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Precalving Distribution and Abundance of Barren-Ground Caribou on the Northeastern Mainland of the Northwest Territories

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ABSTRACT. An aerial survey with about 5% coverage of the northeastern mainland, Northwest Territories (342 000 km^2) was conducted 5-12 May 1983. We estimated there were 120 000 ± 13 900 caribou (0.35 ± 0.041 caribou·km^{-2}) 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.

Key words: caribou, aerial survey, *Rangifer*, distribution, abundance, northeastern Northwest Territories

RÉSUMÉ. Un inventaire aérien d'environ 5% des terres du nord-est des Territoires du Nord-Ouest (342 000 km^2) fut effectué du 5 au 12 mai en 1983. Il fut estimé que 120 000 ± 13 900 caribous (0.35 ± 0.041 caribou · km^{-2}) se trouvaient dans l'aire d'étude. La taille moyenne des groupes de caribous variait entre 6 et 11 animaux parmi 9 strates et fut mise en corrélation ($r = 0.81$) avec la densité des strates de caribous. Quatre régions avec une haute densité de caribous furent identifiées. Trois régions coïncidaient avec les lieux de mise bas des troupeaux déjà identifiés de Melville, Wager et Lorillard. La quatrième région suggère une population discrète dans une région non relevée au sud du golfe Reine-Maud.

Mots clés: caribou, inventaire aérien, *Rangifer*, distribution, abondance, nord-est des Territoires du Nord-Ouest

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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 (N.W.T.). The annual distribution and life histories of those populations is well documented (Banfield, 1954; Kelsall, 1968; Thomas, 1969; Parker, 1972; Heard, 1983). They migrate between calving areas on the tundra (Fig. 1) and winter ranges primarily within the boreal forest.

Caribou living on the N.W.T. 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 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 calve 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) included just over half of the present study area. At least some calving has occurred every year that surveys were 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, unpubl.; Pendergast and Bowden, unpubl.; Bowden and Helmer, unpubl.; 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 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.

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 on the west coast of Melville Peninsula and on the shores of Wager Bay.

METHODS

The 342 000 km^2 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. The strip width and inner and outer halves were delineated from ground markers at 0, 400, and 800 m and delimited by black rods taped to the wing struts. A Beaver and Cessna 185 flew at 160 km·h and a Cessna 337 at 210 km·h. Caribou locations were plotted on a map by a navigator while observers recorded on cassette tape the number

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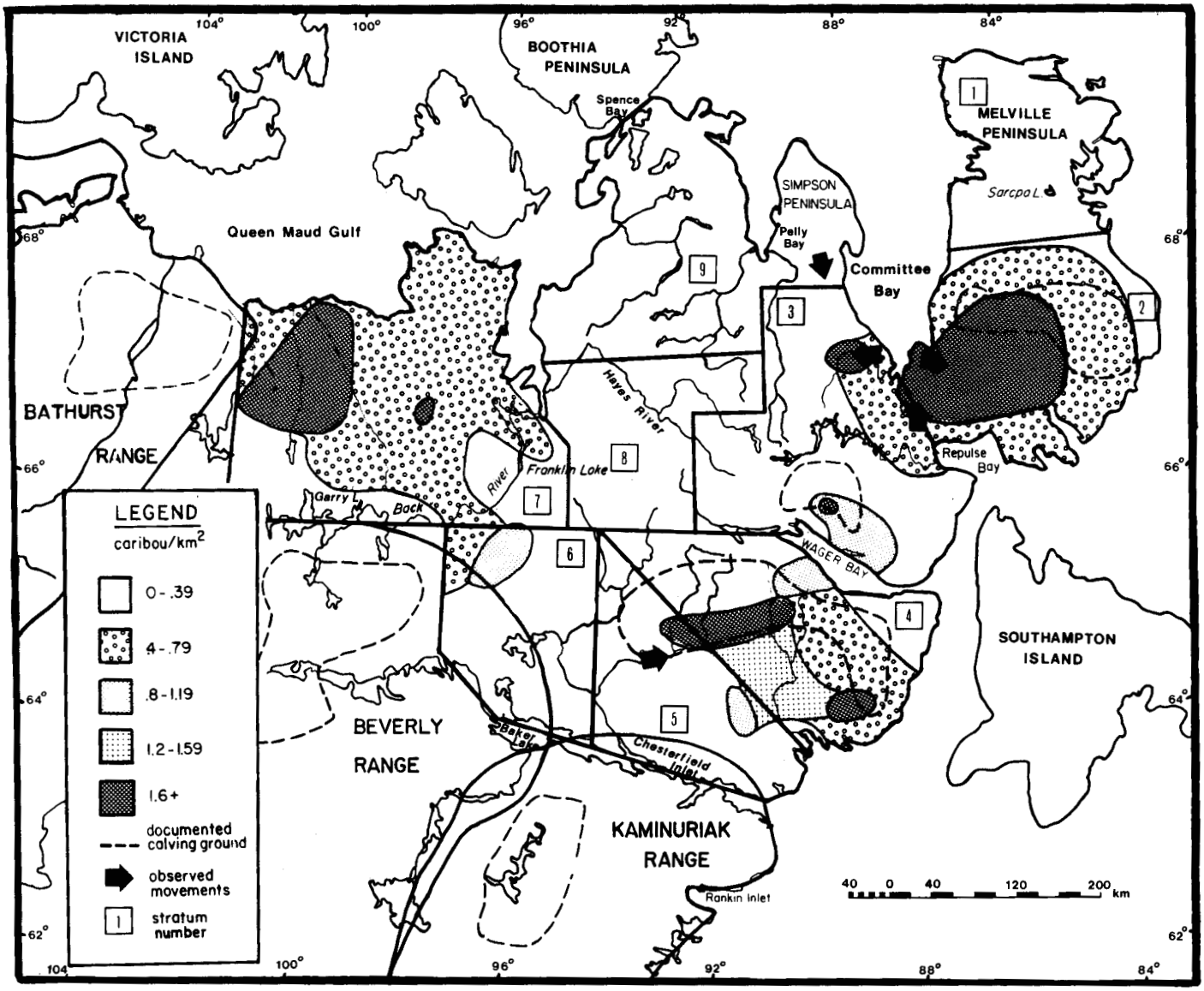

FIG. 1. Survey strata and caribou densities observed in the northeastern mainland of the Northwest Territories in May 1983.

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 all the data.

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

Stratum population estimate ($\hat{Y}$) was calculated as $\hat{Y} = RZ$ 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 $Var(\hat{Y}) = (N)(N\text{-}n)(Sy^2 + R^2Sz^2 - 2RSyz)/(n)(n\text{-}1)$, 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 $Syz^2 = [\Sigma(y)(z) - (\Sigma y)(\Sigma z)/n]/(n\text{-}1)$. 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 8994 caribou, of which 4975 were within the strips of the 9531 km of transects. Their weighted mean density was 0.35 ± 0.041 caribou·km^{-2} ($\bar{x} \pm$ SE), resulting in an estimate of 120 000 ± 13 900 animals (Table 1). Sampling intensity averaged 4.9%, with 71 transects flown of a possible 1449 (Table 1).

Distribution and Movements

The estimated number of caribou varied among strata from 1900 to 38 000 (Table 1). The densities of animals (Fig. 1) are based on average densities recorded on 5 km transect segments. Highest densities occurred in the south Melville, Wager, Lorillard and Queen Maud Gulf strata.

TABLE 1. Estimated numbers of caribou by stratum in northeastern mainland Northwest Territories

Stratum number	Stratum name	Density (caribou·km^{-2})	Population estimate ± SE	Coefficient of variation	Sampling intensity[1] (%)	Mean group size ± SE
1	N Melville	0.10	2500±970	0.38	5.0	7.9±1.15
2	S Melville	1.02	38 000±11 100	0.29	4.8	11.1±0.67
3	Wager	0.31	15 200±2330	0.15	4.8	8.8±0.66
4	Lorillard	0.52	20 000±6000	0.30	5.1	10.0±0.79
5	Chesterfield Inlet	0.12	3300±1450	0.44	3.9	5.5±0.42
6	Baker Lake	0.12	3000±930	0.31	8.0	8.7±1.78
7	Queen Maud	0.48	33 000±5100	0.15	4.7	8.3±0.71
8	Hayes River	0.074	1900±550	0.28	4.9	6.1±1.30
9	Spence Bay	0.064	2900±1000	0.31	4.8	5.5±0.98
Weighted means		0.35			4.9	8.9±0.36
Total			119 800±13 900	0.12		

[1]Proportion of transects flown.

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 Peninsula. 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 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 1). Thirty-two of 562 groups (6%) making up 25% of the count (1238/4998) were larger than 30 animals (maximum = 88). Twenty-one of those groups were in stratum 2, where they made up 50% (838/1667) 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 in the outer half of the transect (2544 vs 2055). 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 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.

North Melville — Our estimate (2500) is similar to Vincent's (pers. comm.) (2900) in June 1982. His methods were similar to ours.

South Melville — The low estimates found on south Melville (2200 in 1972, Rippen and Bowden, unpubl.; 3100 in 1973, Pendergast and Bowden, unpubl.; 1300 in 1974, Bowden and Helmer, unpubl.; and 8300 in 1980, C. Gates, pers. comm.) probably resulted from partial sampling of the area. Sampling was extensive in both 1976 (Calef and Heard, 1980) and 1983, and the population estimates were similarly high (42 000 and 38 000) respectively. We believe there were 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 stratum (200 in 1974, Bowden and Helmer, unpubl.; 2900 in 1977, Donaldson, 1981; 1200 in 1980, Gates, pers. comm.) and the Lorillard stratum (1400 in 1977, Donaldson, 1981; 3700 in 1979 and 2500 in 1980, Gates, pers. comm.) coincide with partial sampling effort.

Sampling distribution in the 1977, 1979, and 1980 surveys were 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 estimate was 66% higher (Wager 9400 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 (0.05·km^{-2} and 0.2·km^{-2} for Baker

Lake and Queen Maud Gulf, Fischer and Duncan, 1976, Fischer *et al.*, 1977; and 0.003·km^{-2} for Spence Bay in 1975, Fischer and Duncan, 1976) than in 1983 even though sampling methods were similar. Caribou numbers may have increased.

Calef and Heard (1980) were the first to document large numbers of caribou in northeastern N.W.T. 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. 1) suggest they may have been used for calving after our survey. Other surveys have documented newborn calves in those areas, but only Calef and Heard (1980) did sufficient reconnaissance to delimit the entire calving ground.

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), when 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 1982-83 (M. Bradley and S. Kearney, pers. comm.).

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

We made incidental observations of a relatively large number of caribou, about 250, on the lower Back River (Fig. 1). 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 (Northern Land Use Information Series, 1980).

The location of high caribou densities during this study corresponding to the calving ground locations defined by Calef and Heard (1980; Fig. 1) 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 may 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. 3) Errors resulting from incorrect definition of strip borders.

Observer bias during this survey was relatively low. Errors of counting were few because group sizes were small and densities low (Table 1).

If observers were overlooking caribou, counts from the inner half of the transect should be 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 were incorrectly defined, we would expect to find 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, but we had no way to evaluate the pilots' abilities to maintain the specified altitudes. Navigators assisted the pilots by occasionally monitoring the altimeter.

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