BATHURST AND BEVERLY CARIBOU HERD SPRING CLASSIFICATION COUNTS, FEBRUARY AND MARCH 1984

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ABSTRACT

From early January to mid-February 1984 large numbers of Bathurst and Beverly barren-ground caribou (Rangifer tarandus groenlandicus) occupied winter range north of McLeod Bay, Great Slave Lake. By 7 March groups of breeding cows, probably from both herds, had migrated northeast out of the trees to form a large aggregation in the area of Walmsley and Fletcher lakes. After 7 March, the rate of migration slowed and the aggregation dispersed. Classifications were conducted from 27 February to 28 March, 1984. We classified 12,456 caribou in 28 groups. The mean group size was 445±132 (X±S.E.) and ranged from 20 to 3022. Of 10,469 caribou 1 year old or older (1+) 13.6% were male and 86.4% were female giving 16 males:100 1+ females. From the ratio of 22±2.0 (R±S.E.) calves:100 1+ females and assuming an initial calf production of 69 calves per 100 females (Parker 1972) and 1+ female survival from June 1983 of 93%, 29% of calves born in June 1983 were alive in March 1984. Overwinter calf survival was poor relative to the 1978-1983 mean. After incorporating the unrepresented male segments of the Bathurst and Beverly herds, we estimated that calves composed 12% of the populations, a recruitment rate into the 1+ populations of 14%. We observed 0.7 wolves per hour of reconnaissance flown. As Bathurst and Beverly cows were in relatively good physical condition over the winter of 1983-84, low calf:1+ female ratios may reflect relatively high wolf predation on Bathurst and/or Beverly caribou, or may be an artifact of sampling biases that arose when calves, yearlings and males segregated out of bands of migrating cows, which reached the barrens in late February and early March 1984.

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INTRODUCTION

Information on herd size, structure, recruitment and mortality rates are essential to the effective management of barren-ground caribou (Rangifer tarandus groenlandicus) populations. The Department of Renewable Resources, Government of the Northwest Territories obtains an index of population size through censuses of the traditional calving grounds of the four mainland caribou herds (Bluenose, Bathurst, Beverly and Kaminuriak). We consider recruitment to be the rate of breeding stock replacement; however, the year at which cows first breed varies among individuals, herds and years, (Bergerud 1971, Thomas et al. 1986, Whitten et al. 1986 p. 240) and we cannot visually distinguish adult age classes. Therefore, we are unable to obtain an absolute measure of recruitment through visual sampling methods and must obtain an index. We feel that yearlings (21-22 month old animals) are consistently underrepresented in spring classification counts as large yearlings may be indistinguishable from small two year olds (33-35 month old animals). Calves (9-10 month old animals) are the only age class that can be consistently identified by visual means in the spring.

In theory, age ratios cannot be interpreted without additional information (Caughley 1974). In practice, the calf:100 cows 1 year old or older (1+ - yearlings and older cows) ratio is a good index of recruitment as the variability of reproductive and adult mortality rates is low relative to the variability in calf mortality. Despite variation

in the age at first estrus, reproductive rates for mainland caribou 2 year old or older (2+) are consistently high, showing little variation between years or herds (Bergerud 1980). Yearlings die at a rate similar to that of older animals (Whitten et al. 1985). Variability in adult mortality rates is low because hunting and predation pressures are relatively constant over the age classes which constitute most of the population. In contrast, the vulnerability of calves to wolf predation throughout their first year (Bergerud 1980, Whitten et al. 1986 p. 240) results in relatively high and variable mortality rates in the calf cohort (Bergerud 1980, Miller 1975, Parker 1972).

Knowing there is some variability in adult mortality rates forces us to interpret small changes in calf proportions with caution. However, large changes in calf proportions probably reflect real variability in calf mortality rates, and correlate with population growth rates (Alexander 1958).

By measuring mortality in the age class which shows the greatest variability, recruitment indices, as calculated from the calf:1+ female ratio in late spring, help to explain observed trends in herd size and provide a qualitative index of herd health and potential for growth.

The calf:1+ female ratio is particularly useful in that it requires no assumptions be made concerning herd composition or calf mortality between late spring (March-April) and June. Those assumptions are incorporated into calculations of recruitment.

Previous attempts to obtain estimates of over-winter calf survival and an index of recruitment for the Bathurst herd (Fig. 1) were not successful due to logistical problems and erratic caribou movements. Spring calf and yearling ratios were obtained in 1978 and 1979 (Heard and Decker 1980), 1981 (Elliot and Decker 1981), 1982 (Williams and Heard 1986) and in 1983 (Gunn in prep.) for the Beverly herd (Fig. 1).

The objectives of this study of the Bathurst and Beverly caribou herds were to:

1. Determine over-winter calf survival and obtain an index of recruitment by esitmating the ratio of calves: 1+ females.
2. Evaluate relative wolf abundance and relative intensity of predation.

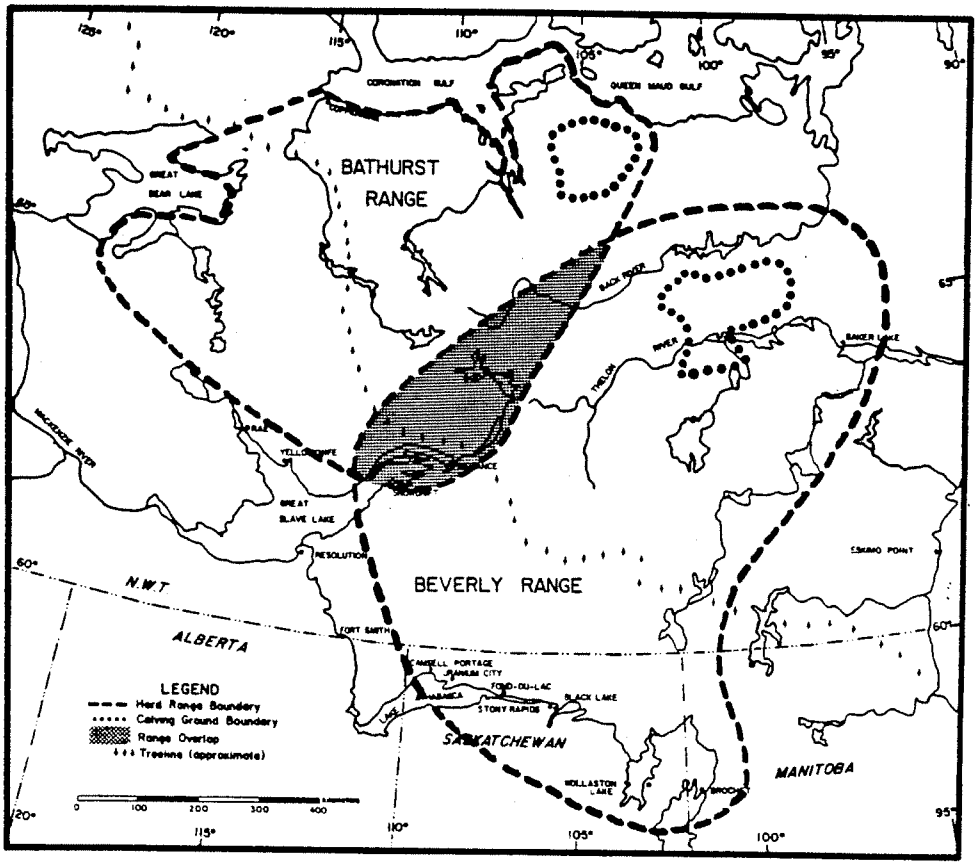

Figure 1. The ranges of the Bathurst and Beverly herds of barren-ground caribou.

METHODS

Information on the distribution and movements of Beverly caribou was provided by the Canadian Wildlife Service (D. Thomas pers. comm.) after five extensive surveys in November and December 1983, and January, February and May 1984. We surveyed the taiga north and east of Gordon Lake with a Cessna 185 aircraft on 6, 16 and 27 February and on 4, 7, 8 and 9 March. From 12-15 March the senior author flew over taiga and tundra portions of the Bathurst herd's winter range using a Cessna 337.

Caribou classifications were conducted on 27 February, 4, 7, 8 and 9 March and from 25-27 March, 1984. From 27 February to 9 March caribou aggregations were located during aerial reconnaissance flights with a Cessna 185 on wheel skis. We landed beside groups and approached on foot. From 25-27 March we used snowmachines to approach caribou closely enough to view them through 20 or 25 power spotting scopes. Unless a penis was visible, sex identification was based on the presence or absence of a vulva. Caribou were classified as cows 2 years old or older (2+), calves, male or female yearlings and young and adult bulls. Calves (9-10 month old animals) were distinguished by their small body size and rounded skull profile. Yearlings (21-22 month old animals) were intermediate-sized animals with a straight face profile. Young bulls were small-bodied males with at least one antler, while adult bulls were large and without antlers. Classifications were recorded on magnetic tape and were later transcribed sequentially into field books.

To obtain age and sex ratios (e.g., calves:1+ females) we used cluster sampling techniques (Cochran 1977:233, 249). We changed sampling areas daily and selected groups arbitrarily to avoid repeat classifications. Animals classified at each site were treated as an independent cluster. The ratios and variances were determined with a ratio estimator formula (Cochran 1977:155, formula 6.13).

RESULTS

Distribution and Movements

In the fall of 1983, Beverly caribou were at Sid Lake, NWT after having drifted southwest from calving grounds near Sand Lake (Thomas and Kiliaan 1984). Large numbers of the Beverly herd then moved towards the west and southwest to an area southeast of the east arm of Great Slave Lake (Fig. 2). Between December 1983 and January 1984 many caribou crossed the east arm of Great Slave Lake between Reliance and Snowdrift (Thomas and Kiliaan 1984). Some of those caribou may have drifted as far west as Gordon Lake. Other segments of the Beverly herd remained in taiga south and east of Great Slave Lake.

Reports from Terra mine employees and native hunting parties described the migration of several thousand (probably Bathurst) caribou into an area northeast of Hottah Lake in November and early December 1983. In late December most of those animals migrated southwest to an area south of the Leith Peninsula and west of Hottah Lake (Letkeman pers. comm.). Observations from reconnaissance flights over the taiga portion of the Bathurst range from 12-15 March 1984 confirmed the presence of several thousand caribou south of Great Bear Lake and small scattered groups northeast of Hottah Lake (Fig. 2). Most Bathurst caribou occupied an area bordered by Gordon and Walmsley lakes (west to east) and MacKay and Great Slave lakes (north to south).

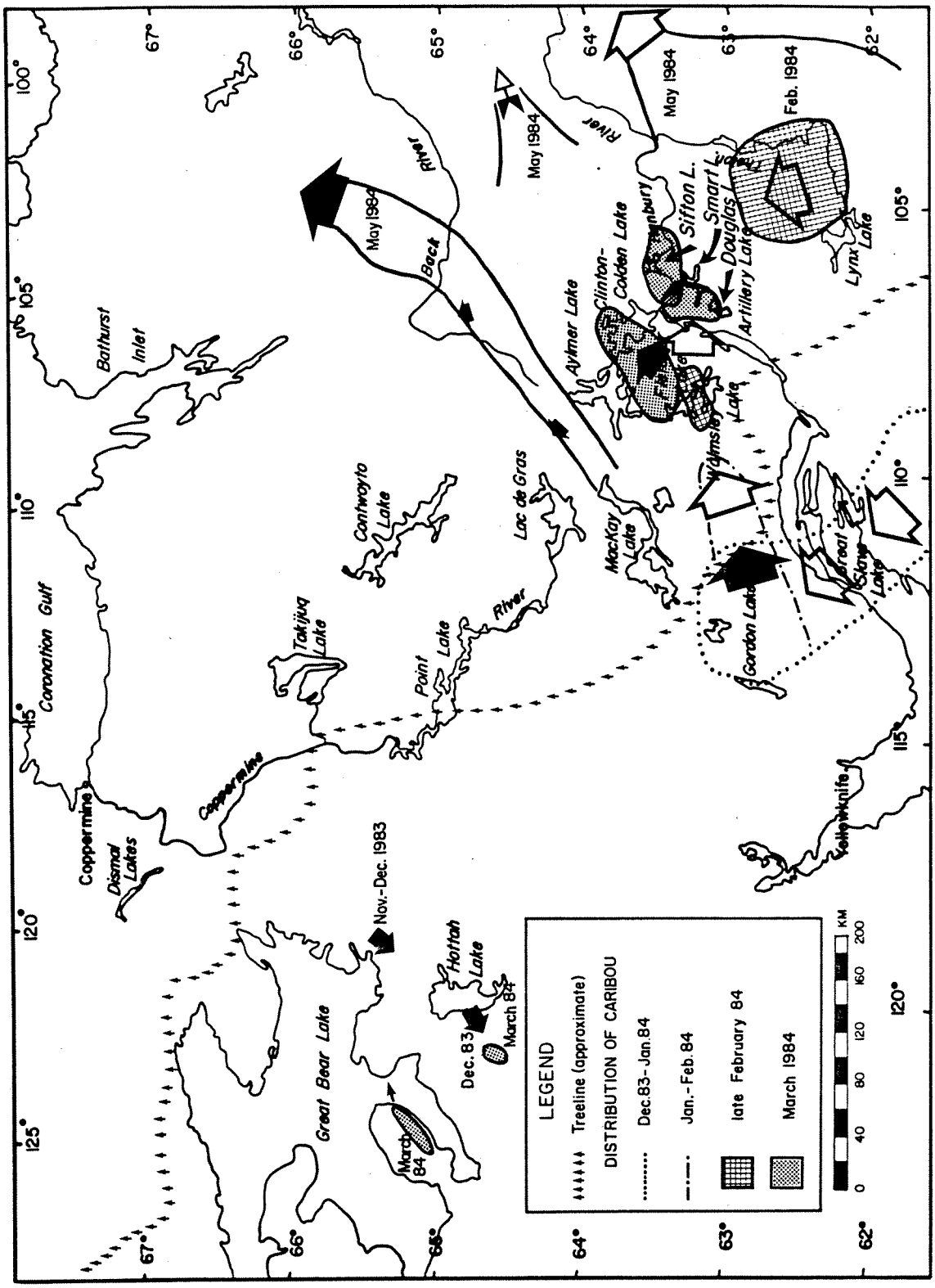

Figure 2. Distribution and movements of Bathurst and Beverly caribou from early-winter 1983 to spring 1984.

Therefore, from early January to mid February 1984 segments of both the Bathurst and Beverly herds occupied the same area of winter range. By 7 March large numbers of cows and calves had left the trees and were in the vicinity of Walmsley and Fletcher lakes. This large aggregation then dispersed. Most caribou migrated southeast to range bordered by Ptarmigan, Deville, Douglas and Smart lakes. Others remained in the Walmsley-Fletcher Lake area or drifted north and east in scattered groups. By 25 March, large aggregations of mainly cows, calves and non-breeding caribou had reached Sifton Lake (Fig. 2). Those caribou continued to drift north during April. Thomas (pers. comm.) reported that by 4 May the migrating cows had split into two movements. One movement centered on the Ellice and Back rivers northeast of MacKay Lake. Those animals were moving north and northeast towards the Bathurst calving ground. A wedge of caribou east of the Thelon River extending from the junction of the Hanbury, Clarke and Thelon rivers to Sid Lake was moving northeast towards the Beverly calving ground. Between the two major movements a large number of caribou were moving northeast through the Thelon Game Sanctuary, bordered on the north and south by the Back and Thelon rivers. It was not clear at that time which calving ground those animals were approaching.

Classification Counts

We classified 12,456 caribou from 28 groups between 27 February and 28 March 1984. (Table 1). The mean group size was 445±134($\bar{X}$±S.E.) caribou and ranged from 20 to 3022. Age and sex composition was 70.2% cows, 16.0% calves, 9.4% bulls, 2.0% male yearlings and 2.5% female yearlings. Of 556 yearlings classified, 248 (44.6%) were male and 308 (55.4%) were female; a ratio of 81 males:100 females. Of 10,469 caribou 1-year-old or older (1+), 1,420 (13.6%) were males and 9,049 (86.4%) were females resulting in a ratio of 16 1+ bulls:100 1+ females (Appendix A).

The sample contained 16% calves or 22±2.0(R±S.E.) calves:100 1+ females (Appendix A). Survival of calves from birth in June 1983 to early March 1984 was 29% assuming an initial calf production of 69 calves per 100 females (Parker 1972) and annual natural mortality of 1+ females of 7.2% (Heard and Calef 1979, Appendix A).

We assumed that the sample sex ratio of 16 1+ males:100 1+ females was not representative of herd composition and that Gunn's (1984) fall 1982 estimate of 61 males:100 females is accurate, and revised our calculations to incorporate the unrepresented male segment (Appendix A). Our revised estimate is 12% calves, which represents a recruitment into the 1+ population of 14%.

Table 1. Bathurst/Beverly spring classification summary, February and March 1984

Date	Site Number	Observer	Cows	Calves	Bulls	Yearling Males	Yearling females	Total	Calves:100 1+ females
27/2	1	DH	236	86	46	6	6	380	36
	2	MW	47	20	10	1	2	80	41
4/3	3	DH	40	14	26	1	2	83	33
	4	MW	39	21	22	0	1	83	52
7/3	5	DH	39	12	43	2	8	104	26
	6	MW	17	1	22	3	2	45	5
	7	DH	36	8	7	2	4	57	20
	8	MW	22	6	2	0	0	30	27
8/3	9	DH	243	60	79	13	23	418	23
	10	MW	339	101	73	12	8	533	29
9/3	11	DH	163	37	13	3	6	222	22
	12	MW	172	43	29	0	10	254	24
	13	DH	8	3	23	0	0	34	38
	14	MW	19	8	4	0	0	31	42
	15	DH	0	0	26	0	0	26	—
	16	DH	2	2	12	4	0	20	100
	17	MW	8	5	3	3	2	20	56
25/3	18	DH	275	29	30	5	6	345	10
	19	MW	132	20	11	4	7	174	14

Table 1. Continued

Date	Site Number	Observer	Cows	Calves	Bulls	Yearling Males	Yearling females	Total	Calves:100 1+ females
26/3	20	DH	440	110	75	16	22	663	24
	21	MW	225	38	16	6	12	297	16
	22	DH	19	3	2	2	5	31	13
	23	MW	548	130	41	17	27	763	23
	24	DH	553	64	45	9	31	702	11
	25	MW	335	51	47	5	16	454	15
	26	CG	1853	313	146	54	80	2446	16
27/3	27	CG	2132	556	250	63	21	3022	26
28/3	28	CG	799	246	69	17	8	1138	20
Total			8741	1987	1172	248	308	12,456	
%			70.2	16.0	9.4	2.0	2.5		

Wolf, Muskox and Moose Observations

We observed 68 wolves (Canis lupus) in 22 packs (mean group size = 3.1±0.6($\bar{X}$±S.E.), range 1-14) in 100.3 hours of flying time or 0.7 wolves per hour flown (Table 2).

We observed 327 muskoxen (Ovibos moschatus) in 10 herds for a mean group size of 32.7±6.2 ($\bar{X}$±S.E.), and range of 7 to 59 (Table 3). Most sightings were between Clinton-Colden Lake and the Baillie River where we counted 214 muskoxen along approximately 70 km of transect at an altitude of 460m agl.

We counted 11 moose (Alces alces) in 6 groups for a mean group size of 1.8±0.3($\bar{X}$±S.E.) and range of 1-3 (Table 4). All sightings were made along 26 km of the Thelon River north of Grassy Island and between Wopmay and Wheeler lakes.

Table 2. Wolf observations from aerial reconnaissance flights, Bathurst/Beverly class count survey 1984.

Date	Pack Size	Location	Comment	Hours Flown
6 Feb/84	0	-	-	4
16 Feb/84	0	-	-	2.7
23 Feb/84	5	62°12'N,109°38'W		
	2	63°07'30"N,109°56'W	H. Kiliaan	
	1	63°10'N,109°59'W	(pers. comm.)	
25 Feb/84	1	61°35'N,107°00'W	H. Kiliaan	37.8
	2	61°30'30"N,106°35'W	(pers. comm.)	
27 Feb/84	2	63°33'N,108°35'W		
	14	63°38'30"N,108°18'W	(approximate)	14.5
4 Mar/84	5	63°23'N,108°12'30"W		
	5	63°49'30"N,107°58'W		
	2	63°32'N,107°28'W		
	5	63°28'30"N,108°19'W	(approximate)	6.2
	1	63°26'N,107°30'W		
	1	63°14'N,107°53'W	(approximate)	
	1	63°23'N,108°05'W	(approximate)	
7 Mar/84	2	63°31'N,108°31'W		
	2	63°22'N,108°41°W	both brown	5.9
	2	not recorded		
	3	not recorded		
	4	63°08'N,107°00'W	1 gray, 3 white	
8 Mar/84	0	-	-	2.6
9 Mar/84	4	63°22'N,107°09'W	(approximate)	3.9
	1	63°26'N,106°56'W	(approximate)	

Table 2 continued

Date	Pack Size	Location	Comment	Hours Flown
12 Mar/84	0	-	-	6.1
13 Mar/84	0	-	-	5.1
14 Mar/84	3	63°44'N,108°07'W S. of Lac de Charloit	digging in esker	6.3
15 Mar/84	0	-	-	5.2
Total	68 in 22 groups mean group size = 3.1±0.6($\bar{X}$±S.E.), range 1-14 68 wolves observed in 100.3 hours = 0.7 wolves/hour			100.3

Table 3. Muskox observations from aerial reconnaissance flights, March 1984.

Date	Herd Size	Location	Comments
7 Mar/84	12	63°08'N,107°00'W	Deville Lake
14 Mar/8	47	65°02'N,106°35'W	South of Beechey Lake
	44	64°33'N,107°45'W	East of Tarantula Lake
15 Mar/84	16	64°07'30"N,106°54'W	observed along one
	59	64°11'N,106°37'W	flight line from
	24	64°12'N,106°36'W	Clinton-Colden Lake
	10	64°13'30"N,106°11'W	to the Baillie River
	50	64°13'30"N,105°39'W	
	55	64°12'N,105°35'W	
	50	63°37'N,106°04'W	on the Hanbury River west of Lac du Bois.
Total	327 in 10 groups mean group size = 32.7±6.2($\bar{X}$±S.E.), range 7-59		

Table 4. Moose observations from aerial reconnaissance flights, March 1984.

Date	No. of Moose	Location	Comment
13 Mar/84	1	65°03'30"N,116°44'30"W	Southwest of Wopmay Lake
	3	63°56'N,115°16'W	Southwest of Wijinnedi Lake
	2	63°39'30"N,115°01'W	Southeast of Ghost Lake
15 Mar/84	1	63°53'30"N,103°59'W	Along Thelon River
	2	63°57'N,103°56'W	
	2	63°48'N,104°13'W	
Total	11	in 6 groups	
	mean group size = 1.8±0.3($\bar{X}$±S.E.), range 1-3		

DISCUSSION

Distribution and Movements

From early January to mid-February large numbers of caribou from both the Bathurst and Beverly herds occupied winter range north of McLeod Bay, Great Slave Lake. It is possible that classification counts in February and March 1984 sampled both herds. Similar Beverly herd movements of this magnitude have not been reported.

Spring migration of breeding cows occurred much earlier in 1984 than in previous years. Literature reports (Darby 1978, 1980; Cooper 1981; Clement 1982) indicate that migrating Beverly cows usually reach the barrens in late April or early May. By 7 March 1984 large numbers of Bathurst and Beverly cows had left the trees. The rapid migration of those animals appeared to slow after they reached the Walmsley-Fletcher Lake area, possibly as a result of cold temperatures and moderate winds experienced between 4 and 9 March (D. Heard, field notes). Caribou wintering southeast of Great Slave Lake also reached the treeline earlier than previously reported. Thomas and Kiliaan (1984) report that other segments of the Beverly herd reached the treeline by 11 March 1984 while a third group was still south of the treeline at Manchester Lake.

In early May 1984 two isolated movements of caribou were approaching the Bathurst and Beverly calving grounds (Thomas pers. comm.). A third movement between the others may have swung north or

east to either calving area, or may have split, with bands of cows separating out as they approached their respective calving areas. Without marking individual animals, the possibility that overlap of segments from both herds on the winter range resulted in the shift of animals between traditional calving areas will remain speculation.

Classification Counts

Calf:1+ female ratios varied greatly (5-100:100) among the 12 sample sites, supporting the observation that male and female caribou make differential use of the winter range (Kelsall 1968, Parker 1972). In late winter 1984, most cows and calves were near or above the treeline, while most bulls remained south of the treeline. This is consistent with previous years' observations of the spring distribution of Beverly caribou (Darby 1978, 1980; Cooper 1981; Clement 1982; Williams and Heard 1986). Calf:1+ female ratios determined at Sifton Lake varied (from 13 to 30) more than expected, as we had thought that the composition of bands of migrating females would be relatively uniform.

As we do not know the relative proportions of Bathurst and Beverly caribou sampled it is not possible to compare the results directly to data from previous surveys. However, 1978 to 1983 classification data for the Beverly herd (Table 5) suggests that 1984 calf survival (29%)

Table 5. Spring calf:1+ female ratios and overwinter calf survival and recruitment estimates for the Beverly caribou herd, 1978 to 1984.

Date	Calves: 100 1+ females (R±S.E.)[a]	Percent overwinter calf survival[b]	Percent recruitment	Source
1978	45±9.8	60	24[c]	Heard & Decker 1980
1979	18±1.6	24	10[c]	Heard & Decker 1980
1981	21±1.2	28	12[c]	Elliott & Decker 1981
1982	43±2.7	57	27[d]	Williams & Heard 1986
1983	43±1.2	57	27[d]	Gunn in prep.
Mean	34±16.5	45	20	
1984	22±2.0	29	14	This study

a Ratios and standard errors determined using ratio estimator formula from Cochran (1977:155, formula 6.13). The sex ratio of unsexed yearlings was taken to be 1:1.

b Assuming initial calf production of 69 calves:100 1+ females (Parker 1972) and annual natural mortality of 1+ females of 7.2% (Heard and Calef 1979).

c Assuming 70 1+ males:100 1+ females (Heard and Decker 1980).

d Assuming 61 1+ males:100 1+ females (Gunn in prep.).

and recruitment (14%) were below average (45% and 29%, respectively) and similar to low values obtained in 1979 and 1981. Beverly (Thomas and Kiliaan 1984) and Bathurst (Williams 1984) cows were in relatively good physical condition over the winter of 1983-84, and there is no reason to suspect lack of forage and/or severe weather as cause for the relatively high overwinter calf mortality. We observed 0.7 wolves per hour in 1984 relative to 0.3 per hour in 1982. However, as the wolves observed per hour flown is only a crude index of wolf abundance, we do not know if this increase (0.3 to 0.7) accurately reflects relatively greater wolf predation pressure.

Low calf ratios may reflect high overwinter mortality or the segregation of calves, yearlings and bulls from bands of cows prior to or during spring migration. Heard (unpublished data) observed 69 calves:100 1+ females in May 1980 at Contwoyto Lake. Heard felt his sample, which was composed of 60 calves and 103 bulls:100 1+ females, represented the rearguard of the Bathurst spring migration with most breeding cows having already passed through en route to the calving grounds.

Our classification data from 9 March 1984 (Table 1) suggests that cows and other sex-age classes segregated as cows left the trees in early March. We sampled 476 caribou on the barrens near Deville Lake (Fig. 2) and found 24 calves:100 1+ females. Smaller samples in the trees southwest of Lac du Mort contained 49 calves:100 1+ females.

However, daily calf:1+ female ratios from aggregations on the barrens range from 12 (at Sifton Lake) to 44 (near Walmsley Lake). This variation masks the extent of segregation that occurred prior to the start of classification counts. We cannot state whether the low calf:1+ female ratio in 1984 reflects relatively high calf mortality or the segregation of herd components resulting in an underrepresentation of calves in our sample.

Large variations in calf:1+ female ratios occur both between widely divergent areas of the winter range and within what we could expect to be relatively homogeneous bands of migrating breeding cows. Biases in ratio estimates could result if classification sampling is restricted to one area and/or a few large aggregations.

In 1986, the Department of Renewable Resources will undertake radio-telemetry studies (funded by the Northern Oil and Gas Action Program) on the Bluenose caribou herd to develop sampling procedures that will reduce the variation (increase the precision) in spring estimates of calf:1+ female ratios.

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PERSONAL COMMUNICATIONS

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APPENDIX A. Calculations

1. Yearling sex ratio = 248 males/308 females
= 81 males:100 females

2. Sex ratio of animals over one year old

1172 bulls + 248 male yearlings = 1420 (1+) males
8741 cows + 308 female yearlings = 9049 (1+) females
% (1+) males = 1420/(1420 + 9049) = 13.6%
% (1+) females = 9049/(9049 + 1420) = 86.4%
Sex ratio = (1+ males/1+ females) x 100 = 1420/9049 x 100
= 16 1+ males:100 1+ females

3. Percentage calves and ratio of calves to 1+ females in sample

1987 calves/12,456 = 16.0% calves in the classified sample.
(calves/cows + female yearlings) x 100 = 22±2.0(R±S.E.) calves:100 1+ females (Cochran 1977:155, formula 6.13).

4. Survival of calves from birth to March 1984

assume: a) initial calf production of 69 calves:100 1+ females (Parker 1972) and,
b) annual natural mortality of 1+ females of 7.2% (Heard and Calef 1979). Natural mortality from June 1983 to late March = 7%, therefore 1+ female survival = 93%

Y cows in June x 0.93 = 100 cows in late March.

Y = 100/0.93 = 108 therefore 108 June cows = 100 late March cows.

69 calves/100 cows x 108 = 75 calves.

75 calves/100 March cows ---> 22 calves/100 March cows.

22/75 = 29 % survival.

5. Correction for unrepresented male segment

Gunn (1984) found 61 1+ males:100 1+ females in fall 1982 for a sample of Beverly caribou.

61/100 x 9049 1+ females = 5520 1+ males but we found 1420 1+ males, therefore add 5520-1420 = 4100 1+ males.

total caribou = 12,456 + 4100 (1+ males) = 16,556.

a) corrected % calves = 1987/16,556 = 12%

6. Percent recruitment into the 1+ population

12% calves in population assuming 61 1+ males:100 1+ females = 12 calves / (100-12) 1+ animals + 12 calves = 12/88 + 12. 12/88 x 100 = 14% recruitment into the 1+ population.

APPENDIX B. Cost of February-March 1984 Bathurst/Beverly classification counts

Item	Cost (X$1,000)
Cessna 185 reconnaissance	6.5
Cessna 337 reconnaissance	8.2
Camp placement with Twin Otter	8.3
Camp supplies	0.4
Total	23.4