PRECALVING DISTRIBUTION AND ABUNDANCE OF BARREN-GROUND CARIBOU ON THE NORTHEASTERN MAINLAND OF THE NORTHWEST TERRITORIES

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YELLOWKNIFE, NWT

1987

File Report No. 71

ABSTRACT

An aerial survey with about 5% coverage of the northeastern mainland, Northwest Territories (342,000 sq km) was conducted 5-12 May 1983. We estimated that there were 120,000 + 13,900 caribou (0.35 + 0.041 caribou/km2) in the study area. Mean caribou group size ranged from 6 to 11 among nine strata and was correlated (r=0.81) with stratum caribou density. We found four regions of high caribou density. Three regions coincided with the calving grounds of previously defined herds, the Melville, Wager and Lorillard, and the fourth suggests a discrete population in the previously unsurveyed area south of the Queen Maud Gulf.

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INTRODUCTION

The Bathurst, Beverly, and Kaminuriak herds of barren-ground caribou (Rangifer tarandus groenlandicus) occupy most of the eastern mainland of the Northwest Territories (NWT) (Fig. 1). The annual distribution and life histories of those populations are well documented (Banfield 1954, Kelsall 1968, Thomas 1969, Parker 1972, Heard 1983). They migrate between calving areas on the tundra and winter ranges primarily within the boreal forest.

Caribou living on the NWT mainland north and east of those herds are believed to be separate from them (Calef and Heard 1980), but their annual distribution and movements have never been fully documented. There are at least three separate calving grounds in the northeast (Calef and Heard 1980, Heard et al. 1981), and both tag returns and direct observations indicate that they are beyond the northern limits of the Bathurst, Beverly, and Kaminuriak herds (Fig. 1, Heard 1983). Caribou are known to remain on Boothia Peninsula all year (Thompson and Fischer 1980).

Because a caribou herd is defined as a group of animals that consistently calves in a distinct and traditional location (Skoog 1968, Thomas 1969), determining the location of calving grounds is the basis for identifying populations. Populations must be identified before management is feasible.

The 1976 studies by Calef and Heard (1980) and Fischer et al. (1977) covered just over half of the present study area. At least some calving has occurred every year that surveys were

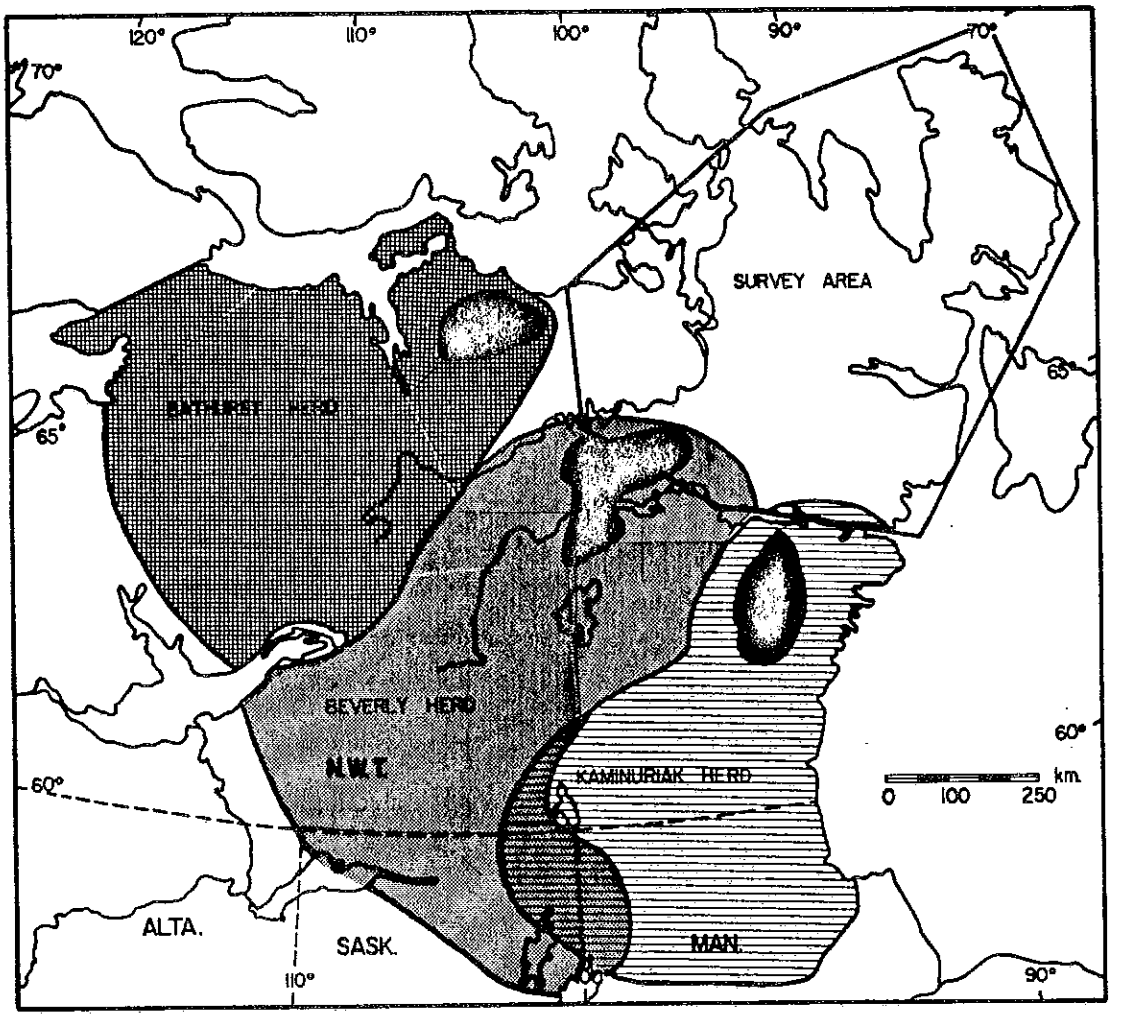

Figure 1. The survey area and ranges of adjacent caribou herds in the eastern Mainland of the Northwest Territories.

conducted (1972, 1973, 1974, 1977, 1979, 1980) in the areas designated by Calef and Heard (1980). However, densities were found to be considerably lower and surveys were too limited to conclude that calving did not also occur elsewhere (Fischer and Duncan 1976, Donaldson 1981, Rippen and Bowden 1972, Pendergast and Bowden 1973, Bowden and Helmer 1974, C. Gates and D. Vincent pers. comm.).

Our objectives in May 1983 were to determine caribou distribution and movements and to estimate caribou numbers on the mainland north and east of the Bathurst, Beverly, and Kaminuriak herds, excluding Boothia Peninsula.

Because the weather during calving in early June generally makes aerial surveys risky or impossible, this survey was done in May, when the weather is usually good, caribou are approaching the areas where they will calve, tracks in the snow will provide data on caribou movement patterns, and caribou are relatively easily observed against a uniform white background.

A condensed version of this report was originally published in Arctic (Vol. 39, No. 1, March 1986, pages 24-28). We wish to take advantage of the file report format to present the data.

STUDY AREA

The general area has been described in detail by Fischer and Duncan (1976) and Fischer et al. (1977). This tundra region experiences a continental climate with May temperatures ranging from -30°C to 0°C. The topography ranges from the flat terrain south of the Queen Maud Gulf to the rugged mountains of the west coast of Melville Peninsula and on the shores of Wager Bay.

METHODS

The 342,000 sq km study area was divided *a priori* into nine strata based on previous survey results (Calef and Heard 1980) and logistical considerations. Sample units were strip transects evenly spaced in each stratum to provide about 5% coverage, the maximum affordable. The survey was completed in 114 flying hours between 5 and 12 May 1983 using three aircraft simultaneously. Each aircraft flew 224 m above ground level and observers in the rear seats counted caribou within an 800 m wide strip on each side of the plane, as determined by black rods taped to the wing struts. A Beaver and Cessna 185 flew at 160 km/hr and a Cessna 337 at 210 km/hr. Caribou locations were plotted on a map by a navigator while observers recorded on cassette tape the number of animals on the inner or outer halves of the transect, and outside it. In the Cessna 185, observers reported caribou observations through an intercom to the navigator who recorded the data.

Calculations followed Jolly (1969) for unequal-sized sample units (see also Caughley 1977a,b).

Stratum population estimate (Y) was calculated as $Y=RZ$ where $R=\Sigma y/\Sigma z$, y is the number of caribou counted on a given transect of area z, and Z is the stratum area. The stratum variance is $Var(Y)=(N)(N-n)(Sy^2+R^2Sz^2-2RSyz)/(n)(n-1)$, where n transects are flown from the maximum number possible N, and Sy^2 is the variance of caribou number per transect, Sz^2 is the variance of transect area and $Syz^2 = [\Sigma(y)(z)-(\Sigma y)(\Sigma z)/n]/(n-1)$. The total population

is the sum of the stratum estimates, and the variance of the total population is the sum of the stratum variances. The standard error of the estimate is the square root of the variance.

No adjustment was made to compensate for observer bias-animals accidently missed by observers. A Wilcoxon Signed Ranks Matched Pairs Test (Siegel 1956) was used to compare counts between observers within each aircraft and between inner and outer halves of the transect.

RESULTS

Caribou Numbers

We observed 8,994 caribou of which 4,975 were within the strips of the 9,531 km of transects. Their weighted mean density was 0.35 $\pm$ 0.041 caribou/sq km ($\bar{X} \pm$ SE), resulting in an estimate of 120,000 $\pm$ 13,900 animals (Table 1). Sampling intensity averaged 4.9% with 71 transects flown of a possible 1,449 (Table 1).

Distribution and Movements

The estimated number of caribou varied among strata from 1,900 to 38,000 (Table 1, Fig. 2). The densities of animals are plotted on Figure 3 based on average densities recorded on 5 km transect segments. Highest densities occurred in the south Melville, Wager, Lorillard and Queen Maud Gulf strata.

We found no indication of any movement from strata 5 and 6 south and west toward the Kaminuriak and Beverly herds' calving grounds. In stratum 5, caribou appeared to be moving north and east to concentrate on the hillsides south of Wager Bay.

Along the eastern shore of Committee Bay (stratum 2) caribou appeared to be moving east into the interior of Melville Pensinsula. Residents of Repulse Bay reported that caribou were migrating to the north in early May (R. Toews pers. comm.). The orientation of fresh trails immediately north and west of Repulse Bay supported that observation. Residents of Pelly Bay reported

Table 1. Estimated numbers of caribou by stratum on the northeastern mainland of the Northwest Territories.

Stratum number	Stratum name	Density (caribou/ sq km)	Population estimate ±1 S.E.	coefficient of variation	Sampling intensity[1] (%)
1	N Melville	0.10	2,500±970	0.38	5.0
2	S Melville	1.02	38,000±11,100	0.29	4.8
3	Wager	0.31	15,200±2,330	0.15	4.8
4	Lorillard	0.52	20,000±6,000	0.30	5.1
5	Chesterfield Inlet	0.12	3,300±1.450	0.44	3.9
6	Baker Lake	0.12	3,000±930	0.31	8.0
7	Queen Maud	0.48	33,000±5,100	0.15	4.7
8	Hayes River	0.074	1,900±550	0.28	4.9
9	Spence Bay	0.064	2,900±1,000	0.31	4.8
Weighted means		0.35			4.9
Total			119,800±13,900	0.12	

1 Proportion of transects flown

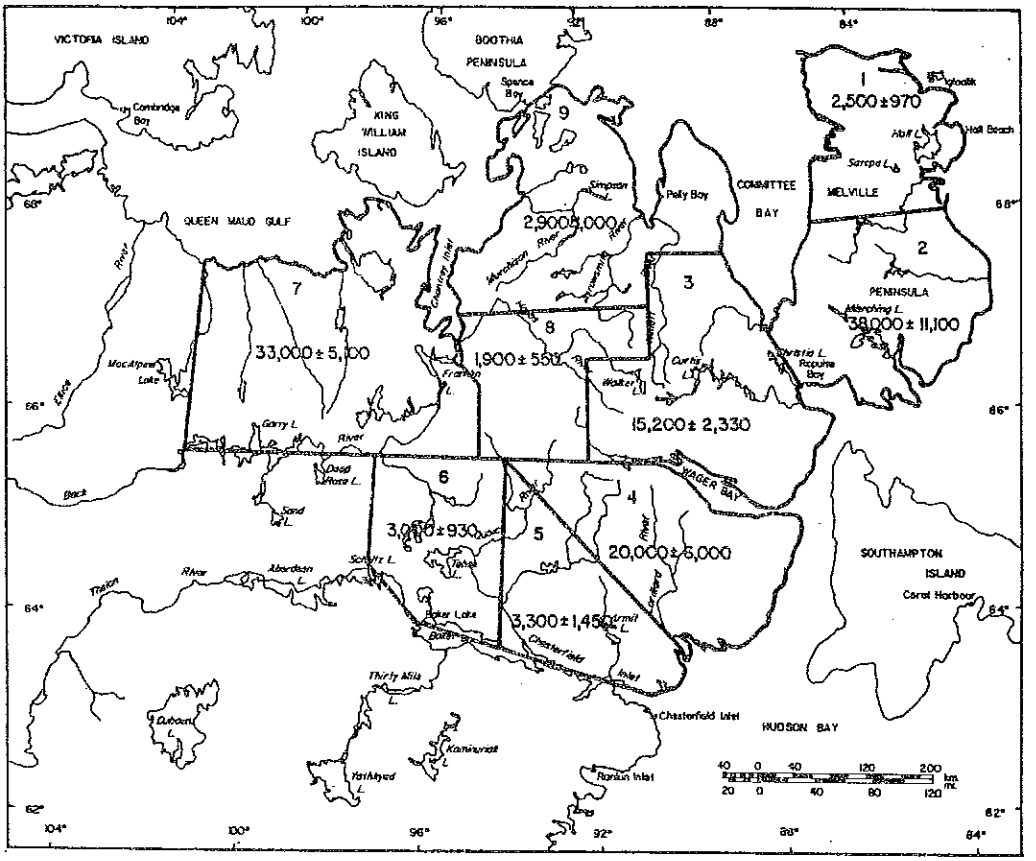

Figure 2. The survey area in northeastern Northwest Territories showing strata and caribou population estimates in May 1983.

caribou movements south from Simpson Peninsula in early May. Some caribou were seen moving inland from the western shore of Committee Bay.

We were unable to detect any movement trends in the Queen Maud Gulf, Hayes River or north Melville strata.

Group Size and Observer Bias

The mean size of caribou groups ranged from 6 to 11 among the nine strata (Table 2). Thirty-two of 562 groups (6%) making up 25% of the count (1,238/4,998) were larger than 30 animals (maximum = 88). Twenty-one of those groups were in stratum 2 where they made up 50% (838/1,667) of the stratum count. Group size per stratum was correlated ($r = 0.81$, $p<0.01$) with stratum caribou density.

One of the nine observers saw more caribou ($p<0.05$) on the inner half of the transect than on the outer half. Overall, more caribou were seen on the outer half of the transect (2,544 vs 2,055). Mean group size was smaller on the inner half of the transect for all observers but significantly so ($p<0.05$) for only one. When data from all observers were pooled, mean group size was smaller ($p<0.05$) on the inner half of the transect (8.1 ± 0.42) than on the outer half (10.2 ± 0.61). There were no significant differences between the counts of observers in the same aircraft.

Environmental conditions were generally favourable for counting caribou except in strata 2 and 9. There was usually an

Table 2. Density and mean group size in each stratum on the northeastern mainland of the Northwest Territories.

Stratum	Density (caribou/sq km)	Mean ± S.E. group size	Range
1	0.01	7.9 ± 1.15	2 - 18
2	1.02	11.0 ± 0.67	1 - 88
3	0.31	8.8 ± 0.66	1 - 42
4	0.52	10.0 ± 0.79	1 - 44
5	0.12	5.5 ± 0.42	1 - 16
6	0.12	8.7 ± 1.78	1 - 32
7	0.48	8.3 ± 0.71	1 - 41
8	0.074	6.1 ± 1.30	1 - 26
9	0.064	5.5 ± 0.98	1 - 25
Weighted mean and standard error of all 562 groups		8.9 ± 0.36	1 - 88

even background of 100% snow cover, bright sunlight, and little glare. The topography of southern Melville Peninsula (stratum 2) and south of Spence Bay (stratum 9) was more varied, and areas of broken, exposed rock provided a disruptive background against which it was difficult to see caribou. Patches of ground fog obscured parts of those two strata.

DISCUSSION

Caribou Numbers

There are no comparable estimates of the number of caribou in the entire area we surveyed, but there are some data with which our stratum estimates can be compared (Table 3).

North Melville - Our estimate (2,500) is similar to Vincent's (pers. comm.) (2,900) in June 1982. His methods were similar to ours.

South Melville - Low estimates from the 1972 (2,200), 1973 (3,100), 1974 (1,300), and 1980 (8,300) surveys probably resulted from partial sampling of the area. Sampling was extensive in both 1976 and 1983 and the population estimates (42,000 and 38,000, respectively) were similarly high. We believe there have been no large changes in the numbers or distribution of caribou on southern Melville Peninsula in the last 11 years.

Wager, Lorillard and Chesterfield Inlet - As on South Melville, low estimates for the Wager and Lorillard strata coincide with partial sampling effort. Allocation of sampling effort in the 1977, 1979, and 1980 surveys was based on the assumption that the location of the calving grounds would be the same as found in 1976 (Heard et al. 1981, Calef and Heard 1980). Calving occurred where expected, but densities were low and there was no attempt to search adjacent areas. Sampling was systematic across all three strata in both 1976 and 1983, but the 1983

Table 3. Spring population or density (caribou/sq km) estimates for different areas of the northeastern mainland of the Northwest Territories.

Stratum(a)	72	73	74	75	76	77	79	80	81	82	83
1.N.Melville										2,900[b,c]	2,500[d]
2.S.Melville	2,200[e]	3,100[f]	1,300[g]		42,000[h]			8,300[j]			38,000[d]
3.Wager			200[g]		9,400[h]	2,900[i]		1,200[j]			15,200[d]
4.Lorillard					14,000[h]	1,400[i]	3,700[j]	2,500[j]			20,000[d]
5.Chesterfield Inlet											3,300[d]
6.Baker Lake			0.05[k]		0.2[l]						0.12[d]
7.Queen Maud											0.48[d]
8.Hayes River				0.003[k]							0.074[d]
9.Spence Bay											0.064[d]

a see Table 1 and Figure 2.
b no estimates are corrected for observer bias.
c D. Vincent (pers. comm.).
d this study.
e Rippen and Bowden (1972).
f Pendergast and Bowden (1973).
g Bowden and Helmer (1974).
h Calef and Heard (1980).
i Donaldson (1981).
j Gates (per. comm.).
k Fischer and Duncan (1976).
l Fischer et al. (1977).

estimate was 66% higher (Wager 9,400 vs 15,200, Lorillard and Chesterfield Inlet 14,000 vs 23,300; $0.05<p<0.1$) suggesting a real increase in caribou numbers.

Baker Lake, eastern Queen Maud Gulf, and western Spence Bay - The 1975 and 1976 surveys resulted in considerably lower estimates of density than in 1983 even though sampling methods were similar (Table 3). Caribou numbers may have increased.

Calef and Heard (1980) were the first to document large numbers of caribou on the northeastern mainland of the NWT. This study supports their conclusions and their suggestion that numbers were increasing.

The low coefficient of variation (C.V.=0.12) obtained during this survey demonstrates that when small groups of animals are evenly dispersed, a precise population estimate can be obtained with relatively low sampling intensity.

Distribution, Movements, and Herd Discreteness

Movement patterns throughout the study area remain largely unknown. Calef and Heard (1980) documented calving grounds on southern Melville Peninsula and north and south of Wager Bay. The high precalving densities in those areas in 1983 (Fig. 3) suggest that they may have been used for calving after our survey. Other surveys (Table 3) have documented newborn calves in those areas, but only Calef and Heard (1980) did sufficient reconnaissance to delimit the entire calving ground.

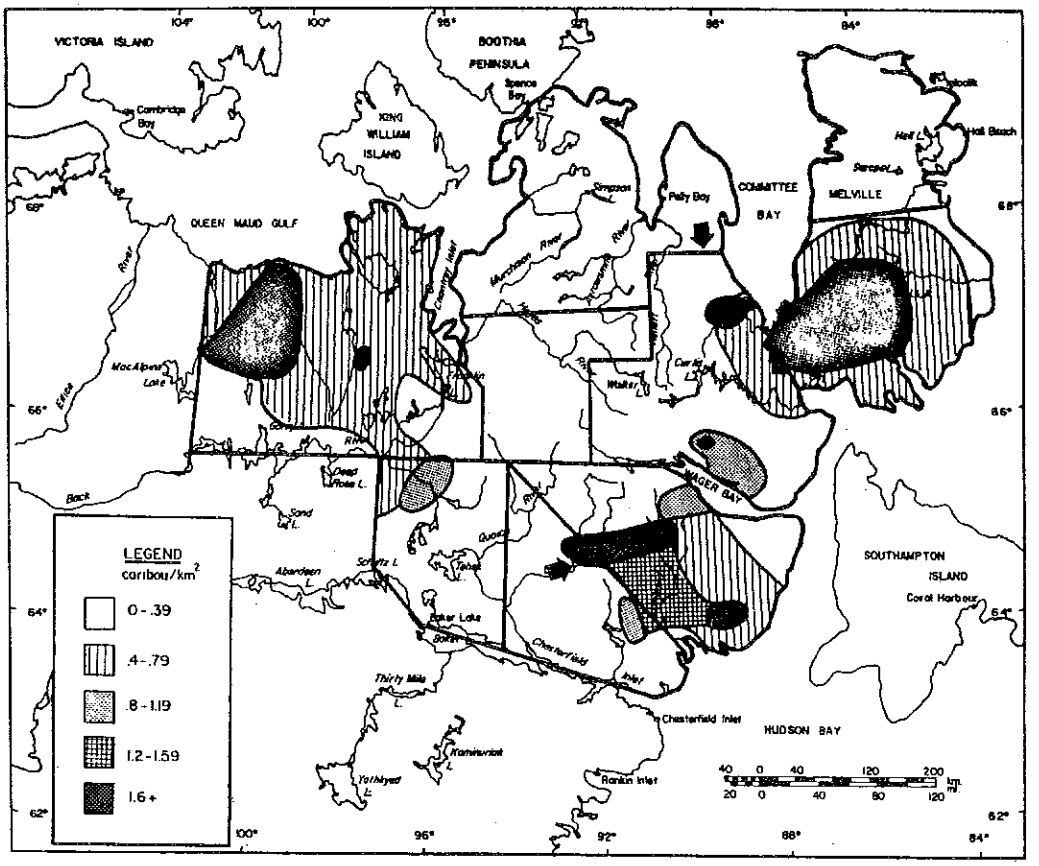

Figure 3. Caribou densities in northeastern mainland Northwest Territories in May 1983.

Some of the cows on Melville Peninsula apparently move north after calving. At the Sarcpa Lake Research Station on northeastern Melville Peninsula, no calves have been seen before mid-July (5 years of data), after which time small numbers are seen near the station (R. Montgomery and C. O'Brien pers. comm.).

Unlike Fischer et al. (1977) and Thompson and Fischer (1979), we did not find any indication of caribou moving south toward Chesterfield Inlet. The Kaminuriak herd apparently used southern winter ranges in 1982-1983 (M. Bradley and S. Kearney pers. comm.).

M. Bradley and A. Gunn (pers. comm.) observed scattered caribou and a few trails going south across Garry Lake towards the Beverly herd's calving ground (Fig. 1) in early June 1983.

We made incidental observations of a relatively large number of caribou, about 250, on the lower Back River (Fig. 3). Others have found a relatively high density of caribou (Fischer and Duncan 1976) and calves (Fischer et al. 1977, L. Allen and W. Darby pers. comm.) near Franklin Lake. This area may often be used for calving (Canada, Department of Energy, Mines and Resources 1980).

The location of high caribou densities during this study corresponding to the calving ground locations defined by Calef and Heard (1980) supports their suggestion of three discrete caribou herds; Melville, Wager (north of Wager Bay), and Lorillard (south of Wager Bay). The Queen Maud Gulf animals possibly constitute a fourth population or may have been a

segment of the Bathurst herd. Radio tracking studies are the only way to determine the annual movements and degree of interchange among those groups of caribou and between them and the adjacent forest wintering populations.

Observer Bias

Observer bias results from three errors:

1. Errors of counting occur when groups are so large that there is insufficient time to enumerate each animal. In groups exceeding about 30 animals, caribou group size must usually be estimated.

2. Observers fail to detect caribou for a variety of reasons:
   a) glare from the sun and disruptive background patterns that make them difficult to see, and
   b) observer fatigue.

   Detection errors always result in an underestimate of the population.

3. Errors resulting from incorrect definition of strip borders may bias the results upwards or downwards.

Observer bias during this survey was relatively low. Errors of counting were few because group sizes were small and densities low.

Caribou should be easiest to see when closest to the plane and large groups should be easier to see than small groups. If observers were overlooking caribou, counts from the inner half of the transect should have been higher than on the outer half and the group size smaller. We found that while mean group size was significantly smaller on the inner half of the transect, counts were higher on the outer half. The higher total for the outer half suggests that in practice it was wider than the inner half. The inner strip can be defined more accurately than the outer.

Viewing conditions were generally good except in strata 2 and 9. The 800 m strip width (400 m is more common), long transects and low caribou densities accentuated observer fatigue and boredom.

If the transect borders had been incorrectly defined we would have expected to have found dissimilar counts between observers in the same airplane. We found no significant differences, suggesting that strip widths were similar on each side. Strip widths are affected by the height of the aircraft above the ground. We were not able to evaluate the pilots' abilities to maintain the specified altitudes.

ACKNOWLEDGEMENTS

We appreciated the safe and skillful flying by our pilots Bob Kizlyk and Ed Rinn and assistance with the field work we received from Joe Ashevak, John Bailey, Jerry Michalski, David Runkle, Bruce Stephenson, Roger Toews, and Don Vincent.

The Department of Renewable Resources, Government of the Northwest Territories paid all costs for this work.

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APPENDIX A. Other wildlife species observed.

One wolf (Canis lupus) was seen in stratum 5 and a group of 8 wolves were seen in stratum 8.

We saw 377 muskoxen (Ovibos moschatus) all within strata 7 and 8. Group size ranged from 3 to 84 with a mean of 22 ± 5.2 per group. A randomly chosen muskox would most likely be found in a group of 41 ± 60 animals. Only 5 of the 17 sightings were within the transect strip. Muskox density was 0.14/sq km, indicating a population of 4,100 ± 2,200 animals.

The distribution of muskoxen was predictable (Urquhart 1982). They are rarely seen in any part of our study area outside what we called stratum 7: the Queen Maud Gulf. Neither Fischer and Duncan (1976) nor Fischer et al. (1977) saw muskoxen between Spence Bay and Baker Lake in surveys conducted between March and May 1975 and March and June 1976. Helmer (pers. comm.) saw no muskoxen when searching for them south of Pelly Bay and Chantrey Inlet in 1981. The senior author saw no muskoxen during two summers (1976 and 1977) spent flying around Wager Bay and southern Melville Peninsula.

Muskox density (0.14/sq km) was similar to that found by R. Case (pers. comm., 0.15/sq km) for areas between major river drainages. He found higher densities along rivers.

The mean group size was larger than that recorded for any other area (e.g. Lent 1978, Miller et al. 1977). Relatively large group sizes are common in the Queen Maud Gulf (Heard field notes, R. Case pers. comm.).

APPENDIX B. Transect data by stratum.

Transect	Area (sq km)	Count
Stratum 1 N=119 Z=24,840 sq km		
1	140	3
2	148	6
3	199	2
4	150	17
5	153	55
6	198	18
Total	988	101
Stratum 2 N=145 Z=37,487 sq km		
1	287	537
2	291	256
3	267	610
4	273	120
5	272	93
6	129	16
7	123	35
Total	1642	1667
Stratum 3 N=186 Z=48,104 sq km		
1	148	25
2	149	19
3	134	105
4	173	43
5	344	75
6	346	71
7	404	181
8	369	102
9	130	71
Total	2197	692
Stratum 4 N=138 Z=387,765 sq km		
1	232	287
2	179	62
3	208	95
4	232	273
5	254	75
6	312	12
7	193	27
Total	1610	831
Stratum 5 N=231 Z=26,670 sq km		
1	314	22
2	155	25
3	288	36
4	232	56
5	182	4
6	106	1
7	80	22
8	105	1
9	80	22
Total	1542	189
Stratum 6 N=87 Z=24,612 sq km		
1	203	25
2	253	86
3	299	57
4	302	14
5	318	9
6	256	16
7	224	18
Total	1855	225

Appendix B continued

Transect	Area (sq km)	Count
Stratum 7 N=211 Z=69,373 sq km		
1	200	146
2	227	131
3	336	316
4	234	61
5	222	21
6	248	40
7	219	191
8	235	77
9	197	74
10	113	9
Total	2231	1066
Stratum 9 N=230 Z=45,914 sq km		
1	309	44
2	181	14
3	384	1
4	112	0
5	104	0
6	160	3
7	144	12
8	131	0
9	197	3
10	189	23
11	248	38
Total	2159	138

Transect	Area (sq km)	Count
Stratum 8 N=103 Z=26,111 sq km		
1	192	17
2	189	8
3	176	22
4	325	36
5	328	6
Total	1210	89

1 N = maximum number of transects in the stratum.

2 Z = stratum area.

Appendix C. Itineraries.

Baker Lake Crew

May		Flying Hours
3	Yellowknife to Baker Lake	3.5
4	Weather too poor to survey-set up strip markers	0.5
5	surveyed	5.0
6	surveyed	8.6
7	surveyed	2.8
8	surveyed	5.6
9	surveyed	6.5
10	surveyed	
11	surveyed and flew to Cambridge Bay	4.9
12	returned to Yellowknife	5.4
	Total	42.8

Gjoa Haven Crew

May		Flying Hours
3	Cambridge Bay to Gjoa Haven and surveyed	5.0
4	surveyed	4.0
5	surveyed and to Spence Bay	6.0
6	weather too poor to fly	1.0
7	weather too poor to fly	0.0
8	surveyed	4.2
9	surveyed and returned to Cambridge Bay via Gjoa Haven	2.8
	Total	23.0

Repulse Bay Crew

May		Flying Hours
4	Rankin to Repulse Bay, surveyed	3.7
6	surveyed north of Repulse, north of Wager Bay	4.9
7	surveyed northwest of Committee Bay	8.4
8	surveyed north of Melville Peninsula to Igloolik	4.6
8	surveyed east shore of Melville Peninsula	5.1
9	surveyed south of Repulse Bay	3.3
10	surveyed south Melville Peninsula	10.2
11	surveyed and returned to Rankin Inlet	8.1
	Total	48.3