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Status of three Canadian caribou populations north of 70° in winter 1977

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Abstract

In March–April 1977, the fourth and concluding year of an ecological study of caribou (*Rangifer tarandus*), we collected 53 animals from three populations on Boothia Peninsula, Somerset – Prince of Wales and Melville – Prince Patrick.

The pregnancy rate in 17 adult females obtained on Melville and Prince Patrick was up sharply to 88% from 6% the previous year, and mean percentage fat in the femur marrows increased from 43 to 79%.

The pregnancy rate in the nine adult females collected on Somerset and Prince of Wales was 100%, up from 73% in 1976, and mean fat in the femur marrows increased from 76% to 88%. Fat reserves were intermediate in seven adult females obtained on Boothia Peninsula. All females older than one year were pregnant.

These data confirmed the close relationship between fat reserves and pregnancy rate and indicated that partial recovery of fat reserves and fertility in the Melville – Prince Patrick population after starvation conditions in winter 1973–74 took more than 2 years.

Caribou on Boothia Peninsula were significantly larger than the insular population but some interchange with caribou of Somerset or Prince of Wales was probable.

Introduction

The Canadian Wildlife Service began a study of Peary caribou (*R. t. pearyi*), with emphasis on the relationship between fat reserves and reproduction, in March–April 1974 with the collection of 25 caribou from Prince of Wales, Bathurst, Byam Martin and Melville islands (Parker *et al.* 1975). In March–April 1975, we obtained 46 caribou on Somerset, Prince of Wales, Melville, Eglinton and Prince Patrick (Thomas *et al.* 1976), followed a year later by a collection of 88 caribou from the same regions and Boothia Peninsula (Thomas *et al.* 1977). According to Banfield (1961) *R. t. groenlandicus* inhabited the latter region.

In all three collections, 1974–76, adult female caribou from Bathurst, Melville, Eglinton and Prince Patrick (Parry population) were in relatively poor condition in late winter. They had little or no back (subcutaneous) fat, their kidney fat indices averaged below 24 and mean fat values in their femur marrows averaged below 44%. Pregnancy rates in adult females of that population remained constant at 6–7%.

Adult females from Somerset and Prince of Wales (Peel population) were in relatively good condition and highly productive. In all three annual collections, subcutaneous fat deposits averaged 8–21 mm in thickness, kidney fat indices averaged 36–95, fat in the femur marrows averaged 65–88% and pregnancy rates ranged from 40–92%.

Average ages of caribou collected from the Parry population, 1974–76, were 5.6, 8.1 and 8.2 years compared with 7.0, 4.2 and 4.4 years in the Peel population.

Data collected 1974–76 indicated marked regional differences in rumen contents, generally insignificant morphological differences between caribou in the Peel and Parry populations and an apparent mixture of *pearyi* and *groenlandicus* phenotypes in the initial sample of five caribou from northern Boothia Peninsula. Fetuses in the three females from Boothia Peninsula appeared to be further developed, by about 14 days, than fetuses in females collected on Somerset.

The 1977 sample provided more information on the Boothia population, more data on the relationship between fat reserves and reproduction and documented the time needed for the Parry population to recover from the nutritional deficiencies of 1973–74.

We tentatively identified three more-or-less discrete populations: (1) Boothia, caribou from that peninsula, (2) Peel, caribou obtained from Somerset and Prince of Wales and (3) Parry, caribou collected on Melville and Prince Patrick.

Methods

Collection methods were similar to those used in previous years (Thomas *et al.* 1976). We also collected samples of plant species found in craters dug in the snow by caribou searching for food, and measured snow depth and hardnesses adjacent to the craters as before.

We determined the animal's age, to the nearest year, from stained annulations and rest lines in transverse sections of roots of the first incisor and first molar.

As in previous years (Thomas *et al.* 1976), we determined percentage fat in marrows of all three long bones of the right hind leg by the oven-dry method (Neiland 1970). In tissue samples from the mandibular canal below the molars, however, we express the results of oven drying as percentage water because conversion of the latter to percentage fat using Neiland's (1970) regression may not give accurate values. The non-fatty residue component is undoubtedly larger in the mandibular sample than in the femur marrows because of the large nerve fibers and blood vessels in the former. Empty space in the canal was not filled with water.

We measured back fat depth, determined kidney fat indices and estimated species composition in the rumens as in previous years (Thomas *et al.* 1976). Length and width of right front and hind hooves were measured as before (Thomas *et al.* 1976) and the surface areas of digits three and four were calculated by a grid method.

Significant differences between means are at probabilities of less than 0.05, unless indicated otherwise.

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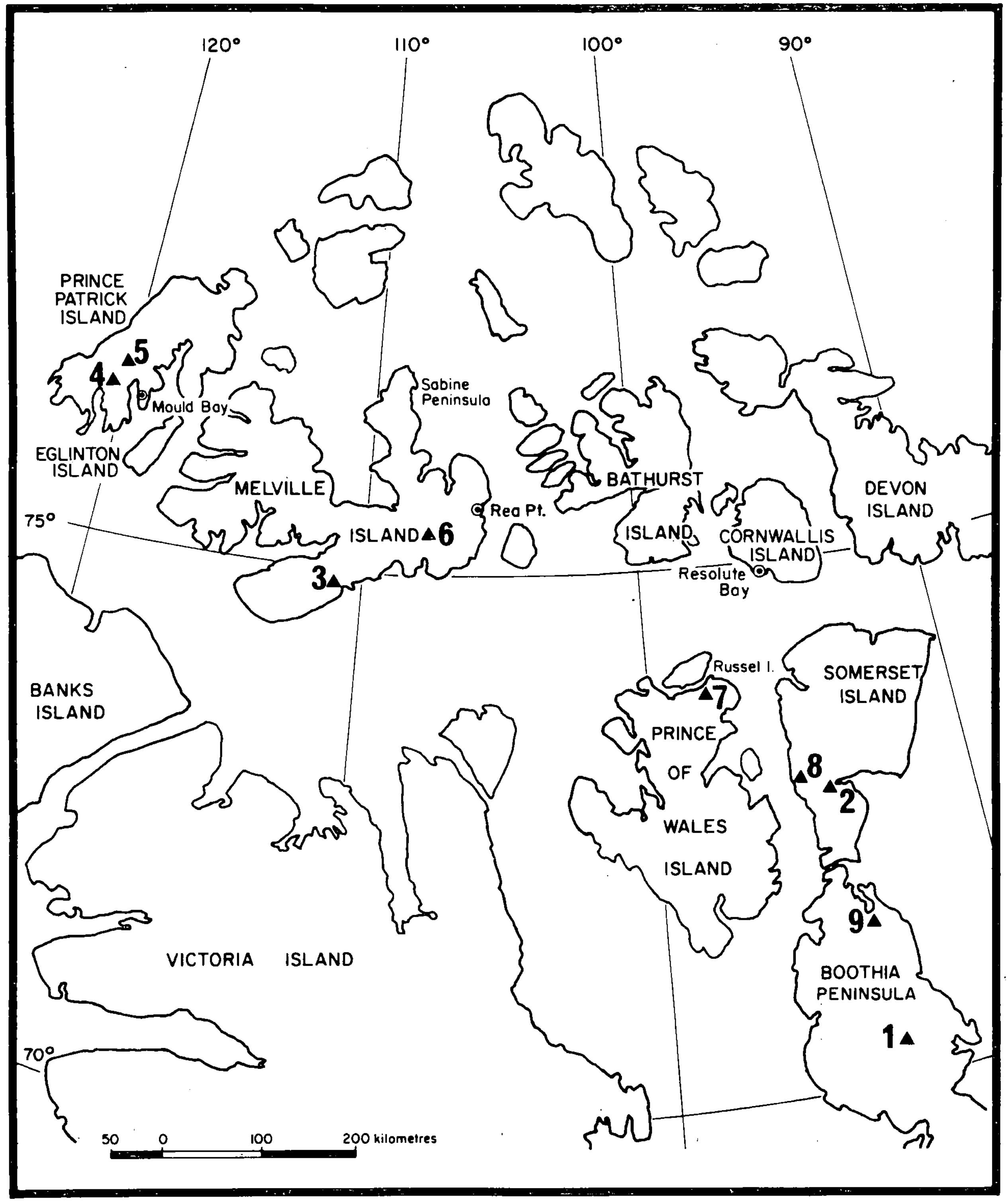
Figure 1
Location of sites at which caribou were collected in 1977



Results

The sample

Caribou were collected at nine sites in March–April 1977 (Fig. 1, Table 1). Detailed meristic data for each specimen taken in 1977 and data on specimens collected in the previous 3 years will be given in a separate report (Thomas in prep.).

Ages and sex of the caribou

Our 1977 sample included 39 females and 14 males, ranging in age from 1 to 13 years (Table 2). We obtained mandibles from an additional 30 caribou shot during the winter of 1976–77 by Inuit living at Creswell Bay, Somerset (Site 2). The latter animals, sex unknown, are included in Figure 2, which shows the age distribution of all caribou obtained from the three populations.

All 20 caribou obtained from the Parry population were 7 years old or older; 9 were 10 years old. Only 8 of 46 caribou obtained from the Peel population were 7 years or older. The age distribution of the 17 caribou from Boothia Peninsula resembled that of the Peel. Average ages of caribou from the Boothia, Peel and Parry populations were 3.9, 4.0 and 9.9 years, respectively.

We noted only one calf among 15–20 caribou, mostly cows, seen on northern Prince of Wales. The ratio of calves to adult females was high at both sites on Boothia Peninsula.

Physical characteristics

We calculated mean values for weight, length, girth, shoulder height and hind foot length of adult females collected from the five regions (Table 3). The data show that adult females from Boothia Peninsula were significantly larger than those from each of the four islands. Only one adult female collected on northern Boothia was the size and weight of a typical adult female from Somerset and Prince of Wales. Inter-island differences in weight will be discussed later.

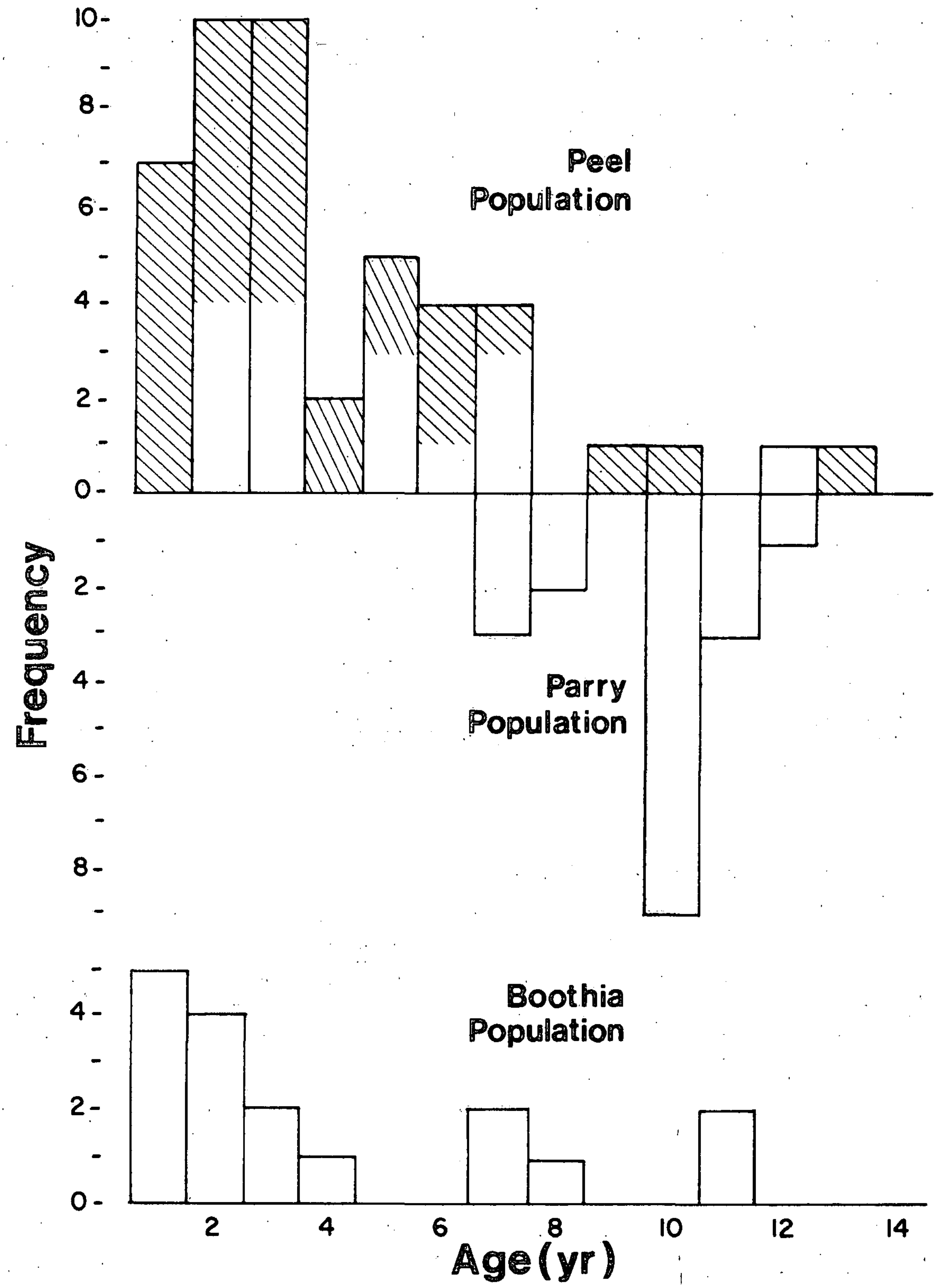
Table 1
Site locations, dates and specimen numbers of the 1977 March–April collection of caribou from five regions of the Canadian Arctic

Site	Region	Coordinates	Date	Specimen nos.
1	Boothia Peninsula	70°17′N, 93°42′W	18 Mar	1–11
2	Somerset	72°45′N, 94°22′W	22 Mar	12–14
3	Melville	74°52′N, 110°50′W	23 Mar	15–19
4	Prince Patrick	76°20′N, 120°13′W	24 Mar	20–26
5	Prince Patrick	76°31′N, 119°52′W	24 Mar	27–29
6	Melville	75°17′N, 107°47′W	25 Mar	30–34
7	Prince of Wales	73°44′N, 98°06′W	29 Mar	35–41
8	Somerset	72°49′N, 95°27′W	2 Apr	42–47
9	Boothia Peninsula	71°27′N, 93°53′W	3 Apr	48–53

Table 2
Ages and sex of 53 caribou collected on four Arctic islands and on Boothia Peninsula in March–April 1977

		Age (nearest year)												
Location	Sex	1	2	3	4	5	6	7	8	9	10	11	12	13
Boothia Peninsula	M	2	3	1										
	F	3	1	1	1			2	1			2		
Somerset	M		2	2										
	F		2	1		1	1							
Prince of Wales	M						1							
	F			1		1		3					1	
Melville	M													
	F							2			6	1	1	
Prince Patrick	M								1		1	1		
	F							1	1		2	1		2

Figure 2
Age distribution of caribou obtained from three populations in the Canadian Arctic during winter 1976-77. Hatched portion of histogram represents caribou collected by Inuit on Somerset prior to our collection



Adult females from Prince of Wales were significantly longer than those from Prince Patrick. Adult females from Prince Patrick were significantly smaller in girth than those from Melville. Weight and girth are influenced by fat reserves and therefore are not reliable indicators of size differences unless comparisons are made between groups in similar condition.

Long bone measurements of adult females led to similar conclusions about size differences of caribou collected from the five regions. Means for lengths of femurs, tibias, tarsi and for total length of those three bones of adult females from Boothia Peninsula were all significantly larger than corresponding means for adult females from each of the four islands (Table 4). There was one exception: means for tibias of adult females from Boothia Peninsula and Somerset were significantly different only if the small individual, typical of the Peel population, was excluded from the Boothia sample. The mean for femur lengths of adult females collected on Prince of Wales was significantly larger than that for adult females from Melville. Other regional differences in means were not significant.

Tables 5 and 6 show a great variation in the length, width and surface area of hooves of adult females from the study areas. Hoof size was not proportional to body size.

Differences in front hoof size among the regions may reflect (1) different substrates that cause different rates of wear in summer, (2) differing snow and icing conditions resulting in above-normal rates of pawing of snow and surface materials or (3) distance travelled in a year. Wear affects both length and width of hooves because the width measurements were taken with the anterior portions of the digits touching and these curve medially. Wear differences aside, the hooves of caribou in the Parry population are, relative to body size, larger than those of the Boothia population.

Fat reserves

Weight

We compared weights of insular caribou only because caribou from Boothia Peninsula were significantly larger in body size. Adult females from Prince of Wales were significantly heavier than those from Melville and Prince Patrick ($P < 0.01$); those from Melville were significantly ($P < 0.01$) heavier than those from Prince Patrick (Table 3). The latter difference is interesting in light of no difference in other indices of condition, which follow.

Back fat

Subcutaneous fat reserves were good in adult females collected on Somerset and Prince of Wales, fair in samples from Boothia Peninsula and poor in caribou taken on Melville and Prince Patrick (Table 7).

Table 3
Size (means ± standard errors) of various physical attributes of adult (>2 yr) female caribou from five regions of the Canadian Arctic in March–April 1977. Sample sizes in parentheses

Physical character	Boothia Peninsula (7)	Somerset (3)	Prince of Wales (6)	Melville (10)	Prince Patrick (7)
Weight (kg)	79.5±1.8	63.8±4.0	69.3±1.6	62.0±1.2	56.1±0.9
Length (cm)	160.3±2.0	147.7±5.9	153.8±1.5	148.7±1.7	147.7±2.1
Girth (cm)	116.1±2.3	107.3±2.1	108.8±1.5	108.9±1.4	104.2±1.5
Shoulder height (cm)	107.5±0.8	102.5±1.9	103.3±0.6	101.1±0.8	100.7±0.8
Hind foot (cm)	49.9±0.5	46.7±0.6	47.3±0.4	46.7±0.3	46.6±0.4

Table 4
Means ± standard errors (cm) of long bone lengths of caribou collected from five regions of the Canadian Arctic in March–April 1977. Sample sizes in parentheses

Bone	Boothia Peninsula (7)	Somerset (3)	Prince of Wales (6)	Melville (10)	Prince Patrick (7)
Femur	27.2±0.3	25.2±0.8	25.3±0.2	24.8±0.1	24.8±0.2
Tibia	29.9±0.5	27.7±1.1	27.8±0.2	27.7±0.1	27.5±0.2
Tarsus	29.0±0.4	26.5±0.6	27.1±0.3	27.2±0.2	27.2±0.2
Femur, Tibia and Tarsus	86.2±1.1	79.5±2.5	80.2±0.6	79.6±0.3	79.5±0.7

Table 5
Sizes of front and hind hooves (one of each, digits two and three only) of adult (>2 yr) female caribou from five regions of the Canadian Arctic, March–April 1977. Sample sizes in parentheses

Measurement	Boothia Peninsula (7)	Somerset (3)	Prince of Wales (5)	Melville (8)	Prince Patrick (6)
Front hoof length (cm)	8.5±0.3	8.9±0.4	8.4±0.3	8.7±0.1	9.3±0.2
Front hoof width (cm)	9.6±0.2	9.5±0.3	9.5±0.2	10.1±0.1	10.4±0.1
Front hoof surface area (cm^2)	51.9±3.3	54.0±4.4	51.2±2.4	54.8±1.4	58.7±0.8
Hind hoof length (cm)	9.1±0.2	8.6±0.2	9.0±0.2	8.4±0.2	8.5±0.1
Hind hoof width (cm)	9.3±0.3	9.0±0.1	9.4±0.2	9.3±0.1	8.9±0.1
Hind hoof surface area (cm^2)	52.0±2.7	46.0±4.2	50.6±1.5	48.4±1.3	47.4±0.9

Table 6
Matrix to show where significant ($p < 0.05$) differences occurred in the length, width and surface area of front and hind hooves (one each) of adult female caribou from five regions of the Canadian Arctic, March–April 1977 (data in Table 5)*

	Boothia Peninsula	Somerset	Prince of Wales	Melville	Prince Patrick
Boothia Peninsula	–			B, a	A,B,C,a
Somerset		–		B	B
Prince of Wales			–	B	A,B,C
Melville				–	A,B

*A = front hoof length, B = front hoof width, C = front hoof surface area, a = hind hoof length.

Table 7
Thickness of back fat on adult (>2 yr) female caribou from five regions of the Canadian Arctic, March–April 1977

	Boothia Peninsula	Somerset	Prince of Wales	Melville	Prince Patrick
Mean thickness (mm)	6.1	19.3	22.2	3.3	3.9
Standard error	2.0	1.8	3.0	1.2	1.9
Range size	0–14	16–22	10–30	0–12	0–12
Sample size	7	3	6	10	7

One of seven adult females from Boothia Peninsula, three of ten from Melville and three of seven from Prince Patrick had no, or only a trace of, subcutaneous fat. None of the seven adult males, four (one not measured) yearling males and five calves had measurable amounts of back fat. All three yearling females had 1-3 mm subcutaneous fat. Clearly the amount of back fat was related to sex and age.

Kidney fat index
Mean kidney fat indices (KFI) were significantly ($P < 0.01$) higher in adult females from Somerset and Prince of Wales compared with those of adult females from the other three regions (Tables 8 and 9). Mean KFI varied by sex (Table 8), although in most cases the small sample size precluded statistical verification. The KFI means for females were higher than those for males from the same region. Age differences were also apparent especially for females in each region. The trend for females was for higher KFI in the age sequence calves, yearling and adults.

Marrow fat
Leg bones
Percentages of fat in the three long bones of the hind leg of individuals were similar. The only region-specific significant differences among the means for percentage fat in the three bones from adult females was a significantly lower value in the femur than in the tibia or the tarsus in the sample from Prince Patrick (Table 10).

Differences among the five regions in percentage fat in the marrows of the femur, tibia, and tarsus were less pronounced than for body weight, KFI, or back fat. Analysis of the data in Table 10 indicated that significant differences occurred between the means for Boothia Peninsula and Melville, Boothia Peninsula and Prince Patrick, and Prince of Wales and Melville. Results of the analysis for tarsi were the same except that the mean for adult females from Prince of Wales was significantly larger than that for adult females of Prince Patrick. Analysis of data for tibias revealed only one significant difference: the mean for adult females of Boothia

Table 8
Region-specific kidney fat index (KFI) means by sex (M, male; F, female). Sample sizes in parentheses

	Mean KFI ± SE		
Region	Calves	Year 1	Adult
Boothia Peninsula	F 15.6(3) M 9.7(2)	F 34.4(1) M 22.5(3)	F 44.6(7)±5.2 M 14.8(1)
Somerset		F 62.1(2) M 22.5(2)*	F 116.6(3)±25.3 M 24.4(2)
Prince of Wales			F 84.6(6)±12.0 M 17.9(1)
Melville			F 42.4(10)±3.2
Prince Patrick			F 38.2(7)±5.4 M 20.6(3)

*$P < 0.05$, between sexes.

Table 9
Matrix to show levels of significance among kidney fat indices of adult female caribou collected from five regions in the Canadian Arctic in March–April 1977*

	Boothia Peninsula	Somerset	Prince of Wales	Melville	Prince Patrick
Boothia Peninsula	–	P<0.01	P<0.01	N.S.	N.S.
Somerset		–	N.S.	P<0.01	P<0.01
Prince of Wales			–	P<0.01	P<0.01
Melville				–	N.S.
Prince Patrick					–

*N.S. = not significant.

Table 10
Mean percentages fat ± standard errors in the marrows of the femur, tibia and tarsi of adult (>2 yr) female caribou obtained from five regions in the Canadian Arctic, March–April 1977. Sample sizes in parentheses

Bone	Boothia Peninsula (7)	Somerset (3)	Prince of Wales (6)	Melville (10)	Prince Patrick (7)
Femur	87.8±1.1	89.1±1.4	87.5±0.9	78.6±2.8	78.7±3.9
Tibia	89.5±0.3	89.5±0.3	88.9±0.5	83.7±2.0	82.9±3.2
Tarsus	89.0±0.8	87.4±0.7	89.8±0.9	84.8±1.0	85.5±1.3

Peninsula was significantly larger than the mean for Melville females.

Percentage fat in the marrows of all three long bones of the Parry population were significantly lower than those of the Peel and Boothia populations.

Differences between females and males (Table 11) suggest that the sexes should not be pooled although sample sizes were too small for statistical verification.

Age class differences in percentage marrow fat were less apparent than were KFI differences. Table 11 shows the only significant differences were between female calves and adults; however, sample sizes are inadequate.
The sex specific means for adults and yearlings were similar and may be grouped (Table 12) thereby increasing the Boothia Peninsula and Somerset samples of females by one and two respectively and resulting in two more significant differences: the mean for percentage fat in marrows from Somerset femurs was larger than that for Melville; the Somerset tarsi mean was larger than that of Prince of Wales.

Sex differences in percentage fat in femur marrows of caribou older than 1 year were significant for samples from Boothia Peninsula and Somerset.

Mandibular tissue
Means for percentage water in mandibular canal samples of adult females from the Boothia (22.6) and Peel (22.1) populations were significantly lower than that of the Parry population (27.7). The mean for adult females from Boothia Peninsula was significantly lower than that for adult females from Melville (Table 13).

Percentage water in tissue samples from the mandibular canals of 30 caribou shot on Somerset from September 1976 to March 1977 ranged from 18.8 to 40.6. Average values (± standard errors) for seven calves, six yearlings and 17 adults were 30.3 ± 1.7, 34.9 ± 3.1 and 23.5 ± 1.0% respectively. Higher water values indicated poorer fat reserves because there is a reciprocal relationship between fat and water content of marrow.

Table 11
Region-specific percentage fat means for femurs by sex (M, male; F, female). Sample sizes in parentheses

Region	Calves	Yearlings	Adults
Boothia Peninsula	F 68.1(3) M 28.4(2)	F 85.4(1) M 79.0(3)	F 87.8(7) M 27.4(1)
Somerset		F 89.2(2) M 80.3(2)	F 89.1(3) M 82.3(2)
Prince of Wales			F 87.5(6) M 84.3(1)
Prince Patrick			F 78.7(7) M 56.3(3)*

*P<0.05.

Table 12
Mean percentages fat ± standard errors in the marrows of the femur, tibia and tarsi of female caribou older than 1 year obtained from five regions in the Canadian Arctic, March–April 1977. Sample sizes in parentheses

Bone	Boothia Peninsula (8)	Somerset (5)	Prince of Wales (6)	Melville (10)	Prince Patrick (7)
Femur	87.5±1.0	89.1±1.0	87.5±0.9	78.6±2.8	78.7±3.9
Tibia	89.1±0.5	89.2±0.3	88.9±0.5	83.7±2.0	82.9±3.2
Tarsus	88.5±0.8	86.4±0.7	89.8±0.9	84.8±1.0	85.5±1.3

Table 13
Percentages water in tissue from the mandibular canal below the molars of adult female caribou obtained March–April 1977 from five regions of the Canadian Arctic

	Boothia Peninsula	Somerset	Prince of Wales	Melville	Prince Patrick
Mean	22.6	24.8	21.2	28.5	26.7
Standard error	1.0	1.4	1.8	2.1	2.3
Sample size	7	2	6	10	7

Pregnancy rate
All seven females obtained on Boothia Peninsula were pregnant as were all nine collected on Prince of Wales and Somerset. Nine of ten and six of seven adult females obtained on Melville and Prince Patrick were pregnant, up sharply from rates of 20 and 0%, respectively, on those islands the previous year.

All three yearling females (two from Somerset and one from Boothia Peninsula) were pregnant. A year earlier none of six female yearlings obtained from the Peel population were pregnant.

Rumen contents
By volume
Regional differences and similarities in rumen contents are readily apparent in the 12 forage items occupying the greatest volume in the rumens of all 53 caribou (Table 14).

Similarities in species present and their proportionate volumes were evident in the samples from Boothia Peninsula and Somerset and in samples from Melville and Prince Patrick. *Luzula* spp. comprised over half of the rumen contents of caribou obtained from the Parry population; they were insignificant in the rumens of caribou from the other two populations. Another monocotyledon, *Carex* spp., comprised 30–35% of the rumen contents of caribou from Boothia Peninsula and Somerset. Monocotyledons were proportionally insignificant in the rumens of caribou obtained on northern Prince of Wales, where *Saxifraga oppositifolia, S. caespitosa* and *Cetraria* spp. made up most of the contents. Elsewhere lichens constituted less than 1% of the contents; however, possible rapid digestion of lichens must be considered in any conclusions about forage intake. Similarly the content of mosses may not reflect their relative intake because of low digestibility and presumed slow passage through the digestive system.

Frequency of occurrence
The list of the 10 most frequently observed plant species in the rumens of all 53 caribou provides a somewhat different picture of rumen contents (Table 15). *Luzula* spp. were the seventh most frequent whereas *Cetraria* spp. and *Thamnolia* spp. occupied positions two and six in the list. The list (Table 15) points once again to the marked regional differences in rumen contents and undoubtedly in diet. Caribou in the study area are catholic in their diet even at one season.

Feeding craters
Feeding craters or scrapes, examined at each site except the second, contained the same species as found in the rumens. In craters at eight sites the most frequently occurring species were (frequencies in parentheses): *Luzula nivalis* (8), mosses (8), *Cetraria islandica* (7), *Thamnolia vermiculata* (7), *Cetraria cuculata* (6), *Stellaria longipes* (5), *Papaver radicatum* (5), *Cetraria tilesii* (5), *Alectoria ochroleuca* (5), *Saxifraga oppositifolia* (4), *Festuca* spp. (4), *Cetraria nivalis* (4), *Cetraria delisei* (4), *Alectoria nitidula* (4), *Parmelia* spp. (4) and crustose lichens (4). The high frequency (10 of 16) of lichen species in the list suggests that caribou were seeking out lichen-rich sites for feeding.

Table 14
Proportion by volume (%) of plant species in the rumens of caribou obtained from five regions of the Canadian Arctic in March–April 1977. Sample sizes in parentheses

Plant species or species group	Boothia Peninsula (17)	Somerset (9)	Prince of Wales (7)	Melville (10)	Prince Patrick (10)	All regions (53)
Luzula spp.	0.0	0.7	2.1	48.5	60.0	20.9
Carex spp.	34.5	29.8	0.9	7.5	0.0	17.7
Mosses	5.9	15.0	2.3	35.0	27.0	16.5
Dryas integrifolia	35.3	18.9	0.0	0.0	0.0	14.5
Saxifraga oppositifolia	8.7	8.3	45.2	0.2	0.0	10.2
Salix arctica	5.6	15.6	+	2.1	0.0	4.8
Saxifraga caespitosa	0.0	0.0	33.6	0.1	+	4.5
Eriophorum spp.	+*	8.9	0.0	3.0	3.0	2.6
Unidentified monocotyledon	0.6	1.7	0.0	1.0	9.9	2.5
Cassiope tetragona	6.8	0.8	+	0.0	0.0	2.3
Cetraria	0.8	0.3	15.9	0.2	0.1	2.0
Other species	1.8	+	+	2.4	+	1.5

*+= trace

Table 15
Frequency of occurrence (%) of plant species in rumens of caribou collected from five regions of the Canadian Arctic in March–April 1977. Sample sizes in parentheses

Plant species or species group	Boothia Peninsula (17)	Somerset (9)	Prince of Wales (7)	Melville (10)	Prince Patrick (10)	All regions (53)
Mosses	76	100	86	100	100	92
Cetraria spp.	70	67	100	70	30	85
Saxifraga oppositifolia	94	100	100	40	0	68
Carex spp.	100	100	43	10	0	57
Salix arctica	88	100	14	40	0	55
Thamnolia vermiculata	47	44	100	80	10	53
Luzula spp.	0	33	29	100	100	53
Dryas integrifolia	100	100	0	0	0	49
Cassiope tetragona	76	56	14	40	0	43
Unidentified monocotyledon	18	44	0	20	40	25

Snow characteristics
Snow conditions in all five regions seemed remarkably similar to conditions in 1976 except that there was more snow on western Melville and less at Mould Bay. Snow was deeper on southern Boothia Peninsula than in the north which may explain in part why the winter range is concentrated in the northern half of the peninsula.

Measurements of snow adjacent to craters at collection sites revealed similar mean depths in the five regions but varying hardness values (Table 16). At site 8 on Somerset the snow was relatively soft, ranging from 10 to 200 g/cm^2. Across Peel Sound at site 7 on northern Prince of Wales, hardness values ranged from 3000 to 10 000 g/cm^2. However, great micro and regional variability in snow characteristics (e.g. sites 4 and 5 on Prince Patrick, Table 16) preclude any generalizations about conditions on an island or comparisons with data from other years from a few spot checks. Annual objective comparisons of snow conditions on a given island will not be accurate until a series of permanent snow stations are established in various habitat types. Furthermore, with the exception of ground and vegetation icing we do not know the relationship between snow characteristics (depth, layering, hardness, etc.) and energy balances in caribou.

Table 16
Mean depths and hardnesses (hardest layer) of snow adjacent to feeding craters at six sites where caribou were obtained in March–April 1977. Standard errors and sample sizes in parentheses follow the means. Range in parentheses below the means

Measurement	Boothia Peninsula site 9	Somerset site 8	Prince of Wales site 7	Melville site 6	Prince Patrick site 4	Prince Patrick site 5
Depth (cm)	3.9±0.5(5) (2.1–5.2)	5.6±0.4(5) (4.2–6.8)	5.3±0.4(7) (3.8–6.8)	6.4±0.9(7) (2.8–9.4)		6.0±1.1(10) (1.5–13.0)
Hardness ($g/cm^2 \times 10^2$)	25.5±8.4 (10.0–40.0)	0.5±0.2 (0.1–2.0)	77.2±8.1 (30.0–100.0)	12.4±4.1(8) (2.0–12.0)	8.6±0.8(11) (4.0–11.0)	36.0±4.8(12) (12.0–65.0)

Table 17
Frequency and numbers of warblefly larvae in caribou from five regions of the Canadian Arctic, March–April 1977

	Boothia Peninsula	Somerset	Prince of Wales	Melville	Prince Patrick
Sample size	17	9	7	10	10
Caribou with larvae	12	2	0	1	3
Mean no. larvae	15	7	–	7	29
Mean no. larvae in those with larvae	23	30	–	67	98
Range of larvae no.	1–57	5–55	–	–	1–213

Pathology and parasites
Frequencies (%) of warble fly (*Oedemagena tarandi* L.) larvae in caribou collected in 1977, with the previous years' frequencies in parentheses, were as follows: Boothia Peninsula 71 (100), Somerset 22 (30), Prince of Wales 0 (13), Melville 10 (0) and Prince Patrick 30 (0). The trend from 1976 to 1977 in frequency and mean number of larvae in caribou in late winter (Table 17, Thomas *et al.* 1977) was lower values for Boothia and Peel populations and higher values for the Parry population.

Weight of antlers
The weight of antlers may be related to physical condition of the caribou at the time of antler development, which is largely dependent on availability of nutritious forage. Mean weights of antlers of adult females collected from five regions in March–April 1977 were in the following order, heaviest to lightest: Prince of Wales, Prince Patrick, Boothia Peninsula, Melville and Somerset (Table 18). This order bears no relationship to the order of physical size of caribou from those regions (Table 3). Significant differences in adult females were: (1) antlers from Prince of Wales females heavier than those from Melville, and (2) antlers from Prince Patrick females heavier than those from Somerset.

The three 3-year-old males collected on Boothia Peninsula and Somerset had not cast their 547–1003 g antlers; the four older males had. Weights of the antlers of two male yearlings from each of Boothia Peninsula and Somerset ranged from 342 to 533 g. These weights are above the mean weight of antlers of adult females from all regions (259 g) but three of these four weights and another single antler (the other was broken off and lost) at 88 g were within the range of adult females. This similarity in antler weight as well as in form explains why one cannot always distinguish yearling males from adult females at a distance if antler size is the sole discriminating criterion. The antlers of yearling females were considerably lighter at 45 (one antler), 89 and 98 g. Antlers of two calves were much lighter at 52 (male) and 48 g (female).

Discussion
A high pregnancy rate in the Parry population is consistent with the relatively high condition indices. In March–April 1976, kidney fat indices of caribou collected on Melville and Prince Patrick and marrow fat percentages in the sample from Prince Patrick indicated: (1) that fat reserves had improved relative to the preceding years and (2) that the pregnancy rate of 6% for both islands was lower than ex-

Table 18
Mean weights (g) and standard errors of two antlers of adult female caribou from five regions of the Canadian Arctic, March–April 1977. Where only one antler was present its weight was doubled

	Boothia Peninsula	Somerset	Prince of Wales	Melville	Prince Patrick
Mean weight	266	191	323	222	274
Standard error	42	23	42	18	17
Sample size	7	3	6	9	7

pected from the condition data (Thomas *et al.* 1977). One problem is that we measure fat reserves in March–April while the pregnancy rate undoubtedly is related to energy reserves in the caribou preceding and during the breeding season in October. There was no indication of resorption or spontaneous abortion of embryos or fetuses in our samples, however ovaries will be examined for *corpora albicantia* associated with pregnancy failure.

Even with a high pregnancy rate in 1976–77 the Parry population is still in danger of extinction. With a mean age of 9–10 years, a maximum life span of ca. 15 years, viability of calves and yearlings dependent on favourable winters and an infertility period of 2–3 years following malnourished states, a severe winter in 1977–78 or 1978–79 could result in extinction. Recovery of the population to 1972 numbers (Miller *et al.* 1975) will take 10–20 years under the most favourable environmental conditions.

Fat reserves and the pregnancy rate in the Peel population were higher in late winter 1977 than a year earlier. Mean thickness of back fat increased from 8 to 21 mm, mean kidney fat indices increased from 36 to 95 and mean percentage fat in femur marrows increased from 76 to 88. The poorer fat reserves in March 1976 may have contributed to the apparent poor survival of calves born the following summer. In March and April 1976, 85% (11/13) and 62% (8/13) of adult females collected on Somerset and Prince of Wales were pregnant (Thomas *et al.* 1977). Miller and Gunn (1977) reported 16.6% calves and 2.2% yearlings among 1833 caribou counted on Prince of Wales in July and August 1976. Only 32.2 and 4.2% of the adult cows were represented by calves and yearlings, respectively.

Pregnancy rates in yearlings seem to be a sensitive indicator of past environmental conditions but what combination of favourable summer and winter seasons is required to achieve early fertility is not known. This facet will be reported later after analysis of climate data. We can measure changes in the animal in response to changes in the environment reasonably well but our measurements of environmental factors are crude and our understanding of how these factors interact to affect the animal is poor. Advances are needed in those areas before we will be able to predict the effect of changing environments on arctic mammals.

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