, and the proportions of calves were similar among sampling strata (Table 2).

TABLE 2. Percentages¹ of Peary caribou and muskoxen calves on Bathurst Island, N.W.T., from an aerial survey, 10-13 August 1981

Stratum:	Peary caribou		Muskoxen	
	Total number	% calves ²	Total number	% calves ³
1	22	18.2	36	8.3
2	66	18.2	34	11.8
3	19	21.1	105	18.1
4	0	—	47	21.3
Total	107	18.7	222	16.2

¹Includes all groups for which all calves were counted during the survey and during ferrying.

²Strata 1 and 3 combined (because expected number of calves was < 5 in each) do not differ ($P > 0.93$) from stratum 2.

³Do not differ ($P > 0.50$) between strata.

TABLE 1. Numbers and densities of Peary caribou on Bathurst Island, N.W.T., during an aerial survey, 10-13 August 1981

Stratum	Number of caribou counted ¹			Caribou-100 km ⁻²		Estimated number	
	On transect	Off transect	Ferrying	Mean	Standard error	Total	Standard error
1	18 (4)	0 (0)	4 (0)	1.7	1.4	70.5	58.4
2	41 (8)	17 (2)	8 (2)	2.5	0.8	159.7	50.8
3	15 (2)	0 (0)	4 (2)	1.2	1.0	58.9	51.5
4	0 (0)	0 (0)	0 (0)	0.0	0.0	0.0	0.0
Total	74 (14)	17 (2)	16 (4)	1.7	0.5	289.1	93.0

¹Number of calves in parentheses.

Peary caribou preferred stratum 2 on Bathurst Island during 10-13 August 1981 (Table 3). Observed caribou also preferred elevations between 151 and 300 m asl, although they tended to be at lower elevations within that zone (overall median, 152 m). Caribou were also found at 60-150 m asl but at less than the expected rate, while none was seen below 60 m or above 300 m asl (Table 3). Observed caribou preferred areas 2.5-10 km from the coast (overall median, 6.5 km), occurred less than expected 10.1-15 km and as expected over 15 km from the coast, while none was seen within 2.5 km (Table 3).

TABLE 3. Relative distributions of Peary caribou (n = 91) and muskoxen (n = 189) observed on and off transect during an aerial survey on Bathurst Island, N.W.T., 10-13 August 1981

Stratum or zone	% of total area surveyed	% of observed animals	
		Caribou	Muskoxen
Sampling strata			
1	24.1	19.8 ¹	18.5 ¹
2	38.8	63.7 ²	18.0 ²
3	30.2	16.5 ²	38.6 ²
4	6.9	0.0 ²	24.9 ²
Elevation above sea level (m)			
< 60	27.8	0.0 ²	34.9 ²
60-150	37.6	26.4 ²	65.1 ²
151-300	34.4	73.6 ²	0.0 ²
> 300	0.2	0.0 ³	0.0 ³
Distance from seacoast (km)			
< 2.5	25.3	0.0 ²	14.3 ²
2.5- 5.0	19.2	42.8 ²	33.9 ²
5.1-10.0	29.1	39.6 ²	22.2 ²
10.1-15.0	15.9	5.5 ²	25.4 ²
> 15.0	10.5	12.1 ¹	4.2 ²

¹Does not differ ($P > 0.05$) from percent of total area surveyed.

²Differs ($P < 0.05$) from percent of total area surveyed.

³Difference from percent of total area surveyed was not tested (expected number of animals < 5).

Muskoxen

The population estimate of 208 muskoxen was less than the minimum number counted during 10-13 August 1981. After excluding calves, the estimate is 167. A confidence interval for the estimate was not determined because of the non-normal distribution of the data. Forty muskoxen that were not seen during the survey were counted on ferrying flights, while 84 were seen on transect and 105 off transect during the survey. Therefore, at least 229 muskoxen were observed, of which only 37% were on transect (Table 4).

Polar Bear Pass was surveyed more intensively than other strata to evaluate its importance for muskoxen in late summer. About 30% of the estimated number of muskoxen were in stratum 4 (Table 4). However, the boundaries of stratum 4 were

probably too narrow, as 44% of all observed muskoxen were within 5 km of it.

About 16% of 222 classified muskoxen were calves (Table 2). The proportion of calves in central and southern Bathurst Island in 1981 was higher than in northern portions of the island, although not significantly so (Table 2).

During the survey, muskoxen preferred strata 3 and 4 (Table 3). Observed muskoxen also preferred elevations below 151 m asl (overall median, 61 m), as none was at higher elevations (Table 3). Apparently, sites 2.5-5 km and 10.1-15 km from the Bathurst Island coast were preferred, while areas within 2.5 km, 5.1-10 km and more than 15 km from the coast were used less than expected (Table 3).

DISCUSSION

Number of Peary Caribou

The 1981 estimate (Table 1) suggested about a 25% increase since August 1974, when Miller *et al.* (1977) estimated 231 caribou. However, after excluding calves, my 1981 estimate essentially equals that estimate. Fischer and Duncan (1976) also surveyed Bathurst Island in August 1974, but their estimate of 228 included caribou on smaller islands to the north and west. Since 22% of the caribou observed during Fischer and Duncan's survey were on these smaller islands, their estimate for Bathurst Island was apparently 20-25% less than Miller *et al.*'s (1977) August 1974 estimate. The large standard errors associated with all three surveys and the apparent variability between the two independent estimates in August 1974 suggest wide confidence intervals around the estimates. Therefore, I conclude that the number of Peary caribou in August 1981 was similar to that in 1974.

Fischer and Duncan's (1976) surveys of Bathurst Island in April and June 1975 had relatively low coverage (i.e., 8.3%). The large difference between the estimates of these two surveys (120 vs. 361) suggests that survey coverage was inadequate (Ferguson, in press). Given the lack of reliable surveys between 1974 and 1981, the trend in population size during those years is unknown.

In April 1980, Thomas and Joly (1981) flew non-systematic reconnaissance surveys over the western Queen Elizabeth Islands. They flew 325 km over Bathurst Island and saw only 2 caribou. This is not surprising, based on my August 1981 sighting density of 0.033 caribou·km⁻¹ and given the variability shown by the higher-coverage systematic surveys.

Thomas and Joly (1981) observed only 10 caribou during about 2700 km of aerial reconnaissance over the western Queen Elizabeth Islands in 1980. Based on a number of assumptions, they went on to calculate a population size of 634 caribou on these islands. Application of their assumptions (Thomas and

TABLE 4. Numbers and densities of muskoxen on Bathurst Island, N.W.T., during an aerial survey, 10-13 August 1981

Stratum	Number of muskoxen counted ¹			Muskoxen·100 km ⁻²		Estimated number	
	On transect	Off transect	Ferrying	Mean	Standard error	Total	Standard error
1	12 (2)	23 (?)	8 (0)	1.2	0.9	47.0	35.4
2	8 (0)	26 (4)	0 (0)	0.5	0.4	31.2	23.3
3	17 (5)	56 (8)	32 (6)	1.3	0.8	66.7	41.6
4	47 (10)	0 (0)	0 (0)	15.7	0.3	63.2	1.3
Total	84 (17)	105 (?)	40 (6)	2.0	0.5	208.2	59.4

¹Number of calves indicated in parentheses. “?” indicates not all calves were counted.

Joly, 1981) to Bathurst Island leads to an underestimate of about 58 caribou in 1981, probably because their assumptions of no recruitment and high adult mortality were invalid. Also in August 1981, McLaren (1981) surveyed the Bridport Inlet-Mecham River area of eastern Melville Island. Regarding Thomas and Joly's (1981) surveys, she concluded that "considerably more animals were present in 1980 than [they] suggested."

Proportion of Calves among Peary Caribou

Calf production and survival is proximately related with snow depth, ground-fast ice and duration of snow cover during previous winters (Miller *et al.*, 1977; Thomas, 1982). At Resolute Bay, the 1980-81 snow cover reached about 25 cm in depth and had an ice-crust layer of < 1 cm from mid-March to late May (D. Gullet, pers. comm. 1982). Assuming comparable conditions on Bathurst Island, winter 1980-81 was milder than winter 1973-74, when snow reached about 40 cm and had a 2.5 cm ice-crust layer from early October to late June (D. Gullet, pers. comm. 1982). Thus, winter ice and snow conditions apparently explain the difference in the percentages of calves between August 1981 (Table 2) and August 1974, when Miller *et al.* (1977) saw no calves and Fischer and Duncan (1976) saw only 5 (9%) calves among 55 caribou.

Thomas and Broughton (1978) concluded that following the severe winter of 1973-74, it apparently took two years for caribou to recover from malnutrition. Only 6-7% of adult females were pregnant in the late winters from 1974 to 1976, followed by 88% pregnant in 1977 in the western Queen Elizabeth Islands (Thomas, 1982). Pregnancy rates on Bathurst Island were sampled only in 1974 when just one of six adult females was pregnant (G. Parker, pers. comm. 1986). In late June 1975, calves made up 35% of 48 caribou observed on Bathurst Island and 25% of 158 on eastern Melville Island (Fischer and Duncan, 1976). This evidence suggests that caribou recovered more quickly (i.e., within one year) in these areas than elsewhere on the western Queen Elizabeth Islands, that caribou on the other islands suffered additional significant stress in 1975 and 1976, or that Thomas (1982) underestimated pregnancy rates during 1974, 1975 and 1976 (n = 14-18). Summer calf counts, which might have confirmed pregnancy rates obtained by Thomas (1982), were not conducted in other parts of the western Queen Elizabeth Islands. The ability to recover during the summer immediately after a severe winter would be a distinct selective advantage.

Because of the small sample size for 1974 pregnancy rates, it is difficult to assess the relative importance of summer survival (vs. low production), which led to the low proportion of calves in August 1974 (G. Parker, pers. comm. 1986). Without 1981 data on spring pregnancy rates or the proportion of calves in June, I cannot determine whether production, survival or both were responsible for the higher proportion of calves in August 1981 than in 1974.

Number of Muskoxen

Miller *et al.* (1977) estimated 164 muskoxen on Bathurst Island on 25-26 August 1974. Fischer and Duncan (1976) estimated about 235 muskoxen on Bathurst Island during 18-25 August 1974 (after subtracting about 5% of the observed muskoxen that were on nearby islands). Fischer and Duncan (1976) observed only 20% of the population north of

Bracebridge-Goodsir inlets, compared to 48% of the muskox population estimated by Miller *et al.* (1977). Fischer and Duncan (1976) covered 26.8% of the entire island, while Miller and Russell (1975) surveyed 25% south of Polar Bear Pass, 16% of northeast Bathurst and 12.5% of northwest Bathurst. The non-normal data prevent a statistical test of the difference between the August 1974 estimates, which may have resulted from differences in sampling intensities and transect placement relative to the clumped muskox distribution, differences in visibility or observer biases and/or a sudden change in actual muskox distribution between the surveys.

The August 1981 estimate of 208 muskoxen (Table 4) falls between the two estimates for August 1974 (Miller *et al.*, 1977; Fischer and Duncan, 1976). However, after excluding calves, my 1981 estimate approximately equals that of Miller *et al.* (1977). Therefore, I conclude that muskox population sizes on Bathurst Island were most likely similar in 1974 and 1981.

Proportion of Calves among Muskoxen

Annual variations in the proportion of muskox calves are attributable to winter weather. Fischer and Duncan (1976) saw only one calf among 135 muskoxen on the south and west coast of the island in late June 1974; and in August 1974 Miller *et al.* (1977) found no calves on Bathurst Island. Parker *et al.* (1975) found very low marrow fat reserves in dead muskoxen in late winter 1974 on Bathurst Island, indicating death by malnutrition following that severe winter. Calf production was higher in 1975, as 7 calves (10%) were observed among 69 muskoxen classified in late June (Fischer and Duncan, 1976). The higher proportion of calves in August 1981 (Table 2) is probably attributable to the milder winter of 1980-81 compared to winter 1973-74. However, I cannot determine whether improved production, survival or both were ultimately responsible.

Distributions of Peary Caribou and Muskoxen

The preference of Peary caribou for stratum 2 (Table 3) was expected based on their seasonal movements previously described by Inuit hunters of Resolute Bay (Riewe, 1976) and by Fischer and Duncan (1976) and Miller *et al.* (1977). During early August 1981, 91% of the caribou within stratum 2 were north of 76°20'N, the northern-most concentration yet documented on Bathurst Island. Peary caribou apparently begin their southward movement in mid-August, as only 25% of the caribou in stratum 2 were as far north during late August 1974 (F. Miller, pers. comm. 1982).

During late August 1974, caribou preferred similar elevations above sea level and distances from the coast as in early August 1981 (Table 3), although in 1974 they also showed some preference for areas farther from the coast (Miller *et al.*, 1977). Locations of dropped antlers observed in August 1981 and in 1974 (Fischer and Duncan, 1976) suggest that caribou move into lower coastal areas shortly after (and possibly during) the rut.

The preference of muskoxen for strata 3 and 4 (Table 3) was expected from previous summer surveys (Tener, 1963; Fischer and Duncan, 1976; Miller *et al.*, 1977). During a 1961 ground survey, Tener (1963) found 28% calves among four muskox herds (n = 69) at Bracebridge Inlet (Fig. 2), which differed (P < 0.004) from the 9% calves observed during his 1961 aerial survey over the entire island. Tener's observations and the consistent preference of central and southern Bathurst (plus the

higher proportion of calves in 1981 (Table 2) and larger group sizes (Ferguson, in press) suggest more summer forage and/or better wintering conditions for muskoxen in southern and central Bathurst Island.

The density of muskoxen in stratum 4 in early August 1981 (Table 4) was less than in other muskox refugia (e.g., Thomsen and Parker rivers, Banks Island, at 93 and 73·100 km⁻² in 1980, Vincent and Gunn, 1981; the Bailey Point region, Melville Island, at 60-110·100 km⁻² from 1972 to 1980, Thomas *et al.*, 1981). Based on observations by Gray (1973), muskox densities in Polar Bear Pass may approach densities in these other areas only during October. Polar Bear Pass apparently is important to Bathurst Island muskoxen in summer and fall, and it may enable the population to enter winter in good condition. Nevertheless, it does not appear to be as important as other refugia used year-round.

In late August 1974, observed muskoxen were closer to the coast (about 40% < 2.5 km) and preferred lower elevations (over 70% < 60 m asl; Miller *et al.*, 1977) than in early August 1981 (Table 3). These observations suggest that Bathurst Island muskoxen move along streambeds toward the coast during August. This corresponds with the influx of muskoxen into the Polar Bear Pass lowlands in late summer during 1968-71 (Gray, 1973).

The preferences by Peary caribou and muskoxen for distinctly different elevations and strata on Bathurst Island indicated little range overlap during early August 1981. The potential for overlap during and/or after the caribou rut seems greater, based on dropped antlers observed at low elevations along the southwest coast, preferred muskox habitat. Even if range overlap occurs, interspecific competition between Peary caribou and muskoxen is usually considered to be negligible (Gray, 1973; Miller *et al.*, 1977; Parker, 1978).

Management Implications

The caribou on Bathurst, Cornwallis, Prince of Wales and Somerset islands have been hunted by people from Resolute Bay. However, since 1974, the Resolute Bay Hunters and Trappers Association (HTA) has imposed a self-regulated ban on caribou harvesting on Bathurst Island. As well, oil and mineral exploration has been limited since the early 1970s. Nevertheless, the caribou population had not increased as of 1981. Being one of the most accessible of the Resolute hunting areas, Bathurst Island remains a focus of interest for future harvesting.

Caribou movements between Bathurst and Cornwallis islands since 1980 have been reported by the Resolute HTA (J. Stevenson, pers. comm. 1982). As a result, in 1982 the Resolute HTA extended their ban on caribou hunting to include Cornwallis and interjacent islands. Since 1982, Resolute Bay residents have harvested caribou only on Prince of Wales and Somerset islands for themselves and for the people of Grise Fiord because of the scarcity of Peary caribou on southern Ellesmere Island. In 1986, the Grise Fiord HTA imposed a self-regulated ban on caribou harvesting on a large part of southern Ellesmere Island for ten years. The Department of Renewable Resources (RR), G.N.W.T., is considering prohibition of caribou hunting by non-Inuit on all of the Queen Elizabeth Islands.

Harvesting of caribou should not yet resume on Bathurst Island, based on the 1981 population estimate. Caribou on Prince of Wales and Somerset islands will probably remain a

principle source of caribou meat for Resolute Bay and Grise Fiord residents. Although hunters observed larger numbers of caribou on southern Bathurst while hunting other species in spring 1984, the Resolute HTA accepted advice that caribou hunting should not resume (R. Hagen, pers. comm. 1985).

To properly define the population boundaries of Bathurst Island caribou, movements within the Melville-Bathurst-Cornwallis-Prince of Wales Island complex would have to be investigated over a number of years. Such a study would also provide baseline information to partially evaluate the potential impacts of pipelines and/or winter tanker and other shipping traffic.

Muskox harvesting on Bathurst Island is prohibited. I recommend that this prohibition continue until a substantial increase is evident.

Polar Bear Pass may be important for the Bathurst Island muskox population. However, available data do not indicate that the pass merits special recognition for its muskox habitat alone, if compared to other muskox refugia in the arctic islands.

The difference between the August 1974 estimates by Miller *et al.* (1977) and Fischer and Duncan (1976) emphasizes the problems of monitoring trends of small, clumped populations. Such populations have inherent problems because normal statistical analysis cannot be used to detect significant increases or decreases. In August 1981, 41 of 48 transects contained no caribou, while 39 contained no muskoxen. Such non-normal data distributions cannot be adequately transformed.

The August 1981 survey also revealed inadequacies caused by compromises made to survey both Peary caribou and muskoxen simultaneously. The high minimum count of 229 muskoxen (compared to the estimate of 208) resulted from extensive ferrying over stratum 3 and 74% sampling of stratum 4 (Fig. 2). Strata 3 and 4 held 64% of all muskoxen observed during the survey, compared to only 16% of observed caribou. The dark-coloured muskoxen were more conspicuous than caribou, and while on transect 56% of observed muskoxen were outside the strip-transects, compared with only 19% of observed caribou. Thus, a large proportion of the Bathurst Island muskox population apparently was observed during 10-13 August 1981.

The primary need is to obtain sufficiently reliable data about trends so that such populations may be adequately managed. If stratification and sampling intensities are determined in advance, any unexpected changes in local distributions prior to a given survey could result in a gross under- or overestimation of the population. Therefore, I recommend an "extensive-then-intensive" survey design. First, a 25% survey of the entire land mass should be completed. Then areas of caribou or muskox concentration should be surveyed intensively. Intensive survey areas should not be delineated *a priori*, as I did for Polar Bear Pass in 1981. With aerial coverage of about 75% in concentration areas, population estimates and actually observed high minimum counts can be compared to provide the reliable information needed for management decisions.

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